ing techniques. Readers including Marin Mersenne and Seth Ward used practices such as topical headings and authority lists alongside others drawn from mixed mathematics. Raphael argues that readers had recourse to this variety of techniques to manage the genre-bending text, which combined Latin physicomathematics with vernacular dialogue. Booksellers, she shrewdly notes, had difficulty categorizing the work.

Raphael's theoretical novelty is to bring reading practices within the compass of philosophical eclecticism. For Raphael, "eclectic" means both "the application of reading strategies drawn from a variety of disciplinary traditions" and "the application of traditional textual methods . . . to Galileo's text" (p. 5). The latter is eclectic because it contradicts the doctrinaire quantitative experimentalism of Galileo's rhetoric and expectations generated by earlier historiography. Raphael insists on the "intellectual validity of the eclectic stance," since it "legitimates the role of the historical actors who retained ties to both novel and traditional claims" (p. 195). The passage from diverse reading practices to eclectic "stances" that can be validated is more claimed than proved: traditional reading practices do not *ipso facto* involve traditional "claims." Since there is no discussion of what it means for practices to be valid (rather than, say, effective), the relationship between practices and claims is insufficiently addressed. In her important article about Galileo's use of the dialogue genre, Raphael observed that Galileo's approach to texts "draws on established practices, albeit with slightly different emphases" ("Galileo's *Two New Sciences* as a Model of Reading Practices," *Journal of the History of Ideas*, 2016, 77:539–565).

Was Galileo also eclectic? A term so watered down as to include everybody no longer does interpretive work. Where Mario Biagioli argued that Galileo deployed the image of the book of nature to engage with and subvert traditional reading practices, the label "eclectic" discourages such readings by allowing us to stop at "bookishness." Raphael is surely correct to observe that "the openness of the dialogue genre . . . may have encouraged" eclecticism (p. 195). But how, exactly, did the calculated heterogeneity of Galileo's text not only facilitate its productive and creative use toward different ends but also help readers locate themselves in charged intellectual categories? How did reading technologies and rhetoric—two practices that Raphael strictly opposes—interact? By mobilizing her rich findings to address this question explicitly, Raphael could more effectively achieve her stated goal of advancing the theory of reader response.

Reading Galileo is a welcome contribution to the histories of reading and of the mixed mathematical sciences. Successfully presenting Galileo's readers as humanists, Raphael will encourage other historians to follow her in linking physicomathematics to current research trends. Finally, because it foregrounds primary sources and sensitively depicts important contexts, this book could serve as an excellent textbook for an innovative undergraduate course on the scientific revolution.

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Lesley B. Cormack; Steven A. Walton; John A. Schuster (Editors). *Mathematical Practitioners and the Transformation of Natural Knowledge in Early Modern Europe*. (Studies in History and Philosophy of Science, 45.) xii + 203 pp., figs., bibl. Cham, Switzerland: Springer, 2017. €95.39 (cloth).

This collection of case studies explores interactions between scholars and craftsmen, natural philosophers and mathematical practitioners. Covering primarily sixteenth- and early seventeenth-century Britain, the volume makes occasional forays into French, Italian, and Dutch contexts. Lesser known mathematical practitioners, such as the Venetian physician-mathematician Ettore Ausonio and the London instrument maker Elias Allen, appear alongside Descartes and Galileo. These mathematical hands and minds got different levels of training: some had gone to university, an engineering college, or were apprenticed by master craftsmen;

others were self-taught. The essays examine who they were, how practical mathematics played out in various sites, and how mathematical expertise was judged by contemporaries. The volume builds on E. G. R. Taylor's groundbreaking social histories of mathematical practitioners who sold their expertise and "argued for the necessity of practical knowledge of measurement, winds, surveying, artillery, fortification, and mapping, rather than for a more philosophical and all-encompassing knowledge of the natural world" (p. 3).

The volume consists of a brief introductory essay followed by eight chapters that are split into three main sections. In the first part, Lesley Cormack and John Schuster propose theoretical framings of early modern mathematical practice, respectively, around Edgar Zilsel's thesis and around the selective appropriation of values, practices, and ideas by mathematical practitioners and natural philosophers. Cormack locates the rise of mathematical entrepreneurs in the sixteenth century, when a greater stress on practicality and the utility of mathematics in nature studies combined with the development of mercantilism, growth of towns, courtly patronage, and challenges to cultural, religious, and political authority. In emphasizing economic and technological changes, Zilsel had overlooked these others, she argues. Schuster reframes the influence of mathematics on natural philosophy in terms of *appropriation* and *translation*. He shows instances where "radical" natural philosophers like Descartes, Galileo, and Harriot coopted technical resources and a language of usefulness from the practical arts in order to legitimize natural philosophy. Instrument makers, meanwhile, appropriated geometrical optics to various practical ends.

Part 2 investigates what mathematical practice looked like. Observing London in 1550–1630, Cormack identifies eighty-five different mathematics teachers, practitioners, and instrument makers and sellers and tours the lecture halls, workshops, and stores where they conversed with mathematically minded merchants, patricians, scholars, and navigators. She argues that there was a vibrant practical mathematical community, created "through shared interest and through the sociability of the exchange of ideas and expertise" across social, economic, and vocational lines (p. 85). These mathematical entrepreneurs did not transform natural philosophy, but they changed who could participate in studies of nature. Steven Walton probes gunners' notebooks and other manuscripts to understand the role of mathematics in the training and self-image of military engineers, gunners, and soldiers. Gunners did not calculate shooting ranges, he demonstrates, but they nevertheless attached their professional competence to mathematical instruments like gunner's rules or quadrants. Alex Keller shows that machine construction and mathematical instrumentation had been two distinct traditions until the Renaissance. He argues that the two formed the new philosophical field of mechanics thanks to three developments: Renaissance commentaries on ancient works on mechanics, mathematical treatises on military engineering, and novel precision instruments.

