

Science and Antiscience in America

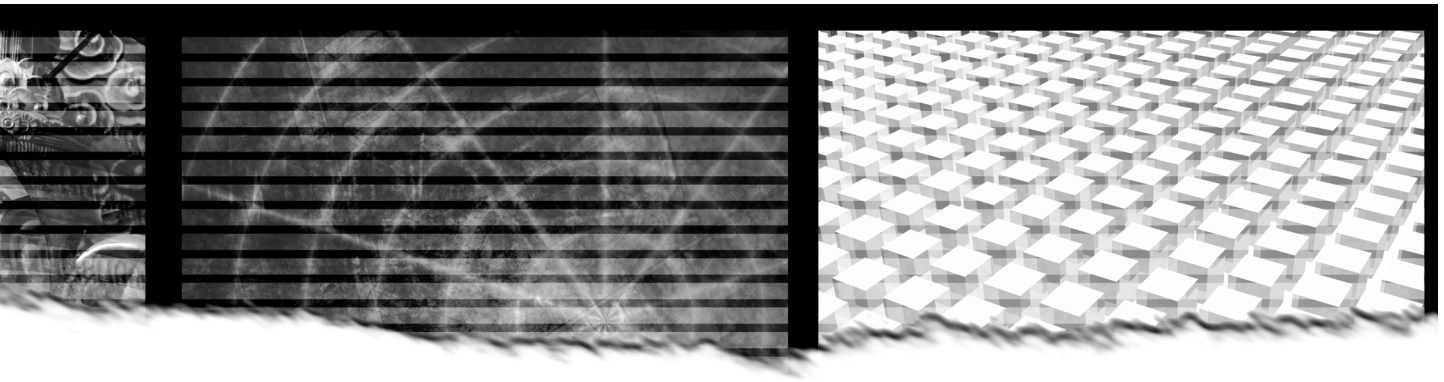
Why It Matters

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If science doesn't inform the decisions we make, the consequence is that people suffer.

ELIZABETH SHERMAN

Every time I fly, I do something that ensures the plane won't crash. Just as I am stepping aboard the aircraft, I touch the outside fuselage next to the door. And then the plane doesn't crash! It's a causal gesture. Every time I've flown I've touched the outside of the plane, and it hasn't crashed. One event reliably preceding another proves that the first causes the second, right? Well, of course, intellectually, I know that my touching the plane doesn't ensure that it won't crash. After all, I am a scientist and I have been studying how the material world works all my professional life. Having said that, do you think I can ever bring myself to abandon my touching-the-fuselage practice? Well, what's the harm? So what if science doesn't inform my behavior?



Yet as a biology professor, I am concerned that science does not inform our behavior, not just as individuals but as a society. I can recall how this concern captured my attention with the urgency it now has for me: I was listening to the then-president of the United States on the news (George Bush), and he suggested that the jury was still out on evolution. And I began to push myself to articulate *why* I was so distressed. Each time I answered myself, I pushed again: so what? I answered, again with “well, so what?” and again, “so what?” So what if science doesn’t inform the decisions we make as a country, a people, a world?

The answer is that people suffer.

The absence of an understanding of how the AIDS virus is transmitted, for instance, has contributed to countless deaths

and can’t always provide certainty. We don’t know when the next Katrina-like storm will occur or when or what the next pandemic will be. But these assumptions about direct causality and certainty speak of a misunderstanding of science.

People seem predisposed to infer causality. I’ve wondered how this predisposition might have come about. Biologically speaking, how might it have served our fitness as we evolved? Consider this: which is more risky, failing to attend to a true positive (*Uncle Bob ate that mushroom and died*) or attending to a false positive (*When I touch the outside of a plane, it doesn’t crash*). Attending to a false positive might not hurt me too much (that is, touching a plane before I get on is not particularly detrimental to me) but ignoring a true positive? (Oops, I

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and millions of children being orphaned in Africa. Scientists had been predicting that a Katrina-like storm was bound to hit low-lying areas in the U.S., and we now know the consequences of having ignored that prediction. Now scientists are concerned that global climate change will have terrible consequences for people living in poor countries.

