Nasir al-Din al-Tusi

Nasir al-Din al-Tusi (February 18, 1201 – June 26, 1274) was one of the greatest scientists, mathematicians, astronomers, philosophers, theologians, and physicians of his time. He was born in Tus in Khurasan (now Iran) to a family whose notion of learning was the study of religious law and how it was practiced. However, his jurist father encouraged his son to study the philosophical and natural sciences. From Tus, Nasir al-Din moved to Nishapur, an important center of learning, where he studied philosophy, medicine and mathematics and earned a reputation as an outstanding scholar.

When al-Tusi traveled to Baghdad, hoping to join the caliph's court, he was captured by the Assassins, a kind of religious-military Isma'ili brotherhood, who obtained power through political murders. The Isma'ili ruler established Nasir as a highly regarded member of his court at the fortress of Alamut, one of a series of impregnable strongholds held by the Assassins in the Elburz Mountains. It was here for the next twenty-five years that al-Tusi did some of his most important work, using the rich library to write on logic, philosophy, mathematics and astronomy. In 1256, the invading Mongols led by Hulagu Khan, grandson of Genghis Khan, captured Alamut. Quite interested in the sciences, Hulagu treated Tusi with respect and appointed him one of his ministers. Later, while serving as an administrator of Auqaf, al-Tusi persuaded Hulagu to build an observatory at Meragha, with al-Tusi as its director. The observatory was equipped with the best instruments from Baghdad and other Islamic centers of learning. It contained a twelve-foot wall quadrant made from copper and an azimuth quadrant and "turquet" invented by al-Tusi. Figure 6.13 is an architect's rendition of the Meragha Observatory. It had a library with some 400,000 books on a wide range of scientific topics and a school for training

specialists in mathematics, science and philosophy. The observatory, which became operational in 1262, lasted until at least the beginning of the fourteenth century, but today all that remains is its foundation. A star globe made of bronze, inlaid with gold and silver in 1279 is now preserved in Dresden, Germany.

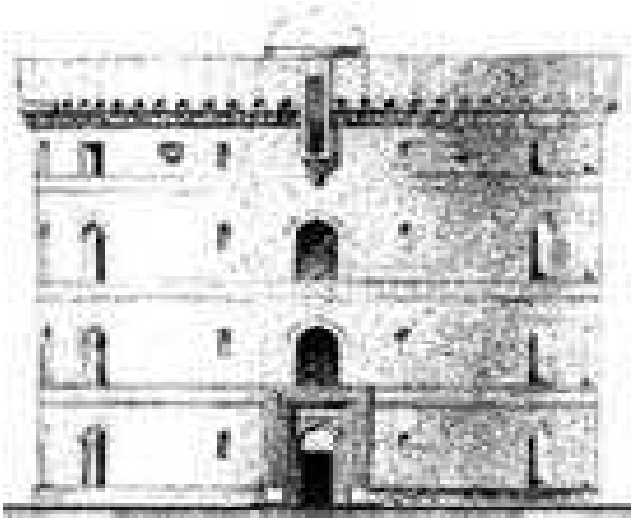

Figure 6.13

Al-Tusi wrote some 150 books in Arabic, Persian, and Turkish, with sixty-four treatises known to have survived. Many were consolidated accounts of what others had previously written. But he also made many original contributions, most particularly in mathematics. He was the first to treat trigonometry as a separate science, rather than just a set of tools for astronomy. He edited the definitive Arabic versions of the works of Euclid, Archimedes, Ptolemy, Autolycus, and Theodosius. He was familiar with the properties of the so-called "Pascal's Triangle" long before Pascal's birth. His most famous astronomical work is the four-volume *Al-Zij-Ilkhani* (*Astronomic Tables of Ilkhan*), dedicated to Ilkhan (Hulagu Khan). It is an accurate table of planetary movements, based on the research carried on at the Meragha Observatory. Al-Tusi's main contribution to logic is contained in *The Ground for the Acquisition of*

Knowledge.

Al-Tusi's commentary on Ptolemy's *Almagest*, called the *Tadhkira fi ilm al-Haya* ("Memoir on Astronomy") is a most thorough criticism of Ptolemaic astronomy. It gave the first mathematical model of planetary motion to appear in medieval times. Al-Tusi appears to have been the first to discover that if one circle rolls around inside the circumference of another and if the second circle has a radius twice that of the first, then any point on the periphery of the first circle describes a diameter of the second. Figure 6.14 shows a fourteenth-century copy of his manuscript and his ingenious device, now known as the "Tusi Couple." The theorem solved a centuries-old problem that plagued Ptolemy and other Greek astronomers: how circular motion can generate linear motion. By means of this construction, al-Tusi succeeded in reforming the Ptolemaic planetary models, producing a system in which all orbits are described by uniform circular motion. Many historians of Islamic astronomy believe that the planetary models developed at Meragha found their way to Europe and provided Nicolaus Copernicus with inspiration for his theories.

Figure 6.14

Quotation of the Day: “[Tusi] was hired to write on Isma′ilism by the hierarchs of Alamut, but after the sect was nearly destroyed by the Mongols, Tusi hired out to them instead, like a true professional scientist of our own days.” – Peter Lamborn Wilson