deteriorate into mere reductivism. Pitkin's hybrid approach, joining analytic method with elements of a genealogical, psychoanalytically informed critique, walks a fine line in this respect.

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Scientific Realism: How Science Tracks Truth
By Stathis Psillos
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This book is divided into four parts. The first part discusses the historical background to the current realism debates. The next two parts of the book deal respectively with objections and alternatives to realism. The final part considers the issues of 'truth-likeness' and the reference of theoretical terms.

Chapters 1–3 review the historical background to the contemporary debates through examination of the writings of Mach and Duhem, and logical empiricists such as Carnap, Hempel, Feigl, and Nagel. Psillos has done some real historical scholarship here, drawing on unpublished material in the Carnap archive. Chapter 4 outlines a positive philosophical argument for scientific realism. Psillos endorses the idea that the success of science is without explanation (miraculous) on instrumentalist accounts. However, he also accepts van Fraassen's protestation that constructive empiricism survives this objection. This motivates consideration of Boyd's more sophisticated arguments for realism based on the success (or instrumental reliability) of scientific methodology. Psillos replies to the accusation that such meta-abductive defences of abduction are viciously circular. Unfortunately, his discussion fails to remedy the more basic defects of this argument, that what is claimed about science is either unclear, or when clarified, doubtful. I am not persuaded that science requires philosophical defence of the sort envisaged here (see pp. 78–9). Philosophers need to understand science rather than to vindicate it. Before returning to the positive tasks of analysing truth-likeness and providing a theory of reference at the end, Psillos responds to standard objections and alternative proposals.

The two objections to realism are the 'pessimistic induction' and the underdetermination thesis. Psillos finds the pessimistic induction in a 1981 paper and sequels by Larry Laudan. Laudan criticized a number of realist claims and arguments by appeal to a large number of purported historical counter-examples. Psillos takes this challenge seriously, and develops replies over three chapters. After first canvassing various realist responses,

he presents two more detailed historical case studies (caloric theory and nineteenth-century optics). Psillos credits Worrall with being the first person to attempt the task required to rebut Laudan by specifying what it is about superseded theories that survives revolutions. But he does not think that Worrall's view, that structure rather than content is retained in newer theories, is the right way of demarcating the surviving part of a superseded theory. Psillos' response to underdetermination leans heavily on Laudan's recent suggestion that observing the consequences of theories 'is neither necessary nor sufficient for empirical support' (p. 169).

The pessimistic induction and underdetermination thesis are arguments against realism, but do not of themselves constitute rival philosophies. The two rival accounts Psillos considers are van Fraassen's constructive empiricism and Fine's natural ontological attitude. The chapter on Fine also considers general issues about theories of truth.

Psillos reviews three attempts to formalize notions of truth-likeness and verisimilitude. He includes brief technical details, simple illustrations of how these approaches work, and the Tichy-Miller proof that Popper's definition fails. It could be argued that this demonstration is redundant given that Psillos also argues that such formalizations would not help realists out even if such technical difficulties could be overcome. Its inclusion reveals that this book is to some extent a survey, rather than exclusively a report on the author's own contributions. Psillos concludes the discussion of verisimilitude by recommending an intuitive notion of approximation which does not need to be formalized. The final chapter on reference starts with the causal theory, but realizing that this gets counter-intuitive results, Psillos reintroduces considerations of theoretical descriptions to arrive at a hybrid causal-descriptive theory.

This is rather a good book, but it has a few serious flaws. At the very least it is written in a clear, straightforward, and persuasive manner. I will give a fuller overall evaluation after commenting on some points of detail.

Very few of Psillos' conclusions seem mistaken to me. The case presented for the causal-descriptive theory is inadequate, however. Work on theories of meaning for science published around 1980 suggested that belief theories of meaning could work and would need to be combined with a descriptivist cluster theory of reference rather than a causal theory. Peter Smith developed such a cluster theory and showed how it accommodated intuitions about historical cases. Psillos provides no real argument against cluster theories, and I still prefer Smith to Psillos in relation to discussion of cases such as ether and phlogiston.

