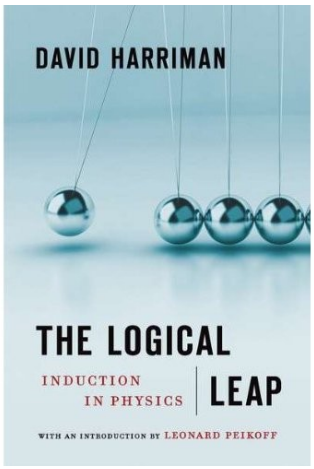

The Logical Leap

Induction in Physics

David Harriman

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Is philosophy relevant to physics? Do physicists need to understand philosophy and its consequences? Most people would say no. Physicists, if not offended, would raise their eyebrows for even having the second question put to them. Indeed, they and others point out, and correctly so, that physics is the most universal of the natural sciences. It teaches us the basic laws of the material world and serves as a paradigm of rational thought. Thus, many a physicist's view on the matter is, Philosophy? Who needs it!

Such a viewpoint has become so widely accepted that when physicist David Harriman tells people his field is philosophy of physics, "they often react as if I told them that I study the mating habits of rocks or the migratory flights of pigs. Even in today's world, they insist, there are a few things one can rely upon – namely, rocks don't mate, pigs don't fly, and a "hard" science like physics has nothing to do with philosophy ("The 19th-Century Atomic War," *The Objective Standard,* volume 1, number 2, page 83, 2006). The last point, however, is dead wrong; in *The Logical Leap: Induction in Physics*, Harriman shows that the existence of physics is not only influenced by philosophy, but its success and progress are utterly dependent on it.

Harriman starts out by noticing a peculiar and unstable situation: "As our knowledge of the physical world has advanced, our understanding of knowledge itself has lagged behind." At the beginning of *The Logical Leap,* Harriman discusses how he witnessed that gap between physics and epistemology during his college years at the University of California, Berkeley:

> In my physics lab course, I learned how to determine the atomic structure of crystals by means of x-ray diffraction and how to identify subatomic particles by analyzing bubble-chamber photographs. In my philosophy of science course, on the other hand, I was taught by a world-renowned professor (Paul Feyerabend) that there is no such thing as a scientific method and that physicists have no better claim to knowledge than voodoo priests. I knew little about epistemology at the time, but I could not help noticing that it was the physicists, not the voodoo priests, who made possible the life-promoting technology we enjoy today.

Sharpening that paradoxical gap with the observation that "the triumphs of science stand as a . . . clear refutation of the skepticism that is endemic in contemporary philosophy of science," Harriman goes on to ask, "Why does this situation persist in universities around the world? How did we arrive at this bizarre contradiction—with scientists developing technology that exploits our detailed knowledge of atomic structure, while philosophers bewail or revel in the alleged impotence of reason to grasp even relatively simple facts?"

And so he arrives at the crux of the matter: the failure of philosophers to offer a solution to what has been called "the problem of induction." Induction is the process of inferring generalizations from particular instances. The problem—how does one know the truth of inductive generalizations?

Harriman shows that a generalization, to be true, must be the statement of a causal connection. Furthermore, a set of generalizations forms a hierarchical pyramid: At its base, the starting point of induction are first-order generalizations consisting of elementary causal relationships such as "pushing a ball causes it to roll." Subsequent higher-order generalizations eventually culminate in scientific theories. Along the way to presenting his fascinating solution to the "problem of induction", Harriman addresses several key questions: What is the structure of inductive reasoning (chapter 1)?; Why is mathematics the language of physics (chapters 2, 3, and 7)?; How does proper interpretation of an experiment depend on a scientist's context of knowledge (chapters 1, 2, and 5)?

That scientists *should* employ the inductive method is not the main theme of *The Logical Leap*; rather, the book makes the stronger claim and demonstrates that scientists *must* use this method in order to make progress. And many scientists are indeed making progress, even now, particularly in the applied fields. But what happens when the inductive method is

misapplied, or worse, abandoned? String theory is a case in point: Some physicists accept it because it is "beautiful", not because it was induced from observational evidence. That sort of evidence has caused many fundamental theories of contemporary physics to stagnate for more than a generation. Indeed, Harriman quotes the late Harvard University chemist E. Bright Wilson, who said, "It is very unsatisfactory that no generally acceptable theory of scientific inference has yet been put forward. Mistakes are often made which would presumably not have been made if a consistent and satisfactory basic philosophy had been followed."

The Logical Leap is the most satisfying resolution of the "problem of induction" that I've come across. It not only shows how inductive reasoning comes about but also demonstrates that it is the sine qua non of progress and success in physics and, more generally, in science. Harriman's brilliant work is destined to be the fountainhead of future studies in the philosophy of science.

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