Illustrating the Phaenomena: Celestial Cartography in Antiquity and the Middle Ages by Elly Dekker

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Reviewed by
Stamatina Mastorakou
IRCPS, Princeton
mastorakou@IRCPS.org

During the last few decades, there has been a growing interest in the study of the material culture of ancient and medieval astronomy, and Elly Dekker's *Illustrating the Phaenomena* comes to fill a gap. It is an impressive and thorough account of 16 extant celestial globes and 40 celestial maps from Antiquity and the Middle Ages. Despite the fact that most of the globes and maps discussed in this book have been presented previously, Dekker gives us a well-rounded account of them. She describes the artifacts collectively, providing the cartographical details of each and the manner of its construction as well as a general comparison of the artifacts to another and to a theoretical model. This allows for an appreciation of their importance, as illustrated by the fact that, as the author points out, globes and medieval maps are significant artifacts that were used until the 15th century to illustrate such books as Aratus' *Phaenomena*, which describes the constellations and their myths.

There is no doubt that Dekker's volume will become a standard reference book on globes and maps from Antiquity and the Middle Ages and will be the starting point for scholars who want to study such artifacts further. The book divides the globes and maps into those that follow the descriptive tradition and those that follow the mathematical tradition. In the descriptive tradition, the stars are located according to their position within constellations; while in the mathematical tradition, they are located according to a set of coordinates. Dekker also picks up specific features of the globes that have to do with their dating, construction, or categorization, first presenting the pertinent bibliography. She then either adopts the most common position in the historiographical debates or goes in depth to give her own opinion or concludes that there is no definitive answer to the point at issue.

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The book opens with some preliminary remarks on astronomical concepts. Dekker takes us through the constellations as first described by Aratus, Eratosthenes, Hyginus, Eudoxus, Hipparchus, and Ptolemy. She then introduces the astronomical concept of the two-sphere model, the basis for understanding the celestial phenomena visible to the naked eye since the fourth century BC. She continues by explaining a number of the circles and concepts that the ancients used to understand the celestial motions, such as the ecliptic or zodiacal circle, precession, colures, and the epochal modes.[1]

The last part of the first chapter is dedicated to what one should know in order to make a globe and to draw constellations on it. The ancients described the stars in constellations by following (most of the time) Hipparchus' rule, according to which the stars are to be described from our point of view here on Earth as if they are facing us and the left and right sides of the constellation's outline are fixed. To draw the constellations on a globe, however, the order of left and right was reversed at least for human or animal images: in effect, globe-makers drew mirror image of what we see in the sky. Historians used to believe that all the ancient globes displayed the constellations from the rear, that is, as mirror images.. But, as some recently discovered globes have made clear, that is not true. The ancients drew the constellations on globes both in sky-view and in rear view—that is, with the observer inside or outside the globe—and sometimes even on the same globe. According to Dekker, the same is true of ancient descriptions of the constellations in texts.

At the beginning of the second chapter, Dekker describes in detail the few extant celestial globes: the Kugel, the Mainz, and the Farnese globes. She also discusses the Salzburg fragment, the Berlin fragment, the Larissa globe—of which only a picture remains today—and Hyginus' globe, which is only known through Hyginus' *De astronomia*. The Kugel globe is the smallest of the three and, according to Dekker, it follows the older Eudoxan tradition

[1] The zodiacal circle is the oblique circle defined by the annual motion of the Sun on the celestial sphere; it runs through the middle of the zodiac or zodiacal band, which lies between the two tropic points. Because precession did not really play an important role in ancient astronomy, there were many different conventions regarding the starting points of the zodiacal signs (30°-segments of the zodiacal circle named after the zodiacal constellations). The colures are defined by the celestial poles, equinoxes, and solstices; and the descriptions of what the colures are and how they are positioned with respect to the constellations are called epochal modes.

in globe-making. The presentation on it of the constellations in images that mirror what we see in the heavens

> adds greatly to the present knowledge of early globe-making and shows that the making of mirror-image globes was not the prerogative of Islamic globe-makers but has its roots in Greek globe-making. [69]

The Mainz globe, on the other hand, shares a number of anonymous star groups with Kugel's globe, groups which were known from Aratus' *Phaenomena*; but mythology plays a more important role on it than on Kugel's. What nevertheless stands out even more on the Mainz globe is the outline of the Milky Way as a broad band whose features appear to follow closely Ptolemy's description. Such a correspondence between Ptolemy's account and the Mainz globe is indeed surprising when considering how inaccurately the constellations are located on the Mainz globe. It suggests, in Dekker's opinion [79], that

> the Milky Way on the Mainz globe ultimately goes back to a map of the globe in the mathematical tradition, although that does not apply to the globe as a whole.

The Farnese Atlas is another extant globe whose date remains elusive to modern scholars. In fact, Dekker, who addresses at length the issues of dating, accuracy, and a possible Hipparchan origin of this globe, concludes that she is

> inclined to accept that—although the Farnese globe contains no actual stars, the circles on the globe are drawn inexactly, the dating of the globe is uncertain, and its sources controversial—the Farnese globe is closest to what remains today of the early mathematical tradition in globe making. Unless new information is discovered, it will remain hypothetical whether that tradition started with Hipparchus or not. [101]

In the third chapter, Dekker examines for the first time 33 celestial maps such as the *Revised Aratus Latinus* that have survived in medieval illustrated manuscripts (9th–15th centuries). All the maps belong to the descriptive tradition and can be divided into three groups:

(1) pairs of summer and winter hemispheres, that is, hemispheres presenting the winter and summer skies at a given location;

(2) planispheres presenting the whole sky in sky-view (the order of the zodiacal constellations is clockwise and you see the Milky Way) and in globe-view (the order is counterclockwise);[2]

(3) sets of hemispheres that show the heavens north and south of the celestial equator.

