

Addressing the public about science and religion

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Murray Peshkin is a theoretical physicist at Argonne National Laboratory.

I have been speaking to diverse small groups about science and religion in the context of the ongoing national debate about the teaching of evolution in our public schools. The response to my talks has been almost uniformly positive. It would be useful for other physicists to do as I have been doing.

My audiences have been service clubs such as Rotary, high-school and college students of science and science journalism, a school-based community event, a League of Women Voters chapter, a Unitarian church, and a microscopy club. They have ranged from a dozen to some 60 or 70 people. Access is a problem but not an insuperable one, since organizations have program chairs hungry for speakers, and local newspapers, especially small suburban ones, are interested in publicizing such activities.

I am not trying to convert the convinced anti-evolutionist. I am trying to inform people about the issues and their importance. That goal is important for scientists because the integrity of science teaching in our public schools is under serious attack. So far, the courts have mostly come to the rescue, but in the end public opinion will carry the day. Reasonable people need to know what science is about, especially what an established scientific theory is and how scientists know when it's right. Nonscientists are vulnerable to arguments like "Evolution is only a theory" and "What's the harm in teaching alternative theories as well?"

It seems that most Americans have religious beliefs that are important to them. For some churches the biblical account of creation is an allegory. Some other churches that interpret the creation account literally hold that there is no conflict between the Bible and evolution. I have come to know theologically sophisticated literal believers who understand that there is no conflict, but I think the majority in my audiences have been uncomfortable with that assertion. They may have been advised by their religious authorities that science and religion are separate discourses and that a reasonable person can subscribe to both,¹ but they do not understand how

cosmological and biological evolution can fail to deny their religious beliefs.

I start my talks by observing that both science and religion have been major contributors to the development of Western civilization and both play an important role in most people's lives, even the lives of those who participate in neither. Religion addresses moral and existential issues. Science does not. Science describes the observable world of experience. In the United States, but not in other Western countries, religion and science are currently experiencing a political confrontation that threatens to do serious harm to science and possibly also to damage religion. I am trying to advance a dialog between the science community and the public by explaining what science is about, how it relates to other subjects, especially religion, and very importantly what the limitations of science are. An example of such an explanation is on my website.¹ Here I will summarize.

Science is based entirely on experiment. To illustrate what that means, I raise the possibility that the world was created three hours ago with all our memories and everything else in place, and I encourage discussion of that possibility. Science cannot refute it. That leads into the notion that a proposition is not a scientific theory at all unless it's falsifiable in principle. Absent a possible experiment, science does not even know the meaning of the proposition. Nobody is surprised when I confess that I'm really not thinking of three hours ago, but of a few thousand years.

Science and religion have different assumptions, different rules of inference, and different definitions of truth or reality. The fence that surrounds science is the test by experiment. That fence is both the greatest strength and the most fundamental limitation of science, and it needs to be respected from both sides. Scientists may have opinions about religion, but they cannot honestly invoke the authority of science when they try to apply the logic of science on the other side of the fence. Similarly, creationists and advocates of intelligent design should not pretend to be conducting a scientific argument.

What is a theory?

Science, in Albert Einstein's words, "describes what is." Such a description consists of certain laws of nature, which summarize observed patterns, and of theories. There are speculative theories that have some limited experimental success. Such theories mostly die young when they are confronted with additional experiments. Durable theories proceed from stated assumptions to describe all the phenomena within their purviews, have broad applicability, and preferably also have strong predictive power. All theories, though, face the near certainty that some day newly discovered experimental phenomena will negate them. Nevertheless, a well established theory will continue to apply within the domain of its success because the experiments on which it is based will never go away.

My explanation of what a scientific theory is comes as news to most people. In common parlance a theory can be a simple speculation. Claims of breakthroughs that overthrow all our theories are made every day. To make the concept of a durable scientific theory concrete, I usually give a very brief outline of the history and applicability of Isaac Newton's mechanics or of James Clerk Maxwell's electrodynamics, emphasizing their spectacular successes but giving no details of the theory itself. To illustrate the predictive power of mechanics, I describe the discovery of the planet Neptune. To illustrate electrodynamics, I mention the discovery of radio waves and the incorporation of optics into electrodynamics. Then I tell of the complete failure of those classical theories when applied to phenomena on the atomic scale or phenomena involving high speeds or strong gravitational forces. We have new theories, typically built on the old ones, for those phenomena. The new theories agree with the old ones within the domain of success of the old ones. They must, or we would not have adopted them. And we continue to use the old theories where they apply because they work and they're much easier to use. I think many, perhaps most, of my audiences understand for the first

time why a powerful theory is something to be respected.

