Michael Hoskin. *The History of Astronomy: A Very Short Introduction.* x + 123 pp., figs., apps., index. Oxford: Oxford University Press, 2003. $9.95 (paper).

Michael Hoskin remarks in *The History of Astronomy: A Very Short Introduction* that Johannes Kepler "is no fit subject for any sort of Introduction, let alone a Very Short one" (p. 54). Nonetheless, Hoskin has succeeded here in the still more difficult task of distilling several millennia of the history of Western astronomy into a pocket-sized book of no more than 125 pages. Drawing on two related volumes that he edited for Cambridge University Press (*The Cambridge Illustrated History of Astronomy* [1997] and *The Cambridge Concise History of Astronomy* [1999]), Hoskin offers a highly readable account of some of the major conceptual developments of Western astronomy.

The book begins with a fascinating but all-too-short chapter on prehistoric astronomy, raising important questions about what we can learn from cultures that did not use traditional texts. Chapter 2 provides an efficient study of astronomy in ancient Mesopotamia, Egypt, and Greece that is conventional in its attention to the intersection of cosmological concerns with the mathematical techniques designed to "save the appearances" of celestial phenomena. Chapter 3 treats astronomy in the Middle Ages with an overt awareness of broader social motivations, describing the theories and practices of medieval Islamic astronomy and the merger of these with the surviving traditions of the Latin West. Two further chapters deal primarily with the achievements of the canonical figures Tycho Brahe, Galileo, Kepler, and Newton, describing the challenges of crafting and recrafting a new physics in light of the new astronomies of the sixteenth and seventeenth centuries. The sixth and final chapter, on stellar astronomy in the eighteenth and nineteenth centuries, is excellent in weaving together the related concerns with stellar brightnesses, motions, and distances and the broader goal of understanding the structure of the stellar system. The narrative ends circa 1850, but a brief epilogue outlines the astrophysics that would exemplify much of the twentieth century.

There are minor instances when the story looks forward in ways that seem ahistorical, notably a digression on Kepler's laws in the midst of a discussion of Ptolemy's equant (pp. 1–20). However, Hoskin also provides careful analysis of issues ranging from the rationality of astrology, to a historiographical critique of the so-called Olber's Paradox, to the just but subtle placement of Nicolaus Copernicus as the culmination of the ancient astronomical tradition. A reader for whom this book is his or her initiation into the scholarship should come away with a nuanced understanding of many familiar stories and perhaps be persuaded to rethink some common assumptions.

Although there is no shortage of introductions to the history of astronomy, none are as accessible in terms of price, length, and readability as this one. For the casual book buyer Hoskin's work is superb. The history of science teacher, though, might wish for a slightly more expansive bibliography in order to provide students with more pathways into the wider literature. The fact that the volume excludes details of the conceptual developments of the last 150 years also restricts its use as a comprehensive introductory text. Neither these points nor the inherent difficulty of striking an appropriate balance in a work of this kind (why not more on non-Western astronomy, for instance, or on astronomy and social values?) should obscure the character of Hoskin's achievement. This book ought to be admired and utilized as a succinct and lucid introduction to the history of astronomy by one of its leading scholars.

PETER J. SUSALLA

Max Jammer. *Concepts of Simultaneity: From Antiquity to Einstein and Beyond.* ix + 308 pp., illus., figs., index. Baltimore: Johns Hopkins University Press, 2006. $49.95 (paper).

As you read this sentence, the moon is circling the earth at a particular location. Einstein taught us, however, that for someone moving with respect to you, your reading that sentence was simultaneous with the moon being located at some quite distinct position. Simultaneity is relative to inertial frame. But is it also conventional? That is, is there a fact of the matter, even given an inertial frame, whether two distant events are simultaneous? Famously, Einstein thought not; and his thinking so was crucial to his discovery of special relativity.