One obstacle to people’s understanding of science is that we have a tendency to infer that one event, A, *causes* another, B, simply if B follows A. Moreover, we want knowledge to provide us with certainty. Science doesn’t always confirm causality

ignored the fact that Uncle Bob died after eating the mushroom, and I then ate the mushroom and also died). So perhaps we are predisposed to infer causality. It serves us to make associations. If we happen to goof on a false positive (the airplane) we can still reproduce. But if we don’t make the association when someone eats a mushroom and dies, then we may die too. So on average, it probably helped us to infer causality.

But what’s the harm in inferring causality at the least provocation? Recently, I read a report noting that some parents in Indonesia have inferred a causal relationship between polio immunization and contracting the disease. In one instance, an Indonesian mother brought her child to be immunized and a day later he developed polio. The most likely explanation is that this child already had the virus incubating in his body prior to the vaccination and was vaccinated too late. But with-

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out understanding how the disease is contracted and how the vaccine works, the mother's logic made sense. She discouraged her neighbors from immunizing their children, which will contribute to the spread of the disease.

Yet science relies on the association of events to make sense of the universe. Once we find an association or a correlation, we can begin to look for causality—the mechanisms underlying a phenomenon. For instance, scientists noticed an association between the acidification of lakes in the Northeast and the loss of many aquatic species of animals. And now, we are beginning to uncover the causal relationship, the mechanisms by which the acid content in lakes hurts animals.

The absence of certainty also contributes to a misunderstanding of science. Not every human being who smokes cig-

arettes will develop lung cancer; we can't even predict (at least not yet) who will. So what do we know? Of thousands of people who smoke, some proportion of them will die prematurely as a consequence. We can only move closer to the truth of how the material world works through the play of large numbers, and thus probabilities.

self-correcting: a hypothesis not supported by evidence doesn't hang around long. Scientists are constantly testing their ideas and those of others with the bar set pretty high for what it takes to be persuaded. Just recently, a Nobel Prize-winning scientist retracted a paper she co-authored because she could not replicate the results.

Science is powerful because it accurately predicts events from the virtually certain (if I drop a ball from a building, it will fall to earth) to the probabilistic (people who don't smoke are likely to lead healthier lives than those who do).

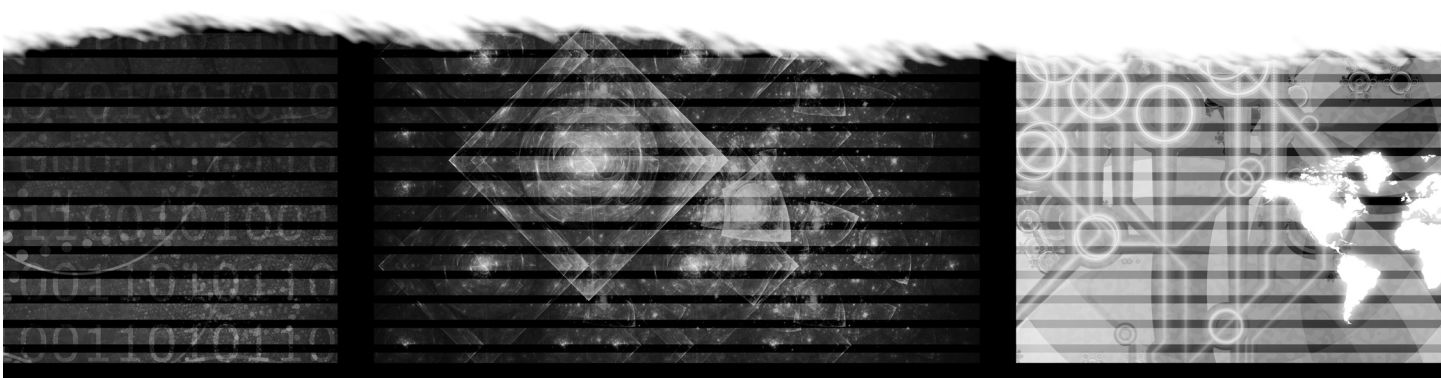
A misunderstanding of science is pervasive in many institutions that shape how we see and act in the world. There are too many such institutions to mention in this essay, so I'll just highlight a few.

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Science requires openness to possibilities and skepticism about how things work. What were your hypotheses? By what observations or experiments did you test these hypotheses? What is your evidence?

