letters

Debate about science and religion continues

I commend Murray Peshkin for his personal involvement in educating the public about science (PHYSICS TODAY, July 2006, page 46). Arming nonscientists with even the most basic scientific reasoning goes a long way in dispelling much of the misinformation propagated by religious fundamentalists. However, I think Peshkin's explanation of boundaries between science and religion is wrong, and even though his education of nonscientists is amiable, his message to the religious among them is condescending.

Peshkin's presentation to religious nonscientists is conciliatory through the claim that science need not overlap with their beliefs, and that they can be safe from scientific scrutiny because science and religion have "different rules of inference, and different definitions of truth or reality." The statement comes without explanation and seems like it is intended to be accepted without question by a receptive audience. Then he writes, "Science is based entirely on experiment," which emphasizes a narrow scope of science and implies ample room for religious belief. This second statement is wrong because it disregards the role of observation, something responsible for astronomy and much of evolutionary biology, to name just two areas. By neglecting to mention observation in this context, he leaves out the essence of science most directly responsible for unease with religion. Specifically, observation means that many religiously motivated claims about nature can be subject to scientific scrutiny even if they are not experimentally accessible; the origins of the universe and of humans are prime examples. Science has cornered religious assertions about the natural world, and the tension arises not when scientists step over some imaginary line into religion but when religion trespasses by trying to explain the natural world. Any supernatural cause that has an effect in the natural world is subject to validation or refutation by science.

Peshkin does give two examples where science cannot tread: "The world was created three hours ago with all our memories and everything else in place," and "No observational evidence can disprove some subtle supernatural intervention." But those statements are just specific examples of the general rules; we can't know the unknowable, and we can't disprove the existence of something. Peshkin seems to imply that these kind of fantastical ideas are a refuge for the religious, without enlightening them to how extremely small a perimeter it leaves them to roam. He does not show, for example, how this fence surrounding religion means the effectiveness of prayer, existence of the soul, and interaction between a deity and the natural world are subject to scientific scrutiny. Instead, his misrepresentation of science appears deliberately designed to comfort those with beliefs in the supernatural.

My charges present a dilemma for Peshkin and for all of us who want to have an honest debate about science education, health care, medical research, and other avenues in which science and religion have rubbed elbows. Either we run the risk of alienating religious people by explaining how little room science leaves for mysticism, or we treat them like children by sugarcoating our empiricism so they can feel comfortable in their beliefs; the latter stance is often mistaken as respect for religion. Perhaps Peshkin's middle ground is good diplomacy, but it is not completely forthright.

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There is much wisdom in the example Murray Peshkin sets and in the specific topics he mentions. However, as someone who has moved in my career from physics to planetary science to astrobiology, I am sensitive to two areas in which Peshkin's approach risks sending the wrong message.

The meaning of the word "theory" has evolved over the past century to the point where no one outside of a few academic oases uses its original scientific meaning. Such establishment bastions as the *New York Times* and National Public Radio, and even many scientists in ordinary conversation, use theory to mean an idea, suggestion, or hypothesis. Common are such phrases as "in theory, such-and-such is true, but in practice . . ." or "in the absence of evidence, several theories were suggested." It is certainly possible to explain to a captive audience that the scientific meaning of this word is almost the exact opposite of its colloquial usage. Much better, however, is to talk about gravitation, relativity, plate tectonics, or evolution without the word "theory." We are likely to communicate more effectively if we do not demand that a lay audience unlearn the familiar meaning of this word.

My second concern is the description of science as based entirely on experiment. We must broaden the definition to include observation and inference about things that have happened in the past or are happening in the universe beyond Earth, since those are the topics that generate the most controversy between science and religion.

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The ongoing national debate about the teaching of evolution in our public schools is best served by clearly distinguishing the experimental sciences from the historical sciences like Darwin's theory of evolution. The historical sciences invariably bring into play the totality of the human experience and thus the debate.

Scientists, philosophers, and theologians accumulate knowledge when analyzing different aspects of reality and search for particular hypotheses or models to fit their respective subject matters. Of course, a main goal is to integrate these kinds of knowledge into an all-encompassing worldview.

