The Logic Behind the Science

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Evidence and Evolution: The Logic Behind the Science. Elliott Sober. Cambridge University Press, 2008. 412 pp., illus. $29.99 (ISBN 9780521692748 paper).

When Darwin was developing his theory of evolution, philosophy of science was just becoming a professional discipline. If you wanted to know what science was, you read John Herschel, William Whewell, John Stuart Mill, or Sir Charles Lyell. One might think that the rise of the philosophy of science would have facilitated the reception of Darwin's theory when *On the Origin of Species* was published in 1859. It did not. These philosophers of science were no less resistant than anyone else to the idea of species evolving through chance variation and natural selection. According to the philosophy of science popular in Darwin's day, Darwin's theory was sorely deficient when it came to proof. Darwin had fulfilled the criteria for *discovery* but not for *proof*. Newton's theory had been proved. Darwin's theory had not. But who was at fault? Was Darwin's theory as deficient as his critics claimed, or were the standards that they used to evaluate Darwin's theory faulty? And how about Darwin's descendants? Even those authors who considered themselves to be Darwinians held views very different from those that Darwin championed through the years. One finds it hard to picture Darwin adopting Peirce's "grand cosmic theory of Evolutionary Love."

Darwin's contemporaries did not do all that well in evaluating his theory. Present-day versions of evolutionary theory are attacked, not just by creationists but also by philosophers and scientists. In *Evidence and Evolution,* Elliott Sober investigates this paradox: Why does evolutionary theory still strike so many critics as being fundamentally mistaken? Part of the problem is scientific. No other scientific theory put forward is so easy to misunderstand, but this is only one part of the story. The other part is the logic that lies behind the science. In *Evidence and Evolution,* Sober provides a steady stream of arguments dealing with topics related to evolutionary theory. Is Popper's criterion of falsifiability up to the task of distinguishing between real science and pseudoscience? What is the most significant difference between natural selection and drift? And does cladistic analysis require anything in the way of scientific theories?

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Sober's book is about the concept of evidence as it applies to evolutionary biology—not all sorts of philosophical issues but primarily one: evidence. What counts as evidence? Is there a univocal definition of "evidence" or are there several alternatives? Chapter 1 is devoted to discussing these questions. Chapter 2 concerns intelligent design. As both critics and champions alike soon discovered, the controversy over creationism, or intelligent design, as it came to be known later, concerns the nature of science. Must science, to count as science, be purely naturalistic, or can miracles be introduced? Chapters 3 and 4 deal with evolutionary biology in general. Can enhanced knowledge of evidence help us better understand evolutionary theory?

Although Sober insists that answers to such questions should be judged by their quality and not by the "union card" that one happens to hold, we all do possess union cards and are trained in only one or very few areas of intellectual endeavor. As Sober emphasizes, his book is a work of philosophy, not science (p. 108). Even so, he hopes that "scientists will find that some of the thoughts developed here are worth pondering" (p. viii). He also hopes that the "philosophers who read this book will be intrigued by the evolutionary setting of various epistemological problems" (p. viii). His book, as he clearly says, is for philosophers of science; as I read it, however, I kept sliding back to think of it as a scientific work. It is both. Sober is well aware that very few evolutionary biologists will already know the logic that he uses in his book. To rectify this situation, he proposes to develop the relevant philosophy from scratch. Right from the start, he avoids using jargon and makes the main points clear by way of simple examples, chiefly polar bears.

Sober presents the three most commonly accepted philosophical views on the relation of evidence to theory—Bayesianism, frequentism, and likelihoodism. At this juncture I would normally give brief summaries of each of these three philosophical views, but I can't, and neither can Sober. One problem is that these views are both technical and complicated. To make matters worse, advocates of each of these philosophical views disagree with one another, and their views have changed over time. There is no single canonical view.

To make matters worse, logicians do not use terms in the same way the rest of us do. For example, Bayesians argue that scientists are in a position to judge which scientific theories are probably true, while frequentists think that they are not. But, as Sober warns his readers, we have to be careful. In ordinary English, "likely" and "probably" are synonymous. So, beware! Remember that in this literature, "likelihood" is a technical term (pp. 9, 35).

As might be expected, Sober does not provide a unified account of scientific

inference. He is eclectic and uses whichever views serve his particular purpose best. For example, he describes likelihoodism as a fallback position for Bayesianism. "When prior probabilities can be defended empirically, and values assigned to a hypothesis' likelihood and to the likelihood of its negation are also empirically defensible, you should be a Bayesian" (pp. 32, 37). As frustrating as all this conceptual variability may be, it cannot be dismissed. No simple definitions can be provided for Bayesianism, frequentism, and likelihoodism, and that is as it should be. Such definitions are proposals, not finished products. Anyone who wants to understand what philosophers have to say about evidence will have to study the first chapter of Sober's book.

