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ARITHMETICS AND DECIMAL POSITIONAL SYSTEM MUHAMMAD IBN MUSA AL-KHORAZMI

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Abstract

The article presents information about arithmetic and the decimal counting system of Muhammad ibn Musa al-Khwarizmi. The great mathematician, astronomer and geographer Muhammad Khorezmi lived and worked at the end of the 8th - first half of the 9th century. He made a great contribution to world science. It has been scientifically proven that he is the founder of algebra.

Keywords: arithmetic, decimal positional system, Bayt al-Hikmah, numbers, mathematical data, comments.

The full name of the scientist is Abu Abdullah Muhammad ibn Musa al-Khwarizmi. The scientist was born in 783 [1, p.23]. How Khorezmi received his primary education and under what circumstances he left Khorezm is still unknown to science. The report given by Ibn al-Qifti is the most accurate evidence of the time of Khwarizmi's arrival in Baghdad. There is a report that Khorezmi came to Baghdad and lived there in the Khutrabbul region. He heads the Baitul Hikma library. Judging by this, it appears to have served a similar function in Marv. During the reign of Caliph Mamun and al-Wasih, three expeditions were organized under the leadership of Khwarizmi to collect books. One of them was organized in Western India around 830 AD. For this reason, the work "Brahmasphuta-siddhonta", brought from India during the time of Caliph

al-Mansur, was probably not the only book with the help of which scientists of Islamic countries became acquainted with Indian mathematics and astronomy. The account given by Ibn al-Qifti does not clearly indicate the existence of Indian numeral and counting systems in this work. We think that Khorezmi brought these data from his expedition and therefore reflected them in his arithmetic work. Khorazmi's arithmetic and algebraic approach ushered in a new era in the field of mathematics, the era of advanced mathematicians, and had a great influence on the further development of mathematics. Taking into account the needs and requirements of everyday life, the scientist collected the most complete information, both scientific and practical, and explained it in detail in a book and compendium.

In his arithematic work, Khorazmi gives the first decimal positional number system in Arabic and a description of its associated applications. Al-Khwarizmi's Latin manuscript, kept in the Cambridge University Library, begins with the phrase Dixit Algorizmi, that is, “I said Algorism.” The copy of the manuscript contains pages 102a-1096 of the manuscript, and the reproduction of the manuscript proceeds from beginning to end. According to the research of A.P. Yushkevich, the title of the manuscript in Arabic is called “Gitob al-zham va-t-tafrikh bi-hicob al-hind” (“Book of addition and subtraction according to the Indian hijab”) [2, p. 178]. Moreover, Khorezmi only added two arithmetic operations. Because the operation of multiplication and division is also performed sequentially, and it is possible. At the beginning of the manuscript, he says that he wants to explain the way in nine syllables, that is, at the end of the “letter”, he wants to explain the ability of a number to quickly express what he wants to explain the use of this word. In the Latin manuscript, the Indian numbers are not

written, but are left blank. Only sometimes in the Indian alphabet 1, 2, 3, 5 are written and a zero is written in a circle.

The Khwarezmian arithmetic manuscripts present not only Indian arithmetic, but also the interpretation of the ancient Greek philosopher. It is also indicated that Khorezm used the mathematical method before him. This idea is supported by the following quote: Odin is also mentioned in another book on arithmetic. The number one is the root of what is typed outside the number. This is the root of each number can be determined based on it. This means that y is determined by itself, that is, without any other considerations" [3, p. 848]. On the one hand, the views of Pythagoreanism include that number "is part of every number", is the "root of every number" and that it is "outside numbers", i.e. indivisible [4, pp. 150-151], with on the other hand, it refers to Aristotelianism [5, p. 86].

Detailing the writing of numbers in Indian numerals in the decimal positional system and the use of the "small circle type 0", Khwarizmi teaches how to pronounce large numbers using only the names of units, tens, hundreds and thousands. As an example, the Horaomi card shows the addition of the number 1180073051492863, which is added as follows: one thousand thousand five times and one hundred thousand thousand thousand thousand times and eighty thousand thousand thousand times and seventy thousand thousand seven times and seven thousand thousand thousand seven times fifty two thousand two times five hundred thousand ninety two thousand eight hundred sixty seven [6, p. 14]. This awkward combination of numbers persisted for a long time in both the East and Europe and disappeared only when the decimal positional system decisively triumphed.

Al-Khwarizmi attaches importance to doubling and doubling, that is, halving. It is known that the by operation belongs to the ancient Egyptian mathematician who performed the operations of multiplication and division by two and division by two. It is not known on what sources Khorezmi based his information. But thanks to Khorezmi's treatise, these operations have long been used in Eastern and European mathematics. Although Khwarizmi knew that doubling is a special case of multiplication, and doubling is a special case of division, the Cambridge copy of the treatise does not mention this. But John of Seville, who revised his treatise, said that doubling is a type of division, and doubling is a type of multiplication, and that these operations are necessary to extract roots from numbers [7, p. 35]. One feels that Khorezmian dualism was based on ancient Babylonian mathematical traditions. His saying "you will divide one into two halves, so that one half will be thirty out of the sixty that make up one" is a clear confirmation of this.

