

**Jimena Canales.** *Bedeviled: A Shadow History of Demons in Science*. 416 pp., notes, bibl., index. Princeton, N.J.: Princeton University Press, 2020. \$29.95 (cloth); ISBN 9780691175324. Paper and e-book available.

Descartes imagined a demon that could manipulate humans into believing only false things. Laplace conjured one that could see the past and the future with perfect certainty. Maxwell's demon decreased entropy, despite this being impossible in practice. Each of these demons (and several others) have interesting histories that have been analyzed before. But they prompt an important question: In what sense are these things "demons," and why do scientists talk about demons at all?

In *Bedeviled*, Jimena Canales tackles this question by collecting and dissecting all the scientific demons she can find, while identifying historical connections between them. These include the demons of Rothstein, Selfridge, Charniak, Einstein, Wheeler, Searle, Haugland, Landauer, Feynman, Born, Compton, Planck, Loschmidt, Monod, Zermelo, and Popper. Some of the case studies involve demons less obviously than others (e.g., Einstein's), but they are all at least demon adjacent, and many are quite surprising. Across ten chapters, an introduction, a conclusion, and a postscript, Canales convincingly shows that the history of Western science can be told as a history of demons. Weaving together primary and secondary sources with original translations, our devil's advocate balances breadth and depth while taking us from the seventeenth century to the present day, tracing developments in mathematics, thermodynamics, relativity, quantum mechanics, cybernetics, computer science, biology, and economics. Zooming this far out is necessary, given that we want a new scientific demonology.

One interesting lesson Canales draws is that the history of science and the history of the humanities should be pursued together. Their separation was always somewhat arbitrary, and the focus on demons makes this especially clear: the imaginations of scientists are influenced by the scientific objects they study, yes, but also by ideas that are deeply embedded in human culture. In this case, the relevant cultural object is the *demon*, which has traditionally been used to represent mechanisms beyond human limitations, in a way that is “somewhat mischievous, though not entirely malevolent” (p. 305). Demons “challenge us to outwit them” (p. 304). They can be giant or tiny, fast or intelligent, they can manipulate natural properties (like light, heat, or life) in unnatural ways, and they can carry or distort messages.

What are *scientific* demons? In many cases, they are the protagonists of thought experiments. In others, they are metaphors, as when Pierre Bourdieu uses Maxwell’s demon as a metaphor for school systems that maintain social order and cultural capital (p. 275). Sometimes a demon anthropomorphizes, as Maurice Kendall’s demon does with chance (p. 280). They are also used as variables that measure our ignorance, inspire new technologies, provide “analytic distance” from a target of study (p. 179), or define a law of nature by providing a class of exceptions. It can be difficult to see what unifies scientific demons (or, maybe better, scientific “demon-talk”), and I couldn’t help wishing for a periodic table of demons. But Canales tells us when and where the demons are, and that is more than enough for a single book.

Normatively minded scholars will want to know whether and why a given demon was epistemologically good or bad for science. Canales doesn’t get into the recent literature on the epistemology of scientific thought experiments, imagination, and metaphors (e.g., by Francesco Berto, James R. Brown, Elisabeth Camp, Steven French, Roman Frigg, Eva Jablonka, Evelyn Fox Keller, Amy Kind, Peter Kung, Nenad Mišćević, Alice Murphy, Nancy Nersessian, John D.

Norton, Fiora Salis, Walter Veit, and Timothy Williamson). But it would be a very interesting project to work out how Canales's findings interact with that literature. For one thing, the book provides conclusive new evidence against the claim of Ian Hacking that thought experiments do not have "lives of their own." Many other fruitful connections will surely be inspired, which is one reason that the book should find its way onto undergraduate and graduate syllabi.

A final thought. Throughout the book, Canales takes demons very seriously, writing about them as real entities with agency, causal power, emotions, ethical responsibility, and goals. For example, we serve the cause of Laplace's demon when we act predictably (p. 32), Compton's demon caused Compton to pursue eugenics (p. 141), Laplace's demon "suffered" because of the atomic bombs (p. 156), and we are all willing victims of Descartes's demon when we read fiction or watch movies (p. 305). I appreciate this way of speaking: in a sense, Canales is emulating the style of the scientists themselves. But it sometimes obscures an important aspect of demon-talk: its humor. Science is hard, and scientists like to have fun, and demon-talk is fun. Focusing more directly on aesthetic features (like fun) wouldn't cheapen Canales's project, because we can take scientific humor seriously, both historically and epistemologically, and doing so would present new interpretive options—for example, thinking about demons as memes—which might be fruitful. It would also prevent the "actions" of demons from overshadowing those of the scientists.

Overall, this book motivates a careful look at demon-talk in science. It retells the history of science as a history of demons, bridges the history of science and the history of the humanities, suggests a greater role for imagination in historical and philosophical accounts of science, and makes important connections between the ethics, aesthetics, and epistemology of science and technology. It sheds new light on the history of scientific practice, especially

physics, biology, computer science, and economics, and provides much food for thought to those interested in the role of fiction and imagination in science.

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