

Science and Non-Science: An Epistemological Conflict

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A small minority of religious people are confusing the public about fundamental differences between science and religion. This essay is intended to help clarify the issues and to support educators, politicians and ordinary people opposing the imposed introduction of religion into science classrooms.

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Definitions

In mid-2005, my father-in-law, Dr Percy Black, Emeritus Professor of Psychology at Pace University in New York, forwarded an interesting question to me from one of his psychology discussion lists.

The psychologist asked whether the meaning of the words *science* and *scientist* had changed over time. Yes indeed. In historical times, a science was very much what is still defined in a popular dictionary as a general field of knowledge:

sci•ence (plural **sci•ences**) noun

1. study of the physical world: the study of the physical world and its manifestations, especially by using systematic observation and experiment (often used before a noun)
2. branch of science: a branch of science of a particular area of study [;e.g.] the life sciences
3. knowledge gained from science: the knowledge gained by the study of the physical world
4. systematic body of knowledge: any systematically organized body of knowledge about a specific subject [;e.g.,] the social sciences
5. something studied or performed methodically: any activity that is the object of careful study or that is carried out according to a developed method [;e.g.,] treated me to a lecture on the science of dressing for success.¹

This definition reflects the popular, non-technical use of the word. It is this generic, non-specialized definition that is used by the antievolution forces in Kansas and other areas of the country to force inclusion of creationist mythology into biology classes.

¹ *Encarta Dictionary Tools* – “Science.” Microsoft® Encarta® Reference Library 2005. © 1993-2004 Microsoft Corporation. All rights reserved.

Epistemology

In contrast with the popular definition of science, a succinct definition that corresponds to how professionals use the word is, “*Science, systematic study of anything that can be examined, tested, and verified.*”²

The *scientific method* is described in part as follows in a popular encyclopedia:

Definitions of scientific method use such concepts as objectivity of approach to and acceptability of the results of scientific study. Objectivity indicates the attempt to observe things as they are, without falsifying observations to accord with some preconceived world view. Acceptability is judged in terms of the degree to which observations and experimentations can be reproduced. Scientific method also involves the interplay of inductive reasoning (reasoning from specific observations and experiments to more general hypotheses and theories) and deductive reasoning (reasoning from theories to account for specific experimental results). By such reasoning processes, science attempts to develop the broad laws—such as Isaac Newton’s law of gravitation—that become part of our understanding of the natural world.³

The critical words here are *tested*, *verified* and *falsified*. The fundamental distinction between a scientific model and a nonscientific model is that the former can in theory be *disproved* through prediction and observation whereas the latter cannot, *even in theory*, be disproved through observation.⁴

Here’s a non-threatening example to illustrate the distinction. Imagine that two people, Alice and Bob, both propose that little green men (LGM) are responsible for propelling their automobiles. Alice predicts that if you open the hood of her car, you will see the LGM hard at work pumping the pistons up and down. Bob, however, says that although he knows there are LGM under his hood, they are very shy and hide from all human observation. In fact, he is confident that there is *no way* to see the LGM under any circumstances or to disprove their existence. Alice’s model can be described as a scientific one, even if it doesn’t last very long under investigation; Bob’s cannot.

The word *prove* once meant to *test*, as in the old phrase, “The proof of the pudding is in the eating.” Today it means to show that something is true. We can prove the truth or falsity of propositions in formal mathematical systems based on assumptions of starting principles and rules.⁵ The assumptions (axioms and rules) cannot themselves be proven. For example, all of

² *Encarta Encyclopedia* – “Science.” Microsoft © Encarta © Reference Library 2005. © 1993-2004 Microsoft Corporation. *All rights reserved.*

³ *Encarta Encyclopedia* – “Scientific Method.” Microsoft © Encarta © Reference Library 2005. © 1993-2004 Microsoft Corporation. *All rights reserved.*

⁴ See, for example, Popper, K. R. (1934, 2002). *The Logic of Scientific Discovery, tr. from German by the author; new edition.* Routledge (ISBN 0415278449).

⁵ Even logical systems may generate propositions that are not provable. For example, Bertrand Russell showed that formal systems, especially those that are self-referential, may generate impossible paradoxes (e.g., positing that a set is a member of itself but also not a member of itself); see Irvine, A. D. (2004). “Russell’s Paradox,” *The Stanford Encyclopedia of Philosophy* (Summer 2004 Edition), Edward N. Zalta (ed.),

modern science rejects the solipsistic belief that the universe is a dream.⁶ Everything in science depends on the beliefs (note the careful and deliberate use of this word) that the universe exists apart from the perceiver and that the patterns of interaction (loosely and misleadingly referred to as “laws of nature”) of matter and energy (and whatever else may be involved in the external universe) are *consistent* rather than *capricious or arbitrary* (and that consistency includes quantum uncertainty⁷).

We cannot *prove* assertions about the natural world. All we can do is propose models (hypotheses) and then show that they are *wrong*. If we work very hard and very well at showing that the hypotheses are wrong but cannot do so for the time being, the hypotheses are provisionally accepted as being *useful*. A shorthand comment is that they are *true* but that phrasing is just a convenience for discussion purposes. It is a pity that non-scientists misinterpret the meaning of that word – the conflict over its usage leads to confusion and hostility between people who use fundamentally different ways of approaching knowledge. The theory of knowledge is known as *epistemology*. The conflict between creationists and scientists is epistemological.⁸

Some creationists view models about the origins of life as inherently impossible to test or to disprove; for example, one revealing comment in an anti-evolution article provides valuable insights into ways of knowing that are incompatible with the scientific worldview:

...[W]e can know – through observation – that the Sun is the center of our planetary system, whereas the question of origins is outside observational and testable science (i.e., there were no human witnesses to the origins of living things).⁹

Despite the writer’s naïve assertion, we do *not* “know – through observation – that the Sun is the center of our planetary system...” This assertion is not merely a simple matter of observational fact. That writer seems to believe in *absolute truths* – literally correct, immutable descriptions of the universe that are isomorphic with reality.¹⁰ In contrast with tenets of absolute faiths, where

< <http://plato.stanford.edu/archives/sum2004/entries/russell-paradox/> >. Kurt Gödel showed that every mathematical system can be used to create propositions that cannot be proven solely using the rules and axioms of the mathematical system itself; see Denton, W. (2005), “Gödel’s Incompleteness Theorem” < <http://www.miskatonic.org/godel.html> > and also the Wikipedia entry at < http://en.wikipedia.org/wiki/Gödel's_incompleteness_theorem >

⁶ See for example Thornton, S. P. (2004). “Solipsism and the Problem of Other Minds.” *The Internet Encyclopedia of Philosophy* < <http://www.iep.utm.edu/solipsis.htm> >

⁷ See for example Hilgevoord, J. & J. Uffink. “The Uncertainty Principle.” *The Stanford Encyclopedia of Philosophy* (Winter 2001 Edition), Edward N. Zalta (ed.), < <http://plato.stanford.edu/archives/win2001/entries/qt-uncertainty/> >.

