

the **CrossFit** JOURNAL ARTICLES

Conjecture, Hypothesis, Theory, Law

The Basis of Rational Argument

Jeff Glassman

Last year, Lee Smolin published a book with a most provocative title: *The Trouble with Physics: The Rise of String Theory, the Fall of a Science, and What Comes Next*. This title promises brimstone for the fire of creationism, and that should sell an extra few thousand copies.

If mathematics is the Queen of Science (borrowing from *Mathematics: Queen and Servant of Science*, a classic by Eric Temple Bell), then physics is the King. It has been the exemplar of science. So, has the revolution begun?

The reviews of *The Trouble with Physics* tell us that Smolin urges not that string theory arises from the decay of physics but instead that string theory is itself symptomatic of something that is wrong in physics (a sick distant cousin), not with physics (a fatal familial disease). According to the criticism (the most valuable part of reviews), Smolin both spends too much time on string theory and gives it short shrift. Could the latter, though, just be string theorists taking offense, and further evidence of what is wrong in physics?

Two independent and published reviews of *The Trouble* suggest that what Smolin observes in physics is what is also happening in climatology—and, in fact, I argue, it is what is happening in all science, from kindergarten curricula to the Pulitzer Prize. Some people attain the highest ranks in a scientific field without ever gaining an understanding of it in the context of science itself. This is what happened to the masters of cold fusion and anthropogenic (manmade) global warming and to advocates for Piltdown man and creationism. This conclusion rises out of the two reviews of Smolin,

which come to his support by ragging on string theory. They do so not from the standpoint of physics, but from the metaphysical, by appealing to the transcending prerequisites of science! One cannot judge physics from within physics. (Gödel would have been pleased.)

Gregg Easterbrook, a science writer and editor at *The New Republic*, *The Atlantic Monthly*, and *Washington Monthly*, and a visiting fellow at the Brookings Institution, published his review of Smolin in *Slate* magazine. Over a year ago he wrote,

The ordering of scientific notions is: conjecture, hypothesis, theory. Pope John Paul II chose his words carefully when in 1996 he called evolution “more than a hypothesis.” Yet the very sorts of elite-institution academics who snigger at creationists for revealing their ignorance of scientific terminology by calling evolution “just a theory” nonetheless uniformly say “string theory.” Since what they’re talking about is strictly a thought experiment (just try proving there are no other dimensions), from now on, “string conjecture,” please.

Notwithstanding that the list in the first sentence is missing a key notion, it and the concluding phrase “string conjecture” sparkle scientifically, regardless of the physics. Easterbrook’s review is fairly rich in the stuff of science, including observations, scale, prediction, testing, and laws. Yet he didn’t catch that the complete ordering of scientific notions is really conjecture, hypothesis, theory, and law.

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Easterbrook's scientific literacy is too wanting for a reader to infer that these flashes of brilliance are his. His limitations are immediately evident from his public conversion from global warming skeptic to alarmist. He reasoned:

Once global-warming science was too uncertain to form the basis of policy decisions—and this was hardly just the contention of oil executives. “There is no evidence yet” of dangerous climate change, a National Academy of Sciences report said in 1991. A 1992 survey of the American Geophysical Union and the American Meteorological Society found that only 17 percent of members believed there was sufficient grounds to declare an artificial greenhouse effect in progress. In 1993 Thomas Karl, director of the National Climatic Data Center, said there existed “a great range of uncertainty” regarding whether the world is warming. Clearly, the question called for more research.

That research is now in, and it shows a strong scientific consensus that an artificially warming world is a real phenomenon posing real danger... [¶] Case closed. (Easterbrook, “[Finally Feeling the Heat](#),” *New York Times*, 24 April 2006.)

The media reverberates, and Easterbrook pumps it by ringing the alarm: “Here’s the short version of everything you need to know about global warming. First, the consensus of the scientific community has shifted from skepticism to near-unanimous acceptance of the evidence of an artificial greenhouse effect.” (Easterbrook, “[Case Closed: The Debate about Global Warming is Over](#),” Brookings Institution Governance Studies, June 2006.)

