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BOOK REVIEW

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## **Peter Achinstein: *Evidence, Explanation, and Realism: Essays in Philosophy of Science***

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### **1 Introduction**

Peter Achinstein is a professor of philosophy at Johns Hopkins University and a university professor at Yeshiva University. He is generally regarded as one of the leading philosophers of science. Achinstein is famous for his work on evidence, explanation, and realism—the three topics with which the essays in this collection deal—but he is equally famous for his work on the history of particle mechanics. In all his work, he combines historical expertise with an unflinching sense for when formal precision is in place and with a natural approach to conceptual analysis.

Achinstein is clearly a child of his time. He started publishing in the 1960s, a revolutionary phase in the philosophy of science. At that time, it was generally thought that the logical empiricists had led the philosophy of science into a cul de sac by overemphasizing the importance of formalizing scientific theories in first-order predicate logic. A newer generation of philosophers of science expected to make progress instead by paying close attention to everyday scientific practice as well as to the evolution of science. Meanwhile, ordinary language philosophy had become all the rage in analytic philosophy more generally. We see traces of these developments in all of Achinstein's works, including the essays collected in this volume.

In all essays in the present collection, there is attention to historical detail. In nearly all of them, philosophical claims are supported in part by dint of examples taken from the history of science. In some of the essays, historical case studies even figure as the main evidence for the central claim defended in the essay; for instance, when Achinstein brings to bear Jean Perrin's experimental work on Brownian motion on the scientific realism debate. Furthermore, there is a good deal of ordinary language philosophy to be found in these essays, most notably in the essays on evidence and those on explanation.

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## 2 Evidence

The first part of the book consists of five chapters which deal with philosophical problems surrounding the notion of evidence. For the past two decades or so, Bayesian philosophy of science has dominated the thinking about evidence. Bayesians have a purely formal and entirely straightforward conception of evidence: E is evidence for a hypothesis H if, and only if, the probability of H conditional on E is greater than the unconditional probability of H. According to Achinstein, this account is too simple. In particular, it fails to do justice to our common ways of talking and thinking about evidence. To simplify one of Achinstein's arguments, suppose you are told that John is given one ticket in a fair 100-ticket lottery, and Mary is given the remaining 99 tickets. From a Bayesian viewpoint, this is evidence that John will win the lottery, for conditional on his being given a ticket the probability that he will win is higher than it is unconditionally. But, if it is evidence for anything, the said information is evidence that *Mary* will win the lottery—which would seem to constitute evidence *against* John's winning. This and similar considerations lead Achinstein to propose a different definition of evidence. Or rather, he first distinguishes between two different notions of evidence—*potential* and *veridical* evidence—and then goes on to define them in ways that draw not only on probability theory (as does the Bayesian definition) but also on the notion of explanation.

To solve the lottery problem, Achinstein requires that for something to count as evidence for something else, the latter must be *probable* given the former, not (necessarily) more probable. But that is still not enough. That Jim will not get pregnant is quite probable given the fact that he takes the pill, yet his taking the pill is not evidence of his not getting pregnant. To avoid this kind of problem, Achinstein adds as a necessary condition to his definition that there be an explanatory connection between the putative evidence and the hypothesis—or rather, for potential evidence, it has to be probable that there is such a connection; for veridical evidence, it has to actually exist.

It might be thought that, while perhaps the thus defined notions of potential and veridical evidence allow us to do justice to how we use the word 'evidence' in common parlance, the Bayesian account of evidence might still be better suited for the purpose of explaining how the same word is used in the practice of science. According to Achinstein, however, that is not the case either. In one essay, he argues that the Bayesian account of evidence as well as various other accounts that philosophers have proposed make little contact with the practice of science. Not only are the notions of evidence offered by these accounts too weak to be of any use in science, they are meant to apply on a priori grounds, while—as Achinstein argues with two case studies—it is, or at any rate can be, rather an empirical matter whether a given datum is evidence for a given theory.

