

The Reviews of *Leviathan and the Air-Pump*: A Survey

Azadeh Achbari

Leviathan and the Air-Pump has come to be viewed as one of the most influential books in the history of science. In the first reviews that appeared after its publication, it was anticipated that the book would generate discussion for decades to come. The early critics were right: the book was full of ingredients for debate, waiting to spark a reaction. The story involved three of Europe's most prominent natural philosophers in the seventeenth century: Robert Boyle, Thomas Hobbes, and (in a smaller role) Christiaan Huygens. Its subject matter was the new "big science" instrument of its day, the air-pump. It dealt with the emergence of "the experimental method" as a systematic means of producing natural knowledge. And, finally, the story featured two competing ways of resolving disputes over knowledge claims and ways to achieve assent.¹

While a few commentators merely summarized the book, others foresaw at once that it would have quite an impact on the history of science as well as on neighboring fields like the sociology, philosophy, and anthropology of science. I. Bernard Cohen, a professor of the history of science and, as such, an authority on Isaac Newton, praised Steven Shapin and Simon Schaffer for producing a novel "exercise in the sociology of scientific knowledge" that "ventured beyond ordinary history of science or history of ideas." Another authority on Newton, Richard Westfall, spoke of a "post-Koyré historical consciousness" that went beyond the internal analysis of scientific arguments. As Lawrence Busch, a professor of sociology, put it, the book offered a new "model of doing research in the social studies of science, integrating the methods of history, philosophy, and sociology." A professor of chemistry, James Traynham, noted that the authors' contextualist perspective, what he called the "outside" versus the "inside" approach, though it enjoyed "an almost unnoticeable status" a generation before, had become "perhaps the major force in the field."

These are just a few reviewers' opinions on what is now considered a classic in the history of science. In this survey I aim to identify the major themes that critics put forward in reviews of the volume over the first six years after its publication and to detail some points made under each theme. Several among these naturally interrelated themes were taken up by more than a few reviewers, and all reviewers discussed more than just one theme. I hope that the selection

Azadeh Achbari is completing a Ph.D. in the history of science. Her recent publications deal with the establishment of international networks in meteorology and the creation of Buys Ballot's wind law that relates wind direction and force to the distribution of surrounding pressures. She is also Editorial Assistant at *Isis*. Department of Science, VU University, Amsterdam, Netherlands; a.achbari@vu.nl.

¹ Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, N.J.: Princeton Univ. Press, 1985), p. 332.

Isis, volume 108, number 1. © 2017 by The History of Science Society.

All rights reserved. 0021-1753/2017/0108-0007\$10.00.

108

that follows does justice to the views of the thirty-some commentators who reviewed *Leviathan and the Air-Pump* at the time.

KUHN'S LEGACY

Owen Hannaway, a historian whose interests included the history of chemistry in early modern Europe, described the book as a “rich and rewarding fruit of the Kuhnian revolution.” He began his review by asserting that Thomas Kuhn had liberated the history of science from the influence of philosophers of science. Kuhn had shown science to be not the work of a “heroic genius” struggling against society but a communal activity “within well-defined disciplinary boundaries solving clearly articulated problems with agreed-upon intellectual and instrumental tools,” a practice he called “normal science.” Even more than by Kuhn’s theory of scientific revolutions, so Hannaway argued, historians of science were inspired in their work by his description of normal scientific practice. Hannaway then went on to interpret Shapin and Schaffer’s study of Boyle’s experimental method and the seventeenth-century community of experimenters around him as a Kuhnian case of normal science. He compared the authors with ethnographers who described in their book “the work habits, rituals, and social structures of an alien tribe.” The authors’ sympathetic treatment of Hobbes’s point of view, he argued, should be seen as a deliberate means to give a detached and balanced account of the hot dispute between the “old dogmatist,” on the one hand, and the community of experimentalists (Boyle included), on the other. That the review was written for *Technology and Culture* may explain why Hannaway did not delve further into philosophical debates and kept his discussion of Kuhn’s impact on *Leviathan and the Air-Pump* short. He ended his review by recommending the book as “one of the most original, enjoyable, and important books published in the history of science in recent years.”

