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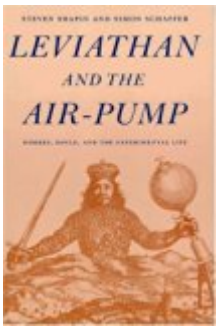

Steven Shapin, Simon Schaffer. *Leviathan and the Air Pump: Hobbes, Boyle and the Experimental Life, Including a Translation of Thomas Hobbes, Dialogus Physicus De Natura Aeris.* Princeton, NJ: Princeton University Press, 1985. x + 456 pp. $28.95, paper, ISBN 978-0-691-02432-5.

Reviewed by Anna Marie Roos

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[Note: This review is part of the H-Ideas Retrospective Reviews series. This series reviews books published during the twentieth century which have been deemed to be among the most important contributions to the field of intellectual history.]

Steven Shapin and Simon Schaffer began *Leviathan and the Air Pump* by noting that the first of the *Harvard Case Histories in Experimental Science* [1] devoted to Robert Boyle's pneumatic experiments provided a "heuristic model of how authentic scientific knowledge should be secured," and a "canonical" example of how history of science was to be done (pp. 4-5). However, despite its admirable qualities, the Harvard study never asked what epistemological assumptions early modern natural philosophers made when they did experiments, and to what extent the development of Boyle's program of experimentation was subject to the social and political concerns of the English Civil War and the Restoration. These are questions that Shapin and Schaffer critically and brilliantly addressed in their work. First, by using such a canonical set of experiments like Boyle's pneumatics as the focus of their research, Shapin and Schaffer were able to refute firmly any sort of traditionalist notions that "hard sciences" like physical chemistry were not affected by social currents. Certainly it was nothing new to take an externalist approach in their analysis of the debate between Thomas Hobbes and Robert Boyle about Boyle's experiments and the existence of a vacuum. However, in the midst of their "sociological study of scientific knowledge," the authors also convincingly illustrated that the controversy that surrounded the air pump's experimental program ultimately resulted in our own practice of science as the development of relativistic and probabilistic knowledge. Shapin and Schaffer showed us the historical precedent for our belief that experiments are the means to scientific truth, and explored the implications of the tenet that scientific knowledge is a social construct.

Thomas Hobbes has not generally been remembered as a "scientist," but as Shapin and Schaffer illustrated, he was a premier mechanical philosopher of the second half of the seventeenth

century, and a worthy adversary to Boyle. Shapin and Schaffer's welcome translation of Hobbes' ***Dialogus physicus de natura aeris*** (in an appendix), demonstrated Hobbes' definition of philosophy as certain and man-made knowledge (such as the axioms of geometry.) On the other hand, Robert Boyle maintained that the foundations of natural philosophy should be generated through the experimental production of matters of fact. As Shapin and Schaffer note, "in Hobbes' view Boyle's procedures could never yield the degree of certainty requisite in any enterprise worthy of being called philosophical" (p. 22). Hobbes' denial of the use of experiments may seem to us to be unreasonable, and Boyle's support of experimental program almost banal, but in an era where scientific epistemology was just developing such tenets were not self-evident.

After all, Hobbes did have a point. Shapin and Schaffer's detailed and painstaking reconstruction of Boyle's air pump experiments indicated that there was indeed more than one reasonable way to interpret the results, depending on whether one believed in a vacuum or not. Further, many of Boyle's air pump experiments were never successfully replicated by his peers. Despite Boyle's detailed illustrations, his instruments were difficult to build and to operate, and, as Hobbes gleefully noted, they leaked, effectively disproving the vacuum that Boyle claimed existed. Hobbes' criticism of Boyle's work in fact led to improvements in Boyle's "engine" and served as a useful corrective to his experimental procedures.

Indeed, the ultimate resolution of the debate between Boyle and Hobbes was shaped to a great extent by concerns external to pneumatics. Shapin and Schaffer's work was especially pioneering in that it specifically informed us how Boyle's development of the experimental enterprise was consciously designed to give its practitioners political and religious legitimacy and hegemony in the Restoration. For example, in every scientific paper, we know there is a detailed material and methods section that allows the reader to witness and participate virtually in the procedures being performed. Students of science are taught that this was to allow testing of the hypothesis by the larger scientific community; Shapin and Schaffer illustrated how the detailed and modest presentation of matters of fact was originally in fact part of an ideological program. Via their "objective" language, natural philosophers were inferred to be modest and trustworthy men who as a group assented to the results of an experiment as probabilistically true. These early "scientists" were consciously portrayed by the early Royal Society as "modest priests of nature," far removed from religious sectaries and enthusiasts deemed dangerous to the Restoration settlement. Natural philosophers who rationally assented to the results of an experiment were unlike religious enthusiasts who claimed all knowledge was the result of individual revelation from God.

Because their decisions were made in a community of fellow practitioners, Boyle claimed that modest experimenters also avoided the philosophical and political dogmatism of one sole authority or Leviathan, much as the English Parliament in concert with King Charles II avoided absolutist government. Hobbes on the other hand "proposed that philosophers should have masters who enforced peace among them and laid down the principles of their activity." Hobbes viewed decision by committee, particularly on a subject as significant as natural philosophy, as dangerous, and likely to produce the same type of civil and religious strife that existed in the English Civil War. Shapin and Schaffer's work is thus an important reminder that Boyle and Hobbes' debate about scientific knowledge was also a larger debate about solutions to maintaining social order.

Although at times the prose style seems to emulate Boyle's own prolix writing, and the material is in places repetitive, ***Leviathan and the Air Pump*** is a pioneering and rich work in "the sociology of scientific knowledge" and in intellectual

history. Shapin and Schaffer drew connections between the history of science and political thought and made a provocative and effective argument that scientific knowledge is to a significant degree socially constructed. In its reexamination of self-evident mores in scientific practice, ***Leviathan and the Air Pump*** forced historians and scientists to reevaluate the role of science in society, as well as the philosophical implications of the scientific method.

Note

[1]. James B. Conant, ***Robert Boyle's Experiments in Pneumatics***. Cambridge, Mass.: Harvard University Press, 1967.

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