⁸ See the Web page by Prof Keith DeRose (Yale University Department of Philosophy) for extensive pointers to resources about epistemology < <http://pantheon.yale.edu/~kd47/e-page.htm> >

⁹ Anonymous (2000). “Special issue of *New Scientist* not so special about special creation!” < <http://www.answersingenesis.org/docs2/4295news5-3-2000.asp> >

¹⁰ An *isomorphic* description has elements in a one-to-one correspondence with elements of the system being described; for example, a description of how a mechanical clock works can be isomorphic with the clock because all the relations are *deterministic and known*. The relations are deterministic in that there are no uncertainties; they are known because the description is complete and correct in all details. In contrast, many models of natural

absolute truths are revealed by divine inspiration (i.e., revealed by G-d, usually directly into the ears of the writer's particular religious sect alone), from a scientific perspective there *is* no center to our planetary system. Since the time of Giordano Bruno (1548-1600)¹¹ and Johannes Kepler (1571-1630),¹² we have *modeled* the solar system *economically* by visualizing the Sun at one focus of a set of ellipses that efficiently describe the motion of the planets – if we choose to ignore the movements of our planets around the galactic core and the movement of the Milky Way galaxy with respect to other galaxies. Viewed from a different frame of reference, the movements of planets are epicycles through space, not ellipses. There *is* no absolute truth about planetary motions: the only truth is the observations; the models are conveniences that depend on the way we choose to define our frame of reference. For that matter, it is *possible* to model a wholly geocentric view of the universe – but it is so complicated to include the retrograde movements of planets and so devoid of coherence and mathematical elegance that no one with any sense would insist on using that model. We'd much rather use Kepler's laws than have to deal with the innumerable and pointless complexities that would result from a geocentric model.

So is the heliocentric model of our solar system true and the geocentric model false? What do you think? I think that using the concepts of *true* and *false* for such models is an inappropriate use of the words. I'd much rather call the heliocentric model more *elegant* or more *parsimonious* and the geocentric model more *complicated* and *less efficient*.

Another problem raised in the passage at hand is the notion that past events are impossible to study scientifically; were this belief true, it would be a serious disappointment to cosmologists, geologists, and evolutionary biologists. I have no conception of how hard-line creationists cope

phenomena are *empirical* and *heuristic*. They are empirical in that they are based on observations in the absence of knowledge of absolute truth; they are heuristic in that they are intended to advance learning rather than to represent fixed and unchanging truth.

¹¹ Giordano Bruno was burned at the stake on Feb 17, 1600 by the Inquisition on charges of heresy. See Kessler, J. (2005). "Giordano Bruno: The Forgotten Philosopher." < http://www.infidels.org/library/historical/john_kessler/giordano_bruno.html >

¹² Koch, D. & A. Gould (2005). "Johannes Kepler: His Life, His Laws and Times." < <http://kepler.nasa.gov/johannes/> >

with reports on scientific cosmogony¹³, geological stratigraphy¹⁴, and the immense mass of information emerging from comparative DNA sequencing studies¹⁵.

Supporters of special creation put together lists of observations that support their model; however, it is impossible for them to define any observation whatsoever which could possibly *disprove* their model, since they start with what they posit as the absolute truth and think of science as the process of accumulating observations that fit their model. *That very lack of disprovability removes their model from the realm of science.*

The assumption about the impossibility of applying scientific methodology to past events also puts dogmatists into a difficult logical position when their fellow apologists for non-rationalism present fragments of undigested scientific information about the geological past that they claim support their model.¹⁶

¹³ For example, a search of the Wilson Web research database available through the Kreitzberg Library at Norwich University using the keyword “cosmogony” immediately brought up articles such as “Modern echoes of the early universe” by R. Cowen, published in *Science News* 167(3):35. The abstract reads, “This week, at a meeting of the American Astronomical Society in San Diego, California, 2 groups of astronomers reported the detection of a primordial sound wave from the early Universe. Shaun Cole of the University of Durham, U.K., and colleagues analyzed data from the Two-Degree Field Redshift Gravity Survey; Daniel Eisenstein of the University of Arizona in Tucson and colleagues examined data from the Sloan Digital Sky Survey. Both groups detected an acoustic imprint from a time just after the big bang when the Universe was a foggy soup of radiation and matter. They claim that the survival of the imprint offers convincing new evidence that the pattern for the current distribution of galaxies was established by random subatomic fluctuations at the time of the big bang.”

¹⁴ “Stratigraphy, in geology, the study of rock layers, or strata, particularly their ages, compositions, and relationships to other rock layers. Stratigraphy provides geologists with clues about the earth’s past. Stratigraphy also allows geologists to predict what types of rocks lie below the ground and to understand geologic processes. Consequently, most geologists regularly use basic elements of stratigraphy in their work.” Microsoft ® Encarta ® Reference Library 2005. © 1993-2004 Microsoft Corporation. All rights reserved.

¹⁵ Dr Francis S. Collins, director of the National Human Genome Research Institute, is a fervent Christian but according to Cornelia Dean (see footnote 20), “...he acknowledged that as head of the American government’s efforts to decipher the human genetic code, he had a leading role in work that many say definitively demonstrates the strength of evolutionary theory to explain the complexity and abundance of life. As scientists compare human genes with those of other mammals, tiny worms, even bacteria, the similarities ‘are absolutely compelling,’ Dr. Collins said. ‘If Darwin had tried to imagine a way to prove his theory, he could not have come up with something better, except maybe a time machine. Asking somebody to reject all of that in order to prove that they really do love God – what a horrible choice.’”

¹⁶ For an extended analysis of the fundamentally non-scientific approach to model-building espoused by creationists, see “*Philosophically based arguments and responses: 25 creationists’ arguments, 25 evolutionists’ answers.*”

< http://www.sullivan-county.com/nf0/fundienazis/25_answers.htm >

Creationist Movements

Mark Isaak has written a good overview of the attacks by creationists on modern evolutionary theory.¹⁷ Isaak begins by pointing out that there are many varieties of thought lumped into the “creationist” camp. In the summary below, I use Isaak’s typology but leave out his extensive references, which are available in the original article online:

