Cretan Hieroglyphs Numerals: A Brief Information

Eka Ratna Acharya*

Central Department of Education, Tribhuvan University, Kirtipur, Kathmandu, Nepal

*For Correspondence: Eka Ratna Acharya, Central Department of Education, Tribhuvan University, Kirtipur, Kathmandu, Nepal, Tel: +97714331076; E-mail: er47acharya@gmail.com

Review Article

ABSTRACT

The term 'hieroglyphs' is mostly used in numeral notations. It is also related to languages, even though mathematics itself is a language. The Cretan Hieroglyphs script is one of the writing systems used on the Island of Crete between 2000-1650 BC. The symbols used in Cretan Hieroglyphs are found in many sources among them Phaistos disk is most popular. Cretan hieroglyphs were indigenous mathematical developments as the local writing systems. There may be the interrelationship among such notations or symbols of different civilizations. It was developed in the basis of culture, rituals, and indigenous practices distinctively. Similarly other local indigenous or antique phase's hieroglyphs were found in different communities. We should care on such indigenous developments would be around in our surroundings too. Here the aim of this paper is to explore the development of Cretan Hieroglyphs numerals as the historical development in mathematical concern. The document analysis and historical approach is used here to conclude the theme of this paper.

Keywords: Cretan Hieroglyphs, Phaistos disk, Knossos, Evans

INTRODUCTION

The hieroglyphs numeral systems were indigenous development in the ground of any civilizations. Popularly people used the word 'hieroglyphs' as the numeral system of Egypt. Egyptian developed hieratic and demotic symbols in their own ground. The term 'hieroglyphic' was coined when the first script documents were unearthed by Arthur Evans at archaeological venue Knossos in Crete. The ancient Greeks first used the term hieroglyph as "sacred carving" to describe decorative characters carved on Egyptian monuments. The term is now mainly used to refer to the system of writing used by the ancient Egyptians. The indigenousness of Greek mathematics as the cultural and ethnographic perception can be understood from the Cretan hieroglyphs. It was also illustrated the paper Geometrical Patterns in the Pre-Classical Greek Area. Prospecting the Borderland between decoration, art, and structural inquiry [1].

The Egyptian hieroglyphs were developed in 3200 BCE and the Cretan hieroglyphs were in 2000/1900-1700/1650 BC [2]. The word hieroglyph comes from Greek language that when the Greeks were entered Egypt, they saw the carvings on temple walls and called them, in Greek, hiero ("sacred") glyph ("carvings"). According to Brier, hieroglyph is the noun form of the word and hieroglyphic is the adjectival form [3].

The hieroglyphic system of Egypt is earlier than Cretan but the term 'hieroglyphs' was introduced by Greeks. Cretan people developed distinct numeral system in different periods but their periods were overlapping. Descendants of hieroglyphic numeral systems have within own region and Aegean.

The Cretan hieroglyphic or pictographic script was first described by British archaeologist Sir Arthur Evans based on his works at Knossos [4]. Cretan hieroglyphic form of writing was developed in the period from about 2000 to 1600 BC [5]. The link between Egyptian hieroglyphic system and Aegean system have seen genetic relation since there exist trade relation between them and the development periods of Aegean system were later than Egyptian [6]. Generally hieroglyphic numerals or symbols were used to maintain the records of the works of the corresponding timelines in ancient civilizations [7].

Crete was the birthplace of several ancient writings, including the Cretan Hieroglyphs with the Linear A and the Linear B scripts. A computational study of the evolution of the three Cretan and four other scripts encompasses a novel translation of the scripts to a DNA encoding, which enables the use of hypothetical evolutionary tree reconstruction algorithms from the area of bioinformatics [8].

REVIEW OF CRETAN HIEROGLYPHS NUMERALS

Cretan hieroglyphic, Minoan are generally divided into two categories-Linear A, Mycenaean and Linear B. It consist 241 symbols in 45 categories [4]. The Cretan hieroglyphic numerals were formerly thought to be ancestral to Linear A, now it appears that Linear A predates the Cretan hieroglyphs, perhaps by as much as a century. The exact historical relationship between the two numerical notation systems is unclear, but it can be believe that it most likely that the Cretan hieroglyphic numerals were a local variant of the Linear A system. The Linear B Mycenaean script used on Crete and the Greek mainland definitely derived from Linear A. Its numerals are nearly identical to those of Linear A. The precise relation between the peoples using the Linear A and B scripts is still unclear, as is the question of the cause of the collapse of the Minoan civilization in the fifteenth century BC. Presumably, during this period, the Greek-speaking Mycenaean adapted Linear A for their own language, resulting in Linear B. The two scripts coexisted in Crete about 1550 to 1450 BC, after that time Linear B replaced completely to Linear A [9]. Linear A, which dates back to about 2500 BC, was the main script used in the Minoan palaces of ancient Crete. There was not uniformity about the time line of Cretan hieroglyphs. On the basis of these different time lines we can say that it was developed around 2000 BC.