With this bandwagonism, Easterbrook reveals two fatal flaws in his scientific literacy. First, science is never about voting, the popularity of a belief, or even beliefs themselves. Models are never validated by consensus, but by facts satisfying predictions. Second, the case is never closed, even when the model has advanced to the ultimate, a law. Relativity didn’t invalidate Newton’s Laws; it just required the domain to be tightened. So, where did Easterbrook get his rather profound information about the ranking of models? If he should have credited Smolin, then Smolin, and his authorities, deserve the recognition.

This year, Michael Riordan, Ph.D., an adjunct professor of physics at UC Santa Cruz and a History of Philosophy Lecturer at Stanford, published the second noteworthy review of Smolin for *Physics World* magazine. He, too, uses the scientific vocabulary, including the terms *model*, *scale*, *observation*, *proof*, *prediction*, *theory*, *hypothesis*, *conjecture*, and *law*. He supports the thesis here inferred to Smolin when he says,

But string theory is not really a “theory” at all—at least not in the strict sense that scientists generally use the term. It is instead a dense, weedy thicket of hypotheses and conjectures badly in need of pruning.

That pruning, however, can come only from observation and experiment, to which string theory (a phrase I will grudgingly continue using) is largely inaccessible (p.1).

Easterbrook gave his example of the importance of scientific model quality when he took academics to task for ridiculing creationist theory while simultaneously labeling the string model as a theory. He also skirted the complementary example: creationists ridicule evolution for being only a theory, but a theory ranks near the epitome of scientific model accomplishment.

Riordan introduces ethical questions into the fray when he writes, “Or [in the practice of science] are there lasting professional ethics, such as the use of rational argument based on observable evidence accessible to any practitioner?” (p. 3).

In response, I offer a schema for science that includes the following, and more.

- Rational argument must be the zeroth axiom.
- Observable evidence must be reduced to measurements—that is, to comparison against a standard.
- Scientific facts, the foundation of all model building and testing, are measurements with an established accuracy.
- Science is a branch of knowledge, the objective branch, and ultimately public.
- The application of science to public policy with unvalidated models is unethical.

As to the last, such unethical behavior has reached a high point in the history of science in the current

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vogue of the threat of anthropogenic global warming, a conjecture.

An understanding of the validity of science and scientific criticism, whether about cosmology, or climatology, or physiology and the efficacy of CrossFit, requires knowledge of Riordan's "strict sense" of the terms *conjecture*, *hypothesis*, *theory*, and *law*.

Be aware, now, consensus on the meaning of these terms is fading. The two reviews demonstrate that. In common use, scientists speak at once of probability theory and the laws of probability. Scientifically credentialed individuals advance unvalidated models by proclaiming a consensus. It's an infection like university grade inflation. Nevertheless, here is a guideline that will improve your science literacy, give you a framework for evaluating all variety of supposedly objective or scientific claims, arguments, and models, and hold you in good stead with real scientists.

Science is all about models of the real world, whether natural (basic science) or manmade (applied science, or technology). These models are not discovered in nature, for nature has no numbers, no coordinate systems, no parameters, no equations, no logic, no predictions, neither linearity nor non-linearity, nor many of the other attributes of science. Models are man's creations, written in the languages of science: natural language, logic, and mathematics. They are built upon the structure of a specified factual domain. The models are generally appreciated, if not actually graded, in four levels:

1. A *conjecture* is an incomplete model, or an analogy to another domain. Here are some examples of candidates for the designation:

- "Ephedrine enhances fitness."
- "The cosmological red shift is caused by light losing energy as it travels through space." (This is the "tired light conjecture.")
- "The laws of physics are constant in time and space throughout the universe." (This one is known in geology as "uniformitarianism.")
- "Species evolve to superior states."
- "A carcinogen to one species will necessarily be carcinogenic to another."

2. A *hypothesis* is a model based on all data in its specified domain, with no counterexample,

and incorporating a novel prediction yet to be validated by facts. Candidates:

- "Mental aging can be delayed by applying the 'use it or lose it' dictum."
- "The red shift of light is a Doppler shift."