Following that, I turn to Charles Darwin's theory of evolution, which I describe as being so completely entangled with Gregor Mendel's theory of genetics that they are really one theory. You don't have to be a biologist to discuss evolution and genetics because the details don't matter in such a talk. A useful account for physicists is given by Philip Kitcher.² The predictive power of Darwin and Mendel is stunning. Hundreds of Darwin's predicted missing links have been found. The genes Mendel postulated in 1860 are seen these days with electron microscopes; biologists routinely cut and paste them and observe the evolution of new genes that enhance fitness to survive. The theory of Darwin and Mendel has yet to encounter its limitations. Some day it probably will, but it is certainly permanent within its vast domain of applicability.

'It's only a theory'

I always discuss the words "It's only a theory" by saying that for practical purposes that's the same as saying "It's only science," and the price we can pay for such contempt for science is high. Belief in Newton's mechanics within its domain of validity is not optional, at least not if you design airplanes or bridges. The sad history of Trofim Lysenko and the calamities he caused illustrates why belief in the right theory, evolution in that case, is also not optional. Agricultural practices based on Lysenko's theories, which contradicted Darwin's evolution, contributed to disastrous crop failures in the Soviet Union in the 1930s and in China in the 1950s.

None of what I am saying threatens religion. No observational evidence can disprove some subtle supernatural intervention in cosmological or biological evolution that would leave us with the evidence we see. That possibility is important to some scientists. It does not interest me, but I cannot argue against it within the logic of science. K. E. Miller, in his book *Finding Darwin's God*,³ dissects the objections to evolution and genetics. He then reconciles his Catholic religion with science by invoking the indeterminacy of quantum mechanics.

The current prosperity in the US derives in large part from 20th-century advances in physics, such as the transistor. In the 21st century, the driving force may well be biology. The anticipated advances in medicine and other practical applications of biology will happen, but not necessarily in this country. We can't afford to degrade biology in our schools.

I have not encountered overt hostility to my message, possibly because the dedicated opponents were few in the audiences I have addressed. If challenged by detailed attacks on aspects of biology, I intend to beg off. I'm a physicist. I plan to let the audience handle it, and simply say that my view has been heard. I expect that it will come out well.

The relation between science and religion is a baggage-laden subject. Style is important if you want to have an impact. I try to be low-key, even sitting rather than standing if that's practical, and trying not always to have the last word. That goes against our professional culture but it helps. I'm often asked about my own religious affiliation or preference, a legitimate question in this arena. I respond forthrightly, including that I have no supernatural beliefs. Then I suggest that we should concentrate on the message, not on the messenger. That response has always been accepted respectfully.

A majority of the people who have approached me about what I said or wrote started the conversation by saying they appreciated my respect for religion. The message to me is that it is essential not only to be respectful, but to be visibly so. People's previous experience has made them wary of scientists discussing religion.

Readers of PHYSICS TODAY may find the decisions in some court cases inter-

esting. The drama begun in the Scopes "monkey" trial has been replayed many times up to the present. Judge John Jones's landmark decision in the recent Dover Area School Board case gives an exceptionally clear discussion of the church-state and scientific issues (PHYSICS TODAY, January 2006, page 32). For the opposite point of view, try Justice Antonin Scalia's dissent in another recent case. These and some other relevant legal decisions are available on the Web.¹

I have to end this essay with a scold. Whenever I ask nonscientists whether they have ever before heard a mature discussion of what science is about, what we require of a theory, and how we recognize the right science, I find that few have. I myself have never been in a classroom, either as student or as teacher, where those issues were discussed. We were too busy with pulleys and levers or Hamiltonians. We need to do better.

References

1. See <http://home.mindspring.com/~sci-rel/>.
2. P. Kitcher, *Abusing Science*, MIT Press, Cambridge, MA (1982). Chapter 1 gives an excellent brief introduction to evolution and genetics.
3. K. E. Miller, *Finding Darwin's God: A Scientist's Search for Common Ground Between God and Evolution*, Cliff Street Books, New York (1999). ■



"I'm on the cusp of a discovery that could benefit mankind for generations ... but, SURE, I can spare a minute."