International Journal of Arts Humanities and Social Sciences Studies
Volume 6 Issue 3 ǁ March 2021
ISSN: 2582-1601
www.ijahss.com

The Written Universal Numbers

Loulou AL-Akl Khoury, PhD
Former AUB Lecturer: English and CS Dept.

Abstract*: Developed countries have borrowed their numerical signs from the Arabs, yet Arabs did not deny having borrowed numbers from the Indians. In the Western hemisphere the Indians were the only ones to have bypassed the primitive stage of repetition and the gathering of isolated elements. And yet, the place of the tens was not indicated. To be indicated one needed to represent "emptiness". The circle or zero that Indians used later indicated the absence of value. Ibn al-Adami around 900 recorded that an Indian knew very well the method of calculation named Sinhind i.e. related to the stars. The book of Kankah, the Indian, was translated to Arabic and became a basic work for scholars. It was redesigned by Khawarismi. The mode of accounting, including the zero, was part of the business world beyond the Alps and part of all Europe. With the development of cities and trade, knowledge was more and more necessary. Hence, Arabic numbers having conquered the West, assumed since then their fundamental role in the development of sciences of all developed countries.*

Keywords: *Arabic, written, universal, numbers, zero, al-Khawarismi.*

In the previous three articles, concerning the Arab Renaissance, the themes discussed were: *Hospitals and Doctors during the Arab Renaissance* (2016)*; Pharmacists and Medicine during the Arab Renaissance Periods* (2016)*; Education during the Arab Renaissance and its Path to the West* (2019). All articles including the present one are selected passages, summarized and translated from the book titled, **Le Soleil d'Allah brille sur l'Occident** (1997) by Sigrid Hunke.

Only Germans and Arabs pronounce numbers from right to left. Developed countries in the world have borrowed their numerical signs from the Arabs. In fact, Charlemagne used to say z*ehensug inti finfzug inti thriu"* that is, hundred and fifty and three. Later on, hesitation took place, concerning the order to adopt for the pronunciation of the tens and unit numbers. Without them, the prodigious monument of sciences, mathematics, physics and astronomy wouldn't have been erected. And yet, the Arabs never denied the fact of having borrowed numbers to the Indians. They pointed out "Arabic numbers" under the term "Indian numbers". Hence, the Arabic numbers were adopted by the West and used all over the world (p. 39).

People of the Mediterranean basin such as Egyptians represented the numerical values 1, 2, 3, by repeated vertical lines (III). Number 4 was represented by a horizontal line (III). Number 8 was represented by the overlaying of two horizontal lines (III).

The Babylonians invented a numeration based on 3 figures only made out of acute angles and straight ones, sometime horizontal and sometime vertical. Their numbers and positions defined respectively their numerical value.

As to the Greeks, in the year 500 BC a new numerical system appeared that they used firstly only in the mathematical sciences: It was composed of 24 alphabetical letters and 3 supplementary signs of Semitic origin. The alphabetical writing was borrowed to the Semitics, Phoenicians and Hebrews and formed a numerical system that used the letters of this alphabet (p.41).

The origin of Roman numbers was a simple notch slot replaced by the sign X which is simply a crossing of two slot units. The number 5 was then represented by half the X sign that is, V.

In the Western hemisphere, the Indians were the only ones to have bypassed the primitive stage of repetition and the gathering of isolated elements: They attributed to every one of the 9 units its independent sign, realizing one of the most important inventions of the human mind (p. 42).

The Chinese mixed units and orders, placing next to each unit the order to which it belongs and defined the value of the position of the unit. For instance, 3000 is 3M, 900 is 9C and 50 is 5L. Later, the West used this device before daring to make the Indian written numerical system its own. Contrary to the Romans and Chinese the Indians wrote units without the indication of its order. Only the Indians and the Mayas achieved the "pure writing position" which made the writing of numbers possible (p. 43). Until the 6th century AD at the latest, numerical writing retained only the numbers 1- 9 creating the pure writing of position. These 9 numbers in 662 AD were already known in other countries than India. The Syrian scholar Severus Sabokht, who on the bank of the Euphrates was the supervisor of a monastery and the director of a school of scholars mentioned, "the ingenious Indian calculus method of the 9 signs superior to any other" (p. 43). And yet, no matter how ingenious this method was, it was not ingenious enough to allow all numbers to be written, for the place of the tens was not indicated. That is, there was no difference between the number 408 and 48 since the order of tens was not marked (p. 44). And this is where the most important Indian intervention was realized leading the numerical system at its highest degree of perfection.

