

C. Islamic mathematics

In the 7th century, a new empire began to spread across the Middle East. The teachings of the Prophet Mohammed inspired a vast and powerful Islamic empire which soon stretched from India in the east to Morocco in the west. And at the heart of this empire lay a vibrant intellectual culture.

A great library and centre of learning was established in Baghdad. Called the House of Wisdom, its teaching spread throughout the Islamic empire. Subjects studied included astronomy, medicine, chemistry, zoology and mathematics. The Muslim scholars collected and translated many ancient texts, effectively saving them for posterity. But they also wanted to create a mathematics of their own, and such intellectual curiosity was actively encouraged in the early centuries of the Islamic empire: the Koran asserted the importance of knowledge, and learning was nothing less than a requirement of God. Mathematical skill was needed to calculate the time of prayer and the direction of Mecca to pray towards, and the prohibition of depicting the human form meant that they had to use much more geometric patterns to cover their buildings: the Muslim artists discovered all the different sorts of symmetry that you can depict on a two-dimensional wall.

The director of the House of Wisdom in Baghdad was a Persian scholar called Muhammad Al-Khwarizmi.

Algebra - Al Khwarizmi

Al-Khwarizmi recognised the incredible potential of the Hindu numerals for speeding up calculations, and it wasn't long before they were adopted as the numbers of choice amongst the mathematicians of the Islamic world. Now these numbers have become known as the Hindu-Arabic numerals. But Al-Khwarizmi was to create a whole new mathematical language. It was called algebra, and was named after the title of his book *Al-jabr W'al-muqabala*, or "Calculation By Restoration Or Reduction". Algebra is the grammar that underlies the way that numbers work. It was a huge breakthrough. Here was a new language to be able to analyse the way that numbers worked. Previously, the Indians and the Chinese had considered very specific problems, but Al-Khwarizmi went from the specific to the general. He developed systematic ways to be able to analyse problems so that the solutions would work whatever the numbers that you took. This language is used across the mathematical world today.

Al-Khwarizmi's great breakthrough came when he applied algebra to quadratic equations. The ancient Mesopotamians had found a method to solve particular quadratic equations, but it was Al-Khwarizmi's abstract language of algebra that could finally express why this method always worked. and would ultimately lead to a formula that could be used to solve any quadratic equation, whatever the numbers involved.

The next mathematical Holy Grail was to find a general method that could solve all cubic equations. It was an 11th-century Persian mathematician who took up the challenge of cracking the problem of the cubic. His name was Omar Khayyam, and he travelled widely across the Middle East, calculating as he went. But he was famous for another, very different, reason. Khayyam was a celebrated poet, author of the great epic poem the *Rubaiyat*. Khayyam's major mathematical work was devoted to finding the general method to solve all cubic equations. Rather than looking at particular examples, Khayyam carried out a systematic analysis of the problem, true to the algebraic spirit of Al-Khwarizmi. Khayyam's analysis revealed for the first time that there were several different sorts of cubic equation. But he was still very influenced by the geometric heritage of the Greeks. Although the geometry allowed him to analyse these cubic equations to some extent, he still couldn't come up with a purely algebraic solution.

It would be another 500 years before mathematicians could make the leap and find a general solution to the cubic equation. And that leap would finally be made in the West - in Italy. During the centuries in which China, India and the Islamic empire had been in the ascendant, Europe had fallen under the shadow of the Dark Ages. All intellectual life, including the study of mathematics, had stagnated. But by the 13th century, things were beginning to change. Led by Italy, Europe was starting to explore and trade with the East. With that contact came the spread of Eastern knowledge to the West.