

## Indians to Prove the Origin of Zero in India

by Rajen Barua - Friday, September 29, 2017

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The Indian origin of zero and the modern numerals with the decimal system have always been a matter of immense national pride for all Indians. India's great contribution of the numerals with the decimal system to the world of mathematics is well recognized at least in some quarters. The great French Mathematician, Laplace who was one who appreciated the contributions of the Indians and he put this in great clarity, when he commented, "*The ingenious method of expressing every possible number using a set of ten symbols (each symbol having a place value and an absolute value) emerged in India. The idea seems so simple nowadays that its significance and profound importance is no longer appreciated. Its simplicity lies in the way it facilitated calculation and placed arithmetic foremost amongst useful inventions. The importance of this invention is more readily appreciated when one considers that it was beyond the two greatest men of Antiquity, [Archimedes](#) and [Apollonius](#).*"

In fact, India has been making great contributions to the world of mathematics in every field. However, in many western quarters where mathematical historiography has been largely shaped by the dominance of the Greco-Christian worldview and the Enlightenment period, India's various contributions in modern mathematics are not well recognized. Many western experts are even starting to question, "*How original are the Indian claims of the origins of the decimal system and the zero?*" Experts say that much of the ancient Indian traditional knowledge was primarily oral and there is not much record to prove India's claims.

While there is general agreement among scholars that the modern numerals with the decimal system in use today hail from India and that these reached medieval Europe via the Arabs, there is no consensus as to whether or not the zero digit was an indigenous Indian invention. Some experts are even questioning, "*Did the Indians borrow the zero from other civilizations? Can the Indians prove that zero actually originated in India?*"

Now, a small but ambitious team of Indian and international scholars called **Project Zero 'ZerOrigIndia'** wants to do exactly that. They have been asking the question: What made the invention of zero possible in India? The mission, the group's [website](#) says is an "*attempt to settle once and for all the continuing controversy in the world as to when, where and why the zero digit was invented.*" The group recently had its conference on Zero in Delhi in April 2017 where many scholars met and discussed on the subject. The group is planning to organize more research and seminars to dig into India's past history.

From records, we know that from the Gupta period (5th century CE), the zero and the decimal system were well established in India. We have records that a mathematician and astronomer named [Aryabhata](#) used zero as a placeholder in the 5th century. [Brahmagupta](#) (628 CE), another Indian astronomer and mathematician, even wrote a treatise on zero. This was many centuries before the West came to know about zero. The knowledge of the Indian numerals

along with the zero and the decimal system was eventually transmitted through the Arabs to the West in the Middle Ages.

For a time, the oldest known example of the zero (zero shown as a circle) was located a temple in Madhya Pradesh and dates back to the 9th century. More recently, a 7th-century dot-zero (that is zero shown as a dot) emerged as the oldest known example, on a stone inscription in a temple from Cambodia. Now, we have some recent good news. An Indian manuscript, titled Bakhshali manuscript, with hundreds of examples of the dot-zero has been radiocarbon-dated in September 2017 at the Bodleian Library at the University of Oxford. The result shows that some fragments of the Bakhshali manuscript date back to the 3rd or 4th century CE. For many years, though, the date of these birch bark documents was debated. The most accepted analysis put them somewhere between the 8th and 12th centuries, based on their contents. The Bodleian tested three different samples, which produced three different ages. The most recent fragment dates to sometime between 850 and 993, and the oldest to between 224 and 383. The Bakhshali manuscript was originally discovered in 1881, by a farmer working fields in what is now Pakistan. The fragmentary manuscript contains what appear to be math exercises for merchants on the Silk Road, intended to teach the calculations they'd need to conduct business.

This carbon dating of the Bakhshali manuscript has had a very positive impact on our search for the original zero. It shows the record of using the dot-zero symbol as early as 3rd century CE. As the concept of zero grew in use, the dot symbols started to expand, until they had that familiar gaping hole in the middle. It is also significant that the Bakhshali manuscript was discovered in a region what is now Pakistan. India was ruled at that time (from 1st-century CE to 3rd century CE) by the Kushan empire. The Kushan Empire was a syncretic empire, formed in the Bactrian territories in the early 1st century. During their rule, there was active trade and commerce through the seas as well as the Silk Road. During that period, Buddhism, patronized by the Kushans, extended to China and other Asian countries through the Silk Road. During the reign of the Kushan Buddhist king Kaniska, there was the third Buddhist council in Kashmir.

