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ESSAY REVIEW

Experimenting with Enlightenment

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Geoffrey V. Sutton, *Science for a Polite Society: Gender, Culture, and the Demonstration of Enlightenment* (Boulder, CO: Westview Press, 1995), xiii + 391 pp., ISBN 0-8133-1575-1.

Christian Licoppe, *La formation de la pratique scientifique: le discours de l'expérience en France et en Angleterre (1630–1820)* (Paris: Editions de la decouverte, 1996), 346 pp., ISBN 2-7071-2530-X.

The historiography of eighteenth-century science, and especially experimental science, is in the process of clawing its way out of the gaping hole that has until recently occupied the timespan between the canonical Newtonian synthesis of the end of the seventeenth century and the 'second scientific revolution' roughly a hundred years later. Both of these books participate in this process, though in quite different ways. Both give readings of texts and practices going well back into the eighteenth century to develop accounts of science in the Enlightenment. Both pay attention to the literary style of scientific texts. And both, while focusing primarily on France, make excursions into the Royal Society and the lecture halls of London. Nevertheless, the reader of these two books cannot help but wonder if they refer to the same historical world; she may well feel rather like the famous traveler who found when he crossed the Channel that the full space of Paris had become a void in London.

The disjuncture between the two pictures is most obvious where the same examples are put to different uses; an example is Johann Bernoulli's correspon-

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dence with the Paris Academy about glowing barometers This exchange was prompted by the failure of experimenters in Paris to reproduce effects observed by Bernoulli, then working in Groningen. Both Licoppe and Sutton see in this episode evidence for common ground shared by the antagonists. For Licoppe it is a story about the primacy of visible phenomena ratified by the experience of (male) spectators drawn from the upper echelons of the social hierarchy. Since the phenomena in question—the luminescence of mercury under various conditions—were not predictable, reliable witnesses were required in both sites. But, again because of the inconsistency of the phenomena, the Parisians could not buy Bernoulli's Cartesian explanation for what he saw in Groningen. By finally agreeing that local variations and accidents accounted for the disparate results, all parties 'preserved each local test [*preuve*] at the price of skepticism on the level of the truth of the theory [*systeme*]' (Licoppe, p. 107).

Sutton uses Bernoulli's explanation to exemplify a viable Cartesian description of the kind of strange phenomena that sparked the interest of men and women outside the Academy. Here the 'system' proposed by Bernoulli, based on pressure pulses in the prime matter filling the airless space above the mercury's surface, linked him to Paris in spite of different experimental results. Fontenelle closed the case by proclaiming that observations would have agreed if all Bernoulli's procedures had been followed (Sutton, p. 183). On this view, Fontenelle, the huckster *par excellence* of Cartesian mechanism, welcomed Bernoulli's theoretical account as grist to his mill. Licoppe's experimenters (Bernoulli and the Parisians alike) privilege observation of contingent events over theoretical explanations, while agreeing that disparities in observational results do not imply lack of skill or integrity in the observers. Sutton's Fontenelle represents 'the first generation that saw itself as a group of working scientists who believed their theoretical framework was largely correct and essentially complete' (p. 187).

What are we to make of this disjuncture in interpretation? It certainly reflects a disagreement over the role of Cartesian 'system' in the practice of science at the turn of the eighteenth century. It also draws our attention to other broad differences in perspective and method. Licoppe is concerned primarily with experimental reports, written by practitioners for each other. He lays out a complex evolution in 'literary technology', from the early years of the Academy of Sciences up to the last days of the old regime. He brings to his analysis a serious engagement with recent Anglo-American historiography of seventeenth-century science, especially the work of Shapin, Schaffer and Dear, and uses occasional forays into the *Philosophical Transactions* as a point of comparison for the French case.[1]

[1]For example, Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985); Steven Shapin, *The Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago: Chicago University Press, 1994); Steven Shapin, 'The House of Experiment in Seventeenth-Century England', *Isis* **79** (1988), 373–404; Peter Dear,'"Totius in verba": Rhetoric and Authority in the Early Royal Society', *Isis* **76** (1985), 145–161.