The final part spotlights the interplay between practical mathematics and natural philosophy. Sven Dupré compares theory and practice in the optical projects of two mathematical practitioners, Ettore Ausonio in Venice and William Bourne in England. Dupré argues that each appropriated different aspects of the perspectivist optical tradition, even as they worked within the same field. Practical opticians weighed theoretical and practical concerns differently and, to a degree, interpreted the optical tradition in ways that reflected their local motivations, such as patronage opportunities. W. R. Laird tracks the sixteenth-century reception and influence of three mechanical works by Hero of Alexandria: the *Pneumatica*, the *Automata*, and the *Belopoiica*. He argues that Hero's pneumatic devices were not easily assimilated into natural philosophy's new science of mechanics because they obeyed different principles than other simple machines. Fokko Jan Dijksterhuis's chapter on *Duytsche Mathematique* (instruction of mathematics in Dutch) traces how practical mathematics became more theoretical and contrasts how it was institutionalized in Holland and in Friesland. Mathematics, Dijksterhuis argues, acquired greater social importance first in state-building efforts and later in academic and aristocratic circles that cultivated the new philosophy.

Mathematical Practitioners and the Transformation of Natural Knowledge in Early Modern Europe frames the philosopher and the practitioner, knowing-by-thinking and knowing-by-doing, not as oppositional types but, rather, as "end points on a continuum" (p. 2). Some essays reconstruct the complexities between theory and practice in the work of various participants in original ways. A potent example is Dupré's comparative study in practical optics. Elsewhere, the dichotomy seems to persist in the current categories of "mathematical

practitioner" and "natural philosopher." To Cormack, Thomas Harriot was a mathematical practitioner who never became a natural philosopher, while to other contributors he was an influential natural philosopher alongside Kepler, Descartes, and Galileo who was also an expert mathematical practitioner (pp. 35, 52, 91). Differences in historical interpretation and classification such as these could have been discussed in greater depth. It is odd that the burgeoning historiography on "hybrid experts," artisan/practitioners, and artisanal philosophers does not make much of a showing. A longer introduction or concluding chapter might have elaborated on the book's central findings. While each chapter's abstract makes navigating within the book easier, there is no index. Typographical and formatting errors abound.

Overall, this slim yet wide-ranging volume offers compelling perspectives for broadening the scholar/craftsman debate. It is relevant to anyone studying the history of science in early modern Europe. As a whole, the essays capture the complexities of the theoretical, practical, and material concerns of mathematical practitioners and invite further discussion.

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Gregorio Baldin. *Hobbes e Galileo: Metodo, materia e scienza del moto.* (Biblioteca di Galileiana, 6.) xxiv + 242 pp., figs., bibl., index. Florence: Leo S. Olschki Editore, 2017. €34 (paper).

As Thomas Hobbes straightforwardly asserts in his *Critique du De mundo*, Galileo Galilei—whom Hobbes had occasion to meet in Arcetri during his third European Grand Tour—is to be considered "the greatest philosopher not only of our century, but of all centuries." Indeed, as Hobbesian scholarship has often underscored, the affinities between Galileo's and Hobbes's natural philosophies are abundant. Yet Gregorio Baldin's book is the first attempt at providing a general and comprehensive evaluation of the historical and theoretical connections between the two thinkers. As Baldin thoroughly demonstrates, Galileo's works were widely known, debated, and often translated, both inside the Newcastle circle that Hobbes attended during the 1630s and among Marin Mersenne's acquaintances and correspondents. According to Baldin, Galileo's influence contributed crucially to shaping the basic principles of Hobbes's mechanistic philosophy. Hobbes's nominalist and conventionalist theory of science, as well as his hypothetical approach to physics, indisputably distinguishes him from Galileo (pp. 107, 126). Nonetheless, the very core of Hobbes's natural philosophy is Galilean: that is, the distinction between—in the later formulation of Robert Boyle—primary and secondary qualities; and the idea that the *objective* properties of things are mathematically quantifiable relationships between moving bodies. This is a thesis that Baldin defends deftly and convincingly.

Mersenne's role in the diffusion of Galileo's doctrines was pivotal (p. xxii ff.). In the first chapter ("Hobbes and Mersenne"), Baldin argues that Hobbes's encounter with Galileo's mathematizing method was conditioned by a wide-ranging confrontation with Mersenne's theory of science. According to Mersenne's *La verité des sciences* and the later *Harmonie universelle*, knowledge supplied by mathematics and geometry is certain insofar as it is constructive, purely deductive, and conventional (p. 9). Physics, relying on experience, is but hypothetical knowledge (p. 16). Hobbes, at least since the *Tractatus opticus II*, follows an analogous distinction; this eventually (in *De corpore*) leads him to a kind of phenomenalism that is very close to Mersenne's skeptical constructivism (p. 30). Yet this is not the whole story, because a Galilean and mathematizing conception of optics allows Hobbes to bridge the gap between physics and geometry (pp. 33 ff., 43 ff.)—that is, between the subjective phantasms of sensation grounding our hypothetical explanations and the objective mathematical properties of bodies in motion. In the second chapter ("Hobbes: Principles of Galilean Philos-