The Cretan Hieroglyphic or Pictographic script was first identified by Sir Arthur Evans [4]. While it was once considered ancestral to the other Aegean scripts, it was developed about more or less the same time as, the Linear A script. Its use is generally thought to have lasted from 1750 to 1600 BC [9]. It is found on around 300 attested seal-stones and clay documents [9]. While the script is still deciphered, it is as a mixed syllabic and logographic structure, like other Aegean scripts. Among the few Cretan hieroglyphic signs that can be interpreted securely are the numerals, which is shown below.
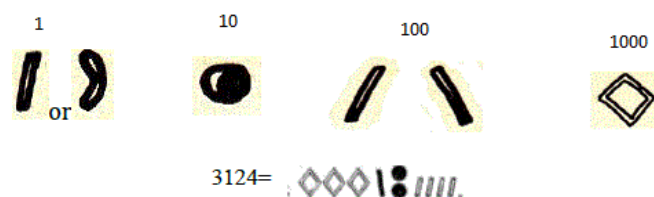

Figure 1. Cretan Hieroglyphs to interpreted numerals in base 10.

From above **Figure 1** we see that the number 1 was indicated by small slanted line or a small arc that could be oriented in any direction such as sometimes went from left to right, sometimes from right to left, and sometimes in both directions alternatively; 10 by circle, 100 by a large slanted line, clearly differentiated from the small line for 1; and 1000 by a diamond-shaped signs [4-6].

The Island 'Crete' of Greece was the center of a highly advanced culture now, known as Minoan about 2200 BC to 1400 BC. The most spectacular stages in the rediscovery of Minoan civilization, such as the excavation of famous palace of Knossos, were brought about by the tireless efforts of the British archaeologist Sir Arthur Evans (1851-1941). The accounting device which gives details of deliveries or exchange system is like as below in **Figure 2** [4].
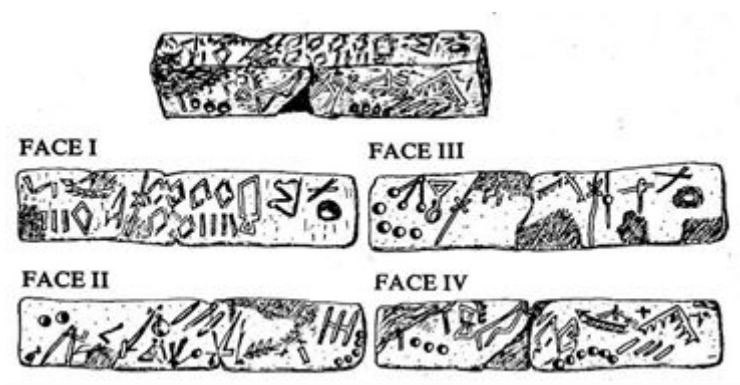

Figure 2. Cretan Hieroglyphs for accounting device.

The system is repetitive-additive and decimal, and usually written from left to right, although right to left. Numeral-phrases are also attested. Groups of multiple repeated signs were sometimes organized using two rows, one above the other, each with no more than five signs, but this rule was not strictly applied, and in other cases the organization of signs were more haphazard. There is no great similarity between the numeral-signs for the Cretan hieroglyphs and any other system, except that the use of the dot for 10 is common with some early Linear A inscriptions. It is probable that the Cretan hieroglyphic numerals are a local variation of the Linear A, numerals. The Cretan hieroglyphic inscriptions include information on commodities such as wheat, olive oil etc., records of transactions, inventories of goods, and similar administrative documents [6,10]. There were no uniformity of the numbers of symbols used there, different researcher claimed different types of symbols and variations in numbers of symbols (hieroglyphs). A scholar Karnava illustrated 6 types of Cretan hieroglyphs; they are syllabogrammes (96), Logogrammes (32), Klasmatogrammes (9), Arithmogrammes (4), Stiktogrammes (1) and Ligatures (4). Altogether there were probably 146 symbols were found [11]. According to Karnava, the following **Figure 3** illustrations the Cretan hieroglyphs [2].

