Eastern Astrolabes by David Pingree

Historic Scientific Instruments of the Adler Planetarium and Astronomy Museum 2. Chicago: Adler Planetarium and Astronomy Museum, 2009. Pp. xxii + 268. ISBN 1–891220–02–0. Cloth $75.00

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I was present at the conception of this book 25 years ago. I recall the moment when Roderick and Marjorie Webster, trustees of the Adler Planetarium and Astronomy Museum, formally invited David Pingree (1933–2005) to catalogue the eastern astrolabes and related Islamic instruments in the Planetarium's collection. I had just arrived in Chicago to take up the position of Curator of the history-of-astronomy collection at the Adler Planetarium, and one of my first initiatives was to secure funding for an interpretive catalogue of the scientific instruments.[1] There was no debate on who should document the Adler's world renowned collection of astrolabes. Rod and Madge would prepare the catalogue of the western astrolabes with my help; and David Pingree, Professor in Brown University's Department of the History of Mathematics, would do the eastern ones.

To understand why Pingree was an outstanding choice, readers will need a brief history of the planispheric astrolabe.

The astrolabe is arguably the most sophisticated and elegant of early astronomical instruments. Fashioned of brass and mathematically complex, the astrolabe was both an observational tool and an analogue computer that could be used to solve astronomical, astrological, mathematical, and geographic problems.

The principal elements of the astrolabe include:

[1] National Endowment for the Humanities Planning Grant, Program of Museums and Historical Organizations (Sara Schechner Genuth, Principal Investigator/Project Director for an interpretive catalogue of scientific instruments at the Adler Planetarium), 1984–1989.

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- a pierced stereographic map of the stars, which rotates;
- a stack of plates, each engraved with the stereographic projection of the local coordinates for a particular latitude;
- a sighting- and angle-measuring device; and
- a suspension shackle.

Invented in the Greco-Roman world (perhaps in Alexandria) perhaps as late as the fourth century AD, the astrolabe incorporated mathematics from the time of Hipparchus and parts of earlier instruments—e.g., the Greek surveyor's *dioptra*, the anaphoric clocks of Vitruvius, second-century portable sundials with stereographic projections, and Ptolemy's observing armillary and horoscopic instruments. The earliest known treatise was written in Greek by Hypatia's father, Theon of Alexandria, in the late fourth century AD. By the seventh century, we have treatises in Syriac followed by others in Arabic in the eighth. Early production was centered on Ḥarrān, an ancient pagan city in northeastern Syria, where people worshipped the stars and scholars shared their interests in Greek philosophy, astronomy, and the astrolabe with Syrian neighbors who were Christians. Under ᶜAbbāsid rule (established in AD 750), Muslim astrolabists flourished in Syria. Sometime before the 10th century, knowledge of the astrolabe spread eastward from the Syro-Egyptian region to Iraq and Persia. Like those in Ḥarrān, the early workshops were predominantly located between the Tigris and Euphrates rivers. About a dozen Islamic astrolabes survive from this period; the earliest dated example is by Basṭūlus in AD 927/8.[2] Continuing eastward, the travels of Muslim scholars such as al-Bīrūnī may have brought the astrolabe to southern India in the 11th century, although the earliest known Sanskrit text on the astrolabe dates from about 1370. It was completed by a Jain scholar under the sponsorship of the Tughluk Emperor, Fīrūz Shāh, who also promoted the fabrication of astrolabes in India. No Indian instruments survive from this period, however. In the mid 16th century, the astrolabe was introduced to Mughal India from Persia, and Lahore became a center of the production of Indo-Persian astrolabes.

Moving westward along the southern Mediterranean, Muslim scholars also spread knowledge of the astrolabe to North Africa and

[2] The oldest in the Adler Planetarium's collection was made by Badr ibn ᶜAbdallāh in Baghdad in 1130/1 for the Saljuq Sulṭān, Mughīth al-Dīn Maḥmūd II.

Muslim Spain (Andalusia) by the 10th century, and from there to the Latin West as Christian and Jewish scholars traveled to Spain and returned with astrolabes and Arabic texts translated into Latin and Hebrew. Knowledge of the astrolabe may also have come directly to Europe from the Byzantine Empire and Greek sources. One Byzantine example dated 1026 survives and was clearly patterned after Islamic instruments.

The Adler Planetarium's collection of eastern astrolabes and related instruments is representative of this diverse history. Made in Spain and western North Africa, in West Asia, the Middle East, and South Asia, the instruments are engraved with inscriptions in Arabic, French, Hebrew, Latin, Persian, Sanskrit, and Turkish. Few scholars have the skills to analyze these instruments, and David Pingree was among them.

