

OBJECTS AS HISTORY  
THE JOURNEY OF ZERO

Trisha Fernandes

ISDI Section G

Prarthana Patil

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## INTRODUCTION

The number that holds a special importance and has travelled through out the world is Zero. It is a number used to denote empty space, can turn around the value by it's absence or presence. "In the story of zero, something can be made out of nothing."<sup>1</sup> It is the key of mathematics and Calculus which is the base of physics, engineering, economic, finance, etc. It is interesting that something which plays such a crucial role has the name Zero which means empty or null.

"Behind this seemingly simple answer conveying nothing lays the story of an idea that took many centuries to develop, many countries to cross, and many minds to comprehend. Understanding and working with zero is the basis of our world today. The story of zero is the story of an idea that has aroused the imagination of great minds across the globe."<sup>2</sup> The invention of Zero was in India but, it was more like the concept of zero got layers of functions to perform from all the different places it travelled. In some it was welcomed and in few it was opposed. It gradually kept maturing and got the position it has today. To know this journey we have to go through different places and periods.

"The earliest known archaeological evidence of any form of writing or counting are scratch marks on a bone from 150,000 years ago."<sup>3</sup> They made clay table and drew symbols on it for keeping records of administrative activities. Then just group of straight line strokes were used for counting. Followed by the roman number like V, VI, XVV, etc. But this number system was confusing for calculation with big denominations. "It needed one of those strokes of genius which we now take for granted to come up with a way of representing numbers that would let you

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<sup>1</sup> "The History Of Zero", *Yale Global Online*, Accessed November 28, 2016, <http://yaleglobal.yale.edu/about/zero.jsp>

<sup>2</sup> Ibid

<sup>3</sup> Ibid

calculate gracefully with them; and the puzzling zero - which stood for no number at all - was the brilliant finishing touch to this invention.”<sup>4</sup>

### SUMERIANS

The Sumerians who invented the writing system, made clay tables for keeping the account of administrative activities. They used symbols that denoted some value. They wrote by making circles and semicircles impressions on clay using a hollow reed. They passed this knowledge to Akkadians in 2500 BC and later to the Babylonians in 2000 BC. It was the Babylonians that first left empty spaces in the columns and later developed a symbol to denote it. From the evidences found it is accepted that it played a role of placeholder.<sup>5</sup> But it was just the start as zero was centuries away to be invented.

### GREEKS

The Greeks were very close to invent zero but had no name for it. As they lacked of positional notation they did not have symbol for zero. When Greek invades Babylonian Empire in 331 BC is when they took zero off with them and understood its importance. The Greeks represented it by ‘O’ symbol whereas the Babylonians had wedges symbol. “Then why this hollow circle? The commonest explanation is that ‘O’ came from the Greek omicron, the first letter of OUDEN: ‘Nothing’, like Odysseus name ; or simply from ‘not’: like our nought.”<sup>6</sup> We notice this symbol was quite similar to

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<sup>4</sup>Kaplan, Robert. *Nothing that is: A Natural History of Zero*. New York: Oxford University Press, 2000. Accessed on November 28, 2016, [https://Books.Google.Co.In/Books?Id=Ztdncwaaqbaj&Pg=PA6&Lpg=PA6&Dq=%22+It+Needed+One+Of+Those+Strokes+Of+Genius+Which+We+Now+Take+For+Granted+To+Come+Up+With+A+Way%22&Source=Bl&Ots=V-Kpd8dryv&Sig=Xjanbgn8dq1e-Pkootwcsnfghx4&Hl=En&Sa=X&Redir\\_Esc=Y](https://Books.Google.Co.In/Books?Id=Ztdncwaaqbaj&Pg=PA6&Lpg=PA6&Dq=%22+It+Needed+One+Of+Those+Strokes+Of+Genius+Which+We+Now+Take+For+Granted+To+Come+Up+With+A+Way%22&Source=Bl&Ots=V-Kpd8dryv&Sig=Xjanbgn8dq1e-Pkootwcsnfghx4&Hl=En&Sa=X&Redir_Esc=Y)

