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Mind your scientific language

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IN DESCRIBING humankind's fascination with extra dimensions for *The New York Times* recently, I made the mistake of mentioning string theory and intelligent design on the same page. My purpose was not to claim they are similar. Quite the opposite. I wanted to describe how both science and religion sometimes provoke heated debates about features of the universe we cannot measure. While string theory has yet to make contact with the empirical universe, it is a legitimate part of science, even if it proves a failure, because its practitioners are ultimately aiming to produce falsifiable results. The proponents of intelligent design, on the other hand, do not seem to have this intent.

My choice of examples provoked a furious discussion on several physics blogs. The juxtaposition particularly irritated a number of string theorists who seem sensitive to any scepticism regarding the whole string enterprise. This was not my intent, although I have been sceptical of many claims and accomplishments by string theorists in the past 20 years.

But the online discussions raise an important issue at a time when science is under attack on a number of fronts - particularly in the US - by groups who wish to change what we teach as science to include concepts that are traditionally the domain of theology.

I want to state up front that the string enterprise has produced a very impressive body of theoretical work and has been pushed forward by many talented and hard-working scientists. However, I believe that what we normally call string theory is not what most scientists would call a theory in the traditional scientific sense.

A scientific theory is a logically coherent and predictive system that has been tested against experiment or observation. It explains observable phenomena and makes falsifiable predictions about them.

Instead, the string enterprise (as one might choose to call it) is a broad set of mathematical concepts which have yet to be incorporated into a rigid theoretical structure that makes precise predictions - unlike the electroweak theory, for example, which makes predictions about particle physics. Nor does it make specific falsifiable assertions about observable phenomena, as evolutionary theory does in biology.

The string enterprise is not the only culprit. Another example of incorrect use of the term "theory" arises in cosmology, where scientists commonly speak of inflationary theory to describe the hypothesised growth of the universe soon after it began. Inflation is not so much a theory as a paradigm, a generally accepted perspective that is not associated with any particularly compelling mathematical model at this point.

The label "string theory" is actually an anachronism. The mathematics of the relativistic quantum mechanics of one-dimensional string-like objects was so named to distinguish it from that of point particles. The former was created in an attempt to circumvent various apparent mathematical infinities that beset the latter, called quantum field theory.

Maintaining this semantic distinction is not merely contentious nitpicking. A key part of the argument made by those who wish to introduce religion into science classes is that evolution is "just a theory". By "theory" these individuals are referring to the common lay usage of the word, meaning a hunch or a guess, and not the more restrictive sense in which the term is normally discussed in science. Because most members of the general public are not familiar with this distinction, the claim has resonated in the popular consciousness.

"The string enterprise has not produced anything that rises to the level of theory"

This causes problems. When debating the nature of science with advocates of intelligent design, I am frequently confronted with the claim that string theory is no more scientific than intelligent design. While I am satisfied that this is not the case, the fact that we probably use the term "theory" inappropriately in this case doesn't help quash the confusion.

Eugenie Scott of the National Center for Science Education, a US organisation that defends the teaching of evolution in schools, has argued that we should train ourselves to not use the term "believe" in a scientific context because it blurs the distinction between science and religion. My argument is the same. String theory is better thought of as a hypothesis or paradigm - a working framework upon which to develop a theory.

Of course there are those who will be offended by my suggestion that we should make it clear that the string enterprise has not produced anything that yet rises to the level of theory in the sense that scientists usually use this term. To them, I would argue that we can save ourselves grief down the line if we more precisely and more accurately represent to the public what we are doing, independently of how exciting those activities may seem to the participants.

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