Building on Shapin's notion of virtual witnessing, Licoppe analyzes semantic structures to expose techniques used by members of an elite community to convince each other of the truth value of their reports. Changes in how they inscribed nature in their texts reflect changes in how they conceptualized nature itself, as well as how science related to society and the state. Sutton, on the other hand, undertakes to turn various familiar, if outdated, assumptions about science inside out, by reading science in the first instance as literature for genteel readers, and concomitantly as a spectacle attended by a well-heeled audience curious about new phenomena. He argues that staged demonstrations of physical principles and spectacular effects served to make a certain kind of science into common currency for this literate public. Demonstrations played a crucial role in convincing the denizens of polite society that science offered an intelligible account of nature that could be engrossing and, above all, amusing. He is, then, looking at experiments as demonstrations of what was already known, as the production of 'well-rehearsed effects'. The seventeenth-century Academy of Sciences becomes one polite gathering among many, alongside salons, and the lecture room becomes the locus of public knowledge and experience of science. As the story continues into the next century, public demonstrations and Fontenelle's accessible accounts of experiments hold their position center stage as the academicians do their work in the wings.[2]

The 'mind of the Enlightenment' is a key term for Sutton, and he sets out to show how science became 'implanted' into it. What makes the book alternately appealing and infuriating is the way this idealist underpinning is worked out in terms of material practices and social settings. This is not Cassirer's Enlightenment mind, developing dialectically through the play of its own inner dynamic.[3] Here the mind of the Enlightenment emerges embodied in the manipulation of instruments and accompanied by the verbal patter of purveyors of science. Enlightenment, though still rooted in empiricism and in rationality, as in traditional intellectual histories, is located in the social spaces peopled by decorously fun-loving aristocrats and would-be aristocrats. At the same time, recurrent reference to a transcendent 'mind' that somehow gives the Enlightenment a distinctive character and coherence undermines this socially grounded analysis. The most original parts of Sutton's account tend to show, in fact, that the Enlightenment cannot be meaningfully unified as a set of philosophical dispositions floating around 'in the air'.

One of the effects of displacing the locus of scientific activity from the Academy to the lecture hall and salon, from the sequestered laboratory to public demonstrations, is the acknowledgement of a female presence at the sites where science met the public. The main characters—Poliniere, Desaguliers, Nollet—display spec-

[2]A helpful and relevant reading of Fontenelle, and especially of his presentation of Cartesian cosmology, is found in Erica Harth, *Cartesian Women: Versions and Subversions of Rational Discourse in the Old Regime* (Cornell: Cornell University Press, 1992).

[3]Ernst Cassirer, *The Philosophy of the Enlightenment* (translated by F. Koellin and J. Pettegrove) (Princeton: Princeton University Press, 1951).

tacular phenomena for the delectation and enlightenment of their mixed-gender audiences. In the same way, Sutton's account of this genre of demonstration itself stands as a demonstration of the phenomenon of women engaging with scientific knowledge. He argues forcefully throughout for the enjoyable nature of much Enlightenment science and takes seriously the entertainment value of demonstrations, to explain the way certain kinds of science permeated the culture of polite society. So women are integrated into the story, as auditors, readers, and even participants. The fashion for natural knowledge, especially as displayed in carefully contrived demonstrations or elegantly written books, constitutes the power of that knowledge. At the same time, though, Sutton avoids the vexed issues surrounding the construction and historical location of gendered meanings. He assumes that what women did was feminine, in short. This approach can only end by begging the question of what 'feminine style' might be in a given time and place.

