Arabic and Persian Mathematics

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.

Abū Abdallāh Muhammad ibn Mūsā al-Khwārizmī

The Islamic Caliphate (Islamic empire) established across the Middle East, North Africa, and in parts of India in the 8th century preserved and translated much of the Greek mathematics which was at that time largely forgotten in Europe. Indian mathematics, and the introduction of the Hindu-Arabic numerals, also had a major influence on Islamic mathematics. Like the Hindu mathematicians, Islamic mathematicians were especially interested in astronomy. The works of Brahmagupta were translated into Arabic circa 766.

Al-Khwarizmi, the 9th century Persian astronomer of the Caliph of Baghdad, wrote several important books, on the Hindu-Arabic numerals and on methods

for solving equations. The word *algorithm* is derived from his name, and the word *algebra* from the title of one of his works, *Al-Jabr wa-al-Muqabilah*. Al-Khwarizmi is often considered to be the father of modern algebra and modern algorithms.

Abū Abdallāh Muḥammad ibn Mūsā al-Khwārizmī (Persian/Arabic: أبو عبد الله محمد بن موسى الخوارزمي) (c. 780, Khwārizm – c. 850) was a Persian mathematician, astronomer and geographer, a scholar in the House of Wisdom in Baghdad.

His *Kitab al-Jabr wa-al-Muqabala* presented the first systematic solution of linear and quadratic equations. He is considered the founder of algebra, a credit he shares with Diophantus. In the twelfth century, Latin translations of his work on the Indian numerals, introduced the decimal positional number system to the Western world. He revised Ptolemy's *Geography* and wrote on astronomy and astrology.

His contributions had a great impact on language. "Algebra" is derived from *al-jabr*, one of the two operations he used to solve quadratic equations. *Algorism* and *algorithm* stem from **Algoritmi**, the Latin form of his name. His name is the origin of (Spanish) *guarismo* and of (Portuguese) *algarismo*, both meaning digit.

A major impetus for the flowering of mathematics as well as astronomy in medieval Islam came from religious observances, which presented an assortment of problems in astronomy and mathematics, specifically in trigonometry, spherical geometry, algebra and arithmetic.

The Islamic law of inheritance served as an impetus behind the development of algebra by al-Khwārizmī and other medieval Islamic mathematicians. Al-Khwārizmī's Hisab al-jabr w'al-muqabala devoted a chapter on the solution to the Islamic law of inheritance using algebra. He formulated the rules of inheritance as linear equations; hence his knowledge of quadratic equations was not required. Later mathematicians who specialized in the Islamic law of inheritance included Al-Hassār, who developed the modern symbolic mathematical notation for fractions in the 12th century, and Abū al-Hasan ibn Alī al-Qalasādī, who developed an algebraic notation which took "the first steps toward the introduction of algebraic symbolism" in the 15th century.

In order to observe holy days on the Islamic calendar in which timings were determined by phases of the moon, astronomers initially used Ptolemy's method to calculate the place of the moon and stars. The method Ptolemy used to solve spherical triangles, however, was a clumsy one devised late in the first century by Menelaus of Alexandria. It involved setting up two intersecting right triangles; by applying Menelaus' theorem it was possible to solve one of the six sides, but only if the other five sides were known. To tell the time from the sun's altitude, for instance, repeated applications of Menelaus' theorem were required. For medieval Islamic astronomers, there was an obvious challenge to find a simpler trigonometric method.

Next time:

Islamic calculation of the phases of the moon and other important Islamic calculation;