Stöffler's Elucidatio: The Construction and Use of the Astrolabe
Edited and Translated by Alessandro Gunella and John Lamprey

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Reviewed by
James E. Morrison
Janus, Rehoboth Beach, DE
janus.astrolabe@verizon.net

How does one review a classic? Johannes Stöffler's treatise on the astrolabe, *Elucidatio fabricae ususque astrolabii* (*Explanation of the Construction and Use of the Astrolabe*), while not the most innovative treatise ever written, was certainly the most influential in the Renaissance. It was reprinted 16 times after its original publication in 1513, and virtually every treatise on the astrolabe since has referenced it. In fact, it was common to refer to the normal planispheric astrolabe as a 'Stöffler astrolabe' in Renaissance literature.

Johannes Stöffler (1452–1531) was the first to hold the chair in mathematics at the University of Tübingen (1507).[1] In addition to his treatise on the astrolabe, Stöffler also published books of astronomical tables and wrote on sundials and astrological instruments. He operated an atelier producing instruments and globes. The first edition of his treatise on the astrolabe was published in Oppenheim in 1513, with later editions from Mainz, Frankfurt (in German), Paris (10 editions), and Cologne. The edition translated here is from 1553 and was published in Paris by Guillaume Cavellat.

Clearly, this success stems from the fact that the treatise is clear, concise, and complete for its time; and that it requires only a modest background to understand. It contains detailed instructions on how to lay out the components of a planispheric astrolabe and how to use this astrolabe for common problems. Then or now, any interested person with moderate drawing skills could make a perfectly useable

⋆ This book is available only from John Lamprey at lamprey@frii.com.Please include the word 'book' or 'Elucidatio' in the subject line of any inquiries.

[1] Johannes Kepler attended Tübingen in the next century.

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astrolabe with nothing more than this book, drawing tools, and a few sources giving current star positions, a modern calendar, and latitudes for places of interest.

The history of treatises on the astrolabe is rich. The first known treatise devoted strictly to the astrolabe was by Theon of Alexandria (Hypatia's father) in about 375. The treatise itself has been lost except for the table of contents which is included in a later work. The first treatise describing actual instruments is by John Philoponus of Alexandria (Johannes Grammaticus) in the sixth century (*ca* 530).

The earliest treatises concentrated on how to draw the astrolabe plate and how to use it to solve common problems. Islamic astronomers added a solid theoretical foundation. Al-Farghānī was the first to establish the mathematical theory of the astrolabe. In the mid-ninth century, al-Khwārizmī applied analytic methods to the astrolabe's design. However, most medieval Islamic astrolabes were designed using tables prepared for that purpose rather than from first principles.

Later, such notable Persian scholars as al-Bīrūnī (973–*ca* 1048 [363–440 AH]) and Nasīr al-Dīn al-Tūsī (1201–1274 [598–673 AH]) wrote detailed treatises on the astrolabe. In 986–987 [376 AH], 'Abd al-Rahmān ibn 'Umar al-Sūfī wrote an amazing treatise of 386 chapters presenting 1,000 uses for the astrolabe.

The astrolabe followed the expansion of Islam into Moslem Spain (al-Andalus, Andalusia). Knowledgeable treatises from Spain date from around 1025, but clearly the astrolabe was known earlier in Western Islam. A treatise on the use of the astrolabe by ibn al-Saffār (1026 [417 AH])[2] became very influential in Europe in a Latin translation made by John of Seville during the middle of the 12th century. This translation, which incorporated both an account of the astrolabe's construction and instructions for its use, was re-edited, copied, and expanded many times, eventually becoming the most widely used text on the astrolabe. All the early treatises on the astrolabe were based in some way on earlier Western Islamic treatises and contributed to the adoption of Arabic names for stars and other astronomical elements.

[2] This treatise is often falsely attributed to Māshā'allāh or, occasionally, to Maslama ibn Ahmad al-Majrītī, al-Saffār's teacher.

Transmission to Christian Europe of Islamic scientific knowledge in general and of the principles of the astrolabe in particular was aided by Christian monasteries on the border with Andalusia. Notable was Santa Maria de Ripoll, a Benedictine monastery near the Pyrenees whose monks translated many Arabic documents for their own use in the 10th and 11th centuries. One manuscript includes at least 11 sections concerning astrolabes. The rapid movement of this knowledge is demonstrated by the fact that Hermann Contractus (Hermannus, Hermann the Lame) (1012–1054), a student at the Reichenau monastery school in Germany, wrote a treatise on the astrolabe based on a Latin translation of the Ripoll manuscripts by Llobet of Barcelona.

