

Numeration in Medieval Sri Lanka and Importance of Sinhala Zero

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Introduction

Sinhala Mathematics and Numeration traditions in ancient and medieval Sri Lanka had lost over time. With the fall of the Kandyan Kingdom in 1815 to the British, the remaining scanty knowledge of Sinhala Mathematics vanished from the memories of the Sinhala people. Michael Everson, an Irish-American linguist, who was instrumental in encoding most Indic scripts in the Unicode standard, highlighted a set of numerals that he wanted to encode in the Basic Multilingual Plane (BMP) in the Unicode Charts among the Sinhala Alphabet. Everson had come to know of the forgotten Numeral set from a book that had become the only textbook for teaching Sinhala in nineteenth-century Europe, which was titled "A Comprehensive Grammar of the Sinhalese Language" by Mudaliyar Mendis Gunasekera. The author, a renowned Sinhala Scholar, had published the book in 1891. I later identified the above numeral set that Everson wanted to encode as the Sinhala Illakkam in my research in 2007.

The Sri Lankan delegation, which went to the Island of Crete in Greece for encoding Sinhala, convinced Unicode to drop two other Sinhala encoding proposals submitted by Michael Everson and IBM. Also, Prof. J. B. Dissanayake and Dr. Nandasara, the two-member delegation, further requested Michael Everson to postpone encoding Sinhala Illakkam in the BMP by assuring him to inform the outcome of further research into Sinhala Numerals. In the early two thousand, Michael Everson submitted a new proposal to the Unicode Consortium due to the unforthcoming of a concrete proposal on Sinhala numerals from the Government of Sri Lanka for almost ten years since the encoding of Sinhala. By the time the news of the new proposal of Michael Everson reached Sri Lanka, this proposal had reached the final stages of encoding in the Unicode Charts. The Sri Lankan Government decided to send Prof. J.B. Dissanayake to convince the Unicode Consortium again to the Working Group II of ISO to postpone the encoding until our team finished the research on Sinhala Numerals. Unicode Consortium agreed in the late stage of encoding Everson's proposal to wait until the Government of Sri Lanka submitted a fresh proposal with the new findings.

Findings of the Research on Sinhala Numerals

Having gone through rock inscriptions, Ola leaf manuscripts, early Dutch and Portuguese rare publications in Sinhala for two long years, we presented the findings in several papers and as a book. The following is the summary of the findings of the research, and some of these findings, I had published as a book titled "Numerations in the Sinhala Language" in 2009:

1. In 1815, the Kandyan Royal court had used a set of ornate numerals similar to Sinhala script, which had been known as Sinhala Illakkam. These numerals are found in the Kandyan convention to number the twelve clauses of the treaty. Sinhala Illakkam did not have a Zero and had evolved directly from Brahmi numerals, which have been discovered in Sri Lanka until 400 AD. Sinhala Illakkam had symbols for 10, 20, 30,40,50,60,70,80,90, 100, and 1000. When writing large numbers such as 2020, one had to use number symbols for 2, 1000, 100, and 20. 2020 will be written as symbols for $2*1000+20=2020$.



ම	ල	෧	෪	෫	ඬ	ඳ	෭	෮	෯	෧෦
1	2	3	4	5	6	7	8	9	10	
෧෦	෨෦	෩෦	෪෦	෫෦	෬෦	෭෦	෮෦	෯෦	෧෦෦	෧෦෦෦
20	30	40	50	60	70	80	90	100	1000	

Figure 1 Sinhala Illakkam

2. In Sri Lanka, a parallel set of numerals to Sinhala illakkam had evolved with a zero placeholder (decimal notation) for astrological calculations from Brahmi Numerals. By 1700, Sri Lankan astrologers widely used this set of numerals, which was known as Lith Illakkam or ephemeris or astrological numerals. I found a plethora of Ola manuscripts written on Astrology in the Kandy Museum using Lith Illakkam or Lith digits for calculations, and most of these writings had been dated to the early 18th century. The tradition of writing horoscopes recording the movement of planets in degrees in Zodiac signs and Nakshatra in astrological digits continued to the twentieth and the twenty-first centuries.

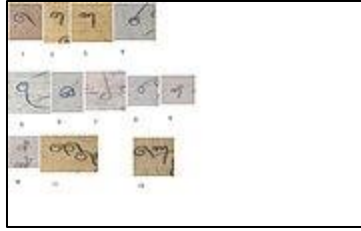


Figure 2 Lith Illakkam

3. In Ola written on astrology in the 17th century, Sri Lankan astrologers had depicted Sinhala zero with Halantha or Hal Lakuna in Lith Illakkam. Most scholars of the West believed until our findings that Sinhala numerals did not have zero or a zero placeholder concept. We have found that Sri Lankan astrologers performed subtraction, additions, multiplication, and division in astrological calculations similar to modern decimal notations complying using the zero placeholder. Although we have not found clear evidence up to now that Sinhala Mathematicians had treated zero as a number individually, looking at some of the calculations that medieval astrologers had performed, we have to deduce that the Sinhala zero had evolved into the status of a number by 1700. In my view, devising the concept of the placeholder is a crucial discovery by Sinhala mathematicians; and I hypothesize that our Sinhala script has been developed based upon the placeholder concept as well when using the Halantha or Hal Lakuna. A good example is how we pronounce "කෙ" (Ke) and "කේ" (Kē). The placing of Halantha or Hal lakuna attached to Ka makes the 'Ae' sound on the left more pronounced, doubling the sound of the earlier, which is similar to writing 10 or 30 in decimals. Therefore, the idea of Sunaya (Zero), and placeholder concepts had crept into the Sinhala script when halant was introduced in the fifth century at the time of building the Sigiriya. In other words, placing Halanta removes the inherent vowel in a consonant, or halant acts as a nullifier, making it a pure consonant.

4. Most historians accept that the first appearance of the symbol for zero in the world would have occurred between 600 AD and 800 AD in India. Khmer zero even predates Gwalior zero, and the zero is shown as a dot. In Sri Lanka, Halant appeared in the Sinhala script in the fifth and the sixth century. I saw a set of bricks found in the Menikdena Stupa in Dambulla at the Sigiri Museum with marks resembling numbers or Sinhala glyphs belonging to the period between the 6th and 8th centuries. Placement of Kombuwa after a mark resembling Sinhala glyphs gave me sufficient reasons to suspect those marks I observed were Lith Illakkam and were arranged according to the decimal notation. I further detected a kombuwa with Hal Lakuna, which I suspected number ten with 1 and 0 arranged according to decimal notation. If I were correct, we could surmise that Sinhala Mathematicians especially 'Ganithayas' may have used Hal Lakuna as the symbol for the zero since it was created in the Sigiri period. Further studies are required to prove the above, if I'm correct in my suspicion, Sinhala Ganithayas may have been some of the pioneers who had used a symbol for zero predating Gwalior zero in the ninth century.

Conclusion

Both Sinhala Illakkam and Lith Illakkam are encoded in Supplementary Multilingual Plane (SMP) and Basic Multilingual Plane (BMP) of the Unicode respectively, since 2009. We have also established beyond doubt that Sinhala Ganithayas have used zero for astrological calculations, and the concept of Sunaya and zero placeholder concept had contributed to the development of the Sinhala Script. Further studies are required to establish whether Sinhala mathematicians had treated zero as an individual number with attributes giving direct evidence. At present, looking at operations performed in astrological calculations, we can only surmise that Sinhala mathematicians had treated zero as a number.