THE SYMMETRY POSTULATE; OR, WINNERS AND LOSERS IN HISTORY

What Hannaway said in passing about the authors’ sympathetic treatment of Hobbes’s objections to the experimental approach was identified by other commentators as one of the most important themes of the book. Richard C. Jennings, a professor of history and philosophy of science, recognized in the authors’ approach the “symmetry postulate” of the sociology of scientific knowledge in the Edinburgh tradition. “Symmetry” referred to their deliberately taking Hobbes’s natural philosophy and Boyle’s “experimental life” (a concept originating from Wittgenstein) equally seriously by considering both points of view as “credible and viable.” In the *British Journal for Philosophy of Science* Jennings agreed with the authors that only such a move made it possible to test in an objective manner our routine unreflective assumption that experimental scientific practice, as proposed and defended by Boyle, was and is still considered to be the best way to generate knowledge. Indeed, Jennings continued, the “decision to adopt Boyle’s programme over that of Hobbes was not a decision that could be made rationally.” It was made on the basis of external political considerations, as both programs were part of more general solutions to political problems of the seventeenth-century English Restoration settlement. It was because of the success of Boyle’s solution to these political problems that we take for granted and do not question the experimental method as the way to produce scientific knowledge. Jennings commended the authors’ revealing this contingency as one of the great strengths of the book.

Without using the term as such, the historian and philosopher A. P. Martinich also endorsed the authors’ symmetrical treatment of Boyle’s and Hobbes’s points of view. In a review published in the *Journal for History of Philosophy*, he agreed with Shapin and Schaffer that historians of science and philosophy had wrongfully neglected Hobbes’s arguments, judging these “embarrassingly poor” solely “because Hobbes was on the losing side.” He appreciated

Shapin and Schaffer's attempt to narrate "the actual debate" and found that they had done "an excellent job of showing the interrelations between science, religion, and politics."

STRANGER'S PERSPECTIVE

In an essay review published in *Studies in History and Philosophy of Science*, Bruno Latour explained how *Leviathan and the Air-Pump* was in fact a solution to the problem of *asymmetry* in "lab studies"—or anthropological studies of science—including his own influential *Laboratory Life* (coauthored with Steve Woolgar). Latour's use of the term "(a)symmetry" was different from Jennings's, but it dealt with a closely related theme. As he explained, anthropologies of science—like his own study—used the ethnographic method of the "outside observer," a stranger to the customs, habits, and practices of lab scientists who describes and tries to make sense of what happens within the spaces of modern laboratories. However, as Latour admitted, he had come to realize that it was "naïve" to assume that anthropologists of science could be "complete outsiders" to science. How could they act as outsiders to a way of life, a culture, that was their own? He called this the "asymmetry of ethnoscience." Latour saw it as Shapin and Schaffer's accomplishment to have shown a way out of this predicament. Their "genius" move "of having taken Hobbes and Boyle at once" allowed an impartial and symmetrical analysis of Hobbes's natural philosophy versus Boyle's experimental science. The symmetry could be extended even further, in that "Boyle [had invented] a political discourse where politics should not count and that Hobbes [had devised] a scientific politics where experimental science should not count." In short, Shapin and Schaffer gave a twist to the method of the outside observer and analyzed seventeenth-century science from a contemporary "stranger's perspective" by taking Hobbes's antiexperimentalist point of view seriously.

While many commentators appreciated the novelty of the stranger's perspective, others posed serious objections to Shapin and Schaffer's claims based on the merits of this approach. Rose-Mary Sargent, a philosopher and historian of science and one of the few female reviewers of the volume, argued in the proceedings of the Philosophy of Science Association that one did not need to look to Hobbes and his natural philosophy to understand Boyle's experimentalism and the beliefs and practices of his fellow-experimenters. There were other serious methodologies for establishing the truth or falsity of statements available at the time. For a fuller understanding of the new experimental practice, it made no difference whether one chose the "member's account" of Boyle or the "stranger's perspective" of Hobbes. Shapin and Schaffer's approach was not more satisfactory than a traditional historical reconstruction of the motivations behind Boyle's advocacy of the new method, Sargent concluded.