- **Flat Earthers** believe that the earth is flat and is covered by a solid dome or firmament. Waters above the firmament were the source of Noah’s flood. This belief is based on a literal reading of the Bible, such as references to the “four corners of the earth” and the “circle of the earth.” Few people hold this extreme view, but some do.
- **Geocentrists** accept a spherical earth but deny that the sun is the center of the solar system or that the earth moves. As with flat-earth views, the water of Noah’s flood came from above a solid firmament. The basis for their belief is a literal reading of the Bible. “It is not an interpretation at all, it is what the words say.” Both flat-earthers and geocentrists reflect the cosmological views of ancient Hebrews. Geocentrism is not common today, but one geocentrist (Tom Willis) was instrumental in revising the Kansas elementary school curriculum to remove references to evolution, earth history, and science methodology.
- **Young Earth Creationists (YEC)** claim a literal interpretation of the Bible as a basis for their beliefs. They believe that the earth is 6000 to 10,000 years old, that all life was created in six literal days, that death and decay came as a result of Adam & Eve’s Fall, and that geology must be interpreted in terms of Noah’s Flood. However, they accept a spherical earth and heliocentric solar system. Young-Earth Creationists popularized the modern movement of scientific creationism by taking the ideas of George McCready Price, a Seventh Day Adventist, and publishing them in *The Genesis Flood* (Whitcomb & Morris 1961). YEC is probably the most influential brand of creationism today.
- The **Omphalos** argument, first expounded in a book of that name by Philip Henry Gosse (1857), argues that the universe was created young but with the appearance of age, indeed that an appearance of age is necessary. This position appears in some contemporary young earth creationist writing. . . . The position is sometimes satirized by suggesting that the universe was created last week with only an appearance of older history.
- **Old-Earth Creationists** accept the evidence for an ancient earth but still believe that life was specially created by God, and they still base their beliefs on the Bible. There are a few different ways of accommodating their religion with science.
- **Gap Creationism** (also known as Restitution Creationism): This view says that there was a long temporal gap between Genesis 1:1 and Genesis 1:2, with God recreating the world in 6 days after the gap. This allows both an ancient earth and a Biblical special creation.
- **Day-age creationists** interpret each day of creation as a long period of time, even thousands or millions of years. They see a parallel between the order of events presented in Genesis 1 and the order accepted by mainstream science. Day-Age Creationism was more popular than Gap Creationism in the 19th and early 20th centuries.

¹⁷ Isaak, M. (2002). “What is Creationism?” < <http://www.talkorigins.org/faqs/wic.html> >

- **Progressive Creationism** is the most common Old-Earth Creationism view today. It accepts most of modern physical science, even viewing the Big Bang as evidence of the creative power of God, but rejects much of modern biology. Progressive Creationists generally believe that God created “kinds” of organisms sequentially, in the order seen in the fossil record, but say that the newer kinds are specially created, not genetically related to older kinds.
- **Intelligent Design Creationism** descended from Paley’s argument that God’s design could be seen in life (Paley 1803). Modern IDC still makes appeals to the complexity of life and so varies little from the substance of Paley’s argument, but the arguments have become far more technical, delving into microbiology and mathematical logic. In large part, Intelligent Design Creationism is used today as an umbrella anti-evolution position under which creationists of all flavors may unite in an attack on scientific methodology in general (CRSC, 1999). A common tenet of IDC is that all beliefs about evolution equate to philosophical materialism.
- **Evolutionary Creationism** differs from Theistic Evolution only in its theology, not in its science. It says that God operates not in the gaps, but that nature has no existence independent of His will. It allows interpretations consistent with both a literal Genesis and objective science, allowing, for example, that the events of creation occurred, but not in time as we know it, and that Adam was not the first biological human but the first spiritually aware one.

Isaak also identifies two forms of evolutionary thinking that contrast with all the others in erecting a distinct barrier between theology and science:

- **Theistic Evolution** says that God creates through evolution. Theistic Evolutionists vary in beliefs about how much God intervenes in the process. It accepts most or all of modern science, but it invokes God for some things outside the realm of science, such as the creation of the human soul. This position is promoted by the Pope and taught at mainline Protestant seminaries.
- **Materialistic Evolution** differs from Theistic Evolution in saying that God does not actively interfere with evolution. It is not necessarily atheistic, though; many Materialistic Evolutionists believe that God created evolution, for example. Materialistic evolution may be divided into methodological and philosophical materialism. Methodological materialism limits itself to describing the natural world with natural causes; it says nothing at all about the supernatural, neither affirming nor denying its existence or its role in life.

Finally, Isaak’s last category also violates the division between theology and science by making assertions that cannot be disproved, even in theory:

- **Philosophical materialism** says that the supernatural does not exist. It says that not only is evolution a natural process, but so is everything else.

The Fundamentalist Assault on Science

The *New York Times* published a review of the fundamentalist Christian attack on science in a series of articles in August 2005.

Jodi Wilgoren reports on the role of the Discovery Institute, a well-funded organization organized by political conservatives to push a faith-based explanation of biological diversity and the origins of different species. Their efforts to introduce theistic elements into science classes are described by the author as following “a path laid in a 1999 Discovery manifesto known as the *Wedge Document*, which sought ‘nothing less than the overthrow of materialism and its cultural legacies’ in favor of a ‘broadly theistic understanding of nature.’” The Institute has focused on bypassing US Supreme Court restrictions on introducing creationism into public school science classrooms; their method is to push “criticism” of evolution as if they are engaged in scientific debate.¹⁸

Kenneth Chang points out that

Intelligent design proponents are careful to say that they cannot identify the designer at work in the world, although most readily concede that God is the most likely possibility. And they offer varied opinions on when and how often a designer intervened. Dr. Behe, for example, said he could imagine that, like an elaborate billiards shot, the design was set up when the Big Bang occurred 13.6 billion years ago. “It could have all been programmed into the universe as far as I’m concerned,” he said. But it was also possible, Dr. Behe added, that a designer acted continually throughout the history of life. Mainstream scientists say this fuzziness about when and how design supposedly occurred makes the claims impossible to disprove.¹⁹

Cornelia Dean notes that many scientists are religious; however, she wrote,

Although they embrace religious faith, these scientists also embrace science as it has been defined for centuries. That is, they look to the natural world for explanations of what happens in the natural world and they recognize that scientific ideas must be provisional - capable of being overturned by evidence from experimentation and observation. This belief in science sets them apart from those who endorse creationism or its doctrinal cousin, intelligent design, both of which depend on the existence of a supernatural force.²⁰

As analysts of the situation in Kansas have noted,

Science uses empirical methods to study the relationship among things in the physical world. The Intelligent Design/creationists want to redefine science to include supernatural causation. . . . Scientists start with empirical observations, then make and test hypotheses, and eventually form

¹⁸ Wilgoren, J. (2005). “Politicized scholars put evolution on the defensive.” *New York Times* (August 21, 2005). Originally posted at < <http://www.nytimes.com/2005/08/21/national/21evolve.html> >

¹⁹ Chang, K. (2005). “In explaining life’s complexity, Darwinists and doubters clash.” *New York Times* (August 22, 2005). Originally posted at < <http://www.nytimes.com/2005/08/22/national/22design.html> >

²⁰ Dean, C. (2005). “Scientists speak up on mix of God and science.” *New York Times* (August 23, 2005). Originally posted at < <http://www.nytimes.com/2005/08/23/national/23believers.html> >

theories about some aspect of the physical world. Many theories contain inferences about things that are not directly observable. However, the Intelligent Design/creationists claim that the *historical sciences* (or *origins science*) are fundamentally less valid than the *non-historical sciences* because we can't observe the past, and that therefore *belief* in evolution is a matter of faith. . . . A scientific theory is a broad explanation that integrates a wide range of observations into a meaningful and coherent whole: that is, theories explain facts. However, in popular usage, theories are speculative and facts are certain. This confusion is exploited to cast doubt on evolution. They claim evolution is *only a theory*, and therefore *other theories* such as Intelligent Design/creationism deserve equal time.²¹