Figure 3. List of Cretan Hieroglyphs.

The Phaistos disk, shown in **Figure 4**, is the largest hieroglyphic inscription discovered in Crete. It consist 61 sign groups, and it exhibits the remarkable peculiarity that ever sign has been separately impressed in the clay white in a soft state by stamp or punch. It is in fact a printed inscription, its' side A is displayed in the Archaeological Museum of Heraklion after the 2014 renovation [12].

Figure 4. Phaistos disk.

ANALYSIS OF THE CRETAN HIEROGLYPHS NUMERALS

The Linear A script was used in the Minoan civilization of Crete between 2000 and 1400 BC, more or less conjointly with hieroglyphics writings [5]. It is written from left to right and also appears on a wide variety of objects like vases with inscriptions incised, painted, or even written in ink, religious objects, clay seals, stamps, labels and large copper ingots,

etc. This writing was therefore used not only by administrators but also in sanctuaries, and probably it was used by private individuals [5]. Linear A numeral-signs are shown below [6, 8].

Linear A Numerals

This numeral system is decimal and repetitive-additive, and is written from left to right with the exponents in descending order (**Figure 5**).

Figure 5. Linear A numeral on Cretan tablets.

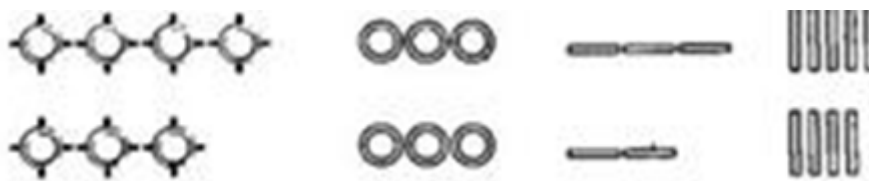The numeral-phrase 7659 = 7000+600+50+9 can be expressed as below in **Figure 6**.

Figure 6. Cretan Linear A numerals.

The dot symbol for 10 is found only in early Linear A documents and is probably related to the identical numeral-sign for 10 in the Cretan hieroglyphs other than this; however, the system remained unchanged throughout its history [6]. Example of Linear A Numeral of Cretan hieroglyphs, dating from 16th century BC is shown in **Figure 7** [5].

Figure 7. Cretan tablet with numerals of the writing linear A.

Linear B Numeral System

The Linear B script was used on Crete and the Greek mainland in the middle to late second millennium BC. The signs of Linear B were usually inscribed on clay tablets, the first of which were discovered in 1900 AD which are looked like as below (**Figure 8**) [6,11].
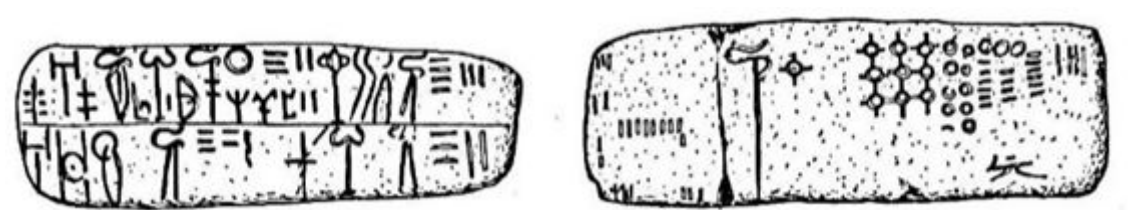

Figure 8. Linear B numeral on Cretan tablets.

Linear B was used to write an archaic Greek dialect on clay administrative tablets. It is written left to right. The Linear B numerals are shown below [6,11].

Linear B Numerals

The structure of Linear B is repetitive-additive and decimal, with the highest exponents of on the left to right in descending order and with five or more identical signs divided into two rows (**Figure 9**).
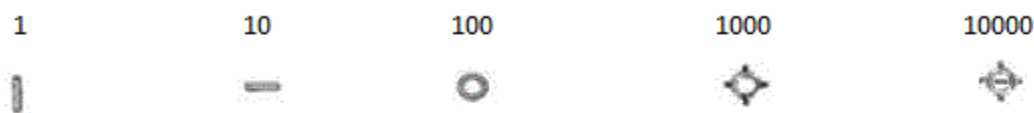

Figure 9. Linear B numeral on Cretan tablets.