PHILOSOPHY OF SCIENCE

Sargent's was perhaps the most critical of the reviews of *Leviathan and the Air-Pump*. It gives the impression that she felt tricked as a reader. She blamed the authors for changing the set of questions that they set themselves in the introductory chapter. As she explained, Shapin and Schaffer rephrased their initial philosophical question about the epistemic value of experiment as a historical question so that it would account for the rise of the experimental method in seventeenth-century England. Their answer to the question at the end of the book, however, turned out to be an answer to another question entirely: "accounting for acceptance of experimental science by the wider polity of Restoration England." Because of the chosen methodological approach, among other things, she concluded that the authors' contribution fell outside the scope of the philosophical debate over the success of experimental science. Viewed from a historical perspective, she found their sociopolitical history of the English post-Civil War intellectual community very interesting, but as a contribution to the philosophy of science she found their conclusions inconsequential and irrelevant for philosophical discussion.

KNOWLEDGE AND SOCIAL ORDER

According to Richard Westfall, whose review appeared in *Philosophy of Science*, Shapin and Schaffer presented the argument between Hobbes and Boyle as “fundamentally an argument about social order, set in the context of the Restoration settlement.” They set themselves the task of examining “the connection between modern science and the new social order in the West that came into being at much the same time.” They argued that the experimental method and the new social order were “two facets of one and the same process” that produced a new solution to the problem of order. No matter how admirable the attempt, Westfall admitted that he remained skeptical. How could Hobbes, “who believed life in the state of nature is solitary, poor, nasty, brutish, and short, seriously regard the proposition that a vacuum exists as a palpable threat to the stability of the state”? Westfall agreed with Shapin and Schaffer that Boyle’s experimental method and the matters of fact thereby produced had led to a new way of reaching assent, but he was unwilling to accept the wider generalizations that the authors made in the book. As he explained, they “inflated the dispute between Hobbes and Boyle into an argument about social order, . . . a battle between rival ways of life.” In conclusion, he argued that their “explanation of modern science, a development of the whole of Western Civilization, in terms of the socio-political context of Restoration England” was an exaggeration that “distort[ed] historical reality.”

Writing in *American Scientist*, John D. North, a historian of science and philosophy and the author of numerous books on the history of astronomy, took a similar stance and refused to accept Shapin and Schaffer’s broader conclusions with respect to the English social order based on the outcome of Boyle and Hobbes’s conflict over natural knowledge claims. North summarized the dispute as two men “offering solutions to the problem of knowledge that were essentially different solutions to the problem of social order.” By analyzing the arguments of Hobbes, Boyle, and their adherents, Shapin and Schaffer had been successful in revealing the resulting Restoration tensions. But North argued at the same time that the authors revealed little of the actual philosophical content of Hobbes’s writings. Another point of criticism in North’s review—and not a minor one—was that their story was “specific and personal,” whereas the conclusion that they drew was of “bold generality”: “Solutions to the problem of knowledge are solutions to the problem of social order.” He found it puzzling that the authors did not see any reason to explain this sentence and wondered whether their claim was justified historically. His own assessment was that the authors had not proven the connection but had merely shown the “cross-linkages between the social and the scientific realms.” They could do this so easily because of the “slippery” use of the word “dogmatist.” In categorizing Hobbes as a dogmatist in matters of knowledge, the experimenters also categorized him as a dogmatist in matters of faith and politics. Therefore, it was assumed that his solution to the problem of order did not find resonance in a Restoration England that hoped to keep civil war from breaking out again, whereas Boyle’s solution, based on consensus, was better suited to the needs of seventeenth-century English Restoration society.

