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★**Discipline & experience. (English summary)**

The mathematical way in the scientific revolution.
Science and its Conceptual Foundations.

University of Chicago Press, Chicago, IL, 1995. xiv+290 *pp*. $60.00; $24.00 paperbound.
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In 1660, John Wilkins characterized the task of the nascent Royal Society as the promotion of "Physico-Mathematicall-Experimentall Learning". Peter Dear quotes the phrase and states it to be the core around which his book is organized (p. 2). The book is a view on the scientific revolution of the 17th century from a particular perspective: the changing and sometimes disputed ways in which truth-claims were set forth and were supposed to establish their legitimacy within those disciplines that began their 17-century career as "subordinated sciences" or "mixed mathematics" and ended up as Newtonian natural philosophy. Pure mathematics is thus left aside, as are chemistry/alchemy and life sciences. Like life sciences and biology, interests in Hermeticism and *prisca sapientia* are just mentioned in a footnote (p. 117) as contemporary phenomena which offer a background or parallel to Bacon's and Gassendi's interest in pre-Socratic doctrines; "Platonism" as a driving force for the mathematization of nature (an all-too-familiar red herring) is as absent from the book as it is from the original sources. Ramus is only mentioned as an exponent of a general interest in method which others formulated in more relevant ways and with reference to Aristotle and Galen (17th-century Ramism, widespread in Protestant universities, is not mentioned at all). These restrictions allow the author to produce a clear argument, without entailing (thus at least the reviewer's opinion) serious losses of information or distortions of perspective, since the book deals with the explicit epistemological arguments and the way actual scientific expositions relate to these arguments, not with the possible cross-fertilization between (say) alchemical and "physico-mathematical" understandings of "experiments" and "experience" nor with the tracing of all-embracing attitudes. (Comparison with the style of anatomical descriptions from Veesalius onward might have been illuminating, however.)

The book is in constant critical dialogue with S. Shapin and S. Schaffer [S. Shapin, *Leviathan and air-pump: Hobbes, Boyle, and the experimental life*, Princeton Univ. Press, Princeton, NJ, 1985]. While recognizing the legitimacy of Shapin's and Schaffer's very local perspective, Dear argues that a development that stretches "from London to Rome, from Paris to Warsaw, and beyond" (p. 4) needs explanations that go beyond the English gentleman, informative though he may be for the particular orientation of the Boylean period of the Royal Society. On one hand, the author finds it useful to suspend "the presupposition that meaning is constructed only in local situations of immediate use" and to assume "that forms of discourse have their own, albeit limited, agency"; on the other hand, he takes as the "social and institutional basis for much of the book's argument [the] educational institutions and their curricular and pedagogical structures" and their shared characteristics (p. 5), in particular the Jesuit colleges and similar institutions where some kind

of scholastic Aristotelianism still constituted the intellectual framework—thus counteracting the "historiographical importance of England in anglophone history of science" (p. 8). Two particular points brought to light by Shapin and Schaffer—*viz* "virtual witnessing" and the use of socially respected witnesses to experiments—are also followed in the broader European context.

Key themes followed through the whole century are (1) the relation between mathematics and "physics" (in Aristotelian understanding) and in particular the position of "subordinate sciences" like astronomy and optics between the two; (2) the meaning of "experience" and "experiment". While the former theme is familiar from other discussions of Aristotelian views of the sciences from the High Middle Ages through the 17th century (though exploited here in innovative ways), the latter goes beyond conventional notions, thus highlighting contrasting epistemological styles that have made less sense in other interpretations. Reminding the reader of Aristotle's understanding of experience as a summary of uniform memories (themselves recapitulations of perceptions), the author shows that the normal understanding of both experience and experiment in the first half of the century was general, dealing with the "normal course of events" from which nature might deviate because of particular circumstances, and with a tendency to distinguish between that which was accessible to everybody ("phaenomena" according to some) and that which required professional abilities and/or special tools for its observation ("experiments" for instance in the Alhazen translations). Such "experiments" remained general, and were not meant to report single observations (which might have hit upon an accidental deviation or "monster") but that which "had been tried hundreds of times", as the oft-quoted commonplace tells. The discussion whether, and how, Galileo actually made the "experiments" of which he speaks is thus put into new light, as is the late appearance of the "problem of induction" as a philosophical problem. Such "general experiments" served perfectly as postulates or axioms when the "subordinate sciences" were organized *more geometrico*. In contrast, the "event experiment", the precise historical description of a singular observation, only becomes common later in the century, and only becomes the rule in the Philosophical Transactions and in circles in touch with Boyle and the Royal Society of his times.

Among the discussions, persons and groups dealt with, only a small selection shall be mentioned here: Jesuit mathematicians from Clavius onwards, in particular their defence of the status of their discipline against the views of their natural-philosopher colleagues; Galileo's debate with Scheiner on sunspots, and with Sarsi on comets (etc.); Cabeo, Arriaga and Riccioli (three Jesuit fathers) on the free fall; Mersenne/Descartes/Fabri on experience and its limits; the problem of nature versus art, and the relevance of experience with art for the understanding of nature (evident for Bacon, impossible for orthodox Aristotelianism according to which knowledge of nature was knowledge about nature's purposes); Pascal, Roberval and others on the Torricellian vacuum and the barometer; Barrow and Newton on mechanics, geometry and natural philosophy; Newton on light, from the 1670–72 lectures until the *Opticks*.

This work gives not the complete story of how that "Archimedean" ideal which had been expressed by Renaissance mathematicians since Regiomontanus (and still by the Jesuit mathematician and architect Aguilonius in 1613 as quoted on p. 166) saved experimental philosophy from getting stuck where Bacon and Boyle had left it, but certainly an important aspect. The style is pleasant, and the excellent bibliographic apparatus is made with unusual regard for the

convenience of the reader.

Reviewed by *Jens Høyrup*