

The number Zero

Like the decimal system, the number zero originated in Asia, but the exact date is hard to trace back. It is nowadays believed that it probably originated in India before making its way to China around the 8th century and then later to Islamic countries. In a work on arithmetic from the Spanish-Jewish philosopher Abraham ibn Ezra from 1146, the decimal system and the number zero (represented as a circle) were first introduced in Europe. Later they were put into use by Leonardo of Pisa in Italy, and then the new system (and the zero) spread all over Europe.

As we have seen in the chapter *Decimal system*, the Indians already had words for the numbers 1 through 9 and even beyond, for example for the powers of ten, which were written in Sanskrit and can be dated back to at least King Ashoka (around the third century). Moreover, they also extended their number sequence in a religious way. Hundred was called 'sata', thousand was 'sahasra' and 'ayuta' was ten thousand, cf. [Katz, 2009, p. 233]. They also gave a number to Buddha that was more or less equivalent to our present number of 10^{421} , cf. [Wußing, 1989, p. 92].

The Chinese kind of brought their place value system to the Indians. They assumably did so by introducing their counting boards (see chapter *Decimal system*).

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Figure 1: Calculating with a Chinese counting board, [Wußing, 2008, p. 53]

The Chinese left blank columns in this board whenever they wanted to represent an intermediate zero directly while calculating on their board (see Figure 1). In written records, a dot was used by the Chinese to represent this blank space. But they had no real notion of the zero that was developed by the Indians. There is evidence from the year 662 (from a Syrian priest), that the Indians

had adopted the decimal system using only symbols for the numbers 1 through 9, and that they had dropped their old system with all other symbols, but there is no mention of the number zero. However, in the Bakhshālī manuscript (a manuscript assumed to be from the 7th century that was rediscovered in 1881 in poor conditions), "the numbers are written using the place value system and with a dot to represent the zero" [Katz, 2009, p. 233f.]. In a work from 718, the Indian way of writing down numbers is described: "When a number is counted to ten, it is advanced into the higher place. In each vacant place a dot is always put. Thus the numeral is always denoted in each place" [Katz, 2009, p. 234f.]. Brahmagupta (598-668), an Indian mathematician who really affected arithmetic, gave rules for calculating with positive and negative numbers and for calculations with zero in chapter 18 of his *Brāhmasphuṭasiddhānta* (a book on mathematics and astronomy): "The sum of a negative and zero is negative, that of a positive and zero is positive, and that of two zeros, zero [...] the product of zero and a negative, of zero and a positive, or of two zeros is zero" [Katz, 2009, p. 236]. So not only did the Indians already have a notion of the symbol of zero but also about how to calculate with it. Some last words about the etymology of the word zero: In Sanskrit, the word for zero was "sūnyā", meaning empty. The Arabic word for zero was then "sifr", which was in Europe latinized into "zephirum" before being changed to zero. Another medieval translation of the Arabic "sifr" was "cifra", which then led to the modern English word "cipher", cf. [Katz, 2009, p. 269]. So the word cipher originally comes from the number zero!

References

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