



Zero in Indian Context

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Abstract

From childhood casually we uses zero as a number. The origin of zero is still hotly debated. Zero was independently invented three times. First time it was invented in Babylonians, second time in Mayans and finally zero invented in India independently.

In Sanskrit, the word 'Sunya' uses in the sense of void or nothing. The earliest symbol for zero ('Sunya') in india was a 'bindu' (bold dot) . Gradually this 'bindu' becomes a solid circular dot and then a circle. 'Baksali Manuscript' contains a numerous calculations involving a solid dot for zero. But exact time (date) is hotly debated. The first written evidence of the use of zero is find at Chaturbhuj a temple in Gwalior, dated 876 CE.

In this paper, we study the concept of zero in Indian philosophical context as well as Indian mathematical context.

Keywords: Zero , Sunya , Bindu , Baksali Manuscript

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Introduction

Most of the scholar believed that zero originated in Indic Civilization but the evidence is almost zero. No place or time, let alone the name of discover or inventor, has ever been suggested. Indic Civilization starts with the Indus Civilization which is earlier than the Vedas. Its inscription exhibit occurrences and sequence of circles that resemble the numerals that have expressed zeros in more recent times; to be a little more precise; more than three thousand years later. Other civilizations roughly contemporary with the

urban complexes of Mohenjo-daro and Harappa used circle also, but they did not refer to zeros.

Period of Vedic mathematics we are on firmer ground. We find not only geometry but integers, a rudimentary decimal system for counting. It did not include negative numbers, but addition, subtraction and perhaps multiplication of whole numbers. The Rigveda made use recursion. It did, moreover, distinguish between cardinal and ordinal numbers. In all these case we are dealing with numbers, not with numerals. The word ' *kha* ', which Indian mathematician used later denote zero, occurs in vedic only in the senses of hole, opening, vacancy or space.

Early History

The Sanskrit word ' *Sunya* ', meaning void or nothing, derived from ' *Suna* ', which is past participle of ' *svi* ', which means ' to swell' or, ' to grow'. In Rigveda, the meaning of ' *sunya* ' is the 'the sense of lack or deficiency'. In Atharvaveda, the word found is ' *ksudra* ' which literally means very small. In Amarakosa, we find a word ' *randhra* ' (meaning a hole or chidra), which is equivalent to ' *sunya* '. Gradually got enfigured into the round symbol of sunya, a solid circular dot to begin with, and then at a later stage only the peripheral circle. The ancient Indian represented zero as a circle with dot inside.

The word ' *sunya* ' was transliterated into Arabic in Al- Khwarizmi. The Persian encyclopedist 'Al- Khwarizmi', in his work De Numeroe Indorum, remarked that if in a calculation, no number appears in the place of tens, then a little circle should be used to keep the rows. The circle is actually the Arabic ' *sirf* ', meaning empty. The word ' *sirf* ' is derived from Arabic word ' *sfr* ', meaning empty.

Zero was independently invented three times. The first zero invented by Babylonians in the 3rd century BCE. The Babylonian placeholder was not a true zero because neither it was used alone nor at the end of a number. The Mayans, halfway around the world in Central America, independently invented zero in the fourth century CE. The final independent invention of the zero was in India in the middle of the fifth century CE. However, the time and the independence of this invention have been debated by scholars. Some of them say that Babylonian astronomy with its zero was passed on to Hindu astronomers but there is no absolute proof of this. So most scholars give the Hindus or Indians credit for coming up with the number zero on their own. A striking note about the Hindu zero is that, unlike the Babylonian and Mayan zero, the Hindu zero symbol came to be truly understood as the

meaning ‘nothing’, and it was used practically in calculations, astronomy and astrology. The concept of Indian zero had reached to Cambodia around the end of the 7th century CE. From India, it moved into China and then to the Islamic countries. The number zero finally reached Western Europe in the 12th century CE.

Zero in philosophical context

In Sanskrit the term ‘*Sunya*’ does not only convey the sense of void or nothing, but also reveals that of perfect fullness (i.e. *purna*). The eternal destroyer, Shiva destroy the universe which known as ‘*Pralaya*’. After destruction of the universe, the eternal creator, Shiva created a new universe which is known as ‘*Sristi*’. This new universe is created out of the sunya.

