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Stephen Gaukroger. *The Collapse of Mechanism and the Rise of Sensibility: Science and the Shaping of Modernity, 1680–1760*.

The Collapse of Mechanism and the Rise of Sensibility: Science and the Shaping of Modernity, 1680–1760 by Stephen Gaukroger

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a rebel, and eventually a courtier of Peter the Great. He was also a prolific writer; his best-known work was an Ottoman history. His other works include a novel, an encyclopedia of music, and works on geography, political science, and philosophy, many of which remained in manuscript at his death in 1723. The only copy of his *Sacro-sanctae indepingibilis imago* (1699–1700), known in the nineteenth century, languished in Russian libraries for years before the eventual publication of a Rumanian translation in 1928 that bore the less suggestive title of *Metafizica*. It then disappeared until Vlad Alexandrescu rediscovered it in Moscow in 2008. The book under review provides a critical edition with a translation into Italian on facing pages.

We are thus able for the first time to appraise Cantemir's interesting melange of old and new philosophical ideas, formulated during long sojourns in Constantinople among intellectuals with connections to, or at least memories of, the academies, classrooms, and libraries of Venice, Padua, Bologna, Paris, Prague. In attempting to devise a Christian approach to natural philosophy, adding biblical insights to his own inspiration, Cantemir was in good company. With the rest of the philosophers belonging to the Mosaic trend explored by Ann Blair and others, he seemed to take the century of religious strife (in his case, viewed from the standpoint of embattled Greek Orthodoxy) as a cue to reexamine the lingering pagan influences on early modern thought, especially Aristotle. And like Robert Fludd in the *Utriusque cosmi . . . historia*, he dedicates the work to God, as "your creature," promising to make the divine Word the basis for a new physics and metaphysics. The work is structured around his "venatio," as Van Helmont or the purveyors of secrets studied by William Eamon might have termed such a quest for knowledge. He attains philosophical maturity, according to his narration, when he finally encounters a figure denominated "Caritas," actually Sacred Science, and tries, at first with little success, to articulate in words the visual representations then shown to him. Sacred Science, as his title states, is unrepresentable; to think otherwise is the fundamental error of the Aristotelian tradition.

Cantemir draws on Van Helmont, rather than Paracelsus or Fludd, for the creation story that will serve as a basis for his Mosaic approach. There are two constitutive elements in the world, not the *tria prima* of the Paracelsians. Moreover, air and water are not simply two of the four Aristotelian elements. The first is sometimes called "spirit" and sometimes "blas," the Helmontian term for an astral exhalation. Water

is really aquatic gas, again drawing on Van Helmont. Both are activated by the *archaeus*, Van Helmont's life-giving principle, elaborated from Paracelsus. In Cantemir, this principle is "the artificer of the species, the protector and multiplier of the seeds (*seminum fautor*)" (p. 138). Humankind partakes of divinity by way of the immortal soul; and introspection is nothing other than knowledge of God. Descartes seems far away indeed from this account. Only if perverted by sense, or by misleading sentiments of hubris deriving from the extraordinary products of human ingenuity, may free will deviate from the dictates of Divine Providence. Yet to state that the divine plan is evidenced in all things is not simply a statement of strict determinism. "Fate" is as misleading a concept as are the other two pagan notions of "chance" and "fortune." If the human mind is unable to discern the necessity of an occurrence, which therefore seems like chance, this is simply because the chain of causality is hidden from view.

The discussion thus turns from the macrocosm of celestial physics to the microcosm of human behavior and ethics, such that in the end the adept (Cantemir himself) may counsel that, once you have acquired the Sacred Science, you may set forth as a good and noble soldier in the front lines of the Sacred Militia, most courageous and most vigorous. "Combat the war of God," he exhorts, in tones that contrast somewhat with the philosophical intents. "Fight a legitimate battle, bring back victory and distinguish wisely what constitutes the good and the honest according to God." The adept has not forgotten that the struggle to achieve enlightenment is more than just a metaphorical one. "Love truth, flee vice, recognize the difference between death and death, life and life" (p. 437).

Apart from the introduction and notes, the text is accompanied by an updating of the original index to Cantemir's manuscript and an index of major terms. While interesting in themselves, neither is of much help for locating names and places throughout the book. However, on the whole, the edition is competent, thorough, and an excellent accompaniment to the growing variety of texts testifying to the wide geographical reach and extraordinary variety of early modern natural knowledge.