Some creationists dismiss parallels between modern-day pressures to suppress the teaching of evolution and the medieval Church's repression of astronomical advances; e.g., the same writer who claimed that science cannot address issues of historical events and processes wrote, "Also, the magazine's editorial lamely presented the hackneyed analogy that a belief in the Bible's version of creation resembles the 300-year-old dogma that the Sun revolved around the Earth."²²

Despite this writer's dismissal of the parallel between creationist / Intelligent Design imposition of their views into science classrooms and the use of the Church's power to suppress heliocentric astronomy in the 17th century, it is important for modern readers to understand exactly what happened in Florence around 1615: the parallels with today's debates are striking. Here are some excerpts from an encyclopedia entry about the heliocentric controversy:

By December 1609, Galileo had built a telescope of 20 times magnification, with which he discovered mountains and craters on the moon. He also saw that the Milky Way was composed of stars, and he discovered the four largest satellites of Jupiter. He published these findings in March 1610 in *The Starry Messenger* (trans. 1880). His new fame gained him appointment as court mathematician at Florence; he was thereby freed from teaching duties and had time for research and writing. By December 1610 he had observed the phases of Venus, which contradicted Ptolemaic astronomy and confirmed his preference for the Copernican system.

Professors of philosophy scorned Galileo's discoveries because Aristotle had held that only perfectly spherical bodies could exist in the heavens and that nothing new could ever appear there. Galileo also disputed with professors at Florence and Pisa over hydrostatics, and he published a book on floating bodies in 1612. Four printed attacks on this book followed, rejecting Galileo's physics. In 1613 he published a work on sunspots and predicted victory for the Copernican theory. A Pisan professor, in Galileo's absence, told the Medici (the ruling family of Florence as well as Galileo's employers) that belief in a moving earth was heretical. In 1614 a Florentine priest denounced Galileists from the pulpit. Galileo wrote a long, open letter on the irrelevance of biblical passages in scientific arguments, holding that interpretation of the Bible should be adapted to increasing knowledge and that no scientific position should ever be made an article of Roman Catholic faith.

Early in 1616, Copernican books were subjected to censorship by edict, and the Jesuit cardinal Robert Bellarmine instructed Galileo that he must no longer hold or defend the concept that the earth moves. Cardinal Bellarmine had previously advised him to treat this subject only hypothetically and for scientific purposes, without taking Copernican concepts as literally true or

²¹ Kansas Citizens for Science (2005). "Summary of Main Issues." < <http://www.kcfs.org/standards05/Summary.issues.html> >

²² Anonymous (2000). "Special issue of *New Scientist* not so special about special creation!" < <http://www.answersingenesis.org/docs2/4295news5-3-2000.asp> >

attempting to reconcile them with the Bible. Galileo remained silent on the subject for years, working on a method of determining longitudes at sea by using his predictions of the positions of Jupiter's satellites, resuming his earlier studies of falling bodies, and setting forth his views on scientific reasoning in a book on comets, *The Assayer* (1623; trans. 1957).

In 1624 Galileo began a book he wished to call "*Dialogue on the Tides*," in which he discussed the Ptolemaic and Copernican hypotheses in relation to the physics of tides. In 1630 the book was licensed for printing by Roman Catholic censors at Rome, but they altered the title to *Dialogue on the Two Chief World Systems* (trans. 1661). It was published at Florence in 1632. Despite two official licenses, Galileo was summoned to Rome by the Inquisition to stand trial for "grave suspicion of heresy." This charge was grounded on a report that Galileo had been personally ordered in 1616 not to discuss Copernicanism either orally or in writing. Cardinal Bellarmine had died, but Galileo produced a certificate signed by the cardinal, stating that Galileo had been subjected to no further restriction than applied to any Roman Catholic under the 1616 edict. No signed document contradicting this was ever found, but Galileo was nevertheless compelled in 1633 to abjure and was sentenced to life imprisonment (swiftly commuted to permanent house arrest). The *Dialogue* was ordered to be burned, and the sentence against him was to be read publicly in every university.²³

Much as in the 17th century, creationists have tried to impose their religious beliefs to forbid the teaching of evolution and have tried to distort the position of evolution in science by using laws and litigation. So far, I know of none who has proposed burning teachers at the stake. An extensive list of bills, proposals, lawsuits and political action campaigns is available at Wesley Elsberry's Antievolution Website.²⁴ A small sample of the chronology of laws and bills drawn from those materials follows:

- LAWS

- 1923, Florida, An anti-evolution resolution based upon William Jennings Bryan's views was adopted as law on May 25th, 1923. This marked the second anti-evolution law enacted within the USA
- 1923, Oklahoma, An anti-evolution amendment attached to a free textbook bill passed, marking the first enacted anti-evolution legislation in the USA The free textbook law and its anti-evolutionary sucker were repealed shortly after 1925.
- 1925, Tennessee, The Butler Act, This law outlawed the teaching of evolution as the descent of man from lower animals. As the most famous example of early anti-evolution legislation, it also provides us with information about what really bothered the anti-evolutionists: the teaching of the continuity of descent of man from non-human primates. This is the real issue that all later legislation would like to address, but does so only obliquely.
- 1926, Mississippi, Mississippi was the first state to adopt an anti-evolutionary law following the Scopes Trial

²³ Encarta Encyclopedia – "Galileo." Microsoft ® Encarta ® Reference Library 2005. © 1993-2004 Microsoft Corporation. All rights reserved.

²⁴ Elsberry, W. R. (2001). "Anti-evolution and the law." < <http://www.antievolution.org/topics/law/> >

- 1928, Arkansas, Arkansas voters approved the anti-evolutionary Initiative Act 1 on the November ballot
- 1973, Tennessee, Senate Bill, This bill mandated both the labeling of evolution as “a theory” and the devotion of equal space in textbooks to “other theories”, explicitly citing the Genesis account of creation as one of these. The bill, with a number of amendments, became law without the governor’s signature
- 1976, Kentucky, Kentucky passed, as a non-controversial law, legislation that allowed teachers to instruct students already believing in biblical creation the tenets of biblical creationism, and allowed such students to earn credit for correctly learning the material
- 1981, Arkansas, Act 590 “Equal-Time” legislation,
- 1981, Louisiana, “Equal-Time” Legislation,
- **BILLS**
 - 1922, Kentucky, An anti-evolution bill was introduced by Rep. George W. Ellis. Ref: ..., which notes that 45 more anti-evolution measures were introduced in the next ten years across the USA.
 - 1923, Tennessee, Anti-evolutionary bills were introduced in both the house and senate, but neither passed
 - 2001, Arkansas, House Bill 2548, A bill proposed by Rep. Jim Holt of Arkansas would make it illegal for public funds to be used to purchase materials containing known false or fraudulent claims. A list of putative false or fraudulent items was included in the text of the bill. These items were apparently produced by Holt going over the anti-evolutionary literature in a series of short skips and hops. Certain items in the text of the bill were exact quotes of the Jack Chick cartoon tract, “Big Daddy?” Holt enlisted the assistance of Kent Hovind, who testified before the Arkansas State House as an “expert”. Holt also claimed to have been influenced by Jonathan Wells’ book, “Icons of Evolution”. A critique of HB2548 documents likely anti-evolutionary sources for much of the text of the bill, points out conceptual and factual problems, and provides links to further information.
 - 2001, Georgia, House Bill 391, This bill directs teachers to distinguish between “philosophical materialism” and “authentic science”, and extends to teachers the “right” to present and critique any scientific theory of the origins of life or species. Not expected to be considered in 2001.
 - 2001, Louisiana, House Bill 1286, This bill directs that the state shall not print or distribute any material containing claims known to be false or fraudulent. It also specifically provides for any citizen to be able to sue the state using the provisions of this bill.
 - 2001, Michigan, House Bill 4382, A bill proposed by Rep. Gosselin (House Bill 4382) seeks to amend 1976 PA 451, “The revised school code”. The bill directs that all references to “evolution” or “how species change through time” should have additional words added that students should be informed that evolution is an unproven theory and that students should explain the “competing theories” of evolution and “the theory that life is the result of the purposeful, intelligent design of a creator.”