In many ways, Achinstein's work on evidence is conceptual analysis at its best. He clearly has an ear sensitive to the subtly different ways in which we use the word 'evidence'. At the same time, the work demonstrates some potential pitfalls and limits of this approach to philosophy.

People say all sorts of things. Should *all* these things be taken equally seriously? If not, which not? For example, while we often use the word 'evidence' in a categorical sense—as when we say that something is (or is not) evidence for something else—we also use it in a graded sense, when we say that something is strong (or weak) evidence for something else. And although in the above lottery case it may sound strange to say that the information that 99 of 100 tickets have been given to Mary and the remaining ticket has been given to John is evidence (in the categorical sense) for John's winning the lottery, perhaps it is not so

strange to say that *to an exceedingly low degree* it is evidence for John's winning the lottery, whereas it is evidence for Mary's winning the lottery *to a very high degree*.

Further, in philosophy it is rarely the case that linguistic intuitions point to precisely one analysis of a given concept. We almost always have to arbitrate between different concept explications on the basis of something other than data about language use. Carnap famously proposed that such arbitration should take place on the basis of the so-called theoretical virtues, such as simplicity and fruitfulness. I am not convinced that Achinstein's proposal offers the simplest way to make sense of the relevant linguistic data. For instance, the purely probabilistic definition:

E is evidence for H if and only if *both* H is probable given E *and* H is more probable given E than it is unconditionally.

will, as far as I can see, take care of all the problem cases that Achinstein adduces in favor of his account. Obviously, it solves the lottery problem, and it also handles perfectly the case of Jim's likelihood of pregnancy: It is probable that Jim will not get pregnant given that he takes the pill, but this is no more probable than that Jim will not get pregnant, regardless of whether he takes the pill.

Achinstein presents a case (p. 38) that he might regard as a counterexample to this proposal. In this case, you have the information that a person takes a medication that, with a probability of .95, relieves certain symptoms. You then receive the information that he is actually taking another medication, which relieves the same symptoms with a probability of .9. According to Achinstein, the latter is still evidence for the claim that the person's symptoms will be relieved, even though it lowers the probability you assign to that claim.

I do not find this case compelling. You might compare the probability you now assign to the said claim with the probability you assigned to it before you received the false information that the person was taking the medication with a .95 chance of relieving the symptoms and, for that reason, consider the second piece of information you received to constitute evidence. Alternatively, you could grant that that piece of information is not evidence but still a good reason to believe the person's symptoms will be relieved—and that that might fuel the intuition that it is evidence. Achinstein repeatedly emphasizes that evidence gives good reason to believe, but one can agree while still holding that not *every* good reason to believe something is evidence for the thing.

### 3 Explanation

The second part of Achinstein's book consists of five essays devoted to explanation. The logical empiricists had thought of explanation in logical terms, in that a certain logical relationship had to obtain between two things for one to count as an explanation of the other. In the 1960s, that thought had come to be regarded as being mistaken (along with much else the logical empiricists had propounded). From that time on, theorists began exploring different approaches to explanation. For instance, some proposed causal theories of explanation, according to which explaining is the highlighting of causal relationships (rather than logical relationships). In the early 1980s, Achinstein developed a theory of explanation that focused on the *act* of explaining something to someone. Specifically, to explain something is to make that thing understandable to someone.

As Achinstein notes, this makes explanation a context-dependent matter, given that what exactly has to be done to make something understandable to someone may depend on the interests and background knowledge of the person seeking understanding. In some

contexts, highlighting logical relationships may be the key to making the person understand. In other contexts, pointing at causal connections may do the job. And in still further contexts, still other things may be called for. Moreover, because the act of explanation is central to Achinstein's theory, a person's intentions matter in regard to whether or not he or she explained something; if he or she had no intention of making something understandable to someone, then he or she did not explain the thing—even if he or she uttered words that, as a matter of fact, made the thing understandable to the persons in his or her audience.