Pingree was Otto Neugebauer's successor at Brown, and renowned for his scholarship in the history of the exact sciences (notably astronomy and mathematics), magic, and astrology in ancient Mesopotamia, classical Greece, Byzantium, India, Latin Europe, North Africa, the Islamic world, as well as for his work in the linguistic and intellectual cultures that linked these regions. Pingree had come to know the Adler Planetarium's collection of astrolabes in the mid 1960s when working as a research associate at the Oriental Institute of the University of Chicago on a project with E. S. Kennedy. Pingree was studying the geographical treatises that astrolabe makers had used as their sources for producing the gazetteers inscribed on the instruments for mosque astronomers and other users to determine the *qibla* (the direction of Mecca) and the times of prayer. The Websters made the Adler's collection available to Pingree in an extraordinary way. Every Monday, they delivered an astrolabe to Pingree at the Oriental Institute and on Friday of each week they retrieved it. This went on until each Islamic astrolabe had been examined. Since this was 20 years before the catalogue project, the Websters and I welcomed Professor Pingree back to Chicago to re-examine the instruments. I well remember fetching the instruments for him and watching him pore closely over them with eyes weakened from diabetes. His intensity was as noteworthy as his generosity in sharing his knowledge with a young scholar like myself.

The catalogue that Pingree produced includes full descriptions of 49 eastern astrolabes. These are divided into those from eastern

Islam (the Mashriq), those from western Islam (the Maghrib), and Sanskrit Indian astrolabes in order to accentuate their differences. Each instrument is photographed in its entirety—both assembled and dismantled—in order to show details of the principal parts. The parts include:

- the *mater* (body), which is inscribed with circles of degrees, calendrical scales, horary quadrants, cotangent scales, gazetteers, and more;
- the *tympans* (plates) engraved with stereographic projections of the altitudes and azimuths of the sphere at given latitudes;
- the *rete* (star map), whose rotation on top of a *tympan* simulates the apparent rotation of the stars around the celestial north pole;
- the *alidade* (or diopter, an older term preferred by Pingree), which is used as a sight and sometimes also as a rule with mathematical scales; and lastly,
- the bolt and 'horse' (an equine-shaped pin) that secure the parts together.

Each catalogue entry fully documents these components, and Pingree is at pains to point out any unusual features. Inscribed words in Arabic, Persian, Turkish, or Sanskrit are transliterated in the entries. The catalogue entries, moreover, include tables of the stars named on the *retes*; cities and geographical parameters given on gazetteers; and the latitudes and longest daylights of the *tympans*. This is a noteworthy feature of the Adler catalogues, and something not typically done in the catalogues of other museums.

In addition, the catalogue also documents 27 other related Arabic, Islamic, or Sanskrit instruments in the Adler Planetarium's collection. These include astrolabe and horary quadrants, *qibla* indicators, sundials, dialing instruments, levels, artillery levels, celestial globes (described by Emilie Savage-Smith), and magic bowls. These entries are sequenced by alphabet letters rather than numerals because these instruments will eventually be included in other volumes of the Adler catalogue devoted to time-finding, surveying, and cartography. The idea of including them here in this volume was that an individual interested in all the Arabic or Islamic or eastern instruments in the collection could thus access them in one handy volume.

Pingree has written a terse historical introduction to the catalogue and a section devoted to biographies of the makers. Useful appendices include lists of Arabic and Sanskrit star names that appear on the instruments, which will enable scholars to see how naming conventions change over time and place. Other appended tables are devoted to astrological information on the instruments such as the planetary lords of the *decans*, terms and triplicities, and the lunar mansions. Bruce Stephenson, a curator presently at the Planetarium, includes a report on the metallurgy of the astrolabes as analyzed by high-energy X-rays at Argonne National Laboratory. Other back matter includes a concordance of catalogue numbers with Adler accession numbers, a bibliography, and an index.

It should be noted that *Eastern Astrolabes* is volume 2 in the series Historic Scientific Instruments of the Adler Planetarium and Astronomy Museum, and that it is intended as a companion to *Western Astrolabes* [see Webster and Webster 1998]. Readers unfamiliar with planispheric astrolabes will wish to consult volume 1's technical introduction and historical essay on the astrolabe and its uses cross-culturally. In volume 2, Pingree presumes that the reader is fully versed in astrolabe arcana, astronomy, astrology, and Muslim practices. By itself, this is a book written by one scholar for other scholars. But since the Adler Planetarium has one of the world's great astrolabe collections—on par with those at the British Museum, the National Maritime Museum in Greenwich, and the Istituto e Museo di Storia della Scienza in Florence, and second only to the Museum of the History of Science in Oxford—this is a volume well worth perusing.

This has been a book long in the making but the outcome is a significant contribution to the field of Islamic scientific instruments and the history of astronomy. It is regrettable that David Pingree did not live to see the book in print, but he would be very pleased to see his 'baby' recognized for the exceptional scholarship that it is.

BIBLIOGRAPHY

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