1 Philosophies of the Sciences[1]

Fritz Allhoff

Philosophy of science is changing. Or maybe it already has. During the twentieth century, there was a tremendous amount of brilliant work done in the philosophy of science by people such as Rudolf Carnap (1928), Karl Popper (1935),[2] Thomas Kuhn (1996), Imre Lakatos (1999),[3] and so on. But what defined much of that work was its generality: all of these people, as well as the traditions in which they worked, were concerned with general methodological issues in science. Whether talking about the logical structure of science, the demarcation of science from other endeavors, the nature of scientific change, or the features and merits of scientific research programs, these contributions almost completely transcended disciplinary boundaries within science. Certainly people were very impressed with physics, especially the experimental success of Einstein's theory of general relativity;[4] philosophy of physics was thoroughly launched in the early twentieth century and, like philosophy of logic and philosophy of mathematics, it has roots in ancient Greece.[5] And Popper evinced some hostility to natural selection – complaining that it was "almost tautological" (Popper 1935, §37) – though he eventually recanted (Popper 1978). But aside from a few exceptions, most of the work for which philosophy of science in the twentieth century will be remembered – and especially from the 1920s through the 1960s – is not endemic to any particular scientific discipline.

[1] I thank Zvi Biener and Marc-Alspector Kelly for helpful comments on this Introduction.

[2] See also Popper 1963.

[3] Lakatos's "Science and Pseudoscience" (1973) is a celebrated public lecture and quite accessible. It is reprinted in many places and available online at http://www.lse.ac.uk/collections/lakatos/scienceAndPseudoscience.htm (accessed October 3, 2008).

[4] See, for example, Dyson, Eddington, and Davidson 1920.

[5] See, for example, Sklar 1992, esp. 11–25. Biology also has some ancient roots as Aristotle wrote about it at length. See, especially, Aristotle 1984a, 774–993. See also Aristotle 1984b, 994–1086.

Shortly after the publication of *Structure*, and with all due respect to Kuhn, there started to be a paradigm shift away from this sort of approach to the philosophy of science or, if that is too strong, at least an increased attention given to individual sciences. Debates over reductionism, especially as catalyzed by Ernest Nagel's work,[6] brought individual sciences into discussions about the philosophy of science. However, the issue of whether biology, for example, reduces to physics is neither a question in the philosophy of biology nor a question in the philosophy of physics, but rather a general one in the philosophy of science, having to do with how to think about bridge laws, translations, and so on. In other words, merely talking about biology or physics – as relevant to some more general question – hardly means that one has started doing philosophy of biology or philosophy of physics. Some of those issues can be incorporated into the philosophy of biology – such as whether Mendelian genetics reduces to molecular biology – but these issues were not yet raised in the early 1960s, nor really until two or three decades later.[7]

In the 1960s and 1970s, philosophical attention began to be afforded to individual sciences in a new way. Again, this is not to imply that no philosophical attention had been given to those sciences before these decades, but rather that new emphases were born. While being careful not to overstate the case, the emergence of philosophy of biology played a large role in this transition. It is probably safe to say that those interested in biology had begun to tire of attempts to subsume biology under physics and were highly motivated to show that they had their own (irreducible) research program. People like Morton Beckner (1959), Marjorie Grene (1959), David Hull (1964, 1969, 1974), Kenneth Schaffner (1967a, 1967b), William Wimsatt (1972), Michael Ruse (1973), and others made substantial contributions to philosophy of biology, particularly in terms of launching it as a *sui generis* discipline and not one wholly subsumed by either physics (whether philosophically or scientifically) or the philosophy of science more generally.[8]

[6] See, especially, Nagel 1961.

[7] See, for example, Kitcher 1984 and Waters 1990. See Schaffner 1967a, 1967b, for earlier attempts.

[8] Or at least so goes the standard story, to which a challenge is issued in Byron forthcoming. Byron collects bibliometric data from four major philosophy of science journals during the time period, 1930–59, arguing that philosophy of biology was already underway. See also Grene and Depew 2004.

I actually think that Charles Darwin should be given more credit *vis-à-vis* philosophy of biology than he usually is. The levels of selection debate, for example, starts with Darwin, even if he was sloppy on the relevant question. Compare, for example, Darwin 1964, 61–3 and Darwin 1998a, 137; the former postulates selection on individuals and the latter selection on groups. Darwin also had some underappreciated thoughts on scientific explanation; see Darwin 1998b, 9–14.