For example: 68357 = 60000+8000+300+50+7 can be written as shown below (**Figure 10**).
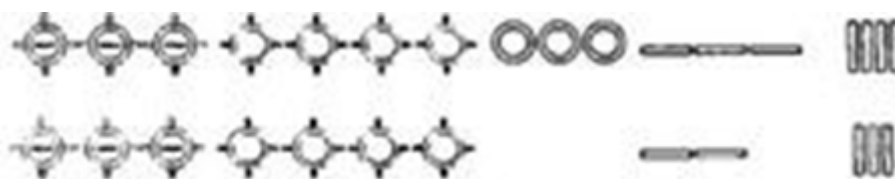

Figure 10. Linear B numeral on Cretan tablets in expanded form.

The Linear B signs are mostly identical with the Linear A signs, except that the signs for 10 are always a horizontal stroke, and there is a sign for 10,000 that is not found in the earlier system. The sign for 10, 000 formed by placing a sign for 10 inside the sign for 1000, it is a multiplicative combination of the sign for 10 and 1000 (10*1000).

The Linear B system definitely originated through direct contact with Minoan 16th century BC, so the two scripts coexisted on Crete for about century. The earlier Linear B inscriptions date from the sixteenth century BC. Linear A and Linear B numeral systems are so similar with structure and numeral-signs [6,8]. Throughout the history of the Linear B numeral system, there is no observable change in the form of the numeral-signs or in the structure of the system. Linear B numerals are found primarily on a clay tablets serving accounting and financial purposes. Numerals are used both for counting discrete objects as well as for measures of dry and liquid volume and weight [9].

Modification of Cretan Numeral Systems

Different phrases numerals Linear A of Cretan Hieroglyphic were modified time to time. The Linear B derived from Linear A but the descendants of the Linear B numerals is extremely interesting. There is no relationship between the Mycenaean numerals and either of the numeral systems developed in archaic and Classical Greece-the acrophonic and alphabetic systems. Mycenaean settlements have been found in Sicily and Southern Italy, providing one possible locus for cultural contact, so there is some relationship between the Mycenaean and Etruscan numerals, however, this theory is controversial, not least because of the time elapsed between the latest known Linear B documents (12th century BC) and the first Etruscan ones (17th century BC). This shows that geographical contact and cultural contact are not the criteria for determination of ancestral and descendants of numeral system. The Linear A tablet found at Chania Archaeological Museum (**Figure 11**) contains the mathematical symbols as numerals. Similar symbols were found in Zakros museum [13].

Cretan Hieroglyphic script is simply a decorative version of Linear A or more precisely, of the lost Cretan Protolinear script. It is the ancestor of all the Aegean scripts which was used mainly by the seal-makers or for ritual usage. The conveyed language must be a conservative form of Sumerian, as Cretan Hieroglyphic is strictly associated with the original and mainstream Minoan culture and religion in contrast to Linear A which was used for several other languages while the phonetic values of signs have the same Sumerian origin as in Cretan Protolinear [10]. The classical mathematical additive operations found in Cretan numerals is illustrated in **Figure 12**.
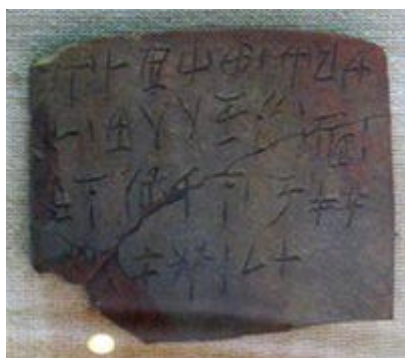
Figure 11. Linear A tablet at Chania archaeological museum.

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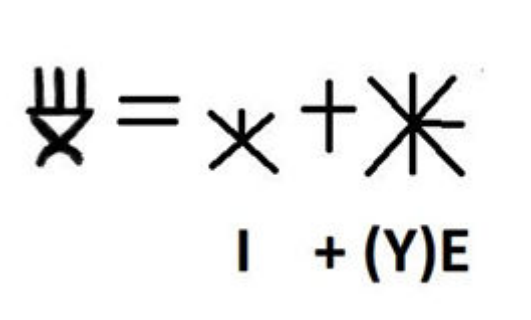
Figure 12. Mathematics in Knossos excavation.