Recall that in 1905 Einstein postulated that the speed of light propagates at the same speed in all directions. This stipulation suggests and is suggested by a natural synchronization procedure. Let Alice be an inertial observer (say, in a spacecraft) and Bob be a distinct observer at rest with respect to Alice. Bob conveniently happens to be holding a mirror oriented toward Alice, and Alice reflects light off Bob's mirror, directing it back to herself. The synchronization procedure holds that an event on Alice's worldline is synchronous with one on Bob's just in case

$$t_2 = \frac{t_1 + t_3}{2},$$

where t_1 is the time Alice reckons she sent the light signal, t_2 the time on Bob's worldline of the reflection, and t_3 the time Alice receives the return signal. By assuming that all observers also use this method of synchronization, Einstein derived the Lorentz transformations, the heart of relativity. Could Einstein have used a different synchronization procedure—one making the speed of light variable while keeping the average round-trip speed constant—and still arrived at a consistent theory? This question exercised Einstein, Reichenbach, and scores of philosophers of science and physicists in the twentieth century. *Concepts of Simultaneity* is a history of our grappling with the important concept of simultaneity, from antiquity to now, but the centerpiece is a detailed history of the conventionality thesis. Think of this book as the prequel and sequel to the celebrated synchronization procedures of Poincaré and Einstein.

Written by the eminent historian and philosopher of physics Max Jammer, the book consists of fifteen chapters. After terminological preliminaries in the first chapter, the next five chapters trace the notion of simultaneity from antiquity through classical physics. The next three introduce relativity, its impact, and the conventionality thesis. The remaining six chapters focus on this thesis: its promulgation, its clarification, and scores of arguments (old and recent, for and against). Here the reader encounters the debates among Adolf Grünbaum, Brian Ellis, Wesley Salmon, Allen Janis, John Winnie, David Malament, and others involving clock transport synchrony and more recent geometric arguments. This episode in the intellectual history of relativity is a worthwhile one to document, and Jammer's discussion of this material is well informed and authoritative. Moreover, it is fascinating to see the twists and turns the debate has taken through the twentieth century.

For myself, I particularly enjoyed the early history of simultaneity. Virtually everyone is discussed (Aristotle, Avicenna, Aquinas, Barrow, Leibniz, Newton, Kant, . . .), and experts will find much to quibble about in these short treatments. However, the novelty of organizing these thinkers around the topic of simultaneity more than compensates for the quibbles. In one chapter we meet Sextus Empiricus's critique of astrology based on the Chaldean method of determining distant simultaneity (sound transmission via gong). Later we discover that Alexander of Aphrodisias was perhaps the first to define a worldwide standard time by defining time via the motion of the outmost fastest celestial sphere. Jammer then highlights Ole Roemer's discovery of the finite speed of light and what that meant for the "visual simultaneity thesis"—namely, the claim that all events one sees together are simultaneous. Anyone interested in time in science will take pleasure in this material.

Because many readers will be familiar with the author and his distinctive style, perhaps the most useful description I can give of this book is that it's very much like his others. I consider this high praise. Jammer's books on force, space, quantum mechanics, and mass occupy a central place in the history and philosophy of science. The present book has the same strengths and weaknesses as the others. The weakness is that the depth of analysis is occasionally uneven. The author will sometimes build up material in exhaustive detail and at other times abruptly drop a topic without resolution. The strength is—as always—Jammer's almost unimaginable erudition. The author is as much at ease writing of the concept "now" and cognates in Egyptian, ancient Hebrew, ancient Greek, medieval Latin, and contemporary German as navigating through hairy tensor algebra in general relativity. As a result, even an expert in the field will come away having learned something new.

Although I highly recommend the book, I did find one critical omission troubling. When treating the prerelativistic period, Jammer often measures developments against Einstein's later operationalism of simultaneity via synchronization—for example, "That a rigorous definition of simultaneity cannot be obtained without specification of a physical operational procedure was never recognized in antiquity" (p. 41). Even if we don't mind history spun this way, should we regard the synchronization procedure as the gold standard in the history of simultaneity? I think the answer is no. Granted, an operationalist procedure was important for the development of Einstein's ideas. But one doesn't require the synchronization postulate to derive or understand relativity. And after Quine's famous critique of the analytic/synthetic distinction (not mentioned), it's not clear that the idea of some parts of a theory being conventional and other parts being empirical makes much sense. Hence the question of rival synchronization procedures takes on less importance. If any question remains, it is whether Einstein's choice was reasonable; but as we learn from the anticonventionalists, clearly Einstein's choice was the simplest and most natural one given the rest of his theory. A critical appraisal of this entire intellectual episode would have been welcome.