Even some biologists – as opposed to academic philosophers – helped to bring more attention to philosophical problems in biology.[9]

As we close out the first decade of the twenty-first century, the once-fledgling field of philosophy of biology has now flourished, and other philosophies of sciences have emerged. Cognitive science, for example, hardly existed as a *scientific field* through most of a twentieth-century psychological landscape dominated by behaviorism.[10] Its emergence in the 1970s has catalyzed tremendous success in understanding the physical basis of mind and behavior, and in a very short time period it has spawned an entire philosophical discourse.[11] Judging from professional meetings and job listings in philosophy, the philosophy of cognitive science – perhaps including its ally, philosophy of psychology – has become one of the most active and popular sub-disciplines within the philosophy of science.

This book presents a collection of essays which celebrate the individual sciences and their attendant philosophical issues. The hope, though, is not just to study each of these in isolation, but rather to present them collectively, in the hope that there might be some sort of cross-fertilization of ideas. For example, maybe scientific laws are thought of differently in physics than in biology and, before this book, little attention has been given to how laws are thought of in the earth sciences at all. Reductionism is an issue in myriad scientific fields, yet many of them have different takes on why they (do not) reduce to physics. Scientific explanation is another area in which different sciences all owe some account, yet these projects are variously executed and rarely look like anything the deductive-nomological (or inductive-statistical) models would have required. By thinking about how individual sciences each carry out aspirations that all sciences have in common, we can gain a better understanding of the associative theoretical foundations.

Let me offer some remarks on the organization of the volume and the essays contained within. The original idea was to do "philosophies of the special sciences" which, roughly, includes all the sciences except for physics.[12]

[9] See, for example, Gould and Lewontin 1979.

[10] See Bechtel and Herschbach, "Philosophy of the Cognitive Sciences," §1 (Chapter 10 in this volume), for a more detailed discussion.

[11] To be fair, there were some progenitors to the contemporary movement, including, in some respects, Aristotle and René Descartes. David Hume would certainly have been sympathetic to current projects, and his moral psychology, for example, was somewhat empirical, if not after underlying mechanisms.

[12] See, for example, Fodor 1974.

But there were several reasons inveighing against this approach. First, it is important to have an essay on the philosophy of physics in a book like this, both for pedagogical reasons and to provide appropriate context for many of the other essays. Second, it is important to have an essay on general scientific methodology for the same reasons; including only philosophies of the special sciences would have precluded either of these essays. Third, it is important to have essays on the philosophies of mathematics, logic, and probability. These might seem like odd inclusions in the book since those three are not even widely regarded as (physical) sciences. Nevertheless, there are obvious reasons to include them insofar as nearly all other sciences make fundamental use of mathematics, logic, and/or probability and are therefore (philosophically) beholden to them. In recent years, philosophical issues in probability have been especially important to more general questions in the philosophy of science (e.g., confirmation theory), so the essay addressing this topic certainly deserves to be included. Lastly, unlike many of the other sciences considered, these have long and substantive histories; we might usefully compare these more mature disciplines to the more nascent ones.

The first unit contains this introductory essay, as well as a general introduction to the philosophy of science. The second unit, "Philosophy of the Exact Sciences," offers the aforementioned essays on logic, mathematics, and probability. In the third, we turn to the natural sciences, exploring the standard triumvirate of physics, chemistry, and biology, as well as the earth sciences. The fourth unit, "Philosophy of the Behavioral and Social Sciences," starts with "Philosophy of the Cognitive Sciences," which is complemented by the following essay, "Philosophy of Psychology." This fourth unit concludes with "Philosophy of Sociology" and "Philosophy of Economics."

Finally, the following essays are meant to be widely accessible; the contributors were told to conceive of their audiences as "advanced undergraduates." A primary aim for this book is to change the way that (at least some) philosophy of science courses are taught; rather than just focusing on general methodological issues, students can be exposed to specific philosophical discussions pertaining to individual sciences. This is not to say that some general grounding in philosophy of science is not essential for that project, whether in a previous course or in the first half of the term. Rather, the essays that follow should complement more traditional studies in the philosophy of science and, indeed, will not make sense without such background exposure. A strong secondary target for the book, though, is

researchers in the fields: it is hoped that a philosopher of physics, for example, might gain perspective by learning about the philosophy of chemistry, or even any of the other fields. Again, cross-fertilization is a principal aim of the book and the fields represented should have a lot to say to each other.

The essayists were charged to present central debates in their fields, while not taking a stance on the associative resolutions; references are presented for tracking down further discussion. There are obvious challenges in presenting an entire discipline within even a long 8,000–10,000 word essay, so a premium was placed on breadth and, again, accessibility. I hope that the essays are valuable and important, and I thank the contributors for sharing their expertise and dealing admirably with all too much editorial feedback.

