AL-KHORAZMII ZIJI AND HISTORY OF ITS CREATION

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ABSTRACT

This article describes the work of the great mathematician, astronomer and geographer, the father of algebra Muhammad Al-Khorazmi "Zizhi Khorazmi" and the history of its creation, and al-Khorazmi's great contribution to the field of astronomy is recognized.

Keywords: *zij, al-Khorazmi, astronomy, longitude, latitude.*

INTRODUCTION

It is known that the great mathematician, astronomer and geographer, Muhammad Al-Khorazmi, the father of the science of algebra, lived in the end of the 8th century and the first half of the 9th century. Information about the work of the scientist is also very scarce, as well as information about his life. According to the saved data, the number of literatures written by him is more than ten. One of the unique works is "Zizhi Khorezmi".

METHODS

An Arabic copy of this work has not been preserved. There are copies of the Latin translation by Adelard Bath in the twelfth century from a revised copy of the work dated 1007 by the Spanish Arab astronomer Maslama al-Majriti (X-XI). These copies are kept in the Bodleian Library of Oxford University, the Mazarini Library in Paris, and the National Library in Madrid. The trigonometric part of "Zij" was published by Y. Kh. Kopelyevich and B. A. Rosenfeld. In addition to these, there are studies of many scientists dedicated to "Zij". The great mathematician and astronomer Abu Rayhan Beruni wrote three works dedicated to "Khorazmi Ziji". But these works have not been preserved until now. In addition, Beruni rejects the misconceptions about his great compatriot in his treatise.

Finally, in the Middle Ages, one of the works devoted to the interpretation of "Khorazmi Zizi" is the commentary written by the Spanish astronomer Ahmad ibn al-Musanna ibn Abdulkarim, who lived in the eleventh century. This work was translated by Abraham ibn Ezra in the twelfth century. There are Spanish and English translations of Ibn al-Musanna's work and studies devoted to them.

RESULTS

"Khorazmi Zizi" consists of an introduction, 37 chapters and 116 tables related to them. In the title of the introduction, the title of the work is written in Latin letters Zij, that is, it is not translated. In the introduction itself, Khorezmi says that he wants to determine the purpose of creating Zij and, among other things, the movements of the planets according to the meridian of the city of Arin.

Chapters 1-5 of the work are about calendars, in which the years, months, and days of the Hijri-Kamal calendar are defined. Chapter 6 is "On the Division of Circles," which divides a circle into 12 signs, a sign into 30 degrees, a degree into 60 minutes, a minute into 60 seconds, a second into 60 tercs, and so on. said to be distributed. Chapter 7 describes the determination of average planets, that is, determination of their average longitude $\bar{\lambda}$ in the deferent or eccentric circle according to the true longitude λ and the equation θ. Chapter 8 describes determining the position of the Sun using a table. Chapter 9 is called "How the Moon's Position is Determined." To determine the position of the moon, Khorezmi gives such a rule: from the table for a certain time, the ecliptic longitude λ is the average anomaly $\bar{\alpha}$, that is, between the straight lines connecting the center of the epicycle with the moon and the center of the universe with the center of the epicycle the angle is determined and according to $\bar{\alpha}$ the equation $\theta = \left|\lambda - \bar{\lambda}\right|$ is found.

Chapter 10 describes the position of Saturn, Jupiter and Mars, and chapter 11 describes the position of Venus and Mercury. For the three upper planets, Khorezmi first determines from the tables the "average planet" longitude $\bar{\lambda}$, from which the anomaly $\alpha_1 = \bar{\lambda}_s - \bar{\lambda}$, and accordingly using the table, the epicyclic equation $\delta_1(\alpha_1)$ and the apogee equalized longitude $s(\alpha_1) = \lambda_A - \frac{1}{2}\delta(\alpha_1)$ determines $\delta_1(\alpha_1)$. Then the center $x_1 - \bar{\lambda} - \lambda_A$ is found $x_2 = x_1 + \frac{1}{2}\delta_1 = \lambda - S$ and from this using the table "center equation" $\mu_1(x_2)$, "equated center" $x_3 = x_2 + \mu_1$ and "equalized anomaly" defines $\alpha_2 = \alpha_1 - \mu_1$. Khorezm α_2 is $\delta_2(\alpha_2)$ the main "center" is $x_4 = x_3 + \delta_2$ and the true longitude of the planet

$$\lambda = x_4 + s = x_3 + \delta + \lambda - x_2 = x_2 + \mu_1 + \delta_2 + \bar{\lambda} - x_2 = \bar{\lambda} + \mu_1 + \delta_2$$

is determined.