- 2001, Montana, House Bill 588, House Bill 588 by Rep. Joe Balyeat, R-Bozeman, was presented as an “objectivity in science education” measure, and would have directed the approval of evolution and creationism materials by an appointed six-member committee. Failed in committee, 14-4 vote, 2001/02/20.
- 2001, US Senate, SB1, AMENDMENT This amendment was drafted by Discovery Institute Advisor Phillip E. Johnson for Pennsylvania Senator Rick Santorum. Santorum offered it as an amendment to Senate Bill 1, which is known as the “No Child Left Behind” bill. It was removed from the bill in the conference committee, and thus is not part of the law, but the language was put into the conference report. The important point to remember is that the amendment was specifically considered and rejected.
- 2001, Washington, Senate Bill 6058, The Washington State Senate considers a bill to require the same “disclaimer” that Alabama required for their textbooks.
- 2001, West Virginia, House Bill 2554, An “equal-time” style anti-evolution bill.

Literalism

The passion applied by supporters of creationism and intelligent design to the efforts to insert their religiously-based views into science classrooms may, for some, be rooted in insecurity about the relation between religion and reality. These people are fixated upon what they call a *literal* interpretation of scripture – i.e., of modern-language translations of Greek and Latin translations of ancient Aramaic and Hebrew writings in which there were *no vowels written down* and where Jewish scholars to this day still debate specific interpretations.²⁵ Some extreme Christian fundamentalists even claim that only the King James version of the English-language Bible is “truly” sacred.²⁶

Some fundamentalists cannot countenance metaphorical or spiritual interpretations of religious texts and are openly threatened by alternative views of reality rooted in science: “But if men and women are nothing more than material substance—which organic evolution teaches—whether or

²⁵ “The original Hebrew alphabet consisted only of consonants (See also Semitic Languages) vowel signs and pronunciation currently accepted for biblical Hebrew were created by scholars known as Masoretes after the 5th century [CE]. These scholars are thought also to have standardized various dialectal differences. The vocabulary of biblical Hebrew is small. Concrete adjectives are used for abstract nouns. The paucity of particles, which connect and relate ideas, and the limitation to two verb tenses (perfect and imperfect) cause an ambiguity regarding time concepts; various syntactic devices were employed to clarify relations of time. A past action was indicated by the first in a series of verbs being in the perfect tense and all following verbs in the imperfect; for present or future action the first verb is in the imperfect tense and all subsequent ones in the perfect.” From the *Encarta Encyclopedia* – “Hebrew Language.” Microsoft ® Encarta ® Reference Library 2005. © 1993-2004 Microsoft Corporation. All rights reserved.

²⁶ David J. Stewart, writing in vivid red and white letters on a black background with liberal sprinklings of capitalization and a cheerful disdain for grammar, states categorically, “...[S]hould it be surprising that the devil would corrupt the Bible a little at a time, with each NEW version being just a little more corrupt than the previous? Not at all. This is why I reject all modern translations of the English Bible (there’s been over 400 English revisions since the 1611 King James Bible...surely the language hasn’t changed that much!). Only the 1611 King James Bible HONORS the Lord Jesus Christ’s deity and Godhead adequately.”

< http://www.jesus-is-savior.com/Basics/what_js_truth.htm >

not Christ died for us has absolutely no meaning. If there is nothing in man which survives death, the death of Christ was unnecessary and cruel.”²⁷

Interestingly, the insistence on literal, word-for-word, historical interpretation of Biblical text is a relatively recent development. Karen Armstrong, writing in *The Guardian Weekly*, explains that

Protestant fundamentalists... claim that they read the Bible in the same way as the early Christians, but their belief that it is literally true in every detail is a recent innovation, formulated for the first time in the late 19th century. Before the modern period, Jews, Christians and Muslims all relished highly allegorical interpretations of scripture. The word of God was infinite and could not be tied down to a single interpretation. Preoccupation with literal truth is a product of the scientific revolution, when reason achieved such spectacular results that mythology was no longer regarded as a valid path to knowledge.²⁸

Armstrong also points out that what we call scripture today has its roots in the oral tradition. Recitations of the traditions were integrated into social interactions; for example, writes Armstrong, “In Judaism the process of studying Torah and Talmud with a rabbi was itself a transformative experience that was just as important as the content.” She emphasizes that the *Qur’an* (a name meaning recitation) was expected to be read aloud, with assonances linking one passage to another in a rich tapestry of meaning. In contrast, “Solitary reading also enables people to read their scriptures too selectively, focusing on isolated texts that they read out of context, and ignoring others that do not chime with their own predilections.”

Intolerance of Uncertainty

Some fundamentalists may be threatened by ambiguity or uncertainty; these people cannot imagine accepting that a situation is still uncertain or subject to change as evidence comes to light. “But science changes all the time” is viewed as a telling criticism of the scientific method by people who believe that G-d speaks directly to them, personally, every day, to tell them absolute truth. My colleague Lars Nielsen comments, “In fact, during the late Middle Ages, the problem of the ‘double truth’ existed, an overt cleavage of ‘knowings’, one that we might consider scientific, the other from faith, and this double truth was actually championed by theologians because they found any sort of link between natural science and knowledge about God to be a constraint on divine omnipotence.”²⁹ Some fundamentalists carry this certainty further and believe that they can and should impose their vision of absolute truth on everyone else.

In the 1940s and 1950s, social psychologists developed a sense that some people exhibited a cluster of beliefs, attitudes and behaviors that came to be described as the *authoritarian personality*. A well-known textbook on social psychology summarizes the research as follows:

²⁷ Claiborne, W. (no date given). “What if evolution were true? #1.” < <http://www.gospelhour.net/2079.html> >

²⁸ Armstrong, K. (2005). Unholy strictures: It is both wrong and dangerous to believe that literal truth can be found in religious texts. *Guardian Weekly* (August 19, 2005). < <http://www.guardian.co.uk/comment/story/0,3604,1546558,00.html> >

²⁹ Nielsen, L. (2005). Personal communication, November 2005. Lars Nielsen is Administrative Director of the Master of Arts in Military History at Norwich University < <http://www.mmh.norwich.edu/overview.htm> >.