References

Aristotle. 1984a. "History of Animals," trans. D.W. Thompson. In Jonathan Barnes (ed.), *The Complete Works of Aristotle*. Princeton, NJ: Princeton University Press, 774–993.

Aristotle. 1984b. "Parts of Animals," trans. W. Ogle. In Jonathan Barnes (ed.), *The Complete Works of Aristotle*. Princeton, NJ: Princeton University Press, 994–1086.

Beckner, M. 1959. *The Biological Way of Thought*. New York: Columbia University Press.

Byron, J.M. Forthcoming. "Whence Philosophy of Biology?" *British Journal for the Philosophy of Science*.

Carnap, R. 1928. *Der Logische Aufbau der Welt.* Leipzig: Felix Meiner Verlag. English translation: R.A. George. 1967. *The Logical Structure of the World and Pseudoproblems in Philosophy*. Berkeley, CA: University of California Press.

Darwin, C. 1964. *On the Origin of Species.* Cambridge, MA: Harvard University Press.

Darwin, C. 1998a. *The Descent of Man.* New York: Prometheus Books.

Darwin, C. 1998b. *The Variation of Animals and Plants under Domestication*, vol. 1. Baltimore, MD: Johns Hopkins University Press.

Dyson, F.W., A.S. Eddington, and C.R. Davidson. 1920. "A Determination of the Deflection of Light by the Sun's Gravitational Field, from Observations Made at the Total Eclipse of May 29, 1919." *Philosophical Transactions of the Royal Society of London* 220: 291–333.

Fodor, J. 1974. "Special Sciences (Or: The Disunity of Science as a Working Hypothesis)." *Synthese* 28: 97–115.

Gould, S.J. and R.C. Lewontin. 1979. "The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme." *Proceedings of the Royal Society of London, Series B* 205.1161: 581–98.

Grene, M. 1959. "Two Evolutionary Theories, I–II." *British Journal for the Philosophy of Science* 9: 110–27, 185–93.

Grene, M.G. and D.J. Depew. 2004. *The Philosophy of Biology: An Episodic History*. New York: Cambridge University Press.

Hull, D.L. 1964. "The Metaphysics of Evolution." *British Journal for the Philosophy of Science* 3: 309–37.

Hull, D.L. 1969. "What Philosophy of Biology Is Not." *Synthese* 20: 157–84.

Hull, D.L. 1974. *Philosophy of Biological Science*. Englewood Cliffs, NJ: Prentice Hall.

Kitcher, P. 1984. "1953 and All That: A Tale of Two Sciences." *Philosophical Review* 93.3: 335–73.

Kuhn, T. 1996. *The Structure of Scientific Revolutions*. 3rd edn. Chicago: University of Chicago Press.

Lakatos, I. 1973. "Science and Pseudoscience." http://www.lse.ac.uk/collections/lakatos/scienceAndPseudoscience.htm (accessed October 3, 2008).

Lakatos, I. 1999. *The Methodology of Scientific Research Programmes*. J. Worrall and G. Currie (eds.). Cambridge: Cambridge University Press [1978].

Nagel, E. 1961. *The Structure of Science: Problems in the Logic of Scientific Explanation*. New York: Harcourt, Brace & World.

Popper, K. 1935. *Logik der Forschung*. Vienna: Julius Springer Verlag. English translation: *The Logic of Scientific Discovery*. 6th edn. London: Hutchinson, 1974 [1959].

Popper, K. 1963. *Conjectures and Refutations: The Growth of Scientific Knowledge*. London: Routledge.

Popper, K. 1978. "Natural Selection and the Emergence of Mind." *Dialectica* 32.3–4: 339–55.

Ruse, M. 1973. *The Philosophy of Biology*. London: Hutchinson.

Schaffner, K.F. 1967a. "Approaches to Reduction." *Philosophy of Science* 34: 137–47.

Schaffner, K.F. 1967b. "Antireductionism and Molecular Biology." *Science* 157: 644–7.

Sklar, L. 1992. *Philosophy of Physics*. Boulder, CO: Westview Press.

Waters, C.K. 1990. "Why the Antireductionist Consensus Won't Survive the Case of Classical Mendelian Genetics." *PSA 1990* 1: 125–39.

Wimsatt, W.C. 1972. "Teleology and the Logical Structure of Function Statements." *Studies in the History and Philosophy of Science* 3: 1–80.