

How the Indian numbers entered Europe

It is commonly thought that Fibonacci brought the nine numerals and zero into Europe with the publication of his book *Liber Abaci* (1202). He was undoubtedly very influential in this respect but he was by no means the first. Arabic astronomy and mathematics were known in Christendom for more than 200 years prior to this and perhaps even longer.

The first sign that the Indian numerals were moving west comes from a source which predates the rise of the Arab nations. In 662 AD Severus Sebokht, a Nestorian bishop who lived in Keneshra on the Euphrates river, wrote:-

I will omit all discussion of the science of the Indians, ... , of their subtle discoveries in astronomy, discoveries that are more ingenious than those of the Greeks and the Babylonians, and of their valuable methods of calculation which surpass description. I wish only to say that this computation is done by means of nine signs. If those who believe, because they speak Greek, that they have arrived at the limits of science, would read the Indian texts, they would be convinced, even if a little late in the day, that there are others who know something of value.

This passage clearly indicates that knowledge of the Indian number system was known in lands soon to become part of the Arab world as early as the 7th century. The passage itself, of course, would certainly suggest that few people in that part of the world knew anything of the system. As a Christian bishop Severus Sebokht would have been interested in calculating the date of Easter (a problem for Christian churches for many hundreds of years). This may have encouraged him to find out about the astronomical works of the Indians and in these, of course, he would find the arithmetic of the nine symbols.

By 776 AD the Arab empire was beginning to take shape and we have another reference to the transmission of Indian numerals. In a work called *Chronology of the scholars* by al-Qifti written around the end the 12th century there is a reference to the earlier transmission of the numerals from India.

... a person from India presented himself before the Caliph al-Mansur in the year [776 AD] who was well versed in the Siddhanta method of calculation related to the movement of the heavenly bodies, and having ways of calculating equations based on the half-chord [essentially the sine] calculated in half-degrees ... This is all contained in a work ... from which he claimed to have taken the half-chord calculated for one minute. Al-Mansur ordered this book to be translated into Arabic, and a work to be written, based on the translation, to give the Arabs a solid base for calculating the movements of the planets ...

The movement of the Indian numbers into Europe may have begun with Pope Sylvester II (d.1003) who was one of the first to suggest replacing the clumsy Roman numerals with the decimal system.

In the 12th century there were several centres of learning by which the Arabic works were made accessible to Christians. These included Toledo in Spain and Syracuse in Sicily. A number of translators flourished in Toledo including Gerard of Cremona (1117- 1187) and John of Seville.

Adelard of Bath was the first of a long series of Arabic scholars of England who travelled extensively in search of Arabic books. Adelard was born in 1075 in Bath, England. He studied and taught in France and visited Syria, Sicily and Spain before returning to Bath. He became a teacher of the future King Henry II. Adelard died in 1160. He translated several works on Mathematics and Astronomy. Among the most important works he translated was the Astronomical tables Al-Majriti (1126). Adelard made a Latin translation of Euclid's Elements from Muslim sources. He also translated Al-Khwarizmi's tables and other works on the abacus and astrolabe.

Al-Khwarizmi's most influential work was the algebra treatise, *Hisab al-jabr w'al-muqabala*. It is the title of this text that gives us the word *algebra*. The word *al-jabr* means *completion* and is one of the operations used in algebra. This is similar to the Vedic sutra पूरणापूरणाभ्याम् - *by completion and non-completion*. In this book al-Khwarizmi states his intention to teach,

... what is easiest and most useful in arithmetic, such as men constantly require in cases of inheritance, legacies, partition, lawsuits, and trade, and in all their dealings with one another, or where the measuring of lands, the digging of canals, geometrical computations, and other objects of various sorts and kinds are concerned.

Early in the book al-Khwarizmi describes the natural numbers.

When I consider what people generally want in calculating, I found that it always is a number. I also observed that every number is composed of units, and that any number may be divided into units. Moreover, I found that every number which may be expressed from one to ten, surpasses the preceding by one unit: afterwards the ten is doubled or tripled just as before the units were: thus arise twenty, thirty, etc. until a hundred: then the hundred is doubled and tripled in the same manner as the units and the tens, up to a thousand; ... so forth to the utmost limit of numeration.

Besides Leonardo of Pisa (Fibonacci) there was another influential author, John of Sacrobosco (1195 – 1256), who taught astronomy and mathematics at the University of Paris. He was probably born in England and educated at Oxford. He wrote a short introduction to the Hindu number system which became the most widely read introduction to the subject in later medieval centuries.

Although, through trade and social integration, there was a long time period during which scholars in Christendom were in touch with the mathematics of the Arabs, it wasn't until the all-powerful upsurge of the Medieval Renaissance, bringing with it a great thirst for knowledge, that the Hindu number system really took a firm grip within the minds of Europeans. The cultures associated with Islam and Christianity have totally absorbed and utilised the decimal system which owes its origin to the insight and intellect of ancient India.

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