In the 1940s, a group of University of California, Berkeley, researchers – two of whom had fled Nazi Germany – set out on an urgent research mission. They wanted to uncover the psychological roots of an anti-Semitism so poisonous that it caused the slaughter of millions of Jews and turned many millions of Europeans into indifferent spectators. In studies of American adults, Adorno and his colleagues (1950) discovered that hostility toward Jews often coexisted with hostility toward other minorities. Moreover, these ethnocentric people shared authoritarian tendencies – an intolerance for weakness, a punitive attitude, and a submissive respect for their ingroup’s authorities, as reflected in their agreement with such statements as, “Obedience and respect for authority are the most important virtues children should learn.”³⁰

The author continues with an explanation that the original research was criticized for possible bias, but later research refined the concept: “... contemporary studies of right-wing authoritarians by University of Manitoba psychologist Bob Altemeyer (1988, 1992) confirm that there are individuals whose fears and self-righteous hostilities surface as prejudice.”

One of the most interesting aspects of the authoritarian personality is intolerance of ambiguity. The early researchers interpreted their findings as showing that the constellation of cognitive attributes in the authoritarian personality included intolerance of ambiguity. A recent paper from the *Psychological Bulletin* summarizes the findings as follows (references are from the original text and are not supplied here):³¹

Frenkel-Brunswick (1948) argued that intolerance of ambiguity constituted a general personality variable that related positively to prejudice as well as to more general social and cognitive variables. As she put it, individuals who are intolerant of ambiguity

are significantly more often given to dichotomous conceptions of the sex roles, of the parent-child relationship, and of interpersonal relationships in general. They are less permissive and lean toward rigid categorization of social norms. Power-weakness, cleanliness-dirtiness, morality-immorality, conformance-divergence are the dimensions through which people are seen. . . . There is sensitivity against qualified as contrasted with unqualified statements and against perceptual ambiguity; a disinclination to think in terms of probability; a comparative inability to abandon mental sets in intellectual tasks, such as solving mathematical problems, after they have lost their appropriateness. Relations to home discipline and to the ensuing attitude toward authority will likewise be demonstrated quantitatively. (Frenkel-Brunswick, 1948, p. 268)

. . . . Intolerance of ambiguity, by increasing cognitive and motivational tendencies to seek certainty, is hypothesized to lead people to cling to the familiar, to arrive at premature conclusions, and to impose simplistic clichés and stereotypes. In a review of research on ambiguity intolerance, Furnham and Ribchester (1995) provided the following list of consequences of this tendency:

³⁰ Myers, D. G. (1993). *Social Psychology, Fourth Edition*. McGraw-Hill (ISBN 0-07-044202-4). Page 397. I have not copied the references cited in Dr Myers text but the original papers are readily found using his book, any current textbook of social psychology or any research database.

³¹ Jost, J. T., J. Glaser, A. W. Kruglanski & F. J. Sulloway (2003). Political conservatism as motivated social cognition. *Psychological Bulletin [PsycARTICLES]* (May 2003) 129(3):339. Located through the *ProQuest* database of Kreitzberg Library at Norwich University.

Resistance to reversal of apparent fluctuating stimuli, the early selection and maintenance of one solution in a perceptually ambiguous situation, inability to allow for the possibility of good and bad traits in the same person, acceptance of attitude statements expressing a rigid, black-white view of life, seeking for certainty, a rigid dichotomizing into fixed categories, premature closure, and remaining closed to familiar characteristics of stimuli. (p. 180).

The penchant for seeing and promulgating intelligent design may be an expression of the intolerance of ambiguity described in these sources. I have personally encountered evangelical Christians who have criticized what they describe as the “wishy-washy” nature of scientific discourse and who have explicitly laughed at scientists’ penchant for accepting our own lack of certainty when discussing models of the world. Creationists sneer at evolutionary “theory” as if it were merely a passing fancy to be accepted or dismissed merely as a matter of preference. I imagine such people shrugging their shoulders as they intone, “Who’s to know if it’s true or not? Let G-d tell you.” Prof Percy Black retorts, “Not *who* – *how*.”

Theocracy

The ultimate form of imposition of faith on the unbeliever is theocracy.³² Some people want to impose their personal religious beliefs on everyone else regardless of others’ beliefs. For example, *ANALOG* editor Stanley Schmidt pointed out that a growing number of pharmacists in the USA are refusing to fill legitimate doctors’ prescriptions for contraceptive pills, citing “their personal religious or moral beliefs.”³³ The arguments are even louder about abortifacients.³⁴ Although the religious pharmacists and their defenders frame the debate in terms of the rights of the pharmacists not to participate in what they define as abortions, these people are licensed by the state to perform a critically-important medical function: carrying out a doctor’s orders for the treatment of a patient. Schmidt puts it succinctly: “A pharmacist whose religion frowns on birth control pills has no obligation to use them—and no right to interfere with someone else whose religious doesn’t forbid them.” He points out that telling those refused service to go somewhere else to find a more cooperative pharmacist are ignoring the realities of small-town or rural folk:

³² The Wikipedia entry on theocracy has useful links < <http://en.wikipedia.org/wiki/Theocracy> >. The entry states, “In the most common usage of the term theocracy, in which some civil rulers are identical with some leaders of the dominant religion (e.g., the Byzantine emperor as head of the Church), governmental policies are either identical with, or strongly influenced by, the principles of a religion (often the majority religion), and typically, the government claims to rule on behalf of God or a higher power, as specified by the local religion. However, unlike other forms of government, a theocracy can be unique, in that the administrative hierarchy of the government is often identical with the administrative hierarchy of the religion. This distinguishes a theocracy from forms of government which have a state religion, or from traditional monarchies, in which the head of state claims that his or her authority comes from God.”

³³ Schmidt, S. (2005). “Diffuse tyranny.” *ANALOG Science Fiction and Fact Magazine* (November 2005) 125(11):4. Using the GOOGLE search engine with keywords “pharmacists birth control pills prescriptions refusing” brought up many recent articles about this phenomenon.

³⁴ See for example an interview by Elizabeth Brackett aired on *Newshour with Jim Lehrer* on June 30, 2005: Morning-after pill protest.” < http://www.pbs.org/newshour/bb/health/jan-june05/pill_6-30.html >

The small-town woman who can't get her prescription filled may be in even worse shape than having to drive 90 miles to the next town. That town may be no different. We already have sizable areas where that narrow subset of Christians called "Fundamentalists" constitutes an increasingly aggressive majority. If all (or even most) of the pharmacists or teachers in a region quietly decide to do what they want rather than what the law says, they the protections nominally provided by the law have become meaningless. In such a situation, much of what people can do, and what is done to them, is determined not by constitutional law, even if such law exists on paper, but *de facto* by an unofficial and unregulated "diffuse tyranny" of people imposing their personal beliefs on others who do not share them."

Schmidt warns, "...there are good reasons for constitutional protection of freedom of religion, and... in practice your freedom to practice your religion *must* end where it conflicts with somebody else's."