To indicate the empty place, one needed to represent "emptiness". The symbol of a circle or a point under the name *sunya* and *sunyabinda* (emptiness) or under the word *kha* meaning the hole indicated emptiness (p.44). The circle – our zero- that Indians used only to indicate the absence of value ended up in their system as an autonomous number. The Syrian scholar, Severus Sabokht, did not know about it, and it was ignored how he managed to do without it.

In 773 AD an Indian astronomist by the name Kankah came to the court of the caliph al- Mansour (745-775) in Baghdad. This event was of utmost importance for the Arabs and Ibn al-Adami around 900 recorded in an astronomical work, *The Pearl Necklace,* that an Indian knew very well the method of calculation, named *Sinhind* i.e. related to the stars. Al-Mansour ordered the book to be translated to Arabic. It was Mohamad ibn Ibrahim al-Fasari who was in charge of executing the job. This book titled by then *Grand Sinhind* became a basic work for the scholars of this period until the reign of caliph al-Mãmoun (813-833). It was redesigned for them by Mohamad ibn Mousa al-Kovaresmi, better known as al-Khawaresmi, who gave his name to the mathematics, Al-Gebra. Al-Khawaresmi used Al-Gebra i.e. algebra to make his mathematical tables which became famous in all the Moslem countries (p. 44-45). In fact, this book is nothing else than the *Siddhanta of Brahmaguta*. Thanks to this book, the Arabs became familiar with the Indian numbers.

In 700 circa, the caliph Abd al-Malak, whose reign reached Spain, replaced the Greek language with Arabic as the language of the diwãn (public registers) and instituted an Islamic currency, the dinar that replaced the Byzantine gold solidus (1). Hence, the Indian numbers, appeared in the calculations of administrative officials as well as in the merchants' calculation (p. 45).

Al-Khawarismi, the renovator of *Sindhind,* wrote a treaty not only for directives but included also practical examples. This is how al-Khawarismi resolved the testamentary executors who faced the Koranic laws of successions, in particular the division of property and the emancipation of slaves (p. 46). In fact, al-Khawarismi wrote books on geography and astronomy that were translated into Latin three centuries later by the Englishman Athelhart of Bath. Hence, these books became accessible to scholars in the West (p. 46).

Two of his books on mathematics immortalized him. The first, *Algabr wal mouqabalah,* signifying enclosure of equations. In the Middle-Ages, this work was translated into Latin and it conserved its Arabic title *Algabr* which later became *Algebra.* The second book was a small arithmetic treaty in which the author explains the use of Indian numerical digital signs and

(1) This event was not an overnight affair hence, some sources mentioned his 2 sons Walid and Hisham. Further, Khalid bin Yazid the alchemist and cousin of Abd al-Malak was consulted to perform the process.

teaches the "Indian calculus", naming numbers, addition, subtraction, multiplications and the calculation of fractions (p. 46).

It is in 1845 that the Frenchman Renaud rediscovered in algorithm the name of al-Khawarismi (p. 48). The translators transcribed textually in Latin the Arabic sources and therefore used the writing of letters and numbers from right to left (p.49). However, al-Khawarismi was not the first to transmit the Arabic numbers to the West. One and a half century earlier, at the end of the 10th century, a Westerner used them and taught them to his contemporary without a major interest.

This scholar and professor of modest origins, became one of the most eminent men of his time and a student of the highest dignity of Christendom: the papacy (p.49). This scholar, in love with knowledge and open to all new ideas, regardless of the fact that were of foreign origins, was a remarkable professor and incited in his students the interest and studies of mathematics. He also gave life to teaching and the work of copyist. He was Pope Gerbet of Aurillac (p. 50).

It is essentially to three names that the Arabs know the written numbers that one day got to be known as Arab numerals. These were Severus Sabokht, Bramagupta and al-Khawarismi. And it is to these three names that this count was linked to the West (p. 56).