Licoppe is silent about women, and gender, though he does locate seventeenth-century experimental reports in a discourse of curiosity, tied to an 'aristocratic ethos' based on the cultivation of novelty and disdain for the manual arts. This 'ethos' functions as the French analogue of the English gentlemanly culture in the work of Steve Shapin (pp. 45, 211). Licoppe's analysis of the formal structures of argumentation in experimental reports is directed to the implied readers addressed by the authors, as well as to their representations of nature. Scientific texts are 'engaged both in the construction of the phenomenon and in that of [their] public' (p. 55). But these readers remain largely disembodied, often literally, as 'virtual readers'. Aristocrats are differentiated from king and from commoners, but aristocracy itself appears to be a monolithic category. Licoppe is perfectly well aware of the shifting relations of aristocracy to the monarch under Louis XIV, as well as subsequent shifts in the conduct of the absolutist state. Given the unquestioned all-male composition of the nascent Academy, and the mixed-gender composition of the elite audiences for science, we might consider what role gender played in the differentiation of academicians from their readers, as well as in the process of seeking aristocratic sympathy and support.

At the most fundamental level, Licoppe writes about knowledge and power, and the shifting forms of expressions linking the two. It would not be too much of a stretch to say that this story also concerns the gendering of knowledge, since the men of the Academy took care to position themselves, their investigations of nature, and their texts with respect to a feminized audience variously composed of aristocrats, women, provincial savants and sundry followers of fashion. Feminization, it is well to remember, is not just a question of the absence or presence of women. As Sutton recognizes, by becoming fashionably 'clever', science borrowed against the social status of its elite audience, at a time when the status of science itself was unstable.[4] But even as some practitioners of science (whether demonstrators,

[4]See Mary Terrall, 'Gendered Spaces, Gendered Audiences: Inside and Outside the Paris Academy of Sciences', *Configurations* **3** (1995), 207–232.

mathematicians, experimenters or observers) lived in polite society themselves, the institutional identity of the Academy was predicated on the maintenance of a boundary circumscribing it. Presenting or displaying natural knowledge to outsiders was itself part of the process of differentiation, the elite audience cast as admirers and spectators rather than practitioners. Academic science was thus construed as masculine and its exposition to the outside world was carefully controlled. The realm of lecture demonstrations was not restricted or policed in the same way as the private space of the Academy. Women were not only present but might participate, turning cranks or drawing sparks from charged bodies. Sutton's insight is to recognize the demonstration space—public, but elite—as a venue for the production of knowledge about nature in a rather particular sense. Similarly, social gatherings in salons or cafes or theatres might include conversation and debate about the phenomena and principles on display around town.

Both Licoppe and Sutton use key episodes to structure narratives with considerable chronological sweep. Sutton's characterization of science as 'enjoyable work' emerges from the story of fashionable attention to natural knowledge going back to Renaudot's *Bureau d'adresse* in the 1630s. He offers his reading of natural philosophy, and especially the tradition initiated by Descartes, as an antidote to histories that privilege the abstract and metaphysical over the empirical. On this account, the appeal of Cartesian explanations for natural phenomena comes down to the common-sense concrete quality of his mechanisms. This fascination with the mechanical then gets transformed, in the fullness of time, into an empiricism that avoids the intricacies of rival theories or hypotheses. The heroes of the story are the demonstrators who make science visible and intuitive. The formation of the 'mind of the Enlightenment' culminates in the elaborate dispute between Franklin and Nollet over how to explain the most spectacular of Enlightenment phenomena, the shocks and sparks of static electricity. This dispute was the turning point in the relations between science and the non-expert public. Earlier lecturers (Rohault, Poliniere) demonstrated phenomena independent of theoretical explanations, bypassing philosophical disputes along Cartesian, Newtonian or Leibnizian lines. The natural philosophy they put on display was held up as an empirical 'exemplar of rationality' (pp. 331–332). Science asserted its claims to truth in the lecture hall, for the benefit of a wide and not necessarily expert audience. But Franklin and Nollet developed rival accounts of the invisible reality beyond the reach of the senses. They disagreed, not about whether particular phenomena occurred, but about interpretation. Their argument centered on the invisible fluids that accounted for effects produced in key experiments, even though the effects were still displayed to polite audiences. Sutton argues that the grounds of disagreement, in the invisible realm of theory, effectively took the ability to judge the truth of the situation away from the fashionable audience witnessing the experiments. It was no longer a question of letting the carefully orchestrated phenomena speak for themselves. The plausibility of explanations was a matter for the experts.