CRAIG CALLENDER

Mark Monmonier. *Rhumb Lines and Map Wars: A Social History of the Mercator Projection.* xiv + 242 pp., illus., bibl., index. Chicago: University of Chicago Press, 2004. $25 (cloth).

In 1566 Gerard Mercator published his famous world map "ad usum navigantium," which showed lines of constant compass direction (rhumb lines or loxodromes) as straight lines. The map according to Mercator's projection has become a standard representation of the world. Quite undeservedly so. For navigators intent on plotting a course, the map is indeed extremely useful. For other purposes, however, it has severe defects. In particular, Mercator's world map exaggerates the size of countries situated far to the north or south compared to those in the tropics. For this reason, it has been attacked in recent decades for having an imperialist bias, downsizing the importance of the third world.

There is a story to be told here, and Mark Monmonier is certainly the person to tell it. He does so with gusto. The book can be divided in three parts. In the first, Monmonier describes early sea charts, Mercator's innovation, and the mathematical elaboration of his work by Edward Wright and Johann Heinrich Lambert. Despite the book's title, there is not much "social history" here. The cartographic problems are explained in a clear way, but it is evident that Monmonier is not really at home in sixteenth-century history. These chapters rely almost exclusively on secondary sources, ignoring most work in languages other than English.

The second part shows how, in the nineteenth century and later, Mercator's map became popular as an all-purpose map. This part contains much useful information. Interestingly, among the most fervent propagandists for Mercator's projection was the military. Loxodromes are useful not just for navigation, but also for calculating the trajectories of long-range artillery. It was the French who first realized the use of Mercator's projection for aiming cannons. The main part of Monmonier's story, however, deals with the United States. He writes about the adoption and use of the Mercator projection by such bodies as the U.S. Geological Survey, the U.S. Army Map Service, and the U.S. Coast and Geodetic Survey. It is clear that this is an area wherein the author is very much at home. But one would like to know how the developments in the United States tally with the general story. Mercator's map, after all, is a world map, and its adoption was not limited to America.

The final part of *Rhumb Lines and Map Wars* deals with the attacks on Mercator's projection in recent years, especially by propagandists for the so-called Peters projection. Monmonier clearly has an ax to grind here. As he shows in detail, Mercator's critics are generally driven by ideological motives rather than by any real knowledge of the characteristics of map projections. Many alternatives to Mercator's projection have been proposed over time, and the one propagated by Arno Peters is among the worst. One of the book's aims appears to be to dispel misunderstanding and prejudice about the Peters projection. As such, it explains the "correct" principles of cartography and map projection, rather than presenting an impartial description of the social factors that promote this or that picture of the world.

Although the book does offer new information, it cannot be deemed thoroughly researched, nor does it present a balanced historical view of the subject. However, Monmonier's personal involvement with the subject makes the volume excellent reading. *Rhumb Lines and Map Wars* will be relished by a general audience; and although it is not a real social history, it certainly shows the social relevance of history of science.

RIENK VERMIJ

Marco Piccolino. *Lo zufolo e la cicala: Divagazioni galileiane tra la scienza e la sua storia.* (Saggi Scienze.) 359 pp., figs., bibl., index. Turin: Bollati Boringhieri, 2005. €26 (paper).

Marco Piccolino's book includes an introductory section, seven chapters, a concluding section, a bibliography, and an index of names. The book treats a bundle of loosely connected topics, ranging from Galileo Galilei (1564–1642) and seventeenth-century astronomy to contemporary biochemistry and physiology. The first chapter focuses on Galileo. The second is mostly about Galileo and Lazzaro Spallanzani (1729–1799), in particular the biological and geological researches of the latter. The third concerns John Walsh (1726–1795) and his experiments on the torpedo, or electric ray, conducted in 1772 at La Rochelle and l'Ile de Ré, in France. The fourth is devoted to Marcello Malpighi (1628–1694),