And the spread of the decimal positional system and numbers in Europe, translations of Arabic arithmetic works, especially the Khorezm Treatise, and Latin, starting from the 12th century. Along with these translations, editions of Khorezmian arithmetic and astronomical works appeared, among the "Book of Algorithms on Arithmetic Practice" by John of Seville, "Introduction of Algorithms in the Art of Astronomy", proposed by A. Magister, the Spaniard Savasorda (c. 1070–1136) played with great importance " A book about measurements". Because these works describe the Indo-Arabic numbers of Hakma. The new accounting system spread very quickly: by the middle of the 12th century it became known in the lands of the Holy Roman Empire, in particular in Austria and Germany. A little later, about 1200 years, the "Book of

Algorismi" (Liber algorismi) was written, which was kept for a long time in the Salem monastery.

Italy soon became one of the important centers for the spread of new arithmetic. Here Leonardo of Pisa wrote his famous Book of Accounts (Liber abaci) in 1202. His book was an excellent work on arithmetic and algebra, based on the decimal positional system of counting. Leonardo was not a priest, like the authors before him who wrote a work on arithmetic, but came from trade and craft circles. His book is also intended for people in this field. Therefore, this work of his greatly facilitated the spread of Indo-Arabic calculus in Italy. Also widely circulated is the Englishman John Halifax (or Sacrobosco) (13th century) "A Simple Algorithm" (Algorisrnus vulgaris). Sacrobosco's book includes addition, subtraction, doubling, doubling, multiplication, division, progression and squaring of integers and in 1290 In the year Peter Ingvarsen, a scientist from Denmark, wrote a commentary on this problem. Sacrobosco's book was published in Strasbourg in 14988. For almost two and a half centuries in Western Europe, arithmetic was studied using Sacrobosco's book. Almost simultaneously with Sacrobosco, Jordan Nemorari wrote his work entitled "Demonstratio de algorismo". In this work, actions are described by integers, and in content it is close to Sacrobosco's book. This book was published in 1534 in Nuremberg and in 1570 in French in Paris [8, p.337].

Conclusion. Muhammad al-Khwarizmi made several important contributions to the development of mathematics, astronomy and geography, and through them to the development of civilization as a whole:

1. He justified and introduced into use the decimal positional number system with nine digits and a zero sign.

2. Created algebra as a science and gave it a name.

3. Developed and introduced a new way of presenting scientific and educational works - through clear and precise rules, which received the name “algorithm” in European literature, which goes back to his name al-Khorezmi in Latin transcription. This concept underlies all modern digital information and computer technology. It was thanks to this method of presentation that the works of Muhammad al-Khwarizmi became widespread. In addition to the listed merits, it is now known that he was the first to use polar coordinates.

4. In the astronomical book (“Zij”) of Muhammad al-Khwarizmi, the movements of the Sun, Moon, five planets, questions of mathematical geography, trigonometry, eclipses of the Sun and Moon were considered. It was translated into Latin in 1126, German in 1914, and English in 1962.

5. The geographical works of Muhammad al-Khorezmi describe the inhabited parts of the earth known at that time. The work was accompanied by detailed maps with rivers, seas and oceans, the most important settlements, the number of which reached 2402. This was the first geographical work in Arabic created in the Middle Ages. His theory of climate greatly contributed to the development of geography.

The arithmetic treatise of Khwarizmi was of great importance in the spread of the decimal positional system of calculation, based on Indian numbers, in Europe and the rest of the world. Since Indian numerals came to Europe through the Arabs, they were and are still called “Arabic numerals.” For a long time, Europeans called the number system based on Indian numbers an “algorithm.” Only in the middle of the 16th century was this name replaced by the phrase “arithmetic”. From then to this day, the word "algorithm" or "algorithm" has come to mean any

regular computational process. Thanks to this phrase, the name of Khorezmi entered science forever. The full name of Khorezmi's algebraic treatise is "Al-kitab al-mukhtasar fi lisb al-jabr wa al-mukabala." The words "al-jabr" and "al-muqabala" in the title of the treatise refer to "completion" and "composition" - the two main operations of medieval algebra. The word "algebra" in Latin transcription became "algebra" and became the name of the new science founded by Khorezm.

References:

1. Muhammad ibn Muso al-Khwarizmi. Tanlangan asarlar. - Tashkent, 1986.
2. Yushkevich A.P. History of mathematics in the Middle Ages. – Moscow, 1983.
3. Masharipova G.K. Different Approaches To Studying The Natural-Scientific And Historical-Philosophical Heritage Of The Khorezm Academy Of Ma'mun. // Turkish Journal of Computer and Mathematics Education. – Turkiya, Anqara. - Vol.12-Issue-11. 2021. - Pp. 846-856.
4. Paik A.E. Essays on the history of mathematics in ancient times. Kapansk, 1967.
5. Aristotle. Metaphysics. Translation and notes by E. V. Kybutsky. – Moscow-Leningrad, 1934.
6. Masharipova G.K. The influence of the natural science, socio-philosophical and spiritual heritage of scientists of the Khorezm Mamun Academy on the development of social thinking. Monograph. – Tashkent, Navruz, 2019. – 364 p.
7. Masharipova G.K. The great discoveries of the Middle Ages are the contribution of Khorezm mathematicians to the development of science. Monograph. – Tashkent: Navruz Publishing House, 2021. – 210 p.

8. Masharipova G.K., Ergashova Sh. The View Of Eastern Thinkers On Youth Education. // International Conference on Research Innovations in Multidisciplinary Sciences. Mart 6th-7th. New York USA. 2021.- Pp. 336-338.