BOOK REVIEWS

Inmaculada de Melo-Martín and Kristen Intemann, ***The Fight against Doubt: How to Bridge the Gap between Scientists and the Public.*** Oxford: Oxford University Press (2018), 232 pp., $39.95 (cloth).

There is a great deal of concern among the chattering classes that the public does not understand science, especially science that is essential for formulating appropriate public policy. Many members of the public fail to vaccinate their children or fail to support moves to reduce climate-changing emissions. But, it is said, the necessity of vaccination or of the amelioration of greenhouse gas production has been established beyond doubt by our best science. So how can people refuse to believe it? Often a good deal of the blame is put on people who should know better, apparent experts who nonetheless insist on arguing against these established facts and sometimes succeed in persuading large swathes of the public to share their benighted opinions.

This excellent book by Inmaculada de Melo-Martín and Kristen Intemann shows how much is not only wrong but even dangerous about this common picture. An interesting observation with which to begin is that as de Melo-Martín and Intemann note, a key part of the preceding story is the so-called deficit model of the public understanding of science, the view that policy goes wrong because the public does not understand science and the solution is to provide them with better information. Social scientists have taken the failure of the deficit model as an established fact for 30 years or so, but arguably it is still quite widely endorsed among philosophers. (Obviously, I do not assume that providing philosophers with better information will immediately solve the problem.)

Much of *The Fight against Doubt* is devoted to discussing how we should think about the apparently expert promoters of false opinions. In rejecting the deficit model, de Melo-Martín and Intemann do not aim to persuade us that perhaps anthropogenic climate change is a myth or MMR vaccinations cause autism, still less that the world was created 6,000 years ago. Indeed the promotion of such views very probably constitutes what they call normatively inappropriate dissent (NID) from established scientific orthodoxy. Their point is rather that, contrary to what is often assumed in the deficit model, it is far from easy to say what constitutes NID.

A criterion for dissent being normatively inappropriate is that it fails to advance, or impedes, scientific progress. An obvious problem, then, is that one does not have to be a card-carrying Popperian to believe that the attempt to criticize scientific consensus is often valuable. Certainly no one should want to put a blanket prohibition on all rejection of scientific orthodoxy. Are there

not features of the kinds of dissent that have been so pernicious that readily distinguish them from the normal, critical process of advancement of science? NID, one might imagine, is often provided in bad faith, or it violates the norms of good scientific method, or it unjustly allocates the inductive risks consequent on its falsity.

De Melo-Martín and Intemann provide careful and convincing arguments against the sufficiency of each of these alternative explanations. Bad faith is hard to detect, and it is neither a necessary nor a sufficient condition for NID. Philosophers of science will need little persuasion that scientific method is a tricky and controversial notion. And it is not always possible to quantify the inductive risk of rejecting a hypothesis that enjoys the consensus of the scientific community. All these criteria have their uses in analyzing scientific debate, but none of them, according to de Melo-Martín and Intemann, is up to the task of defining NID.

To take one illustrative example, suppose that seeking simpler theories is a principle of correct scientific method. Is evolution or intelligent design a simpler theory? Evolutionary theory may claim that it has a simpler ontology, solely empirically observable matter, than intelligent design, which must add a further unknown intelligent cause. But intelligent design supporters may reply that their theory posits only a single cause to explain the world's observed complexity, as opposed to the countless contingencies in the evolutionist's narrative (50). If one doubts whether simplicity is really an epistemic virtue, this only points to the difficulty of agreeing on the content of such a criterion.

Where should we go from here? While, as I have noted, de Melo-Martín and Intemann do not wish to deny that there is NID, and that it is a bad thing, they generally downplay its importance in explaining the failures of policy. Instead, they argue, a more potent explanation of why the public is sometimes skeptical about even the strongest scientific consensus is that their trust in scientists is limited. Moreover, they also claim that excessive attention on the scientific background of policy proposals, even sometimes the belief that scientific findings straightforwardly entail the desirability of certain policies, is a serious mistake.

The emphasis on trust is a very important positive thesis in *The Fight against Doubt*. There are good reasons why the public is somewhat skeptical about what scientists say. There are well-publicized cases of scientific fraud; an ever-increasing proportion of scientific research is sponsored by commercial enterprises, and there is strong evidence that science funded this way reaches significantly different conclusions from publicly funded research. The commercialization of research leads to concerns about scientists' real goals and reasonable suspicions of conflict of interest.