Cretan people were maintaining the records of products of crops-olive oil, wheat and annual tax, etc. in clay tablets. These evidences can be seen in the archaeological museum at Liberty park of Crete. Greece has maintained such evidences in different museums like Acropolis museum, National archaeological museum and Byzantine museum, etc. I met a scholar Minas Tsikritsis at Heraklion who has developed a calendar, shown in **Figure 13**, which express the many aspect of rotation of the planets, moon and the Sun. He explained the rotation of the Moon and the Sun and the intersection their orbits to each other. In my analysis he declared that phenomena on the basis of the research and analysis of Cretan hieroglyphics. The calendar prepared by him is looks like as shown below. Cretan hieroglyphics are the sources of interpretation of numeration and other many modern developments [14]. According to his calculation, after 99 lunar months, the lunar calendar and the solar calendar coincide. For example: 99 (Lunar months)*29.53 (days for each lunar month) = 2923 days approximately. Similarly 8 (years)*365.24 (days for solar year) = 2922 (days) approximately. The synodic period of Venus is 584 solar days after 5 synods, it is 2920 days. Using all three elements Minoans had a way to measure the time (using the lunar calendar for their daily life and the Venus for correction of their daily calendars).
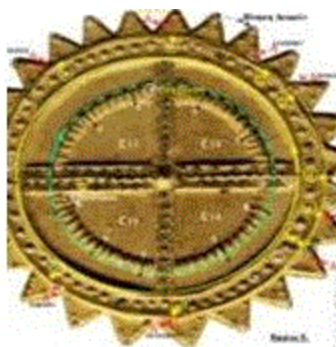

Figure 13. Minas Tsikritsis calendar.

CONCLUSIONS

On the basis of different view, the Cretan hieroglyphs were developed around 20th century BC. The Linear A and Linear B are the main source for the Cretan Hieroglyphics. There was no uniformity in symbols of the numbers used in Cretan hieroglyphics. Among them Evans' exploration is more reliable and main resource for declaration of Cretan hieroglyphics. He categorized into 45 types altogether 241 symbols. These were independently developed in Crete but we cannot deny the relation among other hieroglyphs developed in other civilizations. There was some overlapping in time lines. Cretan

hieroglyphs were based in Cretan culture, rituals and indigenous practices, administrative records and mathematical development.

Acknowledgement

References

1. Нщyrup J. Geometrical Patterns in the Pre-Classical Greek Area: Prospecting the Borderland between Decoration, Art, and Structural Inquiry. Revue d'histoire des mathйmatiques. 2000;6(1):5-58.

2. Karnava A. Cretan Hieroglyphic Script. In: Giannakis GK editor. Encyclopedia of Ancient Greek Language and Linguistics, Brill Publishers, Boston, US; 2014.

3. https://www.thegreatcourses.com/courses/decoding-the-secrets-of-egyptian-hieroglyphs.html

4. Evans AJ. Scripta Minoa.Vol.I. Calendar press, Oxford, USA; 1909.

5. Ifrah G. The Universal History of Numbers: From Prehistory to the Invention of the Computer. John Wiley and Sons, New York, USA; 1985.

6. Ubedi N. The Development of Numeral System of Ancient Nepal. Unpublished PhD Dissertation, Nepal Sanskrit University, Beljhundi Dang, Nepal. 2017.

7. Acharya ER. Study of Mathematics Treatise of Naya Raj Pant. Unpublished PhD Dissertation. Nepal Sanskrit University, Beljhundi Dang, Nepal; 2015.

8. Revesz PZ. A Computational Study of the Evolution of Cretan and Related Scripts. In: Rudas IJ editor. Mathematical Models and Computational Methods. 2015:101-5.

9. Chrisomalis S. Numerical Notation: A comparative history. Cambridge University Press, New York, USA; 2010.

10. Papakitsos EC and Kenanidis I. Cretan Hieroglyphics: The Ornamental and Ritual Version of the Cretan Protolinear Script. Anistoriton Journal. 2016;15.

11. Evans AJ. Scripta Minoa (vol II). Calendar press, Oxford, USA; 1952.

12. https://en.wikipedia.org/wiki/Phaistos_Disc.

13. https://en.wikipedia.org/wiki/Linear_A.

14. https://independent.academia.edu/minastsikritsis.