It is fair to say that Achinstein's work on explanation is no longer influential, due to a large extent to criticisms leveled against it. It would have been a welcome addition to this collection of essays if Achinstein had, perhaps in an appendix to some of the papers, indicated why he believes the theory still stands (as apparently he does; else it would be strange to have these essays reprinted without further comment).

#### 4 Realism

The five essays in the third part of the book all revolve around the topic of scientific realism. The scientific realism debate was one of the main debates in twentieth century philosophy of science. The debate concerns the epistemological status of scientific theories. Do we have reason to believe that these theories, insofar as they are predictively accurate, give a more or less faithful representation of unobservable entities and processes underlying the phenomena, or should we remain agnostic on this matter? Scientific realists believe that science is by and large successful in charting the unobservable part of the world. By contrast, scientific antirealists hold that it must forever remain beyond our ken whether science is successful in the aforesaid regard; what we can know, at best, is that scientific theories save the phenomena.

Much of the discussion in this debate is of a rather abstract nature, focusing on such relatively technical issues as underdetermination—frequently presented as a kind of logical, or rather model-theoretic, problem—the truth-conduciveness (or otherwise) of the theoretical virtues (simplicity, elegance, coherence with background theories, etc.), and the confirmation-theoretic status of the rule called 'inference to the best explanation'. Antirealists are typically motivated by the problem of underdetermination, that is, the problem that even if the data favor precisely one of the theories on the table (which need not be the case), there will be many other theories, possibly not (yet) conceived, that receive or would receive equal or perhaps even stronger support from the data.

Realists tend to respond by invoking the theoretical virtues or, relatedly, the significance of explanatory considerations. According to realists, such factors may be indicative of truth, too, so that when the data alone do not warrant confidence in a given theory, the data in combination with such additional considerations may well do so. In turn, antirealists respond by questioning the epistemological significance of these additional considerations. From their point of view, these considerations are, at most, of pragmatic value. For instance, we favor simple theories because they are easier to understand and work with, not because they have a greater likelihood of being true.

In his essays on realism, Achinstein also addresses most of these issues. However, he manages to make them very concrete by discussing them in direct relation to specific episodes in the history of science. A centerpiece in his defense of scientific realism is his previously mentioned discussion of Perrin's work on Brownian motion, which had led Perrin to the conclusion that molecules, unobservable to the naked eye, exist. Whilst

Perrin's concerns were not philosophical in the first place, and whilst he did not consider various objections that antirealists would certainly have raised against his conclusion, Achinstein's detailed study of Perrin's work makes clear that Perrin's work actually presents an enormous challenge for antirealists. Antirealists may be able to hold their position in the face of Perrin's findings, but in doing so, they will come to resemble the philosophical skeptic who implores us to remain agnostic about the existence of an external world in general (and not just the unobservable part of the world). In other words, their position will come to appear academic and totally out of touch with what is actually going on in science. That, at least, is how things appear after reading Achinstein's essays on scientific realism. I think that may be as far as anyone has gone in defending scientific realism—and as far as anyone should care to go.

## 5 Conclusion

The book, or a selection of essays from it, could profitably be used as course material for an advanced seminar in the philosophy of science. Parts would also make good reading material for a more historically oriented course. For pedagogical purposes, a more extensive introduction might have been helpful. In particular, it would have been good if Achinstein had said more on how close the ties are among the three topics around which this book is organized. For instance, how essential is Achinstein's particular account of explanation to his account of evidence, in which the notion of explanation plays a key role? How crucial is Achinstein's notion of evidence to the success of his arguments in support of scientific realism? Spread throughout the book, one does find answers, or at least pointers to answers, to these questions. Nonetheless, a more systematic discussion of the connections would have been useful. That is a minor point of critique, of course. The book is warmly recommended. It collects some of the best works of one of today's most significant thinkers on science.

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