In Licoppe's narrative, the same dispute occupies a key moment, though it fosters

rather different conclusions. It comes in the middle of a panoramic view of the 'discourse of experiment' from the early days of the French academy and the Royal Society to the end of the eighteenth century. Over the course of this period, the cultural referent of experimental science changed from curiosity and spectacle, to utility, and then to an 'economy of exactitude'. Nature, the subject of this evolving discourse, changed as well. As the value of curiosity was displaced by utility, the nature that had been a collection of singular phenomena became consistent and predictable (and hence potentially useful). Licoppe labels the final stage of this process the decontextualization of experiment, accomplished through the use of precision instruments to produce universal and mathematically exact laws, and exemplified in the work of Coulomb. This process unfolded in tandem with an evolution in the relations of science to society and the government, as the work of science became indispensable to the technological interests of the state.

The Franklin–Nollet episode occurs at the transition from the 'proof from curiosity' (*preuve curieuse*) to the 'proof from utility' (*preuve utilitaire*). Where Sutton saw a clash of theories, Licoppe sees a clash of rhetorics of proof. Thus Nollet only puts forth his two-fluid theory after accumulating examples of what he calls 'admirable' and 'surprising' phenomena. The theory retains traces of tentativeness, as Nollet distinguishes between the absolute reliability of his observations and the probable 'conjectures' they suggest to him. At the same time, he suspects there may be a constant law underlying the multitude of electrical phenomena (pp. 166–169). Franklin, an outsider to the distinctively French culture of curiosity, presents his experiments as evidence of a natural law, the conservation of a single electrical matter. This posited fluid instantiates an '*a priori* vision of the world' and Franklin's definition of positive and negative charge, as superabundance or deficiency of the electrical matter, compels assent to the theory (p. 172). The Franklinian fluid enters the realm of utility *via* the debate over lightning rods.

From this moment, the turn in experimental rhetoric is decidedly toward the utilitarian, and Licoppe gives a brilliant reading of work on the strength of materials (especially wood used in building construction) by Buffon and Duhamel de Monceau. This account, linking academic, architectural and building practices, is rich and suggestive. But taking Buffon as an exemplar of a utilitarian rhetoric of experimentation effectively detaches him from his own widely read and lavishly produced works of natural history. Utilitarian arguments do indeed suffuse Buffon's *Histoire naturelle*, but it also was embedded in a culture of rational curiosity, of widespread fascination with the variety of animal life, and of the aesthetics of display. How, the reader wonders, do these play off each other, and how does this natural history relate to Buffon's experimental investigations, or for that matter, to his mathematical work?

This is not just a matter of including more material for a more comprehensive story. The challenge comes in developing the notion of scientific practice. Through subtle and nuanced readings of his sources, Licoppe has reduced the 'scientific

practice' of his title to the literary practice of writing reports of experiments, or in other language, to the inscription of phenomena and arguments in texts. The relations of these texts to other aspects of the practice of science—theory construction, calculation, design and manipulation of instruments, publication of texts in other genres, institution building, patronage within and outside the Academy—disappear from the picture. The production of natural knowledge in this period might profitably be characterized by the complex interplay between curiosity and utility, spectacle and the search for precision, exclusion and openness, universality and particularity. These categories do not necessarily have to be framed schematically as opposites. The individuals deploying these sometimes complementary, sometimes contradictory resources moved among social and institutional settings, as their texts moved among genres and literary styles. The language and rhetorical structure of experimental reports give us precious insights into the ways experiments and phenomena were transcribed onto the printed page. So does the presence of scientific apparatus in genteel drawing rooms. But I would make a plea for avoiding reductionism in accounts of the experience and representation of natural knowledge. The academies, where Licoppe finds his primary sources, and the demonstration rooms and private homes, where Sutton places enlightened science, were not as far apart as these two histories imply. It would be nice to know more about how these worlds intersected, how knowledge moved across such boundaries, and how individuals made crossing those boundaries work for them.