THE ROYAL SOCIETY CONTEXT

Mordechai Feingold, a historian of seventeenth-century science in Britain, reviewed the volume in the *English Historical Review*. Focusing likewise on cross-linkages between seventeenth-century science, religion, and politics in England, he noticed that the dispute between Boyle and Hobbes was an extension of a previous debate between the latter, on the one hand, and John Wallis and Seth Ward, on the other. These two Royal Society colleagues of Boyle portrayed Hobbes “as a subversive element in the scientific sphere, as he was in the political and religious spheres. He erred not only in his philosophy and unwillingness to desist from controversies, but also in his refusal to admit to the weight of consensus.” For this reason he

was denied membership in a Royal Society that wanted to present itself as a “unified and solid scientific front.” Feingold found it a missed opportunity that no one had yet analyzed that earlier debate. He suspected that the result of such an investigation would fortify Shapin and Schaffer’s claims and “would lend further credence to their insistence on taking Hobbes seriously.”

Three years earlier, the same gap in existing studies on Hobbes had been noticed in a review that appeared in *History of Science*. Paul Wood, the author of the piece and a professor of history with an interest in the intellectual history of early modern Europe, found that the authors had insufficiently contextualized Hobbes’s dispute with Boyle. He argued that Shapin and Schaffer’s discussion of the dispute would have benefited from a detailed examination of earlier polemics between Hobbes, on the one hand, and John Wallis, Seth Ward, and John Wilkins, on the other. Furthermore, Wood found the authors’ rehabilitation of Hobbes “a bit too charitable.” They appeared “to underestimate just how traditional and reactionary Hobbes’ epistemology must have seemed to his contemporaries.” Hence, Wood contended, “it is no surprise that Hobbes was widely perceived as a dogmatist.” Another aspect that Wood found not entirely satisfactory was Shapin and Schaffer’s treatment of Hobbes’s relationship with the Royal Society. As he argued, although Hobbes did have supporters in the Royal Society, they could not have pleaded for his membership in that circle because his “dogmatism and his supposed atheism” would have destroyed the public image of the Royal Society. So they had to exclude him from their circle.

While Wood found Shapin and Schaffer’s historical account of the dispute between Hobbes and Boyle unsatisfactory, he regarded their treatment of Boyle’s experimental program as “highly innovative” and their sociological method as “extremely revealing.” As he explained, the authors’ use of sociological models applied to attempts made by Huygens and others to replicate Boyle’s air-pump experiments was among the most exciting and successful parts of the book. However, he still thought that “more work need[ed] to be done on the micro-politics of the [Royal] Society,” and he stressed the “need [for] a fully nuanced analysis of the negotiations involved in the construction of the experimental philosophy in seventeenth-century England.”

EXPERIMENTAL LIFE

In the *American Historical Review* I. Bernard Cohen recommended, among the many original perspectives offered in the volume, Shapin and Schaffer’s portrayal of the dispute between Hobbes and Boyle as a conflict between two fundamentally different polities: Boyle’s experimental polity, associated with the Royal Society, and Hobbes’s opposing philosophy, built on the authority of the state. He counted their analysis of the emergence of the experimental method as one of the book’s many outstanding features. He also noted the originality of the authors’ analysis of the debates on the public and private nature of experiments and the importance of “collective witnessing” for the validation of the new experimental method.

John Heilbron, a historian of science best known for his work in the history of physics and astronomy, also valued Shapin and Schaffer’s intricate story of the “creation of a sustained practice of experimental natural philosophy.” One of the few points of criticism he made in his *Medical History* review was aimed at the authors’ representation of Boyle’s experimental method as a solution to the social problems of Restoration England. He quoted the authors’ claim: “The experimentalists’ task was to show others that their problems could be solved if they came to the experimental philosopher and to the space he occupied in Restoration culture.” But, as Heilbron remarked, “it was just these problems—social problems—that the Royal Society excluded from its ‘space.’” Nonetheless, he recommended that “all historians of science” study the authors’ account of the difficulties that Boyle and his contemporaries experienced in replicating experiments, a problem of great contemporary relevance.

