# MATHEMATICAL PRACTITIONERS, MIXED MATHEMATICS AND NATURAL PHILOSOPHY IN EARLY MODERN EUROPE

*Mathematical Practitioners and the Transformation of Natural Knowledge in Early Modern Europe*, *Studies in History and Philosophy of Science* 45, eds. Lesley B. Cormack, Steven A. Walton, John A. Schuster (Dordrecht: Springer, 2017), ISBN: 978-3-319-49429-6 (print), 978-3-319-49430-2 (eBook), 203 pp.

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"Theory and practice" is one of those dichotomies that is so entrenched in our thinking that we cannot overcome it, although its shortcomings are often felt. Just like "content and form," "material and ideal," etc., the distinction between "theory" and "practice" is very hard to reconceptualize and it is usually left untouched, since everyone appears to have a grasp on what it means. Historians face a similar situation when they try to avoid notoriously misleading categories like "empiricism" or "rationalism," but end up using them, since they provide the comfortable orientation implied by the utmost familiarity. They seem to be almost inescapable and sometimes the new terms that are designed to replace them actually presuppose them already.

The persistence of the separation between "theory" and "practice" is to be related also to its answering to certain sets of values. The Greeks and the medievals certainly put a higher price on theory and uninvolved "contemplation"; today, the debate over the priority of "pure" versus "useful" research is still going on. What about the early modern period? Was the so-called "Scientific Revolution" triggered by the impulse given by practitioners to the study of nature? The answer of the historians was often motivated by a preliminary preference for theory or for practice in understanding science. Alexandre Koyré, for instance, saw the "Scientific Revolution" as a conceptual change or a metaphysical turn from "the closed world to the infinite universe,"[1] while practitioners were treated by him somewhat condescendingly as unimportant.[2] On the other hand, a materialist like Zilsel argued for the decisive contribution of the "superior artisans"[3] – a position that was for a long time ignored largely because of political reasons. Nowadays, the "Zilsel Thesis" is enjoying a revival – usually freed from the Marxist details – while Koyré's philosophical interpretation has become, after so many years of social history of science, rather unappealing to historians.

The present volume starts from the idea that "we can only understand […] the Scientific Revolution if we take seriously the interaction between those who know by doing (practitioners or craftsmen) and those who know by thinking (scholars or philosophers)" (pp. 1-2). As with any dichotomy, one obvious problem is where does

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practice end and theory begin; the solution is to make their borders less precise: for how else could they communicate? It is the view adopted here: "[…] theory and practice are end points on a continuum, with some practitioners interested only in the practical, others in the theoretical, and most inhabiting and moving through the murky intellectual world in between" (p. 2). One of the best areas to study the interplay between theory and practice is offered by practical mathematics, since this field begun to flourish in the Renaissance; more precisely, the focus of the book is on the role played by the mathematical practitioners in the transformation of natural knowledge during the sixteenth and seventeenth centuries. "Mathematical practitioners" is a category understood largely in Eva Taylor's terms,[4] namely as "men who earned their living by teaching, writing, constructing and selling instruments, and acting in technical capacities" (p. 3), people who instead of searching for an all-encompassing view of the natural world, preferred to speak about the utility of their knowledge. Lesley B. Cormack considers that the volume furthers the debate about mathematical practitioners by establishing the following points: (1) the variability of the identity of practical mathematicians and their practices; (2) the fact that, in spite of this variability, participants were able to recognize a family resemblance between the different types; (3) the differences in practical mathematics typically depended on the different social, cultural, political, and economic contexts in which it was practiced; (4) the need for new historiographical approaches to the study of practical mathematics (pp. 7-8). These are certainly important conclusions, though somewhat unsurprising.

Cormack's second chapter, "Handwork and Brainwork: Beyond the Zilsel Thesis" offers a revised and more sophisticated version of the "Zilsel Thesis": the developments that have to be taken into account are not just economical, but also political, cultural, and religious. In fact, it turns out that money was less important than cultural capital. Also, utility was very much a rhetoric developed by practitioners looking for court patronage, rather than a concern for real applications of their ideas. Still, Zilsel's key idea that the Scientific Revolution started with people who combined theory with practice is maintained and illustrated with figures like Edward Wright and Thomas Harriot. Things were to change however in the later seventeenth century, when natural philosophers didn't need anymore to legitimate themselves in front of patrons in terms of the utility of their knowledge, and begun to take distance from "rude mechanicals".

