Arabic and Persian Mathematics (Part 2)

In reading about these areas of mathematics that we often take as obvious. it often was, once someone had worked it out beforehand. This series is about some of the lesser-known of those people.

Regarding the issue of moon sighting, Islamic months do not begin at the astronomical new moon, defined as the time when the moon has the same celestial longitude as the sun and is therefore invisible; instead they begin when the thin crescent moon is first sighted in the western evening sky. The Qur'an says: "They ask you about the waxing and waning phases of the crescent moons, say they are to mark fixed times for mankind and Hajj." This led Moslems to find the phases of the moon in the sky, and their efforts led to new mathematical calculations.

Predicting just when the crescent moon would become visible is a special challenge to Islamic mathematical astronomers. Although Ptolemy's theory of the complex lunar motion was tolerably accurate near the time of the new moon, it specified the moon's path only with respect to the ecliptic. To predict the first visibility of the moon, it was necessary to describe its motion with respect to the horizon, and this problem demands fairly sophisticated spherical geometry. Finding the direction of Mecca and the time of Salah are the reasons which led to Moslems developing spherical geometry. Solving any of these problems involves finding the unknown sides or angles of a triangle on the celestial sphere from the known sides and angles. A way of finding the time of day, for example, is to construct a triangle whose vertices are the zenith, the north celestial pole, and the sun's position. The observer must know the altitude of the sun and that of the pole; the former can be observed, and the latter is equal to the observer's latitude. The time is then given by the angle at the intersection of the meridian (the arc through the zenith and the pole) and the sun's hour circle (the arc through the sun and the pole).

Moslems are also expected to pray towards the Kaaba in Mecca and orient their mosques in that direction. Thus they need to determine the direction of Mecca (Qibla) from a given location. Another problem is the time of Salah. Moslems need to determine from celestial bodies the proper times for the prayers before sunrise, at midday, in the afternoon, at sunset, and in the evening.

In years gone by the significance of the Arabic civilisation was regarded purely as preserving the Greek texts that would otherwise have been lost.

Recent research paints a new picture of the debt that we owe to Islamic mathematics. Certainly many of the ideas which were previously thought to have been brilliant new conceptions due to European mathematicians of the 16th, 17th, and 18th centuries are now known to have been developed by Arabic/Islamic mathematicians around four centuries earlier. In many respects, the mathematics studied today is far closer in style to that of Islamic mathematics than to that of Greek mathematics.

Al-Khwārizmī's contributions to mathematics, geography, astronomy, and cartography established the basis for innovation in algebra and trigonometry. His systematic approach to solving linear and quadratic equations led to algebra, a word derived from the title of his 830 book on the subject, "The Compendious Book on Calculation by Completion and Balancing".

The book was written with the encouragement of the Caliph al-Ma'mun as a popular work on calculation and is replete with examples and applications to a wide range of problems in trade, surveying and legal inheritance. The term algebra is derived from the name of one of the basic operations with equations (al-jabr, meaning completion, or, subtracting a number from both sides of the equation) described in this book. The book was translated in Latin as Liber algebrae et almucabala by Robert of Chester (Segovia, 1145) hence "algebra", and also by Gerard of Cremona. A unique Arabic copy is kept at Oxford and was translated in 1831 by F. Rosen. A Latin translation is kept in Cambridge.

Figure 1 A page from al-Khwārizmī's Algebra

Next time we will look more at this book and its application to algebra