The question we need to ask is, is the 3rd Century CE the earliest record of the Indian numerals with zero symbols? What happened before this? The records are fuzzy here. One reason is that many ancient Indian mathematical texts have long been extinct. Often the only indication that they once existed comes from the work of subsequent commentators making reference to lost works from an earlier age.

The Brahmi numerals that existed in 3rd century BCE, which were the ancestors to the present Indian numerals, did not have the decimal system nor the zero. One basic question that is arising now is, "*When exactly did the Indians adopt the decimal system and more importantly when was the zero added to the Indian numerals?*". As mentioned earlier, some experts are even questioning did the Indians borrow the zero and the decimal system from other civilizations such the Chinese, the Babylonians, the Mayan or the Egyptians? Some of these questions are easy to answer while others are not. Especially, the origin of zero has been an enduring subject of debate. The Egyptians had a decimal system without a glyph for zero, the Babylonians had a place value for zero, so did the Chinese; or was zero borrowed from the Greeks?

[Ptolemy](#) (130 CE), the Greek astronomer, was using a symbol for zero (a small circle with a

long overbar) in his work on mathematical astronomy known as the Almagest. Ptolemy's zero was used within a sexagesimal numeral system (borrowed from the Babylonians) otherwise using alphabetic Greek numerals. However, it was used alone, not as a placeholder and the positions were usually limited to the fractional part of a number (called minutes, seconds, thirds, fourths, etc.). They were not used for an integral part of a number. In later Byzantine manuscripts of Ptolemy's Almagest, (10th Century AD), the Hellenistic zero had morphed into the Greek letter omicron (otherwise meaning 70). It is conceivable, according to some, that the Indians borrowed the zero from Ptolemy. But the Indians need to prove otherwise.

The Indians, therefore, have a big task to counter these arguments and show how the zero originated in India. There are still tens of thousands of ancient manuscripts in India and in the world at large that have still not been studied for any clues that may point to the origin of the zero digit. In that connection, it would be very timely to undertake a concerted effort now to discover what extent evidence may as yet be produced before crucial manuscripts deteriorate further or are lost altogether. It may be noted that recently a stone inscription bearing the numerals 2312078 (showing the zero as a dot symbol) was suddenly discovered in Golaghat, Assam. The date of the inscription, however, is yet to be evaluated properly. The group is exploring on the issue at present. There are many such undiscovered hidden records waiting to be discovered and analyzed.

India's fascination for big numbers is one major argument as a motivation for the Indians to invent the zero. The Hindu cosmology deals in billions of years. For example, a cycle of day and night of Brahma is 8,640,000,000 human years! One plausible theory is that the early use of such large numbers eventually led to the adoption of a series of names for successive powers of ten. While the Greeks had no terminology for denominations above a myriad (10,000) and the Romans above thousand (1000), the ancient Indians dealt freely with no less than eighteen magnitudes of ten.

We know from a record of an early Buddhist work in the 5th century BCE, that the prince Gautama Buddha correctly recited the counting beyond the koti on the centesimal scale: "*Hundred kotis are called ayuta, hundred ayutas niyuata, hundred niyutas kankara, hundred kankaras vivara, hundred vivaras ksobhya, hundred ksobhyas vivaha, hundred vivahas ustanga, hundred ustangas, babula, hundred babulas nagabala, hundred nagabalas tithi lambha and so on upto another twelve terms ending with tallaksana.*" (Thus one Tallaksana is  $10^{53}$ .) The word-numeral system was the logical outcome of proceeding by multiples of ten. The decimal place-value system was developed when a decimal scale came to be associated with the value of the places of the numbers arranged left to right or right to left, and this was precisely what happened in India.

Scholars at Project Zero say the key may lie in early Hindu and Buddhist philosophical discourses about the concept of "shunya" or "emptiness" or "void," which began many centuries before the mathematical zero came about. "We find the cultural notion of zero-ness or emptiness in philosophy, grammar, music, dance, visual arts, and architecture much earlier. We want to trace its steps as far back as we can and look for the 'bridges' between philosophy and mathematics. What was the philosophy that provided a fertile ground for such an invention?" The carbon dating of the Bhakhshali manuscript to 3rd century CE will help us to focus in the

Kushan empire in the region of Pakistan and Kashmir.

The group is engaged in exploring all the avenues for digging into India's past records to find the clue to the origin of zero in India. We hope in the process of establishing the origin of zero in India, we would be able to establish proper recognition for India which it is due.

If you feel proud as an Indian, you may visit the [website](#) and help the team in its effort to establish the origin of zero.

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