<sup>5</sup> Jessie Szalay, “Who Invented Zero?”, *LiveScience*, Accessed on November 28, 2016, <http://www.livescience.com/27853-who-invented-zero.html>

<sup>6</sup>Kaplan, Robert. *Nothing that is: A Natural History of Zero*. New York: Oxford University Press, 2000. Accessed on November 28, 2016, [https://Books.Google.Co.In/Books?Id=Ztdncwaaqbaj&Pg=PA6&Lpg=PA6&Dq=%22+It+Needed+One+Of+Those+Strokes+Of+Genius+Which+We+Now+Take+For+Granted+To+Come+Up+With+A+Way%22&Source=Bl&Ots=V-Kpd8dryv&Sig=Xjanbgn8dq1e-Pkootwcsnfghx4&Hl=En&Sa=X&Redir\\_Esc=Y](https://Books.Google.Co.In/Books?Id=Ztdncwaaqbaj&Pg=PA6&Lpg=PA6&Dq=%22+It+Needed+One+Of+Those+Strokes+Of+Genius+Which+We+Now+Take+For+Granted+To+Come+Up+With+A+Way%22&Source=Bl&Ots=V-Kpd8dryv&Sig=Xjanbgn8dq1e-Pkootwcsnfghx4&Hl=En&Sa=X&Redir_Esc=Y)

the one we used in the present times. Even the thought behind the design of it to select a hollow circle to show nothing. But it was still long time for zero to get its name and value.

## INDIA

The invention of zero as a number took place in India. Some believe that this concept of zero existed in India much earlier than the Babylonians. The known use of numbers in India can be traced back in the Harappan civilisation in the tokens they used. Soon they started use of pictographs and had standard weights system. They were the first to use 10 as base as compared to the 60 as base in Mesopotamia. After the end of Harappan civilisation, India had the concept of Infinity and progressed in Geometry, Astronomy and finally the number zero.<sup>7</sup> There is also a conflict whether zero was invented by Brahmagupta or Aryabhata. “Brahmagupta explained ‘if you subtract the number from itself you all obtain zero’ and The sum of a positive and negative is their difference; or, if they are equal, zero.”<sup>8</sup> In the Hindu culture it is believed that everything starts from nothingness that means Sunyata. So to denote nothingness the symbol could have been created.<sup>9</sup> Aryabhata during 500 AD invents a number system which has no zero but still was a positional system. He used the word "kha" which means place for position. There are evidences that dot symbol was used to denote empty place in positional notation. The first record of the Indian use of zero which is dated and agreed by all to be genuine was written in 876. In India the concept of zero existed as place holder and as number itself as balance in positive and negative numbers.

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<sup>7</sup> “Invention of Zero - History of Indian Mathematics”, *Quatr.us*. Accessed on November 28, 2016, <http://quatr.us/india/science/math.htm>

<sup>8</sup> Ibid

<sup>9</sup> Robert Cumming, “Why is the concept of zero so important”, *Quora.com*, Accessed on November 28, 2016, <https://www.quora.com/Who-invented-zero-and-how>

## PLACE VALUE NOTATION

India contributed a very great invention to the world and that is the place value (Positional Notation) system. And zero could be a byproduct of this system. Before this system the symbols had to be repeated to show the right amount. Like in Egypt using the hieroglyphic script the numerals were  $| = 1$ . This style can be seen in the Babylonians but, their place value system is a different one its base was 60 rather than 10. In simple words they would multiply by 60 instead of 10. However, as time passed, ideas evolved, and by 500 A.D, a 10 base system was invented by the Indians that had numbers one to nine, used place value notation and used a Zero.<sup>10</sup>

Place value in simple words is breaking down the number in tens, hundreds, thousands place and so on. The position of the number tells its value. This helps to simplify addition and multiplication. For example, 170 is  $1 \times 100 + 7 \times 10 + 0 \times 0$ . Imagine using Roman numerals to do calculations, with symbols like I, L, XII and many more, it would be confusing to write the correct answer. Due to the presence of so many symbols neither maths nor science would be easy to do.