The earliest Latin astrolabe treatises were based on Arabic translation; they were not very well organized and often contained meaningful errors (such as incorrect instructions on how to divide the ecliptic). Adelard of Bath (*ca* 1080–*ca* 1160), who traveled extensively in the Middle East, where he learned Arabic and the basics of Islamic science and astronomy, dedicated a treatise on the astrolabe to Henry Plantagenet (Henry II) in 1147. Newer and better treatises evolved in the 13th century as more experience was gained. The most widely used treatise was compiled from several texts, mainly the translation of ibn al-Saffār mentioned above. This translation became the standard text for the astrolabe's construction and use, and is referenced often by Stöffler. One notable, entirely European contribution was the *De plana spera* in the early 13th century by Jordanus de Nemore, which presented the theoretical foundation for the stereographic projection.

The first European treatise in the vernacular on the use of the astrolabe was written in French by Pèlerin de Prusse in 1362 at the request of the Dauphin Charles, later Charles V (reigned 1363–1380). In about 1390, no less of a literary figure than Geoffrey Chaucer wrote a treatise on the astrolabe in vernacular English for his 10-year-old son, Lewis, which a later scribe with a sense of humor apparently subtitled *Bread and Milk for Children.* This work, which is hard going for an informed adult much less a child, demonstrates a high level of astronomical knowledge and, as a vernacular work, received fairly wide circulation.

Meanwhile, back in the Islamic world, treatises on astronomical instruments continued to develop and, perhaps, reached their peak in

the 13th century. Texts and tables covered the entire range of practical Islamic astronomy and led to a rich literature in instrumentation that included astrolabes, sundials, and quadrants. For example, a 14th century Mamluk treatise by Najm al-Dīn al-Misrī includes detailed illustrated descriptions of over 100 variants of the astrolabe, sundial, and quadrant.

Given this long history of treatises on the astrolabe, what sets Stöffler's apart? The answer seems simple: Stöffler's treatise was a printed book, whereas the older treatises existed only as handwritten copies. As a printed book, it could enjoy wide distribution at a reasonable price. That is not to say it is not a very good book, because it is; but it did hit the market at exactly the right time with exactly the right information as the popularity of the astrolabe was nearing its peak in Europe. The practice of astrology was almost universal in 16th century Europe and the astrolabe was a convenient astrological tool for constructing horoscopes. The popularity of the astrolabe was directly related to the cultural importance of astrology. For example, the conjunction of the Moon and all the planets in Pisces in February 1524 was considered an omen of terrible catastrophes and prompted tracts by no fewer than 56 different authors, including Stöffler.

The treatise has two parts: 'Construction' and 'Use'. The part concerning construction contains very clear, illustrated instructions on how to lay-out the front and back of a standard planispheric astrolabe. The instructions can be used today if the reference tables are supplemented with modern values.

The part on usage begins with instructions for such basic uses of the astrolabe as finding the time from the altitude of the Sun or a star and describes several methods of timekeeping. It also provides some instruction on astrological topics such as house systems, planetary influences, ascensions, and revolutions. This part finishes with some very interesting material on using the astrolabe to solve surveying problems, which I particularly enjoyed.

There are two ways to contextualize Stöffler's treatise. It can be understood in relation to other old treatises with English translations and in relation to modern treatises. It seems reasonable to restrict the present discussion to European treatises, since including Islamic treatises, which were more complete and sophisticated, would enlarge the subject to unmanageable proportions.

There are two other old European treatises on the astrolabe available in English.[3] Both were originally written in the vernacular and have recently been made widely available in modern English. The first is the *Practique de l'astrolabe* (1362) written by Pèlerin de Prusse in French: this treatise has been published in translation by Laird and Fisher [1995]. The other is Geoffrey Chaucer's treatise which has been published, transliterated and documented in a number of books. The most widely quoted commentaries are Skeat 1872 and North 1988. There are many, possibly hundreds, of commentaries on Chaucer's treatise. Several transliterations into modern idiomatic English are available on the web.

These two earlier treatises only describe the astrolabe and its uses in brief. Stöffler's treatise supplants both with its detailed description of how to lay out an astrolabe and and its detailed figures illustrating both the instrument and its uses. All three provide insight into astrological thinking of their eras.

Gunella and Lamprey's translation can also be understood by comparing Stöffler's treatise to modern works of the same genre.[4] The modern treatises on the astrolabe written during the last half-century in order of date of publication are:

- Michel, Henri. *Traite de l'astrolabe.* Paris: Librarie Alain Brieux, 1976.[5]
- Saunders, Harold N. *All the Astrolabes* Oxford: Senecio, 1984.
- D'Hollander, Raymond. *L'Astrolabe. Histoire, thèorie et pratique.* Paris: Institut océanographique, 1999.
- Tardy, Jean-Noël. *Astrolabes. Cartes du ceil.* Aix-en-Provence: Édisud, 1999.
- Morrison, James E. *The Astrolabe.* Rehoboth Beach, DE: Janus, 2007.