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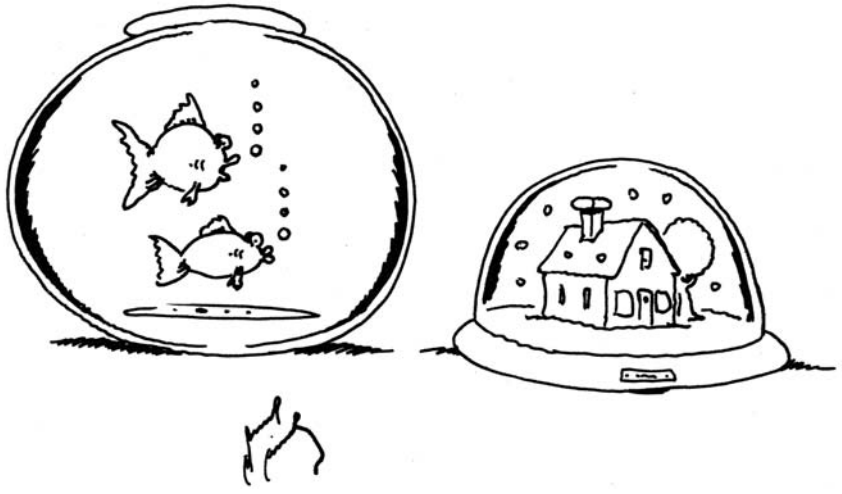
Religious concepts and beliefs are based on the notion of divinity, so one must posit the existence of the supernatural, which transcends nature but may contain all or part of it. The overwhelming majority of Americans subscribe to the existence of such a realm.

A first, reasonable, and useful definition of science is the study of the physical aspect of nature, and its subject matter is data that can be collected, in principle, by purely physical devices. Therefore, the laws of experimental science are generalizations of historical propositions—that is, experimental data. Note that consciousness and rationality are purely nonphysical, since purely physical devices cannot detect them. In addition, life cannot be reduced to the purely physical, so living beings are both physical and nonphysical.

Human rationality develops formal logic and creates mathematics to summarize data into laws of nature that lead to theoretical models covering a wide range of phenomena. However, scientists deal with secondary causes. First causes involve metaphysical (ontological) questions, which regulate science. Without the ontological, neither the generalizations nor the historical propositions of the experimental sciences would be possible.

An extreme form of reductionism supposes that all that exists is purely physical and that the nonphysical aspect of reality follows from the purely physical and the laws governing their interactions. Unfortunately, this is often what is in the mind of the public when discussing evolution. For that reason, one must spell out what prior information is assumed in evolutionary theory; otherwise, people would associate Darwin's evolution with a particular worldview, for instance, atheism. In addition, it ought to be emphasized that advances in medicine and other practical applications of biology are based essentially on the results of laboratory experiments and not the history of the evolution of life on Earth.

The public should be made aware that the laws of experimental science are quite consistent with most theological presuppositions. It is in the study of unique historical events—say, in cosmological or biological evolution—where the conflict between science and religion may arise. For instance, the Christian faith is based solely on the historicity of Jesus of Nazareth, his death, and his resurrection. Absent those historical events, there would be no Christian faith. Experimental science has nothing to say regarding any particular historical event.



"Oh great! Now I'll have to form a whole new cosmology."

Isaac Newton's mechanics and James Clerk Maxwell's electrodynamics are excellent prototypes of scientific theories. No designer or theological considerations are needed in the theories themselves except when considering the nature of the humans who created the mathematical schemes. Therefore, the consideration of humans in any theory must be based on the integration of science with other kinds of knowledge—theology, for example.

The question of origins, especially the origin of man, poses a most difficult problem—in particular, the emergence of life from the purely physical. Surely, the results of experiment are used to analyze all extant data in the historical sciences; nevertheless, the fundamental problem of origins is more a historical rather than a scientific problem.

Finally, Peshkin indicates, "a proposition is not a scientific theory at all unless it's falsifiable in principle." Of course, if one is to apply Karl Popper's principle of falsifiability, a theory must make unambiguous predictions. In weather forecasting, the physics underlying the dynamics is well known, and given the initial conditions, long-range forecasting is very limited indeed. Surely, the evolution of life on Earth is a much more complex system, so the claims made by those advocating evolutionary theory can never really be falsified.

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The issues of scientific validity and science versus pseudoscience were never addressed in any courses I took as an undergraduate science major, and I observe the same situation in today's university introductory science courses. How are undergraduates—or graduate students, for that matter—supposed to learn these things? Murray Peshkin is correct when he says, "We need to do better."

For about the past five years, I have begun my introductory astronomy courses with a detailed interactive talk on the nature of science and critical thinking. I incorporate a study of logical fallacies, another item missing from most science courses. I use actual letters to the editor of the local newspaper as debunking fodder. This introduction to critical thinking takes about two weeks, but by the end of the semester, my students know how to tell science from pseudoscience and belief, and they know how to gauge the scientific validity of a claim. Instructors who leave this material out of their courses are doing a great injustice to students and to science in general. The presentation I use in my classes is available on my website http://www.sticksandshadows.com) along with a small but growing collection of custom applications of critical thinking to astronomy.

All introductory science courses should be built around critical thinking, with examples from the various scientific disciplines providing applications. If students never understand the nature of science, they will never truly understand how and why we know about exotic entities like black holes.

My experience has been that students welcome discussion on the differences between science and religion, a necessary topic when it comes to criti-