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Sharaf al-Dīn al-Ṭūsī

Glen van Brummelen

Born **Ṭūs, (Iran)**, ***circa* 1135**

Died **(Iran), 1213**

Although Sharaf al-Dīn al-Ṭūsī is known especially for his mathematics (in particular his novel work on the solutions of cubic equations), he was also the inventor of the linear astrolabe, a tool that derives from the planispheric astrolabe but is more easily constructed. From his name we may infer that Sharaf al-Dīn was born in the region of Ṭūs, in northeastern Iran. He spent a major part of his early career as a teacher of the sciences, including astronomy and astrology, in Damascus and Aleppo; he also taught in Mosul. Among his students was Kamāl al-Dīn ibn Yūnus, who would eventually teach Sharaf's namesake, the great **Naṣīr al-Dīn al-Ṭūsī**.

Sharaf al-Dīn al-Ṭūsī devoted several treatises to the linear astrolabe, sometimes called the staff of al-Ṭūsī. Its principle is simple – many of the important circles on the planispheric astrolabe, especially the almucantars (altitude circles) and the circles of declination, are centered on the meridian line. The main rod of the linear astrolabe is equivalent to the meridian line and contains markings to indicate the centers of these circles and their intersections with the meridian. The ecliptic (which appears on the movable rete of a standard astrolabe) is represented by the intersections of the beginnings of the zodiacal signs with the meridian when the rete is rotated. Many typical operations on a traditional astrolabe require the locations of points of intersection of these various circles. By attaching ropes to the appropriate points on the staff to act as radii, the circles and their intersections can be reconstructed and the astronomical problem solved. A scale giving chord lengths in the meridian circle extended the linear astrolabe's range of applications. Attached to a plumb line, it was also used to take observations of solar altitude. Additional markings allowed the determination of the *qibla* (the direction of Mecca) and solutions of astrological problems.

The simplicity of the linear astrolabe made it easy to construct, but its less than artful appearance rendered it unattractive to collectors. It was neither as durable nor as accurate as a planispheric astrolabe, and its operations were less intuitive. None have survived.

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