The second point should also, perhaps, be obvious but definitely bears reemphasis and elaboration. Differences in policy choice do not merely or even

mainly reflect differences in scientific opinion but rather different values. To take a fairly extreme case, catastrophic climate change in 100 years' time is only a problem if you think that we have some ethical responsibility for future generations. It is possible to argue that future generations do not exist (now) and only existent things matter. It is at any rate something philosophers debate. So climate change deniers and activists might agree about the facts of anthropogenic climate change but disagree about the policy implications of these facts. More generally, different priorities attaching to individual autonomy and the common good underlie disagreements on a wide range of policy question, and the disagreements may be quite independent of agreement or disagreement about the scientific facts. The idea that misinformation about scientifically established truth is what is really at stake may easily distract attention. Indeed, it is quite widely agreed by philosophers of science nowadays that values inescapably and appropriately shape scientific beliefs themselves.

The book leaves me with one rather dark reservation. It is that the argument about trust seems—in a sense that is in no way critical—rather old-fashioned. I am writing this 2 days after my country, the (just barely) United Kingdom, followed the Unites States in appointing (at least we did not elect him) a notorious liar as our political leader. Boris Johnson built his career making up amusing stories about European bureaucracy that were published as fact in a leading British newspaper, and then he rose to the top of his political party by leading a campaign to leave the European Union based on a range of indisputable falsehoods. It is not merely that Johnson makes up whatever purported facts suit him at that particular moment. More disturbing still is that everyone knows, and, while some commentators do see this is as a regrettable characteristic for a prime minister, on the whole nobody seems to care very much.

My very pessimistic worry is that epistemic trust is no longer a positive attitude that has much salience in the current social milieu. As one of Johnson's main rivals for the leadership of his party, Michael Gove, remarked during the campaign to leave the European Union, "the people in this country have had enough of experts" (interview by Faisal Islam, Sky News, June 3, 2016, https://www.youtube.com/watch?v=GGgiGtJk7MA). What Johnson offers in the place of truth, or expertise, is hope. The political failures of his predecessor he attributes largely to an insufficiently optimistic personality. What was impossible for Eeyore is no problem at all for Tigger. It is not just that we do not believe the experts, more fundamentally it is just that we do not like them very much. The decision to push the Facebook "like" button precedes rather than follows our deciding to believe what they have to say. Hence, we believe movie stars or just "influencers" rather than experts.

In summary, de Melo-Martín and Intemann have provided an invaluable analysis of the failure of the public to accept the overwhelming consensus of

experts and rightly warned us against attaching too much of the blame for this to dissenting voices. They also do a great service in pointing out the dangers, not merely intellectual, of overestimating the role of scientific findings in the formation of policy. And they are surely right that the lack of trust in scientists is a crucial part of the explanation of the problem. Although they are right, too, that there are aspects of science that go some way to explain this lack of trust, and they make a number of sensible suggestions about how trust might be restored, I fear that the problem may be more deeply rooted in the contemporary Zeitgeist than they allow. I hope I am wrong.

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Otavio Bueno and Steven French, ***Applying Mathematics: Immersion, Inference, Interpretation.*** Oxford: Oxford University Press (2018), 288 pp., $60.00 (cloth).

Recent decades have seen intense interest in models: What are they? How do they work? Should they be understood realistically? And so on. More recently philosophers of mathematics have come to focus on the nature of applied mathematics. Similar questions have arisen: How does mathematics apply? Or, more to the point, how does mathematics model the world? Is it, as Eugene Wigner suggested, a miracle? Can mathematics explain physical phenomena and, if so, does this mean mathematics must be true, as realists sometimes argue? The topics of models and applied mathematics come together in this very fine volume.

For a long time Otavio Bueno and Steven French have been addressing these issues. Sometimes they did so together, sometimes singly, sometimes with other coauthors. They see themselves now as having converged on a common outlook. *Applying Mathematics* is the outcome, a systematic account of their views on models and especially how mathematics figures in all this. Among other things, Bueno and French offer an alternative to Mark Steiner's approach to the applicability of mathematics and a sensible response to Wigner's puzzle about the unreasonable effectiveness of mathematics.

In this short review, we discuss a couple of topics, Bueno and French's particular conception of mathematical models and how they see mathematics as explanatory. But it should be noted that there are lots of other interesting things in this book, such as the use of problematic mathematics (e.g., Dirac's delta function), that we must pass over.

Making sense of applied mathematics is the principal aim of Bueno and French. Like many contemporary philosophers of science, they hold that the key to understanding science is to be found in models. Theories are hardly