

the passionate claims of pseudoscientific beliefs, it's our duty to dust off our neglected tools of scientific rhetoric.

To constructively counter pseudoscience, I suggest, first, that we not denigrate or belittle its merchants or consumers, and second, that we take time to understand perspectives of the pseudoscience and antiscience audience.

Belittling others with names like “idiot” and “kook” as found on the informational website suggested by Hassani contributes nothing to any conversation. It feeds into the “they don’t respect us” narrative of pseudoscience purveyors. Each person comes to us as they are. They may ask, “How does a photon *know* there’s only one slit and not two?” in the double-slit experiment. If we snicker at their apparent notion of sentient photons, we miss the fact that they’ve visualized themselves riding alongside photons as Albert Einstein did in his famous *gedanken* experiments. We earn respect as educators by treating questions as catalysts of intelligent conversations and by empathizing with each person.

Most pseudoscience consumers believe that they’ve adequately applied the scientific method and that their intuition is subsequently correct. Many are simply misled by rhetorical use of colloquial language. Rather than worrying about misuse of the word “energy” as Hassani does, I’d worry more about the word “wavefunction.” The fact that nearly everything in quantum theory derives from this purely nonphysical entity will eventually go viral. We must clearly emphasize that because the physical world is complex and difficult to comprehend, our models and theories shouldn’t be carelessly misconstrued.

Let’s fine-tune our rhetoric skills. I recommend reading Plato’s lively dialog *Gorgias*, in which he concludes that bare rhetoric serves no educational purpose—it merely persuades. Pseudoscientists are talented rhetoricians exploiting natural human frailties such as the desire to be right. Rhetoric cuts to the quick. In the arsenal of pseudoscientists it opens floodgates to dangerously misleading beliefs. Our rhetoric as scientists must be based on meaningful facts and feed into natural human instincts, such as curiosity.

In the 2014 “debate” between Bill Nye, the Science Guy and CEO of the Planetary Society, and Ken Ham, president of Answers in Genesis, Ham’s rhetoric

was well-packaged: “Well, there’s a book for that!” Ham’s audience vibrantly applauded. Nye’s facts were met with unwavering silence. Behind Ham’s curtain is the false narrative that science is divided into “observational” and “historical” knowledge. In his consumers’ minds, events of the past cannot be known if we were not there to witness them firsthand, and the Bible represents the firsthand account. We could exclaim, “Well, there is the universe for that!” but what compelling narrative does it support?

We must counter the rising tide of destructive pseudoscience by engaging in penetrating scientific rhetoric in public spaces.

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Although I completely agree with Sadri Hassani’s warning, I think the philosophical questions that motivate scientists are universal. As physicists, we should respect and celebrate the asking of questions, even as we point out how science and pseudoscience differ in arriving at the answers.

The notion of conscious photons, for example, has a long and fascinating history. One example of a rational question and an answer that we might mock today stands out for its utter charm. French encyclopedist Denis Diderot (1713–84) supported the Greek conception of invisible, indivisible, inert atoms. However, he reasonably pointed out, “To suppose that by placing next to a dead particle one, two, or three other dead particles, one can form the system of a living body amounts, it seems to me, to a flagrant absurdity, or I am grievously mistaken” (reference 1, page 148).

Modern scientists still struggle with the solution to his problem. Diderot took the bull by the horns and simply endowed the atoms themselves with a quality he called sensitivity, on which he based a complicated story of the emergence of life. He explained one consequence of his theory in a letter to his lover Sophie Volland:

Those who loved each other during their life and have themselves interred side by side are perhaps not as foolish as one might think. Perhaps their ashes come into con-



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tact, mingle and unite! Who am I to know? Perhaps they have not lost all feeling, all memory of their past state; perhaps they retain a remnant of warmth and life, which they enjoy in their own way at the bottom of the cold urn that holds them. . . . O dear Sophie, I thus cling to the hope that I may touch you, feel you, love you, seek you, unite with you, and meld into you when we no longer are . . . if the molecules of your erstwhile lover were destined to become inspired, aroused, and to seek yours scattered in nature! Allow me this reverie, so sweet to me; it would assure me eternity in you and with you (reference 1, page 151).

After this last quote, the late learned and humane quantum chemist Bernard Pullman added laconically: "After animate, sensitive, and intelligent atoms, here now are atoms in love. And why not, indeed?"

