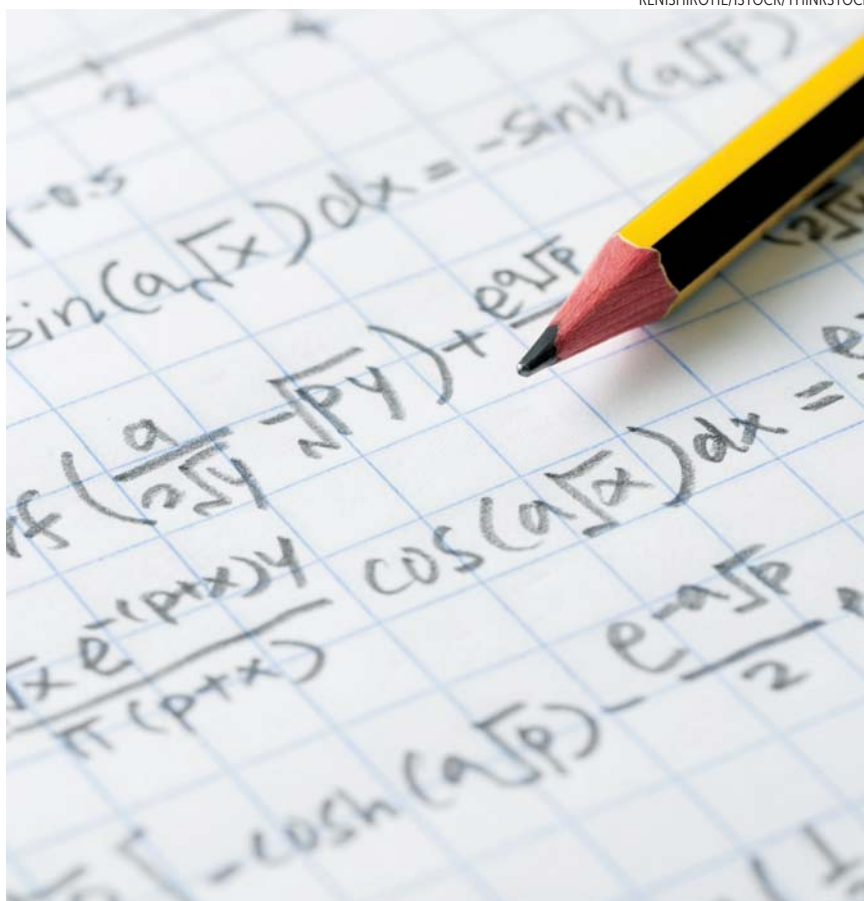


KENSIIROTIE/ISTOCK/THINKSTOCK



Can the scientist play a role in the laws of physics?

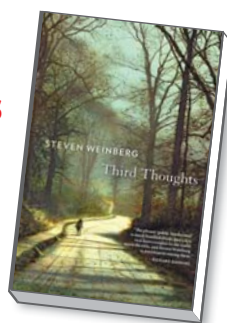
In chapter 10 of *Third Thoughts*, a delightful collection of essays for the general reader, Steven Weinberg remarks, "I generally review a book only if I think it will give me a chance to sound off on some issue that interests me." I couldn't agree more.

Many of the book's essays originally appeared in the *New York Review of Books*, but others are from more obscure venues or are previously unpublished. Weinberg often hits the nail right on the head. In chapter 14 he writes, "It is a bad sign that those physicists today who are most comfortable with quantum mechanics do not agree with one another about what it all means." In chapter 15, "The manned space flight program masquerades as science, but it actually crowds out real

Third Thoughts

Steven Weinberg

Harvard U. Press,
2018. \$25.95



science at NASA, which is all done on unmanned missions. . . . The only technology for which the manned space flight program is well suited is the technology of keeping people alive in space." And in chapter 20, "It is generally foolish to bet against the judgments of science, and . . . when the planet is at stake, it is insane."

That we are kindred spirits is vividly

confirmed in chapter 23, where Weinberg says scientists "often have an experience that is deeply enlightening, and is not granted to everyone. It is the experience of finding that you have been wrong about something. . . . The world has been greatly damaged by political and religious leaders who were sure they knew the truth." I expressed a similar sentiment in my 2005 book *It's About Time*: "This process of discovering that one's former beliefs are wrong . . . is what makes the pursuit of science so engrossing. The world would be a far better place for all of us if this joy in exposing one's own misconceptions were more common in other areas of human endeavor."

Although I often agree wholeheartedly with Weinberg, I do want to sound off on one issue that greatly interests me. It is indeed bad that physicists comfortable with quantum mechanics disagree on what it all means, but I reject Weinberg's conclusion that the disagreement "may be warning us that the theory needs modification." He hopes for a theory in which a wavefunction collapses after measurement because "superpositions of states of large things . . . suffer an actual rapid spontaneous collapse."