The historian Peter Harman, the author of many books on the history of natural philosophy and physics in the eighteenth and nineteenth centuries, reviewed *Leviathan and the Air-Pump* in the journal *History*. He summarized Shapin and Schaffer's message thus: the debate between Hobbes and Boyle "was essentially a conflict between different views about the basis of assent and order in Restoration society." He found the authors' main argument unconvincing, arguing that they pressed their readers to accept their views by means of rhetoric and the terminology of the sociology of knowledge. Further signaling their "thoroughgoing relativism," Harman dismissed the authors' "radical interpretation" in favor of other "cogent explanations of Hobbes' scientific reputation (by Alan Shapiro) and exclusion from the Royal Society (by Quentin Skinner)." He also referred to studies by Charles Webster and Michael Hunter, who had offered more satisfactory historical interpretations of "the links between the debates associated with experimental science and the wider political turmoil in the period."

The philosopher Ian Hacking, who reviewed the 1989 paperback edition in the *British Journal for the History of Science*, found the history of Boyle's experimental science as presented by the authors whiggish, "because there is no way of unthinking the experimental style of reasoning that came into being." He read the book as a history of origins. A "thoroughly whig history," *Leviathan and the Air-Pump* told the story of how we came to accept the experimental method while "singling out a few striking figures as the motors of history." He was not impressed by the authors' work, claiming that origins, although interesting, did not teach us much about what made the experimental method as a new style of scientific reasoning different from other styles of reasoning.

According to the historian of physics Dominique Pestre, Shapin and Schaffer's study showed how the dispute between Hobbes and Boyle went beyond the sphere of natural philosophy and the production of knowledge. Their acute analysis, he argued in the *Revue d'Histoire des Sciences*, demonstrated the success of Boyle's experimental method "to the extent that the Restoration settlement was secured." The specific historical contingency of the victory of Boyle's experimental method was all the more fascinating in view of its sustained impact. At the same time, Pestre hoped that an explanation could also be given for the long-lasting success of the experimental method. Perhaps, he speculated, the reason was the "formidable efficacy of this programme in the instrumental relation of humans with reality."

SOCIOLOGY OF SCIENCE

In general, *Leviathan and the Air-Pump* was well received in sociological circles. In the journal *Sociology* Trevor Pinch, a sociologist with a deep interest in science and technology studies, found Shapin and Schaffer's account of the success of science "brilliant and highly readable." The authors' history of Boyle's air-pump experiments was a successful attempt to push back "the ideas of social constructivism . . . to the dawn of the scientific revolution." One of the passages that Pinch chose to discuss was the authors' explanation of Hobbes's objection to Boyle's experimental system by using the analogy of the Duhem-Quine thesis. Hobbes pointed out that the air-pump experiment carried with it theoretical assumptions embedded in the construction and functioning of the apparatus, which ruled out the possibility of a crucial test. This sort of analysis was what made the story a convincing interpretation of how the experimental method came to be accepted as a systematic means of generating scientific knowledge and achieving assent.

Lawrence Busch, another sociologist, was among the few reviewers to note that Shapin and Schaffer treated scientific knowledge claims as "inherently political statements." In his words, "rather than attempting to show how politics impinges upon the pursuit of science, they reverse[d] the problem." He foresaw that their claim that "the language that transports politics outside of science is precisely what we need to understand and explain" would provide participants in the

social studies of science program with interesting problems for some time to come. As Busch argued further in *Science and Technology Studies*, “unlike many studies of contemporary science that took a social constructionist stance,” Shapin and Schaffer’s book was “not content merely to show what happened in the laboratory; they insisted on showing how the civil war in England, the religious disputes of the day, and the philosophical assumptions and assertions of the actors entered into the arguments over what one could conclude from the air-pump experiments.” In other words, they showed that an everyday scientific practice like the experimental method, taken for granted by many in the social studies of science, was a social construct and had historical origins. While applying the social constructionist approach to an episode in the history of science, Shapin and Schaffer opened new vistas for social studies of science as well as for historical research. Because of their subject matter, the authors’ analysis of competing ways of making and judging scientific knowledge in seventeenth-century England was also relevant to contemporary society. Together with all this praise went Busch’s sole complaint: the outrageously high price of sixty dollars for the volume. Other reviewers also hoped that a more affordable paperback edition would appear, as indeed it soon did.

