from the sixteenth century. It is only with a book simultaneously this sweeping and this steeped in compelling details that the true magnitude of both the attempt and the accomplishment can be made evident. Navigation was indeed revolutionized.

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The Astronomical Clock of Strasbourg Cathedral: Function and Significance. Günther Oestmann.
Scientific Instruments and Collections 8. Leiden: Brill, 2020. xvi + 328 pp. €149.

At first glance, perhaps, *The Astronomical Clock of Strasbourg Cathedral*, a three-hundred-page academic book about a large clock, might seem appealing only to a limited readership—namely, historians of early modern technology and horology enthusiasts. But this book deserves a wider readership, for a number of reasons. First of all, monumental astronomical clocks, as clocks like the one at Strasbourg Cathedral were called, proliferated throughout northwestern Eurasia from the fourteenth to the sixteenth centuries. Cities large and small, including Prague, Venice, Wells, and Strasbourg, spent enormous sums to build massive clocks with multiple trains of automata, carillons, and astronomical complications—to forecast tides or eclipses, or to depict the zodiac—and installed them in prominent places, such as in cathedrals or adjacent to public squares. Such a widespread and significant use of resources to build and install complex machines in public places demands its own sustained inquiry, and this volume represents one of the first such examples since the first half of the twentieth century.

Furthermore, the clock at the cathedral of Notre-Dame in Strasbourg is one of the most historically important of these machines, in part due to its mechanical complexity and in part due to the interest in the clock from natural philosophers in the seventeenth century like Robert Boyle and René Descartes, who saw in the clock analogues to the universal order and the existence of animals. The Strasbourg clock was first built in the middle of the fourteenth century and was then rebuilt in the second half of the sixteenth century, so it is a useful case study of the first and second waves of mechanical clock design and construction. Finally, astronomical clocks, such as the one in Strasbourg, told time in a multiplicity of timelines, and for different registers. Through bells, dials, and moving statues, the clock displayed hourly, daily, weekly, and monthly time. Those least educated or farthest away could rely on the bells to tell time, while those closer or more learned could read the dials to determine the altitude or position of a celestial body or the best time for bloodletting. Automata with religious overtones reminded viewers of the sacred Christian timeline of incarnation, Passion, and, ultimately, salvation, while astronomical complications like the astrolabe oriented the viewer in space, as well. The rooster, first installed in the fourteenth-century version,

crowed and flapped its wings every hour and was deemed such an important symbol of the clock itself that it was refurbished and included in the renovated sixteenth-century clock.

Oestmann's study, which is published in Brill's series on scientific instruments and collections, takes as its main focus the sixteenth-century iteration of the clock, although it begins with the first instantiation, built between 1352 and 1354. After a brief discussion of the automata of that fourteenth-century mechanical clock, the author moves into the initial attempts in the first decades of the sixteenth century to renovate the clock, which was finally carried out under the leadership of mathematics professor Conrad Dasypodius between 1571 and 1574. Then Oestmann moves on to a consideration of the artistic embellishments on the clock (which have received attention from art historians interested in the work of painter Tobias Stimmer) and the technical elements, before exploring the relationship between Dasypodius's design and his interest in ancient architecture (Vitruvian) and engineering (Alexandrine). Finally, the volume contains a number of useful appendixes, including several excerpts of Dasypodius's writing; a description of the design of an astronomical clock (now lost), designed by Isaac Habrecht (responsible for the technical execution of the Strasbourg clock designed by Dasypodius) in 1583; and dozens of illustrations, diagrams, and images. Because Dasypodius's writings about the clock survive (alongside his commentary on Ptolemy and his text on the importance of mathematics), as do contemporary accounts from the university and town leadership, as well as from artisanal archives, Oestmann has a rich body of sources to contextualize this important artifact and reveal its meanings to the people who devised, built, and installed it. The result is a volume that should find readers among scholars interested in the history of science and technology, early modern studies, the Reformation, urban studies, and the relationship between engineering, art, and design.

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Thrifty Science: Making the Most of Materials in the History of Experiment.
Simon Werrett.
Chicago: University of Chicago Press, 2019. x + 304 pp. $45.

As a member of the last generation of Brownie Girl Guides to earn a Thrift badge (discontinued in 2003), I was raised to associate thrift with a particularly gendered form of postwar make do and mend homemaking. To gain the small triangular Thrift badge, embroidered with a piggy bank, for my Brownie uniform, I had to darn a sock, make something out of secondhand material, and have my mother confirm that I kept my uniform clean and tidy. Simon Werrett's monograph *Thrifty Science* makes clear that the skills of keeping one's belongings neat and in good repair, and making something