On other issues Psillos reaches the right conclusions from incorrect premises. It was a pervasive assumption of logical empiricism that theories would entail observational hypotheses. These 'experimental laws' would be testable directly, and thereby enable the indirect testing of the laws about unobservable matters contained in the theories that entailed

them. That this simple picture does not apply to any real scientific theory like Newton's was argued by Putnam in his contribution to the Library of Living Philosophers volume on Popper. Putnam argued that Newton's theory entails no predictions. Psillos may simply not know this work, but he mentions the example of Newton's explanation of Kepler's laws, and so might have arrived at Putnam's conclusion had he thought more deeply about the case. Although many philosophers of science may know Putnam's idea in principle, discussions of issues such as underdetermination still frequently assume that numerous scientific theories all entail the same set of observational laws. Psillos is right in rejecting the underdetermination thesis, that there always are equally well-confirmed alternatives to any favoured scientific theory, but his reasons for this, based on Laudan's view that not all observational consequences confirm a theory, are just not radical enough. Theories have very few, if any, observational consequences. Psillos makes essentially the same mistaken concession in his critique of van Fraassen, that a theory entails all the evidence there is for it (e.g. p. 219).

As mentioned earlier, Psillos devotes three chapters to rebutting the pessimistic induction, i.e. the claim that superseded theories are not even approximately true, and that it is therefore unjustified to think that current science is any more true than the theories of the nineteenth century or before. Psillos attributes this line of thought to Laudan, and discusses caloric and ether theories historically to conclude that 'There is . . . much more substantial theoretical continuity in theory-change than Laudan allows' (p. 145). This conclusion is correct, but Psillos is not the first person to have realized this. Psillos sees Worrall, Kitcher, and later Hardin and Rosenberg as the only people to have arrived at comparable conclusions about what is wrong with Laudan's view. He is prepared to defend Laudan's objections to them so as to claim that his view alone survives. But this is to give a completely misleading picture of the history and dialectics of the debate, ignoring the many scientists and philosophers who have defended the view that superseded theories are approximately true. It would be very surprising if Psillos were aware of none of them, as Laudan cites ten authors who have defended some sort of cumulativist picture of relations between successive theories, from Whewell (1840) to Krajewski (1977). A view relevantly similar to recent convergent realist claims can be found in some logical empiricist accounts of scientific progress. Interest in the issue was rekindled after Kuhn and Feyerabend independently challenged the received wisdom that the classical limits of relativity showed that Newton's theory was approximately true (1962). Indeed, what Psillos calls the pessimistic induction is what Putnam (1976) called the 'meta-induction', explicitly tracing its origins to Kuhn. This is no minor point of historical scholarship. Even if Psillos is not attempting to provide a survey of work on this issue, it makes no sense to discuss

Laudan without also considering Putnam. For Laudan does not just present a historical objection to any realist view, but criticizes arguments which are more specific to Putnam. Putnam followed Boyd in suggesting that realism is justified as the best explanation of the success of the feature of scientific methodology whereby scientists look for new theories which will contain existing theories as approximations. There are thus two issues raised by Laudan's work. When we are in possession of a new theory (e.g. Einstein's), can we then justify the claim that the old theory (Newton's) was approximately true? If scientists are trying to improve on an accepted theory (e.g. Newton's), do they only consider new theories which will retain the old one as an approximation? These are controversial issues, but Psillos sheds no new light on them. My view is that Laudan is partly right in objecting to the general claims about history and methodology which Putnam and Boyd had made, but that the core realist idea that we can see some superseded theories as approximately true is left unscathed. A large number of cases of theory-change are relevant here, and we can draw on earlier philosophical discussions of them. Psillos' claims that realists only need to consider two superseded theories (caloric theory and nineteenth-century optics, p. 145), and that he is the first person to have done so properly, are just wrong.

I have said most about the least satisfactory part of this book. More generally, this is a somewhat uneasy mix of survey and original work. Psillos could have written the definitive review of the realism debates, but has not done so because he has ignored so much important work from the period 1960–80. The first part of the book is a good survey, and when later Psillos concentrates on presenting his own arguments (adapted from previous papers), he at least tries to mention the main alternative approaches. So the book can be used as a good way into the literature, following up sources which are cited although not discussed in detail. Psillos is a serious philosopher, and it is helpful to have his discussions of the main issues and arguments in the realism debates collected in one volume. Although one might hope that a philosopher wanting to advance scientific realism would do more than just present counter-arguments to the vocal minority of non-realists (Laudan, van Fraassen, and Fine), Psillos', arguments are generally better than average. Despite the reservations I have expressed, this book is to be broadly welcomed and can be recommended.

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