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BOOK REVIEW

Modeling modeling

Stephen M. Downes: Models and modeling in the sciences: A philosophical introduction. New York and London: Routledge, 2020, 114 pp, £34.99 PB

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Recently, a number of philosophers, for example, Chalmers (2015), have asked the meta-philosophical question: does philosophy make progress? This question may be a serious one in 'core' areas of philosophy like ethics and metaphysics, but its application to philosophy of science seems strained. In philosophy of science, it is (near?) universally recognized that the last half-century or so has seen significant progress. While there is much internal dispute, a broad consensus has developed that we now have a much better understanding of science and the sciences than we did in the early twentieth century. This progress has clustered around several core themes:

1. Idealization is essential to science, not a mere temporary imperfection.
2. To understand science, we must investigate science's methods, practices, technologies, social structure, etc., not merely its theories.
3. Scientific disciplines are typically methodologically and theoretically autonomous.

While these developments may be logically independent, they are closely related. One common thread is the centrality of models and modeling in scientific practice. Whereas traditional views treated the scientific theory as the central unit of philosophical analysis, early work by Hesse (1966), Levins (1966), Cartwright (1983), Wimsatt (1987), Giere (1988), and others argued that much work in the sciences does not fit this mold. Rather than aiming at collections of universally quantified statements which accurately describe regularities in the empirical world (≈theories), many scientists instead produce surrogate systems, which resemble the world in some ways, but not others (≈models). These surrogates can then be investigated, and if the fit between them and the world is reasonably close, we can thereby find out about the world. This shift from theory-centric to model-centric philosophy of

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science brought with it many of the major advances in philosophy of science listed above.

Once it was accepted that scientific progress depended, in large part, in the construction of useful models, rather than true theories, this motivated the question of which forms of idealization, that is, intentional disparity between model and target, were legitimate and which undermined the usefulness of the model. Predictably, it was quickly noted that this depended on what the model was being used for. As different domains create different puzzles and pressures, different idealizations and different kinds of models are appropriate for different sciences. So the shift from theory confirmation to model construction as the core of scientific inquiry brought with it the pluralism, particularism, and practice-centrism that define the contemporary landscape in philosophy of science.

This progress makes the publication of Stephen Downes' *Models and modeling in the sciences: A philosophical introduction* both welcome and timely. For those not working in these areas of philosophy of science, the distillation of these central advances, highlighting why the focus on models has been so significant and what exactly such a shift involved, will be a helpful roadmap. And for those in the field, it is useful to have a compact text for updating undergraduate syllabi to reflect this shift. Of course, in any book of this nature, there will be much that one could disagree with. But I will largely avoid theoretical quibbles in this review. This is an introduction, and ought to be evaluated as such, not on whether it provides the final word on the role of modeling in science. In this light then, we can ask: what do we want out of an introduction?

One way to get at this question is by asking: why do we need introductions in the first place? Why not just read the original material? In any advanced discipline, the source material will be technical, presuppose prior knowledge, and there will be lots of it. So, an introduction will be a useful improvement on the primary literature to the extent that it is clear, transparent, and, ideally, brief. Further, the greater the coverage of the target discipline it provides, the better. And, of course, it must portray the source material accurately. Any text exhibiting these virtues would be a good resource for those new to the field.

Downes' book does this capably. It begins with a litany of useful examples from across the sciences. It then asks what models are and what kinds of models there are (Chapter 3), before turning to whether models are representations and if so what this means (Chapter 4), and finally how models can/should be assessed (Chapter 5). It presents the literature accurately and clearly, with as much completeness as could be expected in such a slim volume, clocking in at under 100 pages, and with ample pointers to the primary literature.

An ideal introduction, however, would serve as an advertisement, not a mere roadmap, enticing the reader to devote more time to the issues. This is especially true if it is to be used in an introductory course. Professional philosophers and other academics can be assumed to arrive with enough background to see why they would benefit from working through these debates, but the same cannot, in general, be said of undergraduates. So you really have to drive home the significance of this work. Given the above-discussed role that attention to modeling played in revolutionizing philosophy of science, and overturning traditional and powerful accounts of

scientific inquiry, this is not an impossible project. In this respect, Downes' book somewhat misses the mark. I will finish by detailing a few ways in which I think the excitement of this movement in philosophy was not really conveyed by Downes' discussion, and which thus make this a less engaging introduction.

The first is organizational. The first, and longest, major chapter introduces maybe two dozen models from many different sciences. These serve as benchmarks against which to compare philosophical claims made about scientific models later in the book. Many students, I fear, will not have the patience to work through descriptions of these models carefully enough for them to serve this purpose, without any signposting about why they matter, or what is at stake. One would not begin a comparative anatomy textbook with a neutral description of a dozen organisms, before introducing analogy and homology in subsequent chapters. I think the book would be much better if these 'model models' were introduced throughout the discussion, which could then highlight their pertinent features.

More generally, I think one of the biggest strengths of the book, its careful, pluralistic approach, is also one of its biggest weaknesses. At all points, Downes stresses that science is messy and particular, and thus, one must be careful in making claims of any generality. This is a position I am deeply sympathetic to, but it can get in the way of a good story.

An example is provided in Chapter 4, but similar points could be raised about several discussions in the book. The question under discussion in this chapter is: in virtue of what do models represent their target, if they do so at all? Various proposals, along with reasons for skepticism about each, are offered. A novice reader would be able to follow the debate well enough, but would get little sense for why they should care about the results. What would turn on the conclusion that some models are non-representational? Or that models represent in virtue of similarity rather than isomorphism to their targets? The reader is left in the dark.

Often, the best way to get readers into a debate will involve giving up the neutral position of the pedagogue and promoting a view. Plenty of points Downes raises could serve as case studies here. In this chapter, for example, Giere's view that models can be neither true nor false could be contrasted with Wimsatt's claim that models are useful in virtue of their falsity. This provides an opportunity for Downes to demonstrate how philosophy is done, rather than merely report on it. Connections could be drawn to debates about representation in philosophy of mind, or to historical discussions of the epistemology of science, or to various other areas. I think drawing these connections, and plumping for a view, would go a long way toward presenting this as an active and interesting area for new readers to engage with. But without seeing these debates play out, the issues can seem a bit lifeless.

As Downes discusses, one of the most interesting features of scientific models is that they often exhibit trade-offs: increases with respect to one virtue come at the expense of others. For example, more general models typically sacrifice precision or accuracy. Downes' book serves to exemplify the ubiquity of trade-offs. It is admirable in the clarity it provides to a wide range of issues, in a highly condensed space. And it presents the material carefully and even-handedly. But in doing so, it risks failing to convey what made these topics so exciting in the first place. It thus serves best as a guidebook for those already motivated to pay attention. Nevertheless, I

believe the book will be a useful guide for teachers and for anyone who would like an account of just the ways in which philosophy of science has managed to progress since the mid-twentieth century.

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