This limitation means that we are free to exercise our religious beliefs but not to impose them on others who do not share those beliefs. In the words of a bumper sticker I have always liked, "DON'T LIKE ABORTION? DON'T HAVE ONE."

Most people are aware of the existence and behavior of theocracies on our planet today. A *Commentary* article by Paul Marshall summarizes some of the most powerful theocratic regimes in power today.³⁵

- Saudi Arabia enforces a rigid interpretation of the Wahhabi school of Islam. There are strict interpretations of *shari'a* (Islamic law) that impose a narrow religious interpretation on almost all aspects of individual behavior. "In Saudi Arabia, as in regimes and movements influenced by its example, questioning the government can be regarded as tantamount to questioning God; political opposition can be seen as apostasy or blasphemy, and punishable as such."
- In Iran, the mullahs who took control of the government after the ouster of the US-supported Pahlavi regime in 1979 have also imposed harsh religious edicts on everyone in the country. "Khomeini declared himself head of government and claimed almost divine powers; his own words, regardless of their relation to sacred texts, would define the boundaries of Islam. The Iranian fundamental law issued in Khomeini's name bars from political office non-Muslims or Muslims who do not demonstrate allegiance to the mullahs' rule, which is referred to as the 'guardianship of the jurist.' The law allows political participation-the formation of parties, rights of assembly, a free press – but only on condition of its 'compatibility with standards of *shari'a*,' a restriction that has allowed the authorities to suppress almost every meaningful expression of democratic opposition. The penal side of Iranian law is equally harsh. For an unmarried perpetrator, the punishment for adultery is 100 lashes; for a married one, death by stoning. It is a crime to listen to certain forms of music or to watch certain

³⁵ Marshall, P. (2005). "The Islamist's other weapon." *Commentary* (April 2005) 119(4):60

movies, and employment is restricted to those who believe in the 'guardianship of the jurist.' The penalty for killing a woman or a non-Muslim is less than that for killing a Muslim man, and there is no penalty at all for killing 'apostates' or members of unrecognized religious minorities like the Bahais."

- In Pakistan, "In the 1980's, blasphemy laws were introduced, subjecting those who 'defiled' the name of the prophet to the death penalty. More recent legislation makes it possible to imprison for three years any member of the minority Ahmadi sect who calls himself a Muslim or does anything that 'outrages the religious feelings of Muslims.'"
- In Afghanistan, the Taliban regime imposed harsh restrictions based on their interpretation of *shari'a*: "Women were forbidden to go to school, work outside the home, or travel without a male relative. Apostates and homosexuals were killed, and music was banned."
- In Sudan, strict *shari'a* laws were introduced in 1983; "In just the first year of the new laws, 58 public amputations were carried out in Khartoum province alone, including twelve 'cross-limb' procedures in which a hand and a foot were cut from opposite sides of the offender's body. Public floggings were broadcast daily on national television, and public hangings, followed by crucifixion, were carried out at sites built especially for the purpose. In 1985, seventy-six-year-old Mahmoud Mohamed Taha, perhaps the country's leading religious scholar, was hanged, having been convicted of apostasy for criticizing the new laws. Opposition to these barbaric practices--which were inflicted for the most part on poor Christians from southern Sudan--renewed a rebellion that, until the recent peace agreement, claimed more than two million lives."
- In the Zamfara state of Nigeria, imposition of *shari'a* law on non-Muslims in 1999 led to closure of "churches and non-Muslim schools and mandating 'Islamic' dress." In 2002, the theocratic governor of the state mandated the compulsory use of Arabic, a foreign language for most of the people in Zamfara; the result has been widespread civil unrest in which "tens of thousands of people have died in *shari'a*-related violence in Nigeria." In addition, "The governor of Yobe state has said he will defend the new laws even at the cost of civil war, and Sani has urged the advocates of *shari'a* to form their own armies to defend Muslims and promote Islam."

Another state that is under internal pressure from theocrats is Israel. Daphna Baram reported in the *New Statesman* that even though secular (non-religious) Jews still form a majority of Jews in Israel, they have been under constant pressure from orthodox Jews who demand compliance with

their interpretation of *Halachah*, or Jewish traditional law.³⁶ For example, in Jerusalem, it took demonstrations by young people to overturn the closing of movie-theaters on the Jewish Sabbath. The orthodox establishment defines who is to be defined as a Jew (for example, not all conversions by rabbis in the United States are accepted as legitimate by the Israeli orthodox hierarchy – and therefore by the Jewish state), who will be buried in Jewish cemeteries and even whether young Jews must serve in the Israel Defense Force (orthodox youths generally do not). Baram ends,

One could argue that the middle-class Israeli seculars have never had it better: the Orthodox establishment long ago gave up on peering into the plates of pork-eaters or wasting time trying to shut down corner shops that operate on the Sabbath. The religious concentrate their energies on getting state funding for their schools and community enterprises.

Nevertheless, the feeling of suffocation is greater than ever. Three years of intifada, economic deterioration and a widening of the gap between haves and have-nots have made the seculars feel as if they are losing their birthright, the haven that their ancestors toiled to establish in the state of Israel. The sense of siege compromises the famous Israeli patriotism; and thoughts of immigration, considered shameful two decades ago, are now openly discussed. Middle-class parents are openly voicing their wish that their children could have a foreign passport, “just in case”; Israelis with Polish grandparents who fled the Nazis in the 1930s are now trying to get them to renew their Polish passports, which may grant clear passage to the EU. If such migration turns into a full-scale phenomenon, it would be, for better or for worse, the end of Israel as we know it.

These reports remind me of a famous science fiction story by the great libertarian writer Robert Heinlein. In “*If This Goes On—*” he describes a United States of America ruled from dictator called the Prophet Incarnate living in a palace in New Jerusalem and guarded by graduates of the Academy at West Point assigned to a military unit called the Angels of the Lord. The culture accepts the stoning of the ungodly (the “pariahs”) when they are caught outside their ghettos after the curfew. The story progresses through a bloody revolution and the destruction of the corrupt theocracy.³⁷

Another interesting theocracy novel is Canadian author Margaret Atwood’s *The Handmaid’s Tale*.³⁸ Amazon.com reprints a succinct abstract from *Library Journal*:

In the Republic of Gilead, formerly the United States, far-right Schlafly/Falwell-type ideals have been carried to extremes in the monotheocratic government. The resulting society is a feminist’s nightmare: women are strictly controlled, unable to have jobs or money and assigned to various classes: the chaste, childless Wives; the housekeeping Marthas; and the reproductive Handmaids,

³⁶ Baram, D. (2004). “The defeat of the pork-eaters: in Israel, Orthodox Jews are not only winning the demographic war against their secular enemies – they are changing the nation’s culture, too.” *New Statesman* (Dec 6, 2004) 133(4717):32. Located through INFOTRAC database via the Kreitzberg Library at Norwich University.