BRENDAN DOOLEY

Stephen Gaukroger. *The Collapse of Mechanism and the Rise of Sensibility: Science and the*

Shaping of Modernity, 1680–1760. x + 505 pp., bibl., index. Oxford: Oxford University Press, 2010. \$65 (cloth).

This substantial and erudite volume is the second in Stephen Gaukroger's massive project on science and the shaping of modernity. The first of the series, *The Emergence of a Scientific Culture* (Oxford, 2006), posed the programmatic question of the distinctiveness of the scientific culture of the modern West: How did science contribute to a profound transformation of intellectual culture that resulted in the assimilation of virtually all cognitive values to scientific ones? One intriguing response to this question offered in the first volume was that in the early modern period the consolidation of a scientific culture was accomplished not by a separation of religion and natural philosophy, as is often assumed, but by the fact that natural philosophy could be accommodated to projects in natural theology. Hence, an emerging natural philosophy drew on religion for its social legitimation. That book, perhaps needless to say, offered much more besides, and it showcased Gaukroger's rare capacity to pose broad questions of considerable importance while dealing with specific issues in great scholarly detail. This present work continues in much the same vein, with painstaking and illuminating expositions of a range of historical developments, but always with a view to informing the overarching question of how scientific values came to form a model for all of our cognitive claims.

The Collapse of Mechanism and the Rise of Sensibility is organized around three key developments of the period 1680–1760. The first is to do with the attempt to establish new metaphysical foundations for areas of inquiry that ranged from natural philosophy to theology and ethics. Gaukroger's discussion focuses on Malebranche, Spinoza, and Leibniz. Refreshingly, this treatment gives due consideration to the first of these thinkers, whose contributions do not always receive the attention they deserve from historians of science. Gaukroger concludes that in the first half of the eighteenth century these impressive attempts to lend a metaphysical unity to the sciences ran into a "dead end."

The second theme concerns the tradition of "physico-theology." This enterprise, conducted primarily in England, sought a convergence between the truths of natural theology and natural philosophy. As already noted, in the first volume of the series Gaukroger plausibly suggested that the consolidation of experimental natural philosophy in the seventeenth century depended on its capacity to establish its religious credentials.

Natural philosophy succeeded in part because it could be useful in the sphere of natural theology. In the next phase of the story, however, Christianity itself is increasingly understood in light of a new, modern conception of "religion" in which the essence of various faiths is identified primarily with their cognitive content. This enabled not only an impartial comparison of religions but also a comparison of the grounds of belief of Christianity and natural philosophy. As natural philosophy became more secure in its cognitive claims, the prospects for the dissolution of the physico-theological union became considerably greater.

The third development under consideration took place largely in the Francophone world. In its simplest version, the *philosophes* appropriated natural philosophy as an exemplification of enlightened rationality and used it to promote their broader agenda. But the story Gaukroger relates here is not the familiar narrative of an Enlightenment triumph of science and reason over superstition. Rather, the assumption that there was a unified Newtonian-Lockean program that exemplified reason became increasingly difficult to sustain, not least because of the development of a French Lockeanism that, from the middle of the eighteenth century, began to emphasize the way in which our cognitive judgments are actually underpinned by sensibility, rather than reason. This was one of a number of factors in the rise of sensibility.

There are many particularly illuminating passages in the book, and I shall draw attention to just two. In the fifth chapter, Gaukroger examines competing accounts of natural philosophy and of what counted as a satisfactory explanation in that domain. Traditionally, Aristotelian natural philosophy had concerned itself with matter theory, explaining change in terms of causal principles that were associated with the essences of things. These principles could be, and to some extent were, carried over into a corpuscular matter theory, with explanation residing at the level of micro-mechanics. In these cases the explanatory model is one of reduction, with phenomena being accounted for in terms of underlying structures. What these reductive models of explanation have in common is an attempt to penetrate beneath the phenomena to something more fundamental. But we also have at this time alternative "horizontal" explanations that are mechanical or geometrical and that either pertain to the phenomena alone or have recourse to mathematical generalizations that require no reference to matter theory. (Complicating the issue further is the explanation role of causation, which, following the abandonment of

Aristotelian matter theory, tends to recede into the background. Thus, how the new notion of “force” relates to efficient causation remains problematic.) Gaukroger’s helpful setting out of these new plural modes of explanation, of which I have given a very cursory account, offers a fresh perspective on the early modern importation of the mixed mathematical sciences into natural philosophy. At the same time, it points to developing difficulties with the explanatory ambitions of mechanism and points forward to the rejection, in the eighteenth century, of the ideal of comprehensive systematic explanation in the various branches of natural philosophy.

