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## Zero, The Number Symbol: Invention And Importance

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### Abstract

Zero is symbolized by the numeric character '0' in mathematics. History of inventions of zero is mentioned in different civilizations from Mayan to Greek. The number zero plays different roles in many branches of mathematics. Modern computers are based on binary system which uses only two bits 0 and 1. In this paper Invention and Importance of zero is investigated.

**Keywords:** Zero symbol, civilizations, history of zero, different roles, importance, number system, rules of operation.

**1. Introduction:** The History of Zero dates long back to the mathematician Fibonacci, who introduced zero to Europeans. Different civilizations of world claim that they know or introduced zero in the number system. Mayan civilization, Babylonians, Egyptians, Romans and Greeks says that they used zero well before others. There was much discussion on invention/ discovery of zero, many articles and books written on this. Zero is the first extension of natural numbers, later on number system is extended to real number and complex numbers. Invention of zero opened new world in mathematics [1,2].

Zero is symbolized by the numeric character '0' in mathematics. It means no quantity or number or the lowest possible amount or level. The story of zero is the story of an idea that has aroused the imagination of great minds across the globe. In this paper Invention and Importance of zero is investigated.

### 2. Results and Discussion

**2.1 History of Invention:** The Mayan civilization may have been among the first to have a symbol for zero. The Mayan flourished in the Yucatan peninsula of Mexico about 1300 years ago. They used the zero as a place holder, in a vertical place valued system. Greek astronomer Ptolemy (150AD) was the first to write a zero at the end of a number, for this he used a circular symbol. At this time Greeks and Romans were using cumbersome Roman number system.

In the history of Babylonian [3], there was no use of the zero, they used special symbol for separation mark between sentences, and later on it was used for zero. There are definite possibilities that the Babylonian used this mark for zero within number. Up to eight century B. C., there seems to be no evidence that the Babylonian ever regarded zero as number. Aristotle discussed division by zero in connection with speed through vacuum. Babylonian in Mesopotamia (3000 B. C.) had a sexadecimal system using base 60. However, they didn't use zero at the end of number. This is as we make no distinction between the numbers 2 and 120( $2 \times 60$ ), 3 and 180 ( $3 \times 60$ ), 4 and 240 ( $4 \times 60$ ) etc. Only context could differentiate them.

The Sumerians were the first to develop a counting system to keep an account for the stock of goods, Cattles, Horses etc. The Sumerian system was handed down to the Akkadian around 2500 B. C. and then to the Babylonian in 2000 B. C. It was Babylonians, who first conceived of mark to signify that a number was absent from column.

The Indians were the first to see that zero can be used for something beyond nothing. Evidences are there that the numerical system was used in Vedas, Mohenjo-Daro and Harappa civilization (3000 B. C.). In second century BC the Indian scholar Pingala used binary numbers in the form of short and long syllables. The oldest text using decimal positional system including zero is the Jain text 'Lokavibhaga' dated 458 A. D. In 498 AD, Indian mathematician and astronomer Aryabhata stated that "Sthanatsthanamdasaganamsyat" i.e. From place to place each is ten times the preceding, which is the base of modern decimal place value system. The first undisputed use of the symbol for zero is a stone inscription found at the Chaturbhuj temple at Gwalior in India dated 876 A.D. There are many documents on copper plate also.

In the sixth century, Indian mathematicians developed place valued system. They introduced the concept of zero to keep their symbols in their proper places. In the seventh century, Hindu scholars introduced to Islam, the idea of zero and place-value. These ideas spread rapidly throughout the Arabic world and the Hindu Arabic numerals come into existence, Fibonacci was so impressed with the ease of this numerals that he wrote a book 'Liber abaci' in 1202.

Brahmagupta (598 AD – 660 AD) [4, 5] was the first to give the rules of operation of zero in his book 'Brahmasputha Sidhanta' (The opening of universe). Addition, Subtraction, and multiplication by zero was defined by him, but he stated that 'zero divided by zero is zero' which was wrong regarding the division by zero. Later on Bhaskaracharya (1114 - 1185 AD) in his book 'Lilavati' claimed that division of a quantity by zero is an infinite quantity.

Arabian mathematician Mohammed ibn-Musa al-Khowarizmi (790 –850 AD) wrote 'Hisab-al-Jabrwa-al Muqabalb' (Calculation of Integration and Equation) which made Indian number system popular. 'Soonya' became 'al-sifr' or 'sifr' [6]. The impact of this book can be judged by the fact that 'al-Jabr' became 'Algebra' of today. Al-Khowarizmi also developed quick methods for multiplying and dividing numbers known as algorithm- a corruption of his name. An Italian mathematician Leonardo Fibonacci (1170 AD- 1230 AD) took this number system to Europe. The Arabic 'sifr' was called 'Zephirium' in Latin, and then it was called as 'cypher'. This number system was called 'Hindu-Arabic number system, this positional system of representation integers revolutionized the mathematical calculations and also helped in Astronomy and accurate navigation.