In the dozen pages leading to that conclusion, Weinberg repeatedly uses the word "measurement" colloquially and uncritically; he does not elaborate on its meaning, even though he explains most technical concepts. Yet measurement is one of the most problematic terms in quantum mechanics. John Bell famously said that the word "has had such a damaging effect on the discussion, that I think it should now be banned altogether in quantum mechanics." In 1981 Bell wrote to Rudolf Peierls that "the ideal instantaneous measurements of the textbooks are not precisely realized anywhere anytime, and more or less realized, more or less all the time, more or less everywhere." Yes indeed!

By my definition, a measurement is any action anybody takes on the world, and the outcome of the measurement is the experience the world induces back on the person who took it. This view of measurement, called QBism by its proponents, is unacceptable to Weinberg because it incorporates "the relation of humans to nature" into "what we suppose

are nature's fundamental laws." He hopes for a physical theory that would explain "what happens when people make measurements from impersonal laws that apply to everything, without giving any special status to people in these laws."

Here he unwittingly puts his finger on what I believe is the actual source of the near-century of discomfort and disagreement. There is an implicit assumption, shared by almost all physicists, that the scientist must be separated from the science. The usual appeals to measurement with classical outcomes, it seems to me, are unsuccessful attempts to objectify and impersonalize processes in which an individual scientist acts on and

is reacted upon by the world. The collapse of the wavefunction after measurement represents nothing more than the updating of that scientist's expectations, based on his or her experience of the world's response to the measurement. Weinberg hopes to keep the scientist out of the laws of nature, but our chronic failure to agree on the meaning of quantum mechanics demonstrates the futility of his hope.

Nor does Weinberg's hope make sense to me. Science is a highly developed form of human language. Embedded in books and papers, it is a distillation of the communicated individual experiences of all scientists. Why insist that science should make no reference to

the process that has established it? The laws of quantum mechanics are exactly the same for everyone who uses them. In that important sense they are entirely objective. If a scientific law involves both the scientist and the world, it does not mean that science can tell us nothing about people, as Weinberg mysteriously worries, any more than it means that science can tell us nothing about the world.

Usually I agree with Weinberg. When I disagree, the challenge of articulating my dissent gives me fresh insights into my own understanding. In both cases I find this a stimulating and admirable book.

N. David Mermin

*Cornell University
Ithaca, New York*

A sign at the 2017 March for Science in San Francisco, CA.



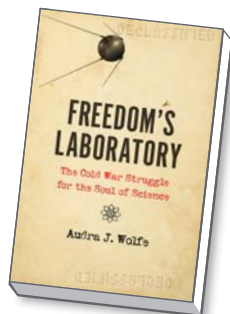
MASTER STEVE RAPPORT CC BY 2.0

The legacy of Cold War science propaganda

Audra Wolfe makes clear that the meticulously researched *Freedom's Laboratory: The Cold War Struggle for the Soul of Science* was in preparation long before Donald Trump entered the presidential race. In 2019, however, it is hard to imagine a history of science that is more timely than one that situates our current political environment in the context of the Cold War.

Freedom's Laboratory
The Cold War Struggle for the Soul of Science

Audra J. Wolfe
Johns Hopkins U. Press, 2018. \$29.95



As Wolfe notes in the epilog, the post-2016 sociopolitical moment gave rise to the March for Science movement, which

sought to "apolitically" defend science's role as "a pillar of human freedom and prosperity." But, as Wolfe explains in the text that precedes that observation, the notion that science is free from politics has the most political of origin stories. US intelligence organizations crafted that message as part of anti-Communist propaganda campaigns both at home and abroad. In other words, March for Science organizers who insisted that it was possible for science to be apolitical were in fact making themselves spokespeople for old propaganda.

Is the propaganda wrong? Given the dearth of history of science in science curricula, it's hard to imagine that scientists are on the whole equipped to make an informed assessment. To come up with an answer, scientists will have to consult their consciences and study difficult and potentially embarrassing history. In that sense, Wolfe's text is essential reading for both students and scientists who have been immersed in the idea of science as an apolitical pursuit.

Freedom's Laboratory is at turns unsurprising and terribly shocking. While it is hardly news that the Central Intelligence Agency and other US government entities believed in the importance of cultural propaganda during the Cold War, what caught me off guard was the sheer number of scientists whom I recognized and what they were up to. For example, I knew that James Webb—for whom the oft-delayed but promising NASA *James Webb Space Telescope* is named—was a homophobe who went to great lengths to