The Astrolabe by James E. Morrison

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The astrolabe is probably the archetypal astronomical instrument of the pre-telescopic age.[1] It combines a simple observational tool for measuring angles (typically, a star's elevation above the horizon) with both fixed and moveable planispheric projections of the heavens. Combining these features in a hand-held device proved to be a remarkably felicitous idea. The astrolabe allowed one to tell time, day or night; to determine the altitude and azimuth, as seen from a specified place at a specified time, of a star or an ecliptic location; and in general to convert freely between equatorial (celestial) and altazimuth (local) coordinate systems. When used with planetary tables, the astrolabe provided the simplest way to draw up an astrological chart. In Europe, the astrolabe dropped out of favor in the 17th century due to its limited precision; but in the Islamic world, ingenious enhancements for determining the circumstances of daily prayer extended the astrolabe's useful life through the 19th century.

Real astrolabes are intricate, valuable, and often beautiful instruments, usually made of brass. Some remain in private hands, but most by now have been snapped up for museum collections. Replica astrolabes are used in university courses to teach the history of astronomical practice. And forged astrolabes are still commonly offered to tourists in the bazaars of North Africa and the Middle East.

This large new book is about the astrolabe as an instrument. Most fanciers of astrolabes will have no use for it at all, I am afraid.

[1] I should disclose at the start that the dozen or so photographs of actual astrolabes decorating this book were provided (free of charge) by Chicago's Adler Planetarium, my employer. Morrison's use of these images has not influenced my evaluation of his book.

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It is above all a book for people interested in the theory and practice of the device.

My first observation is that if you want to design or actually to make an astrolabe or one of the many related instruments, you would be extremely foolish to proceed without having this book in front of you. Jim Morrison has made many astrolabes, of many types, and in so doing has worked out technical issues that simply do not arise in more superficial study. In this book he makes what he has learned available to all of us. He shows how to calculate the scales that appear on an astrolabe, and how to use them, taking care to point out subtle distinctions that one would likely not think of until it was time actually to produce an instrument. Two appendices supply the stellar positions and solar coordinates that the ideal readers of this book will use in laying out their astrolabes.

Second, if you want to know how to use an astrolabe or even really to understand how astrolabists in the past used it, Morrison's book provides perhaps the most thorough discussion (which is not to say the easiest) available anywhere today. His longstanding obsession —that is not too strong a word—with the astrolabe has caused him to think about the significance of all the little details that other, less dedicated students have usually decided to put off for another day. He makes explicit, in equations and diagrams, the mathematics underlying almost every scale that has ever appeared on an astrolabe.

Morrison's broad scope adds greatly to the book's appeal. The mariner's astrolabe, a weighted sighting device, is omitted; but variant astrolabes of any mathematical interest receive concise and fully detailed analysis. These include, beyond the standard planispheric astrolabe, ingenious so-called universal astrolabes useable at any latitude, such as the Saphea Arzachelis, the Mathematical Jewel of John Blagrave, the Rojas and the de la Hire astrolabes, and the astrolabe quadrants associated with the names of Prophatius, Gunter, and Sutton. It is safe to say that if a handheld instrument involves a projection of the sky, Morrison has noticed it, figured out exactly how it works, and provided a careful explanation in this book.

If your only interest is in physical astrolabes, astrolabes as objects, you should go elsewhere. This is not a book about actual astrolabes, but a book about the astrolabe as an idealized scientific instrument. Works that describe and picture individual instruments—

collection or auction catalogues and the like—offer the specific details (and the visual pleasure) that Morrison foregoes. R. Gunther more or less established this genre in *Astrolabes of the World* [1932]. Notable examples include the catalogue by S. Gibbs and G. Saliba of astrolabes at the National Museum of American History [1984]; A. Turner's catalogue of astrolabes in the former Time Museum collection [1985]; K. van Cleempoel's *catalogue raisonée* of instruments from the Flemish Louvain school [2002], as well as his catalogue with F. Charette and others of astrolabes in the National Maritime Museum collection at Greenwich [2005]; and the catalogues by R. and M. Webster [1998] and D. Pingree [2009] of Western and Eastern astrolabes in the Adler Planetarium collection.

Complementing these descriptive works is a generous shelf of technical literature that delves more or less deeply into astrolabe mathematics, while remaining primarily devoted to the analysis of actual instruments. This book does not fit at all on that shelf. Its photos of instruments are purely decorative; its explanations are abstract and mathematical. It is not that Morrison ignores specific details and the quirks of real instruments; far from it. But historical nuance is not of primary importance to him. His historical assertions are well-informed and for the most part correct, so far as they go, but tend to be blunt and oversimplified. That is because they are not the point of his book.

Morrison writes for people interested in the construction and function of ideal astrolabes. Some of the questions he addresses seem strangely irrelevant to this historian: for example, how precise could a measurement of solar time be, using an astrolabe laid out and fabricated as accurately as 21st-century technology allows? To me, the question simply does not arise. To Morrison it is of very great interest.

The author's scholarly research extends to sources available in English or French, but not in Latin or Arabic. Since most of the sources that he requires are available in English translation, this limitation is less problematic than it would be in a historical monograph or a descriptive catalogue of actual instruments

Despite its ahistorical approach, the book has very considerable merit for a historian. Morrison's broad and precise coverage of astrolabe variants condenses a great amount of analysis that historians

will not need to repeat—indeed, analysis that few historians are capable of repeating. Trigonometric expressions for astrolabe scale values capture the ideal mathematics of an astrolabe. Numerous example calculations ensure that readers who care how an astrolabe was used can feel confident that they really understand the procedures captured in Morrison's mathematics.

If you merely want to understand the astrolabe in general terms, this book is much more than you need. If you basically understand the theory and use of the astrolabe, but have not worked through all the esoteric details—and fear that some of them might ensnare you if you ever were to need them—you will cherish the book. It is paperbound to save cost, but a generous margin will allow heavy-duty readers (of whom I foresee quite a few) to punch the pages for a three-ring binder.

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