Thomas Hankins, a physicist and historian of science, characterized Shapin and Schaffer as “leading advocates of the sociological approach to the history of science.” He noted in *Science* that their purpose was to show that “the creation of scientific knowledge is profoundly political, . . . in the wider sense that science is part of the entire body politic,” and he argued that they had “chosen well in Hobbes.” On the whole, Hankins’s evaluation of the book was positive, except with respect to the authors’ definition of scientific boundaries in social terms. As he concluded, “the differences between geometry and chemistry are not entirely social.”

ENGLISH TRANSLATION OF HOBBS’S *DIALOGUS PHYSICUS*

Harold W. Jones’s critique in the *British Journal for the History of Science* stands out among the reviews for its detailed attention to the quality of the English translation of Hobbes’s *Dialogus physicus de natura aeris* that originally appeared as an appendix to the volume. According to some reviewers, the translation contributed to a revival of Hobbes studies; yet while almost all of them appreciated the inclusion of the English text in the book, no one else assessed the translation itself. Jones proved to be a very exacting reader, who seems to have examined every page of the book minutely before composing his review. He also had an eye for details like spelling and the syllabic and etymological division of words by the book’s printer. He put the book down with “mixed feelings.” In his review he picked out numerous instances of awkward phrases resulting from clumsy and sometimes even erroneous translation. His conclusion was rather harsh: the translation was in need of a thorough revision. Perhaps it was this judgment that moved the authors not to include their translation in the 2011 revised edition of the volume.

THE INSTRUMENT

Marie Boas Hall, whose one and only review of *Leviathan and the Air-Pump* appeared, curiously, in two different journals, *Ambix* and *Annals of Science*, was not much impressed by Shapin and Schaffer’s work. One of the few aspects that she did appreciate was the authors’ attempt to explain the difficulties of building air-pumps, which made them scarce; but, as she argued, they did not explain the difficulties of making new discoveries with the instruments once constructed. Her rather short review was given more to listing various omissions by the authors than to the arguments that they did offer to build up their story. Assessing the book in rather general and nondescript terms like “interesting” and “useful,” she criticized it as “too doctrinaire” for her taste and a “little careless of historical interpretation,” without giving specific examples or further explaining these points of criticism.

In contrast, other reviewers valued the authors' analysis of the difficulties involved in the process of replicating experiments as one of the original aspects of the book. Trevor Pinch, for example, remarked that replication, "which is often held to be the touch-stone of the experimental form of life[,] turns out to be very messy indeed." According to Richard Westfall, the authors deserved praise for demonstrating that the air-pump was not accepted and disseminated instantly as a scientific instrument among scholars of pneumatics. He found that their story convincingly showed how introducing a new instrument into the scientific community is not without difficulty. The device was new, rare, and expensive. It was difficult to operate successfully, and the phenomena that it revealed remained confined to a few privileged observers. Westfall assessed Shapin and Schaffer's exposition of how the air-pump was introduced in the seventeenth-century scientific community as brilliant.

AN ENGLISH AFFAIR

I. Bernard Cohen and John Heilbron were among the few reviewers to express their disappointment that *Leviathan and the Air-Pump* made no comparisons with developments elsewhere in Europe. While Cohen would have been happy to read more about the relations between scientific and civil polity in seventeenth-century France, the Netherlands, and Germany, Heilbron excused the authors for the omission. Shapin and Schaffer's "prolix" treatment of Boyle's triple technologies had rendered the volume so large that there was no room left for discussion of parallel practices on the Continent, like the witnessing of experiments or policies directed against speculation about causes at the Roman College and in the academies of Florence and Paris.