“Aryabhata clearly mentions in his book *Aryabhatiyam*, *sthaanam sthaanam dasha gunam* meaning from place to place increase 10 times”.<sup>11</sup>

This was a genius method as any number could be represented with just 10 symbols and complicated maths could be solved like multiplication, division, and all that the modern maths has. As Albert Einstein rightly said, “We should be thankful to Indians who taught us how to count, without which no worthwhile scientific discovery would have been possible.”<sup>12</sup> This whole concept is considered to be invented by Aryabhata but, he has just combined all the existing knowledge

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<sup>10</sup> Doctor Reno, “History of Place Value And Zero”, *The Math Forum*, Accessed on November 28, 2016, <http://mathforum.org/library/drmath/view/52566.html>

<sup>11</sup> Place Value, not Zero is most important invention of ancient Indian Mathematicians | *HitXP by Gurudev*, Accessed on November 28, 2016, <http://www.hitxp.com/articles/science-technology/place-value-important-invention-ancient-indian-mathematicians/>

<sup>12</sup> *Ibid*

from the traditional Sanskrit method. “Place value system is an even ancient invention of India, and is in built into the very language of Sanskrit. For instance, the name for Eleven is *eka dasha* in Sanskrit where *eka* means one and *dasha* means ten. Note that this Sanskrit place value system is from the left, while modern place value system is from the right. So in Sanskrit when we say eka dasha, the left most value is 1 (eka), and the next value is ten (dash). While in modern notation 11, the right most value is 1, and the one to its left is 10.”<sup>13</sup>

Initially when this system used just 9 symbols from 1 to 9, it created a problem of representing empty value spaces with a symbol. Initially a space would be left for example, 101 will be shown as 1 1. This difficulty was solved with the invention of zero and its placement in the number system. From this we understand that there is a lot of importance of zero and its placement in any digit on the basis of Place Value Notation. And it has the risks of addition or subtraction of zero but the system is better as compared to others.

### ARABS

In Sanskrit it was Sunya and the Arabs called it Sifr or Safira which means empty in Arabic.<sup>14</sup> The name Sifr has also derived the word Cipher. Zero travelled with the Arabic Voyagers along with spices and the exotic items. It landed in Baghdad during 733 AD the mathematicians there developed it on the base of Indian number system. Around the 9th century, Mohammed ibn-Musa al-Khowarizmi worked on equations or Algebra as we all call it. He also developed Algorithms that is quick method to calculate with division and multiplication. By 879 AD the circular shape of zero started getting oval similar to the one we use today. Later due to the Spain conquer zero reached Europe.

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<sup>13</sup>ibid

<sup>14</sup> “The History Of Zero”, *Yale Global Online*, Accessed November 28, 2016, <http://yaleglobal.yale.edu/about/zero.jsp>

## CHINA

First China used number rods for counting. They too left empty space but did not have a symbol for it. It was Qui Jiushao who brought the use of zero from India to China at the same time when it reached Europe. During this period people also started using abacus which was like a modern calculator.<sup>15</sup>

## EUROPE

“Zero found resistance in Europe though - the Hindu-Arabic system was opposed by the number system established by the Roman Empire. But this changed in the 13th Century when academics such as the Italian mathematician Fibonacci started championing the new number system in their work. This helped zero gain a solid foothold across Europe.” Fibonacci worked on Al-Khwarizmi’s algorithms from the book *Abacus* in 1202. Fibonacci’s work was noticed by Italian and German bankers. Zero was the hero and they could keep balanced record of their account book with positive and negative amount entries and liabilities equaled to zero. Zero was still under suspicion although its use as arabic numerical because of its easy application and change from one symbol another. The merchant used it as code and that is when the word Cipher derives meaning code from arabic Sifr.<sup>16</sup>

Some Applications of zero are-

CARTESIAN COORDINATES - The graph origin point (0,0) was invented by Rene Descartes. It was used to graph triangle, parabola, etc.