Reference

1. B. Pullman, *The Atom in the History of Human Thought*, A. Reisinger, trans., Oxford U. Press (1998).

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► **Hassani replies:** Mario Beauregard, Gary Schwartz, and Natalie Trent associate several notable physicists with the integration of consciousness in quantum theory. History is filled with great scientists who held unscientific, even anti-scientific beliefs. Lord Rayleigh believed in ghosts; J. J. Thomson believed in dowsing and psychics; William Shockley and James Watson sponsor racialism and eugenics. But these ideological mistakes, sometimes referred to as Nobel disease (see *PHYSICS TODAY*, September 1998, page 29), are not made right because of the science of their makers, and the science is not made wrong because of the ideological mistakes of its discoverers. It is the message that counts, not the messenger.

One person who can authoritatively judge the role of mind in quantum theory is John Bell, who proved its non-locality—a concept that pseudoscientists have deformed into their own commodity. Bell stated,

I think it is not right to tell the public that a central role for conscious

mind is integrated into modern atomic physics. . . . The only "observer" which is essential in orthodox practical quantum theory is the inanimate apparatus . . . once the apparatus is in place, and functioning untouched, it is a matter of complete indifference . . . whether the experimenters stay around to watch, or delegate such "observing" to computers.¹

Experiments that demonstrate our mental ability to influence physical objects would be as revolutionary as experiments that demonstrated the existence of the electron, the atomic nucleus, and gravitational waves. Why don't the authors submit their results to mainstream journals so that the larger community of experimenters could verify them? Yes, mainstream journals—that is where all the aforementioned experiments were published and where all science revolutionaries disseminate their ideas.

There are essentially three categories of scientists: mainstreamers; those mainstreamers who bend the mainstream; and those who leave the mainstream and become pseudoscientists.

All true scientists are in the first category. If they are exceptionally creative, they may end up in the second category. Pseudoscientists, being rejected by the mainstreamers, misinform the public with assertions that "science revolutionaries have also been rejected by mainstreamers, as we have." Nothing is further from the truth. Galileo Galilei, Isaac Newton, Albert Einstein, Erwin Schrödinger, and other great scientists were mainstreamers who made it to the second category.²

Larry Dossey calls consciousness "science's greatest mystery." For centuries, biology was "science's greatest mystery" because of the manifestation of life in living organisms. Many biologists believed in vitalism, the idea that a "vital force" regulated the activity of animate objects but could not "be derived from matter and reduced to anything more basic," as the "Manifesto for a post-materialist science" states about mind.³ However, with the discovery of DNA, "vital force" is no longer needed to explain the electrochemical reactions taking place at the subcellular level. Since the source of consciousness is the brain, the scientific answer to its nature will come only from the molecular investigation of neurons, not from near-death "experiments."

Mysteries always exist in science, and there are two ways to deal with them. One is to wait and give science a chance to resolve them. The other, the age-old strategy of pseudoscience, is to exploit the limitation of science and inject speculative and unproven conjectures as answers. While biologists have abandoned vitalism, the idea has not died out. It has been disguised and taken up by modern pseudoscientists: Consciousness is the new face of vitalism!

Tim LaFave raises a good point regarding debates between science and pseudoscience. Unfortunately, the outcome of such debates would be enormously in favor of pseudoscience, as the Nye–Ham debate demonstrated. When the listeners are scientifically illiterate, the snake oil vendor wins. That's why, in my Commentary, I proposed that pseudoscience be challenged in the classroom, where science is not drowned in the rhetorical charm of pseudoscience.

Philosophy, despite "its utter charm," as Hans Christian von Baeyer suggests, has been at odds with science ever since their separation. Democritus, the ancient scientist, said about philosophy: "Nothing exists except atoms and empty space; everything else is opinion." Modern physicist Richard Feynman was more blunt:

Here's this great Dutch philosopher [Spinoza], and we're [Feynman and his son] laughing at him. . . . You can take every one of Spinoza's propositions, and take the contrary propositions, and look at the world and you can't tell which is right. Sure, people were awed because he had the courage to take on these great questions, but it doesn't do any good to have the courage if you can't get anywhere with the question. . . . [Philosophers] seize on the possibility that there may not be any ultimate fundamental particle, and say that you should stop work . . . [because] "You haven't thought deeply enough, first let me define the world for you." Well, I'm going to investigate *without* defining it!⁴

References

1. J. Bell, *Speakable and Unspeakable in Quantum Mechanics: Collected Papers on Quantum Philosophy*, Cambridge U. Press (1987), p. 170.
2. S. Hassani, *Skeptical Inquirer* **39**(5), 38 (2015).
3. M. Beauregard et al., *Explore* **10**, 272 (2014).