³⁷ Heinlein, R. (1940). “If This Goes On –.” Novella first published in *Astounding Science Fiction* (Street & Smith Publications). Heinlein expanded the story into a short novel that was published as part of the *Future History* series as *Revolt in 2100* in 1953 (reissued in 1986 by Baen with ISBN 0-671-65589-2). There is an extended analysis of this story by Bill Paterson in *The Heinlein Journal* v7 (July 2000) that is available at < <http://www.heinleinsociety.org/rah/works/novels/ifthisgoeson.html> >.

³⁸ Atwood, M. (1986). *The Handmaid’s Tale*. Houghton Mifflin (ISBN 0-395-40425-8).

who turn their offspring over to the “morally fit” Wives. The tale is told by Offred (read: “of Fred”), a Handmaid who recalls the past and tells how the chilling society came to be.

These cautionary tales from two different generations of thoughtful writers warn us of the danger that rigid dogmatists pose to fundamental liberties in the United States.

Concluding Remarks

I want to make it clear that I have no objection to religious, historical, cultural, poetic, mythological, musical, artistic and theatrical representations of cosmogony and the origins of life. Indeed, I often go to synagogue; I read, study, enjoy and appreciate *Bereishit* (Genesis) and the other books of the Torah and the Hebrew Bible; I celebrate the Sabbath and raise my voice in praise of G-d. For that matter, I have enjoyed reading Native American creation myths, Greek and Roman mythology, and Chinese mythology. I think the jazz ballet “La Création du Monde” by Darius Milhaud is at least as valuable a contribution to human culture as other representations of creation. What I don’t do is expect to engage in these activities and discussions in an astronomy class, a biology class, a geology class or a physics class.

Knowledge may be infinite and it may be borderless, but for practical purposes, we slice knowledge up into pieces and apply convenient labels that help us segment it into manageable portions for pedagogical purposes. Thus we distinguish between physics and chemistry (even though they overlap), botany and zoology (even though there are creatures that don’t fit neatly into either gross classification), history and literature, poetry and music, religion and cultural anthropology. Would anyone seriously accept pressure to have astrologers present their beliefs in an astronomy class? Would astrologers be happy if they were forced to accept astronomers as unwanted guest lecturers in their astrology courses? Or would practitioners of homeopathy be happy if chemists insisted on being able to introduce discussions of molarity, probability and double-blind clinical trials into their homeopathy courses?

More to the point, how pleased would fundamentalist Christians be if atheists insisted on introducing challenges to the belief in G-d in Sunday-school classes on the basis of “fairness” and “open discussion?” Just imagine the uproar if atheists in Kansas demanded that school districts put stickers on Bibles reading, “Many people believe that the writing in this book is mythology, has no accurate descriptive value about historical events of any kind, and is best understood as having allegorical and poetic value only.”

Although some *scientists* may make personal comments about their religious beliefs, *science* has no position on religious matters that are not testable. If someone believes that a god created the universe, science has nothing to say on the matter. However, if someone asserts *as a matter of fact* that men have one less rib than women because a creation myth states that the first woman was created from the first man’s rib, that’s a matter of scientific investigation and disproof.

Seeing intelligent design in nature is not a disprovable proposition. There are no observations which can counter such a view even in theory. “Intelligent design” is not part of science.

My friend Michael Bopp comments that scientists are determined to limit the definition of science to what is testable (disprovable) at a particular time in history. Without strict inspection of proposed topics for inclusion in science, we run the risk of corruption of the social enterprise – much as we saw happen in Soviet Russia when Lysenko destroyed the rational basis for genetics in the 1920s.³⁹ Incorporating non-science into science without discrimination seriously threatens the basis for rational application of knowledge to practice. For example, poor science can lead to errors in social and technical realms. “If I can build a bridge based on a dream or on instructions from G-d without having to subject my designs to external, technical review, I can endanger everyone using that bridge.” Perhaps someone can walk their own bridge, but making others cross it is unreasonable and dangerous. Science guards a certain realm. It does not claim to apply to all realms; it just focuses on a narrow range of human knowledge. Until religious thinkers can present testable propositions, those in the scientific community are unable to consider their questions.⁴⁰

My friend and colleague Robert Gezelter points out that another problem that theocrats never like to address is that they cannot all be right from their own point of view. It is noteworthy that one never hears of creationists proposing to include Hopi, Navaho, Vedic or Maori creation myths into science classrooms. One of the most valuable contributions of the Enlightenment is the realization that religious pluralism – the acceptance of different approaches to religious truth – is a much better idea than religious wars. If one group gets to dictate the nature of truth, it may try to suppress conflicting versions of absolute truth. That way lies a new dark age.⁴¹

The attitudes underlying the attack on science are in my opinion deeply rooted in an absolutist view of the relations among human beings within a nation and even between nations. If G-d tells you the absolute truth about the history of the earth, biological evolution, abortion, sexuality, gay marriage, and how to run your country, it's not too much of a stretch to extend one's beliefs into absolute edicts that should be forced on everyone else on the planet. In this sense, all of these convictions of absolute truth – and the obligation to force them on others – are religious imperialism that is not particularly different from the fanaticism of theocrats in other cultures.

³⁹ “Lysenko, Trofim Denisovich (1898-1976), Soviet agronomist, who was the leader of the Soviet school of genetics that opposed Mendel's law and maintained that acquired characteristics can be inherited. He was born near Kyiv and educated at Kyiv Agricultural Institute. His theories received official support; they were taught in biology courses in the USSR and incorporated, with sometimes disastrous results, into Soviet agricultural programs. Lysenko held several important scientific posts during his career, including the presidency (1938-56) of the Lenin All-Union Academy of Agricultural Sciences and the directorship (1940-65) of the Institute of Genetics, USSR Academy of Sciences. After the death of Joseph Stalin in 1953, Lysenko was strongly criticized, and his influence gradually diminished.” Microsoft ® Encarta ® Reference Library 2005. © 1993-2004 Microsoft Corporation. All rights reserved.

⁴⁰ Bopp, M. (2005). Personal communication. Dr Bopp is Director of the **Four Worlds Center for Development Learning** < <http://www.fourworlds.ca> > and coaches research and change processes related to community health and social and economic development around the world.

⁴¹ Gezelter, R. (2005). Personal communication, November 2005. Robert Gezelter is a software consultant and a Distinguished Visitor of the IEEE Computer Society. His Web site is < <http://www.rlgsc.com/default.html> >.

From another perspective, the attack on science teaching is an example of the dangerous and growing political ascendancy of people who feel that their religiously-based view of the world should be imposed on everyone else regardless of the principles of religious freedom that informed the foundation of this country. Seen from this point of view, defenders of religious freedom – and of freedom from impositions from other people’s religions – must justifiably defend the distinction between science and faith in education.

To summarize, *science* as perceived by scientists is organized knowledge *subject to empirical disproof* and scientists are people who use science as a tool for increasing human knowledge. Unless thoughtful people clarify the crucial distinction between the popular or loose definition of science and the technical or specialized definition of science, we will continue to hear discussions at cross purposes in this country.

So the next time you chat with a creationist about educational issues, listen carefully to your interlocutor and find out whether this person has any intention of letting you or anyone else live *your* life free of the constraints of *their* personal belief system.



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