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<sup>15</sup>“Invention of Zero - History of Indian Mathematics”, *Quatr.us*. Accessed on November 28, 2016, <http://quatr.us/india/science/math.htm>

<sup>16</sup>Ibid

CALCULUS - By now zero was common. Newton and Leibniz took a big step in understanding zero. Except for division by zero all other calculations were easy. For example - How would no fruits be divided in two fruits? Indeterminate is the answer and also the key to calculus. The discovery of calculus opened a whole new world, especially in physics and engineering. And zero played a crucial role in invention of calculus. "Calculus allowed anyone to break dynamic systems down into smaller and smaller units approaching zero, but cunningly avoided the trap of having to divide by zero."<sup>17</sup>

PHYSICS - To measure absolute temperatures, intensity, quantum mechanical physical system, etc.

CHEMISTRY - Atomic numbers, periodic table, chemicals mixing quantity measurements, etc.

ASTRONOMY - "Astronomers use year numbers not only to identify a calendar year, but also to identify a certain instant (known in astronomy as an epoch)."<sup>18</sup> Saros number of the solar eclipse.

BINARY NUMBERS - So many years later zero again became a very important element of modern day computer programming. "As the binary numerical system formed the foundation for modern computer programming, zero once again proved its worth. A binary number in computing

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<sup>17</sup>Abigail Beall, "Getting something from nothing: Mathematician reveals the fascinating story behind the number zero and how modern life couldn't function without it". *The Dailymail*, April 15, 2016, Accessed November 28, 2016, <http://www.dailymail.co.uk/sciencetech/article-3541925/Getting-Mathematician-reveals-fascinating-story-number-ZERO-modern-life-couldn-t-function-without-it.html>

<sup>18</sup> Ibid



and maths (pictured) is expressed in the binary numeral system which represents numeric values using two symbols: typically 0 (zero) and 1 (one).”<sup>19</sup>

## CONCLUSION

The concept of zero took so many years to develop and many mathematicians have worked to bring it to the position it is today. It is the most celebrated global symbol used. What is interesting in the number zero is it’s meaning that says empty space or ‘nothing’ when it almost covers everything. It has played a crucial role in invention of many great concepts and is still doing it. When we mention zero in any amount it has great responsibility in the position it is placed. The place value notation system which we follow has derived to make the placement of numbers and the calculations easy. It does have a risk of absence or presence of a digit that would created an issue, but as compared to other systems for calculations it is the easiest and more accurate system. It has the capability to place the numbers in different digits perfectly and by using just minimal ten symbols. We just can't imagine working with roman numbers for daily life calculations. Although the concept of zero has travelled all around the world, India has played a very important part in the history of zero. The sanskrit language, the cultural and religious texts of India have answers to many concepts in the world hidden within them. They have the treasure of knowledge. Just a number has so much of history and research behind its use. “The development of zero across continents, centuries, and minds has made it one of the greatest accomplishments of human society. Because math is a global language, and calculus it’s crowning achievement, zero exists and is used everywhere. But, like its function as a symbol and a concept meant to denote absence, zero may still seem like nothing at all.”<sup>20</sup> The journey the zero has covered from just being a concept with

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<sup>19</sup>Ibid

<sup>20</sup>“The History Of Zero”, *Yale Global Online*, Accessed 28 November, 2016, <http://yaleglobal.yale.edu/about/zero.jsp>

different symbols, discovery of zero, rules to use it, perform calculations with it, positive and negative numbers, Algorithms, Algebra, Cartesian Coordinates, Calculus and finally the modern computer system of Binary numbers. Often mathematics is not one of the favourite subjects and the above words might seem like a horror words but, when you go deep and understand how much efforts have gone behind these concepts it justifies the concept being though and vast. We just can't imagine a world without zero today. So to conclude zero because of its function to denote empty space got the name with meaning null. But in reality this same function it performed gave it special characteristics and importance it has today.

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