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There is compelling evidence that the Bush administration manipulated data and coerced scientists when the data were not consistent with the administration's view of the world. I was gratified when President Obama stated that we would "restore science to its rightful place," in his inaugural address. Nevertheless, we must attend to the consequences of the Bush administration's disregard of evidence in its decision-making process. In February of 2004, sixty-two leading scientists (including Nobel laureates, National Medal of Science recipients, and advisors to the Eisenhower and Nixon administrations) criticized the Bush administration for its science poli-



cies. Their declaration includes the statement that “When scientific knowledge has been found to be in conflict with its political goals, the administration has often manipulated the process through which science enters into its decisions.” For example:

- After Bush took office, the Department of Health and Human Services deleted Web site references to the efficacy of condom use in the fight against the spread of AIDS
- NASA scientists have reported that they have been pressured repeatedly by Bush appointees to alter or delete climate change findings in their reports
- The Bush administration interfered with stem-cell research, which could have facilitated the development of treatments to ameliorate Parkinson’s disease and diabetes

So what if science doesn’t inform our decisions? People suffer.

Alas, the way in which science is often taught at colleges and universities can contribute to its misunderstanding. Too often, science is presented as a disembodied collection of facts. How many of us had science classes that failed to engage us in the actual enterprise? How many science classes insist that students generate their own questions, design and carry out appropriate experiments, and grapple with evidence?

I also have concerns regarding the ways in which the media report on scientific issues. For example, in the fall of 2005, the Dover (Pennsylvania) Area School Board passed the following resolution: “Students will be made aware of gaps/problems in Darwin’s theory of evolution and of other theories of evolution including, but not limited to intelligent design.” The school board further required that science teachers read a kind of evolutionary disclaimer to their biology classes. The board was sued by a group of parents upset by this decision, and the case was widely reported for some time. Various print, TV, and Internet media interviewed one person who was in favor of the resolution and one who was not, as though both points of view reflected equally legitimate scientific understandings. At the time, I was teaching a course called “Science and Antiscience in America,” and I asked my students what they thought about this tendency of the media to present all sides (or more typically “both sides”) of an issue, particularly as it pertains to scientific questions. Mostly, my students thought that it was an appropriate way to cover an issue in order “to be fair.” I asked them to suppose the story was about teaching that the world was flat versus round? “Oh, that’s different,” they’d say. Yet the preponderance of evidence for the *fact* of evolution is as robust as that for a round earth.

It is, at times, difficult for any of us to confront our own biases and examine them in light of evidence. Many of my students had no difficulty disparaging the folks who eschew evolution. But some of them bristled when I suggested that dismissing science as simply “a vehicle for continued male domination” is equally problematic. When you begin your inquiry with the answer rather than the question, whether the answer is “God did it” or “Western intellectual thought is simply a way to ensure the power of white men,” then it isn’t inquiry at all; it’s dogma.

Finally, I am deeply disturbed that roughly half of Americans don’t accept evolution. (I don’t like to use the phrase “believe in” evolution; it’s like choosing whether or not to believe in gravity.) Darwinian evolution (including the modifications biologists have brought forth over the years) is the only explanation that scientists have found for the relevant data. The wealth of data is so vast, evolution explains these data so well, and nearly the entire community of professionally trained biologists is so persuaded by this explanation that it is unlikely any other explanation will come along to supplant it. However, as good scientists, we remain open to the possibility of a better idea developing to explain the data. Until it does, there is no scientifically valid reason to hold any other view than that our species (and all other species of animals, plants, fungi, and bacteria) have arisen on the planet through the process of evolution.

But more than that, this denial of evolution speaks to an anti-intellectualism, a brand of antiscience that contributes to human suffering. If people can deny evolution, which is well supported by scientific evidence and widely accepted by the professional scientific community, then they will deny any scientific findings they dislike. The same methods and insights that have informed how scientists understand the movement of the planets, how molecules work, and what medical remedies are most effective have also informed our understanding of evolution. We can choose to cherry pick only the data that support a particular bias about how the world works, but how does that help us if the world does not work that way?

Science is a way of asking testable questions about the material world; the knowledge we have gained is imperfect, provisional, and can be derived only through the play of large numbers, and yet it is the best we can do in addressing certain problems. Einstein expressed this view most eloquently:

All our science, measured against reality, is primitive and childlike—and yet it is the most precious thing we have. □