Another highlight, coming in the final chapter of the book, is the treatment of eighteenth-century theories of history and human development. Here Gaukroger makes it clear that the changing status of natural philosophy cannot be accounted for simply in terms of what we used to refer to as “internal” developments, but requires an account of second-order discourses: that is, contemporary commentary on the significance of the new discoveries, theories, and methods of the sciences of nature. In eighteenth-century France, these tended to come in the form of developmental theories of human knowledge, with their accompanying narratives of historical progress. A key figure is d’Alembert, who shifts the focus from epistemology to history and offers a genealogy in which the natural philosophical achievements of his predecessors (primarily Bacon, Descartes, Newton, and Locke) are seen as exemplifying a new stage in the development of human knowledge. This dawning epoch signifies the new maturity of humanity and the enlightened condition of the age. Gaukroger’s approach here complements the recent work of Dan Edelstein on the genealogy of the Enlightenment. For Gaukroger, as for Edelstein, the achievement of *philosophes* such as d’Alembert was not the setting out of new rational methods of investigation but, rather, the construction of a narrative about how preceding natural philosophers were the harbingers of a new enlightened age. These approaches are contrasted with that of Hume—who, arguably, better reflects the actual commitments of the experimental natural philosophers. As Gaukroger demonstrates, Hume offers “natural histories” in place of genealogy and regards it as a dangerous error to imagine that any cognitive enterprise can be founded on a putatively autonomous rationality. Hume thus represents a challenge to the identification of science with pure rationality and insists on a balance between reason and sensibility.

There is, perhaps, more here on the collapse of mechanism than on the rise of sensibility.

While the multiple reasons for the fragmentation of mechanism are set out in compelling detail, the account of the successes of sensibility—which remains a somewhat elusive category—is not as finely drawn. But considered in light of the overall accomplishments of the book, these are minor concerns. This volume is an exemplary exercise in intellectual history, and I eagerly anticipate the next installment in the series.

PETER HARRISON

Dagmar Hülsenberg; Ingo Schwarz (Editors). *Alexander von Humboldt: Gutachten zur Steingutfertigung in Rheinsberg 1792*. 161 pp., illus. Berlin: Akademie Verlag, 2012. €49.80.

On 6 June 1792, the twenty-two-year-old Alexander von Humboldt inspected a ceramics factory in Rheinsberg, Germany, for Friedrich Anton von Heinitz of the Prussian Bureau of Mining and Metalworks. Freshly minted by the Freiberg School of Mines and already a royal assessor, Humboldt was to determine how to improve productivity at Rheinsberg. His thirty-two-page handwritten report (*Gutachten*), missing for many decades, was rediscovered and transcribed into modern German in 1980. The present study is the first thorough analysis of this piece. The editors give sixty pages of in-depth commentary before presenting a side-by-side transcription, with facsimile, of the original. A useful glossary of technical terms follows. The production will certainly interest all readers of *ISIS* working on artisanal knowledge and industrial history, particularly during the time of the so-called Industrial Revolution.

Humboldt was acutely aware of the superiority of English manufacture by comparison to Germany’s, and his report contains frequent references to practice across the Channel. In this age of Wedgwood pottery and growing interest in porcelain, Rheinsberg’s glazed products had been competing unfavorably with English stoneware designed to look like porcelain. The Germans attempted to adopt the process—which called for clay, quartz, and limestone—but the factory had hit a bottleneck in wood supply, and the quality of the stoneware was comparatively poor. In his report, Humboldt proceeded systematically through all facets of the Rheinsberg works, discussing the major ingredients of its stoneware, the mills, and the furnaces. The Germans used far less limestone than did the English, Humboldt observed, which allowed for cooler furnaces (and the use of less fuel) but also reduced the quality of the finished product. The