Just as Sober found himself in a bind with respect to the three philosophical views that he uses, he is placed in the same quandary when it comes to his three families of examples. There is no one canonical version of any of them, either. But an evolutionary biologist has one advantage: the examples Sober introduces are real examples drawn from scientific literature, and an evolutionary biologist is likely to already have a working knowledge of at least some of those examples. In sum, Sober uses three different clusters of *philosophical* views to evaluate three different clusters of *scientific* examples. Is that complex enough?

One might be surprised to see intelligent design on Sober's list of theories that he intends to evaluate. After all, it is anything but a well-established scientific theory. It is instead a paradigm example of pseudoscience. Sober includes intelligent design on his list for two reasons. First, to distinguish between genuine science and pseudoscience, one needs to look at putative examples on both sides of the divide. Second, too often the criticisms lodged against intelligent design count just as strongly against one or more of the other two examples. Sober's problem with intelligent design "is not that it makes inaccurate predictions but that it doesn't predict much of anything" (p. 154).

In *Evidence and Evolution,* Sober is concerned almost exclusively with inferences and propositions. For example, Popper's criterion of falsifiability is used frequently to show that a particular proposition is either scientific or not. Scientific statements have to be falsifiable, not false (pp. xvii, 49, 129–130, 358). Sober argues that falsifiability should not be used to define testability in general or to criticize creationism (p. 130). His arguments are persuasive, but a more fundamental criticism of creationism concerns people, not propositions. The problem with advocates of intelligent design, not to mention other combatants, is that a statement may be falsifiable but not acknowledged as such. In the past, the human eye was cited time and again as a paradigm example of a well-designed structure; when it was discovered to be less than well designed, it made no difference. Heads, I win; tails, I do not lose. Sober does distinguish between people and propositions (p. 346), but in his entire book he limits his discussion of politics and the law to five pages (pp. 184–188). The result is that intelligent design is evaluated almost exclusively in terms of arguments when intellectual honesty is equally relevant, and maybe more so.

One of the most influential papers in the philosophy of biology—"The spandrels of San Marco and the Panglossian paradigm: A critique of the adaptationist programme"—by S. J. Gould and R. C. Lewontin, was published in 1979. This paper has been anthologized more frequently than any other paper in the philosophy of biology. Certainly Sober has reprinted it several times, but in this book, he mentions adaptationism only in passing (pp. 261, 361), noting that the distinction between current utility and adaptation is one of the most important distinctions in evolutionary biology. But why does Sober all but ignore adaptationism in this book? Does he think that it has been pilloried so often and so well that it doesn't warrant yet another hearing? Or possibly he now thinks that adaptationism is not as pernicious as he once thought it was? I opt for the second explanation. However, something has happened in the transition from the original title to Sober's citation: "adaptationist programme" has become "adaptationist paradigm."

In the 1960s a new philosophy of classification arose, termed on occasion "numerical taxonomy," at other times "phenetic taxonomy." It was "numerical" because of the use made of computers. It was "phenetic" in the sense that nothing that might count as a "theory" should be allowed to enter into the classificatory process at least in the early stages of classification. A decade later, a second philosophy of classification termed "cladistic analysis" arose; it differed significantly from numerical taxonomy. The most fundamental distinction made by cladists was between cladograms and trees. Cladograms may look like stylized trees, but they are not. In traditional trees, the vertices represent speciation events, whereas in cladograms, they represent degrees of generality.

One of the peculiar aspects of cladistic analysis is that at least some cladists joined with the phenetists in condemning the intrusion of anything having to do with evolutionary theory in their classifications. One of the contributions that Sober made to this literature was to show that, like it or not, cladistic parsimony turns out to involve assumptions about the evolutionary process. Even if classifications could be made free of theory, it would be a mistake to do so.

In the early part of this review, I pointed out the interdisciplinary character of Sober's book. It contains lots of heavy-duty philosophy as well as quite a bit of evolutionary biology. Few potential readers will have a deep understanding of both. For readers who want a better understanding of evidence and how it bears on evolutionary theory, Sober's book is the best place to begin. In fact, it is the best place to end, as well. The likelihood that anyone else will be able to do a better job is slim to nonexistent.

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