In 776 AD, one hundred and fourteen years after Severus, *Sidhanta of Brahmagupta* appeared in Arabic translation and included the ten complete signs. It became the basic bedside book of all scholars of that period until the reign of the caliph al-Mãmoun. On the other hand, more than 100 years after Pope Gerbert the Latin translations of the book of arithmethic by al-Khawarism, the *Liber Algoritmi*, was brought to the West through Spain. It is the knowledge of the written calculation through the nine numbers and the zero that the school of algorithm was transmitted to the future generations (p. 56). The infiltration of this knowledge to the West was through Spain, then Italy at the court of Frederic II, emperor of Hohenstaufen. Hence, the West found his al-Khawarismi (p. 58).

I. A Merchant Teaches the West

In 1180, Leonard Bonaccio born in Pisa ran the counter of his father installed at Béjaïa on the Algerian Coast. Leonard was instructed in arithmetic by an Arab professor since he was destined to embark in flourishing commercial entreprises, and the method of calculation in use by the Arabs is manageable and diverse. He learned to solve power square roots, extracting roots, equations with one, two, three unknowns, differential and integral equations of the second or even the third degree such as Abu Kamil, Omar al- Khayam, Ibn Sina, al-Barami and al-Karadchi had stated them, since with roman numbers one could only do additions and subtractions. Also he researched the libraries of Alexandria and Damascus. Obsessed by his passion for mathematics, he studied all that ancient manuscripts and what the practice of business could teach him about Greek, Indian and Arab calculus (p.59). This 23 year old young man wrote in Latin the book titled, *Le Liber Abaci* that established his renown so as "the Latin people would not be judged ignorant in those matters". His work attracted the attention of Frederic II, emperor of Hohenstaufen (p. 59-60).

The first chapter of the voluminous *Liber Abace* deals with the 9 numerical Indian numbers that the Arabic master taught Leonard to write the Arabic way (p. 61) that is, from right to left as well as he taught the sign 0 named *sifr* (zero) in Arabic (p. 62). The Indians had the o, circle that symbolized the absence of value, nothingness, and was named *synya* (emptiness) (p. 62). The Arabs translated it to *al-sifr*. Leonard adapted the Arabic word *al-sifr* and Latinized it as *cephium.* In Italy, the word *cephium i*n his work became *zefero* and finally zero (p. 62).

II. The Battles of Numbers

The mode of accounting, including the zero was part of the business world beyond the Alps and part of all Europe. And yet a certain distrust as being aware of, for one falsification of a number is accessible to anyone. This gave free will to fraud (p. 63). And yet, these numbers started their implant. They took over other numbers that took too much space. It is easier to read 998 than DCCCLXXXXVIII. Yet, centuries passed before the new signs took definitely over the Roman numbers (p. 63).

But, whoever wish to handle these numbers had to completely revise his mode of thinking (p.64). "Who wanted to learn to calculate, using the new figures of the new numbers should first know their forms, and then learn the power and the role of their positions in which they are placed", said a German medieval author (p. 66).

Once again, the zero could not take the place of a number except on the right, tenfold immediately the number placed on the left. To write the number 20, German beginners in the Middle-Ages, faithful to the Arabic writing, learned to write first the zero, then the number 2. They learned to write 23 from right to left and to read, three and twenty (p.66). For a long time, to avoid the zero, many will make a wide detour rather than writing the number zero of 202, they will write CC2. For the number 300, Sebastien Frank would write IIIC.

With the development of cities and trade, the necessity of enjoying wider culture and knowledge was more and more necessary. Hence, knowledge crossed the walls of monasteries to penetrate the cities (p. 68). Sons of German, Dutch and English merchants brought back in their countries the teaching learned in the houses of Italian trades that were taken for models. Finally, knowledge flooded since the invention of printing (p. 68). Hence, Arabic numbers having conquered the West, assumed since then their fundamental role in the development of sciences, technologies, industries and trades of all developed countries.

To conclude, it is said, that some archeologists excavate only half a site, leaving the other half for future better techniques and understanding. Time has come, for "oriental literary history" to be relieved from historical amnesia and its past acknowledged.

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