3. A *theory* is a hypothesis with at least one nontrivial validating datum. Candidates:

- Relativity.
- Big Bang cosmology.
- Evolution.

4. A *law* is a theory that has received validation in all possible ramifications, and to known levels of accuracy. Candidates:

- Newtonian mechanics.
- Gravity.
- Henry's Law.
- The laws of thermodynamics.

Each of these candidates can stir arguments worthy of a paper, if not a book, and no model is secure in its position. Weak scientists will strengthen their beliefs and stances by promoting their models while demoting the competition. Some familiar models fail even to be ranked because they are beyond science, usually for want of facts. Candidates:

- Creation science or notions of "intelligent design."
- Astrology.
- Parapsychology.
- UFO-ology.

So, what really is "the trouble with physics"? The Easterbrook and Riordan, the reviewers of Smolin's book with that provocative title, say that it lies not in physics but in the inflation of the string conjecture into a string theory. To understand what the reviewers mean requires the beginnings of science literacy, framed by the definition of science and its four grades of models.

Most citizens wouldn't be interested in these two reviews, much less Smolin's book—even if it were titled "Harry Potter and the Trouble with Physics." The trouble with physics is a technical question asked and answered in the context of the structure of science. Physics will proceed little fazed by the label—"conjecture" vs. "hypothesis" vs. "theory"—applied to the string model.

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But many more citizens will be acutely interested in whether their school board puts “intelligent design” into its grade school curriculum or into its text book criteria, and how. And a majority of citizens will be personally affected should the United States adopt the Kyoto Accord. Here the charlatans and demagogues are trying to exploit the public vulnerability created by a public school system that has replaced science and mathematics with recycling and self-esteem curricula.

The notion of intelligent design belongs in the public school program. The science curriculum should show that, because science builds on facts (measurements compared to standards as explained above) and because God and the supernatural can never be measured but must remain mysterious and otherworldly, intelligent design and creationism are matters of faith, not science. To a scientist-believer, science takes the measure of what God appears to have done, not of God. Science can never figure out what size Birkenstock God takes.

Just as intelligent design is a threshold question between nonscience and conjectures, anthropogenic global warming (AGW) is a threshold question between conjectures and hypotheses. AGW is a centuries-old conjecture elevated to an established belief by a little clique of quacks who proclaim themselves the Consensus on Climate, guardians of the vault of exclusive knowledge. Does this sound familiar? Is the Consensus patterned after the Council of Trent? As a matter of science, as opposed to a matter of belief, the AGW conjecture is gathering more contradictory evidence than supporting. The layman can test it and understand its failings by applying just the few principles outlined here.

AGW fails the test because it is proclaimed by a consensus. Science places no value on such a vote. A unanimous opinion, much less a consensus, is insufficient. Science advances one scientist at a time, and we honor their names. It advances one model at a time. When the article gets around to saying “most scientists believe...,” it’s time to go back to the comics section. Science relies instead on models that make factual predictions that are or might be validated.

AGW fails on the first order scientific principles outlined here because it does not fit all the data. The consensus relies on models initialized after the start of the Industrial era, which then try to trace out a future climate. Science demands that a climate model

reproduce the climate data first. These models don’t fit the first-, second-, or third-order events that characterize the history of Earth’s climate. They don’t reproduce the Ice Ages, the Glacial epochs, or even the rather recent Little Ice Age. The models don’t even have characteristics similar to these profound events, much less have the timing right. Since the start of the Industrial era, Earth has been warming in recovery from these three events. The consensus initializes its models to be in equilibrium, not warming.

And there’s much, much more.

Anthropogenic Global Warming is a crippled conjecture, doomed just by these principles of science never to advance to a hypothesis. Its fate would be sealed by a minimally scientifically literate public.

Now, go forth and scientificate.



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He has also worked as a bush pilot for Alaska Helicopters and was a Naval Aviator in helicopters and single- and multiengine aircraft, instructor pilot, and maintenance test pilot, making LCDR in the reserves before resigning with a total of 12 years.

Currently, he spends a lot of time researching and writing for his [blog](#), which contains original material dismantling so-called global warming on the highest scientific standards.