[3] There is also Georg Hartmann's treatise which was written in 1527; but this was never published until the translation by Lamprey [2002]. This treatise shows a high level of technical sophistication.

[4] I should advise the reader that I have known John Lamprey for many years, that I did some proofreading of his manuscript, and that I will be comparing Stöffler's treatise to my own [2007] *inter alia.*

[5] A PDF file of an English translation by James E. Morrison may be obtained by contacting him at janus.astrolabe@verizon.net.

I am using the term 'treatise' in a very narrow sense in this regard. There are many other books that contain basic information about the astrolabe's design and use and many have lovely pictures of old instruments. However, for present purposes, I will restrict this discussion to complete books devoted to the technical aspects of the design and use of the astrolabe.

A brief perusal of any of these texts immediately shows the difference in how the design of these instruments is described today *versus* how Stöffler approached the same subject.

- All the modern treatises devoted to the astrolabe rely on mathematical constructions based on relatively simple trigonometry and analytic geometry to describe the arcs and circles on the astrolabe plate. Stöffler's treatment is purely geometric, with no supporting theory presented. D'Hollander [1999] and Morrison [2007] both have detailed derivations of the underlying mathematics. Saunders [1984] and, to some extent, Tardy [1999] contain some of the mathematical background, but both are so poorly organized that it is difficult to dig it out. Michel [1976] contains the basic math, but lacks detail in its application.
- Stöffler has very detailed instructions on how to draw the astrolabe's components with only a straight-edge, compass, and protractor. This approach has undeniable appeal to those whose talents are more artistic than technical. Only Morrison [2007] presents both geometric and analytical methods.
- D'Hollander [1999] and Morrison [2007] include extensive historical background. Michel [1976] has a very brief historical overview; Tardy [1999] and Saunders [1984] have very little. Stöffler has none, unless you consider the book itself to be living history.
- All the modern treatises on the astrolabe cover universal astrolabes and other instruments related to the astrolabe, while Stöffler's is concerned only with the planispheric astrolabe. This is not a criticism: universal astrolabes were not well known in Europe until after Stöffler's treatise was published, although they were known to specialists and academics.
- Finally, D'Hollander [1999] and Tardy [1999] are available only in French. The English translation of Michel [see 157n5, above] has limited availability to date. Saunders 1984 has been out of print for many years. This leaves Morrison 2007, this translation of Stöffler's *Elucidatio*, Lamprey's translation of Hartmann's work

[2002], and the older treatises mentioned above as the only astrolabe treatises available in English.

I am reluctant to comment in any detail on the fidelity of the translation itself since I do not read Latin. Still, I can say that the translation is clear, well-presented and illustrated, with relevant footnotes as required to clarify obscure references in the text. In some places, the translation seems a bit strained as idiomatic English, which is probably unavoidable since it was done from Latin to English *via* Italian. I would quarrel with tiny details on the selection of certain words, but the meaning is never less than clear. Many translations of classical material include a commentary. The subject matter in this instance is simple enough that additional annotation or explanation is not really needed, although some commentary on the accuracy of Stöffler's calculations would have been welcome.

In the final analysis, this translation is a major contribution to the literature in English on astrolabes and should be in the library of every student of the history of science. I am hopeful that the publication of this translation and Faith Wallis' translation of Bede's *De temporum ratione* [1999] inspire others to undertake projects in the history of astronomy of similar value.

Bibliography

D'Hollander, R. 1999. *L'Astrolabe. Histoire, thèorie et pratique.* Paris.

Laird, E. and Fisher, R. 1995. *Pèlerin de Prusse on the Astrolabe: Text and Translation of his* Practique de astralabe. Medieval and Renaissance Texts and Studies 127. Binghampton, NY.

Lamprey, J. 2002. *Hartmann's Practika: A Manual for Making Sundials and Astrolabes with the Compass and Rule.* Bellvue, CO.

Michel, H. 1976. *Traité de l'astrolabe.* Paris.

Morrison, J. E. 2007. *The Astrolabe.* Rehoboth Beach, DE.

North, J. D. 1988. *Chaucer's Universe.* Oxford.

Saunders, H. N. *All the Astrolabes.* Oxford.

Skeat, W. W. 1872. *A Treatise on the Astrolabe.* Chaucer Society: First Series 39. Oxford.

Tardy, J.-N. 1999. *Astrolabes. Cartes du ceil.* Aix-en-Provence.

Wallis, F. 1999. *Bede: The Reckoning of Time.* Liverpool.