books on the philosophy of science by philosophers for this one to include the considered philosophical observations of a scientist along with those of philosophers of science, but this is only because its subject, Pierce, unlike almost all the breed, was, as a practicing physicist and chemist, an exception to the rule. Delaney does not show how Peirce's account of science grew out of its practice, or how the issues on which he concentrated might be characteristic of doing science. To illustrate the point and suggest its value, I present what two physicists have to say about a specific issue. In introducing "theoretical entities," Delaney quotes Peirce writing in 1898:

The things that any science discovers are beyond the reach of direct observation. We cannot see energy, nor the attraction of gravitation, nor the flying molecules of gases, nor the liminiferous ether, nor the forests of the carbonaceous era, nor the explosions of the nerve cells. It is only the premises of science, not its conclusions, that are directly observed.

Approaching the same issue from a different orientation, E. Schrödinger in his essay, "The Mystery of Sensual Qualities," notes in 1956 . . . the strange fact that on the one hand all our knowledge about the world around us, both that gained in everyday life and that revealed by the most carefully planned and painstaking laboratory experiments, while on the other hand this knowledge fails to reveal the relations of the sense perceptions to the outside world, so that the picture or model we form of the outside world, guided by our scientific discoveries, all sensual qualities are absent . . . . This procedure [clothing facts in the terminology of theories], while very useful for our remembering the facts in a well-ordered pattern, tends to obliterate the distinction between the actual observations and the theory arisen from them. And since the former always are of some sensual quality, theories are easily thought to account for sensual qualities; which, of course, they never do.

"The strange fact" led Schrödinger to proposals similar to Peirce's about the physical basis of consciousness and the oneness of mind. For Peirce it led to a doctrine of sings and the claim that semeiosis crosses the apparent chasm between "sensual qualities" and the "theoretically" real outside world as a common-place of existence. Similar examples could be drawn from the writings of A. Einstein, N. Bohr, P. Dirac, D. Bohm, and many philosophical issues from the same ground.

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James Hoopes compiles Peirce's work on semiotic in his anthology *Peirce On Signs*. Hoopes provides a chronological anthology of twenty-one of Peirce's writings on semiotic with an introduction giving a brief biography of Peirce, a history of semiotics, Peirce's contribution to the discipline and an evaluation of the present state of semiotics compared to Peirce's contribution.

The chronological model of this anthology follows the development of Peirce's view of signs. Yet, the strongest point of these selections is the inclusion of Peirce's metaphysical discussions. Chapter 1, "An Essay on the Limits of Religious Thought Written to Prove That We Can Reason upon the Nature of God," exposes the reader to one of Peirce's central problems: Can we rationally think about the incomprehensible, not fully conceived, and indeterminate? Peirce solves this problem through the logic of signs and he develops his typology in Chapter 2, and 3; "[A Treatise on Metaphysics]," "On a New List of Categories." This semiotic is central to any understanding of experience as explained in Chapters 4, 5 and 6; "Questions concerning Certain Faculties Claimed for Man," "Some Consequences of Four Incapacities," and Grounds of Validity of the Laws of Logic: Further Consequences of Four Incapacities." Peirce argues in these essays that thought arises from the esthetic dimension of experience and is made meaningful only as this experience is appropriated as signs. This interpretation is especially true of the concept of self and, therefore, an understanding of the self is only possible as a sign in relation to other signs. A meaningful self is necessarily part of a community of inquirers. Chapter 7 is Peirce's review of "[Fraser's The Works of George Berkeley]," and is used by Peirce to criticize the nominalism he saw in the scientific community. He shows that general ideas are as important as individual facts because there is a real relationship between one object and another that can be represented by a general third, a sign. Yet, Chapter 8, "On the Nature of Signs," qualifies this idealism by explaining the necessary physical basis of signs. The popular essays "The Fixation of Belief" and "How to Make Our Ideas Clear," included in this anthology as chapters 9 and 10, emphasize the objective nature of signs. Science succeeds because it has appropriated the natural relationship between sign and nature. Furthermore, physical sensations achieve meaning as they are related and interpreted by consciousness. Chapter 11, "One, Two, Three: Fundamental Categories of Thought and of Nature" and Chapter 12, "A Guess at the Riddle" explain Peirce's typology of Firstness, Secondness and Thirdness. Chapter 13, "James's Psychology," is Peirce's criticism of William James's *The Principles of Psychology*. Chapter 14, "Man's Glassy Essence," explains how thought as feeling can be interpreted through signs to create general ideas. The interpretation of signs explains the basic unity of mind and matter ignored by material explanations. Chapter 15, "Minute Logic," discusses the relationship between semiotic, logic, and truth by explaining the concept of thirdness. Thirdness is also central to
Hoopes' brief introductions are excellent. He gives clear explanations of each selection and provides background to the pieces as well as denoting problems and changes in Peirce's thought. Yet, he overlooks a few things. For example, while clearly noting for the reader Peirce's other series of articles, Hoopes does not explain that Chapter 14, "Man's Glassy Essence," is part of the six-part Monist series that is also connected to "One, Two, Three: Fundamental Categories of Thought and of Nature," and "A Guess at the Riddle." The Monist series is pivotal to a clear understanding of Peirce's project and generated the most controversy of any of his work in his own day.

Another problem with this one-volume work is the omission of any cross-references to The Collected Papers of Charles Sanders Peirce, edited by Hartshorne, Weiss and Burks. While reference is clearly made to original sources and Indiana University Press's Chronological edition, many students will not have equal access to these sources and could use reference to the Collected Papers.

One final point is that in the introduction Hoopes dares to give a thumbnail history of semiotics starting in medias res with the modern philosophers Descartes and Locke. While economy is central to an introduction, no mention is made of the ancient and medieval thinkers who contributed to Peirce's semiotics. For example, Duns Scotus is omitted in the introduction and relegated to an explanatory footnote in Chapter 4.

Putting these minor quibbles aside, Hoopes does yeoman's work with this anthology. With the current cross-disciplinary interest in semiotics, this book provides a convenient resource for students. Any comparisons with Buchler and Weiner's anthologies are favorable. While covering the same basic material as Buchler and Weiner, Hoopes provides easy access to some other neglected texts. James Hoopes has given the academic community a valuable resource with Peirce on Signs.

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