One word concerning the concept of a "Scientific Revolution": like any externalist, Zilsel used the concept and took it almost for granted; interestingly, Cormack is also "bound" to use it (though she takes a tour trough the criticisms that were brought to it): the whole approach needs to have this *explanandum*.

John A. Schuster's chapter, "Consuming and Appropriating Practical Mathematics and the Mixed Mathematical Fields, or Being 'Influenced' by Them: The Case of the Young Descartes" criticizes heavily the use of causal categories like "influence," "shaping" or "imprinting" when speaking about the relation between practical or mixed mathematics and natural philosophy; he proposes instead "appropriation" and "translation" of resources from one field to another. Schuster also reiterates an important important idea developed in his previous works,[5] namely that the mathematization of natural philosophy was rather a physicalization of the mixed mathematical sciences. Schuster's story is convincing, but I think that the whole argument is constructed having in mind mixed mathematics and less practical mathematics. The first three case studies about the young Descartes that he offers as support are clearly concerned with mixed mathematics (hydrostatics, optics, mechanics), while only the last one has to do with practical mathematics (lens grinding). Sometimes it seems that practical mathematics is coupled with mixed mathematics almost as an afterthought; admittedly, they stand close to one another, but the impression is that they are too easily joined together.

My suggestion is that one direction to study Descartes' relation with practical mathematics is, besides the collaboration with Ferrier, his exchange with Johannes Faulhaber, who was part of the *Rechenmeister* tradition – a German version of practical mathematics.

Cormack's next chapter, "Mathematics for Sale: Mathematical Practitioners, Instrument Makers, and Communities of Scholars in Sixteenth-Century London" shows how instrument shops, book shops and, in part, also Gresham College gathered in the late 16$^{th}$ century a community of mathematical practitioners and mathematically-minded men, prefiguring the later coffee house culture. She claims that this early mathematical exchange laid the groundwork for the sociability and culture of debate characteristic of the Royal Society. However, these men were not interested in philosophizing about nature, but in the practical outcomes of their mathematical knowledge.

Steven A. Walton's chapter, "Technologies of Pow(d)er: Military Mathematical Practitioners' Strategies and Self-Presentation," is detailed analysis of military mathematical practitioners (Thomas Harriot, William Bourne, Thomas Digges, Edmund Parker) and their use of mathematics to gain social status.

The chapter on "Machines as Mathematical Instruments" by Alex G. Keller investigates the sixteenth century fascination for machines and mechanics, earlier prefigured by Leonardo.

Sven Dupré compares in his chapter "The Making of Practical Optics: Mathematical Practitioners' Appropriation of Optical Knowledge Between Theory and Practice" the optical projects of Ettore Ausonio and William Bourne and shows that their different appropriation of the optical tradition depended on the personal and local context, having as result a different balance between theory and practice.

W. R. Laird's chapter, "Hero of Alexandria and Renaissance Mechanics," traces the reception of Hero's mechanical works in the Renaissance and shows that Hero's pneumatics contributed little to theoretical mechanics in the sixteenth century, because its principles were hard to reconcile with the general principles of the other simple machines.

The last chapter, "Duytsche Mathematique and the Building of a New Society: Pursuits of Mathematics in the Seventeenth-Century Dutch Republic" by Fokko Jan Dijksterhuis, compares the different ways in which practical mathematics was institutionalized in the Dutch provinces of Holland and Friesland, showing how societal setting and mathematical practice evolved alongside.

To conclude, this volume is a piece of fine scholarship which adds important insights to the debate about the role of mathematical practitioners in the transformation of natural philosophy in the sixteenth and seventeenth centuries. What I think is missing is a more precise determination of the relation between practical mathematics and mixed mathematics – but this does certainly not diminish the value of the book.

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**References**

[1] Koyré, A., *From the Closed World to the Infinite Universe* (Baltimore: Johns Hopkins Press, 1957).
[2] See, for instance, Koyré, A., "Galileo and Plato," *Journal of the History of Ideas* 4/4 (1943): 400-428.
[3] Zilsel, E., *The Social Origins of Modern Science*, eds. D. Raven, W. Krohn, R. S. Cohen (Dordrecht: Kluwer Academic Publishers, 2003).
[4] Taylor, E. G. R., *The Mathematical Practitioners of Tudor and Stuart England* (Cambridge: Cambridge University Press, 1954).
[5] See, for instance, Schuster, J., *Descartes-Agonistes: Physico-mathematics, Method & Corpuscular-Mechanism 1618-33* (Dordrecht: Springer, 2013).