“The vacuum is truly a living void, pulsating with endless rhythms of the destruction and creation”

Presence of nothing i.e ‘*Sunyata*’ is the same as nirvana, which ‘encompasses the end and the beginning’. According to Buddhist school –

“ just as emptiness of space is necessary condition for the appearance of any object, the number zero, being no number at all, is the condition for existence of all numbers”

Zero in mathematical context

In the history of human civilization for the first time the term sunya was used in metrices by Pingala (before 200 BCE) in his Chandra- Sutra. Out of 315 sutras Pingala uses mathematical conception in sutras 20-35. He uses the word ‘*sunyam*’ which meaning absence of an operation. In sutras 28-31, he gives the idea of combinatorial and binary arithmetic, i.e., conversion of a decimal number to binary & vice versa. He gives the solution of the problem of finding the total number of arrangements of two things in ‘*n*’ places, repetitions being allowed. The two things considered are two kinds of syllables “long”(guru) and “short”(laghu), denoted by l and g respectively.

Pingalas four sutras translated into English by Sarma as follows :

Sutra 28: “[First write down the number of syllables in the given meter and go on halving that number. Each time] when [the number is] halved (*ardhe*), [write down in a separate row or column the digit] 2 (*dvih*).

Sutra 29 : “[When you reach an odd number, subtract 1 from it.] Whenever 1[is subtracted (*rupe*), write down in a separate column a] zero (*sunyam*).

Sutra 30 : "[Continue thus until the process stops. Then where you wrote a] zero (*sunye*), [multiply by] 2 (*dvih*).

Sutra 31 : "'Where [the number was] halved (*tavad ardhe*), multiply [the result of the second process] by itself (*tad gunitam*)."

The meaning of the above sutra will be clear from calculations given for the *Gayatri metre* which contains 6 syllables.

	A	B	C
1. Write the number of syllables	6		
2. Halve 6	3	2	$(2^2 \cdot 2)^2$
3. 3 cannot be halved; so reduce it by 1	2	0	$2^2 \cdot 2$
4. Halve 2	1	2	2^2
5. 1 cannot be halved; so reduce it by 1	0	0	1.2
	Stop	Begin upwards	

Columns A and B refer to the sutra 28 and 29, whereas column C refers to the sutras 30 and 31.

In his sutra Pingala uses a clear mathematical concept of zero and conversion of decimal number to binary and vice versa.

The oldest mathematical document on the Indian subcontinent is *Baksali Manuscript*. This Manuscript was found in 1881, in the village *Baksali*, about eight km. north-east of Peshawar (now in Pakistan), by a farmer who dug while cultivating a land. This document, written on birch-bark and contains seventy fragmentary leaves. In *Baksali Manuscript*, one finds numerous intricate calculations involving decimal place-value notation of numerals, including a solid dot for digit zero. The exact date, time and purpose of manuscript is widely debated.

The first written evidence of the use of zero as a decimal digit is concerned, depicted as a neat round circle and found in Indian soil, as of now, one may find it in the two stone inscriptions of Gwalior, dated 876 CE, discovered in the nineteenth century.

Two fundamental operations by zero viz. addition and subtraction can be found in *Panchasiddhanitika* of *Varahamihira* (505 CE). However, these are described in language and not symbols. Clear mathematical computations involving zero along with formulations of rules necessary for such calculations are found in *Brahmagupta's* work *Brahmasphutasiddhanta* (completed in 628 CE). He treated zero (referred to as *kha*) as separate



Inscription at Chaturbhuj Temple Gwalior
showing 270 in ancient Nagari script

number, neither positive (*dhana*) nor negative (*rna*) . In chapter seven, on Ganita, he states

‘Dhanayor dhanam rnam rnayor dhanarnayor antaram samaikye kham’

Which means, ‘ [the sum of two] positive [number]s [is] positive, [that of two] negative [number]s [is] negative, [the sum of one] positive [number and one] negative [is their] difference, [the sum of] two equals [opposite in sign, is] zero’.

Conclusions

Who invented zero is hotly debated. But it is established that India invented zero independently. Zero was first invented in Babylon and second time it was invented by Mayans, but their zero could not influenced the numeral system. Hindus invented third time zero in India around the middle of the fifth century. India gave the world a priceless gift – the decimal notation. The decimal notation derives its power from two key strokes of genius: the concept of ‘place-value’, and the notion of zero as a digit. Finally we conclude that the greatest contribution of Indians to world is Nothing!, nothing means Zero.

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