USE OF JARGON

Trevor Pinch was one of the few reviewers who easily adopted Shapin and Schaffer's terminology of "material, literary, and social technologies" instead of finding them obstacles to a ready understanding of their argument. That he was himself a sociologist may well have helped him understand the authors' vocabulary better than most reviewers, who could not get used to the sociological terminology of the authors. Richard Westfall, for example, complained that Shapin and Schaffer used a "pervasive sociologizing jargon, eclectically indebted to Wittgenstein and Foucault, which for this reader posed an obstacle to ready comprehension." In a review in *Nature*, Willem Hackmann, assistant curator of the Museum of the History of Science at the University of Oxford, feared that scientists would find "this community's particular language-games at times rather off-putting, with its terms such as 'literary technology' and 'boundary-speech.'" In *Isis*, Margaret Jacob (a cultural historian of science) also complained about the technical language. In her words, the book was "a remarkable achievement, a pleasure to read (despite those 'actors' and 'technologies')." Thomas Hankins found the terminology of the analysis "more confusing than helpful." Another historian of science, Robert Kargon, who reviewed the book in *Albion*, found the language "allusive, often elusive." Charles Webster's only criticism in his otherwise positive review in the *TLS* was directed at the style of the argument, which he found at times "over-didactic, repetitive and prolix." The term "prolix" appeared in more than one review. Marie Boas Hall, for example, who called the authors' jargon "sociologese," complained that "repetition [made] for a prolixity rivaling that of Hobbes and Boyle." She found the volume more suited to the scientist-historian than to the historian of science. Harold Jones likewise found the book too detailed—so much so that the detail rendered the book unintelligible: "we tend to lose ourselves in 'the experimental life.'" Finally, John Heilbron compared the authors' definitions of "'social spaces'; 'disciplinary spaces'; 'physical space'; 'abstract space,'" and other descriptions of filled spaces and spaces void of air with a "spissitude [that] bamboozles even its creators."

Reviews (as listed in the *Isis* Current Bibliography)

- Abbri, F., *Nuncius*, 1987, 2(1):241–244
 Busch, L., *Science and Technology Studies*, 1987, 5(1):39–40
 Cohen, I. B., *American Historical Review*, 1987, 92:658–659
 Feingold, M., *English Historical Review*, 1991, 106:187–188
 Hacking, I., *British Journal for the History of Science*, 1991, 24:235–241
 Hackmann, W. D., *Nature*, 1986, 321:480
 Hall, M. B., *Ambix*, 1986, 33:157–158
 Hall, M. B., *Annals of Science*, 1986, 43:575–576
 Hankins, T. L., *Science*, 1986, 232:1040–1042
 Hannaway, O., *Technology and Culture*, 1988, 29:291–293
 Harman, P. M., *History*, 1987, 72:176
 Heilbron, J. L., *Medical History*, 1989, 33:256–257
 Hill, C., *Social Studies of Science*, 1986, 16:726–735
 Jacob, M. C., *Isis*, 1986, 77:719–720
 James, P. J., *History and Philosophy of the Life Sciences*, 1990, 12:134–137
 Jennings, R. C., *British Journal for the Philosophy of Science*, 1988, 39:403–410
 Jones, H. W., *British Journal for the History of Science*, 1987, 20:122–123
 Kargon, R., *Albion*, 1986, 18:665–666
 Latour, B., *Studies in History and Philosophy of Science*, 1990, 21:145–171
 Martinich, A. P., *Journal for History of Philosophy*, 1989, 27:308–309
 North, J. D., *American Scientist*, 1987, 75:216
 Oldroyd, D., and W. Lynch, *Social Epistemology*, 1989, 3:355–372
 Pascual, M. J., *Sylva Clius*, 1988, 4(2):81–82
 Pestre, D., *Revue d'Histoire des Sciences*, 1990, 43:109–116
 Pinch, T., *Sociology*, 1986, 20:653–654
 Sargent, R.-M., *PSA [Proceedings of the Biennial Meeting of the Philosophy of Science Association]*, 1988, no. 1, pp. 53–63
 Stewart, L., *Historical Studies in the Physical and Biological Sciences*, 1988, 19:193–197
 Traynham, J. G., *Interdisciplinary History*, 1987, 18:351–353
 Webster, C., *Times Literary Supplement*, 31 March 1987, p. 281
 Westfall, R. S., *Philosophy of Science*, 1987, 54:128–130
 Wood, P. B., *History of Science*, 1988, 26:103–109