Dekker describes in detail how these maps were constructed and suggests that there was what she calls a 'hemispheric model' according to which the grid in the hemispheres must have been drawn. Next, she tries to establish a date of construction for the artifacts, suggesting that it is the location of the equinoctial colure with respect to the stars that can be used as the criterion for dating. Last, she establishes which tradition the maps follow and how they can be grouped according to their similarities. Through her analysis, it nevertheless becomes clear that sometimes due to internal inconsistencies, deliberate adaptations, or systematic or copying errors, it is very hard to discover the relevant epochal modes for some of the maps that derive from globes. Planispheres, for example, present the celestial sphere in one piece from the celestial north pole to the ever-invisible circle and this makes the author postulate [433] that

> It was probably because of this format that for a long time it was taken for granted that these medieval planispheres are based on stereographic projection.

When Dekker examines the details of the construction of these planispheric maps, however, she concludes that they are not in fact stereographic projections: instead, she maintains, they are based on an equidistant model in which the parallel circles are drawn proportional to their distance from the north celestial pole. For the two pairs of maps consisting of hemispheres separated by the equator, it is not clear if they derive from Aratus' *Phaenomena* as do the maps discussed thus far. The detailed analysis of these two maps raises more questions than can be answered regarding the tradition that they follow. An interesting point here is that the map found in the middle of an astronomical poem may be connected to the globe-making ventures of Gerbert of Aurillac.

The transition from the descriptive Aratean to the mathematical Islamic astronomy in Europe was not immediate. This is showcased in the fourth

[2] There are five copies in sky-view, five in globe-view, and 10 humanist planispheres in globe-view.

chapter on Islamic celestial cartography, which opens with the oldest artifact, the ceiling painting in the bath house of Quṣayr ʿAmra, which is believed to have been built in the first half of the eighth century. It is very hard to uncover the source for this celestial map and, despite what the extant literature claims, Dekker believes that the ceiling painting does not reflect any detail that would require knowledge of Ptolemy's *Almagest*. The author extends her analysis of the first treatises dealing with the use of globes written by astronomers from the Middle East, an activity, which, she maintains, underlines the significance of globes in education. Among the many treatises presented, the *Book on the Constellations of the Fixed Stars*, which the Persian astronomer al-Ṣūfī wrote for his patron ʿAḍud al-Dawla in the ninth century, is most interesting. In this treatise, al-Ṣūfī embarks on criticizing his predecessors' observations, especially those by Ptolemy, even though he dismisses some Ptolemaic stars because he was unable to see them. In any case, Dekker concludes that al-Ṣūfī created an amazing star atlas for the contemporary students of astronomy trying to bridge the gap between globes and the sky in the new mathematical tradition. At the end of this chapter, we read about all the other mappings found on celestial globes. Some of them follow an eastern tradition in globe-making that predates the work of al-Ṣūfī, while others clearly show the impact of al-Ṣūfī's work. It is interesting that although the earliest extant mathematical celestial globes were made in Muslim Spain in *ca* 1080, they show glimpses of an early eastern tradition in globe-making. In addition to a few Greek features and typical Islamic elements, these globes have characteristics that are seen neither in early Greek sources nor on later Islamic globes.

In the fifth chapter and final chapter, Dekker describes the Cusanus globe, the oldest extant medieval globe made in the Latin West that dates from around 1320–1340. This globe is the closest to what the author imagines a Greek model of Ptolemy's precession globe would have looked like. It raises a number of interesting questions to be followed up, including its place of origin. Around 1425, Conrad of Dyffenbach made the earliest still extant set of maps based on the Ptolemaic star catalogue using the completely new trapezoidal projection and the polar azimuthal equidistant projection, which was not finished. A more successful use of the latter projection was made in *ca* 1453 in a pair of maps which are closely connected to the Vienna globe-making enterprise, although this projection was, apparently, not yet fully understood. An outstanding feature of these Vienna maps is their iconography, which prompted all maps and globes in the 16th century to present the human constellation figures in rear-view. Only two 15th-century globes have survived: the globe made by Hans Dorn in 1480 and another made by the astronomer Johannes Stoffler in 1493. Both underline their use for astrological doctrines. In the first half of the 15th century, the first extant celestial maps in the mathematical tradition emerged and, although they might have started in Antiquity, no maps survived and that is definitely an interesting point that needs further study.

The book is equipped with many illustrations of the globes and maps discussed in detail by Dekker along with some tables and charts and also five appendices, a bibliography, an addendum, a manuscript index, and an author index.

The breadth and depth of Dekker's analysis have opened up an array of exciting issues to be pursued, one of which concerns the accuracy of the information presented on globes, a subject that the author touches upon only briefly. Questions that come to my mind are: Accurate according to whom? What do we mean by 'correct', 'wrong' or 'astronomically incorrect' in each context? Why is it important, if it is at all? Although the book does not suffer from the lack of illustrations, it would have been beneficial to add some more pictures of the fascinating artifacts that Dekker describes as well as perhaps some more subcategories in each chapter so as to allow even the total novice to dive into these complex issues. I would hope that researchers will use Dekker's excellent book as a stepping stone to expand further on the history of globes and maps, their makers, their purpose, as well as their audiences so as to understand these fascinating objects even better.

Once more: Dekker has delivered a great piece of work on celestial cartography, which together with her study on globes at Greenwich is bound to become a classic.