The next great mathematician to use zero was Rene Descartes, the founder of the Cartesian coordinate system. As anyone who has had to graph a triangle or parabola knows, Descartes origin (0, 0). Although zero was now becoming more common, the developer of calculus, Newton and Leibnitz, would make the final step in understanding zero.

**2.2 Observations:** In the following, let us record the observations made by the great peoples concerning the invention which marked a new epoch in the history of human progress and development.

In a book "On the Foundation and Technique of Arithmetic" G B Halsted [7] writes: It was in arithmetic and algebra that India kept the lead. The inventor or inventors of the decimal place-value system and the zero mark are not known. The earliest use of the zero symbol, so far discovered, is in one of the scriptural book dated about 200 B C. It is considered probable that the place value system was invented about the beginning of the Christian era. The zero, called shunya or nothing was



originally a dot and later it became a small circle. It was considered a number like any other number [8].

In a book "Discovery of India" Pandit Jawaharlal Nehru writes: Highly intellectual and given to abstract thinking as they were, one would expect the ancient Indians to excel in mathematics. Europe got its early arithmetic and algebra from the Arabs- hence the 'Arabic numerals'- but the Arabs themselves had previously taken them from India. The astonishing progress that the Indians had made in mathematics is now well known and it is recognized that the foundation of modern arithmetic and algebra were laid long ago in India. The clumsy method of using counting frame and use of Roman and such like numerals had long retarded the progress when ten Indian numerals, including the zero sign, liberated the human mind from these restrictions and threw a flood of light on the behavior of numbers [9]. These symbols were unique and entirely different from all other symbols that had been in use in the other countries. They are common enough today and we take them for granted, yet they contained the germs of revolutionary progress in them. It took many centuries for them to travel from India, via Baghdad, to the Western world.

Prof. A. L. Basham, in his book, "The wonder that was India" writes: The debt of the Western world to India in this respect cannot be overestimated. Most of the great discoveries and inventions of which Europe is so proud would have been impossible without a developed system of mathematics, and his, in turn, would have been impossible if Europe had been shackled by the unwieldy system of Roman numerals. This achievement of some unknown, though now easily taken for granted, was the work of an analytical mind of the first order. He, who devised this new system, from the world's point of view, after the Buddha, is the most important son of India.

**2.3 Importance:** The number zero serves double duty as place holder and representation of the absence of value. Zero plays also the role in mathematics as the additive identity of the integers, real numbers and many other algebraic structures which mean it is as neutral element for addition and is also an absorbing element for multiplication. Zero as digit in itself in number system, ex.  $5-5=0$ . Zero also plays different roles in various branches of mathematics like zero function in calculus, bottom element of a bounded lattice in lattice theory, Turing degree of the partial computable function in recursion theory etc. Without zero we would lack calculus, financial accounting, the ability to make arithmetic computation quickly and especially in today's connected world, computers. Modern computers are based on binary system which uses only two bits 0 and 1 [10].

When anyone thinks of one hundred, three hundred, or seven thousands, the image in his or her mind is of digit followed by few zeros. The zero functions as place holder i. e. three zeros denotes that there are seven thousands, rather than only seven hundreds. If we were missing one zero, that would drastically change the amount. Large numbers would still exist without zero but they would be more cumbersome to work with. Higher mathematics would still exist without zero, but the proofs would be far less elegant and require far more work.

Zero is known by different [ 11 ] names like nought/naught, nothing, none, void in English, soonya in Sanskrit, sifr in Arabic, cypher in Europe, zephyrum in Latin, zefiro in Italian, chiffre in French, zephyrus in Greek. In sports zero is called by different names such as nil in football, love in tennis and duck in cricket. Italian mathematician Fibonacci used the term zephyrium for sifr, which became zefiro in Italian, later on contracted to zero and this term came in common use.

The use of positional system to indicate fraction was introduced around 1579 AD by Francois Viete. The dot for decimal point came to be used a few years later, but did not become popular until its use by Napier.

3. **Conclusion:** There is much literature written on invention / discovery of zero. There is no particular name, who invented zero, but it is clear that he is Indian, who has done this. Hindu numeral system and rules of operation of zero travel from India to Europe via Arab.

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