The position of the two lower planets is determined in the same way. The only difference is that the "average planet" for the lower planet corresponds to the "average sun", i.e. $\bar{\lambda} = \bar{\lambda}_s$ and the anomaly does not depend on $\alpha_1, \bar{\lambda}_s$ and in this case $\bar{\lambda}$ and α_1 determined from the table.

In chapter 12, the position of the ascending node of the moon is determined. Chapter 13 is "On the Stationary, Right and Reverse Motions of the Planets," in which the motions of the planets are explained according to the theory of the Ptolemaic system. Chapter 14 is "Intervals corresponding to the above-mentioned stops", in which Khorezmi specifically looks at the issue of stops. Chapter 15 is called "On the Declination of the Sun", Chapter 16 is "On the Latitude of the Moon", Chapter 17 is called "On the Latitude of the Three Higher Planets". The reason for the change in latitudes of the upper planets is that the plane of the epicycle is parallel to the plane of the ecliptic, and the constant inclination of the deferent to the ecliptic. It is shown that it is in constant weight.

Chapter 18 is called "On the Apogee and Perigee of the Planets." Chapter 19 is On the Nodes of the Planets. Here, the longitudes of the ascending nodes of the planets are given. Chapter 20 is "On the Moon's One-Day Motion." Then the moon's one-day motion is $13^0 10' 34'' 52''' 48^{IV}$ and one-hour motion $0^0 32' 56'' 47''' 52^{IV}$ is said to be. And in chapter 21, it is said that the daily motion of the Sun is $0^0 59' 8''$ and the hourly motion is $0^0 2' 27'' 50''' 25^{IV}$. Chapter 22 is called "About the appearance of the crescent moon on the night of the 29th day of the lunar month." It talks about the situations of the moon being north and south of the ecliptic and the difference between the time of the crescent appearance and the meridian of Arin.

Chapter 23 deals with trigonometry, and it is called in Latin Inventio elgeib per arcum et e concervo, that is, "To find the sine by the arc and vice versa." In this chapter, using the Khorezmian table, "flat sine"; that is, the sine line shows $Rsin\alpha$ ($R -$ the radius of the circle) and the "reflected sine" $Rsin\ vers\ \alpha = R(1 - cos\alpha)$ to determine. This chapter covers the multiplication table of numbers in the hexadecimal system and the "Table of Sines". In Latin, sine is called elgeib (from the Arabic word "al-Jayb"), and sine versus is called elgeib elmankuz (from the Arabic word "al-Jayb al-Mankus").

Chapters 24-27 are devoted to mathematical geography. Chapter 24 is called "How to determine the latitude of an arbitrary land", in which Khorezmi gives the rules for finding geographical coordinates by mathematical and astronomical methods. Chapter 25 is "Ascensions of the Constellations on the Right Sphere," in which the constellations are determined from the celestial equator. Chapter 26 deals with a more complicated issue, that is, the question of making a desired constellation or degree in an arbitrary place. Chapter 27 says "The length of the optional daylight hours in the optional place". It provides a rule for determining $\frac{1}{12}$ part of the day at any time of the year depending on the latitude of the place.

This rule

$$h = 1^h + \frac{1^h}{12 \cdot 15^0} arccos\left(2\frac{cos^2\varphi - sin^2\varepsilon}{cos^2\varepsilon \cdot cos^2\varphi} - 1\right)$$

can be expressed in the form.

Chapter 28 is called "How to determine the shadow of an arbitrary object according to the height of the Sun", and Khorezmi returns to the issue of trigonometry. To determine the "flat shadow" of a gnomon with a length of 12 "fingers", that is, the cotangent line is $12\,ctg\,h$ (h is the height of the sun) and the "reflected shadow", that is, the tangent line is $12\,tg\,h$ brings the rules. If we define the "flat shadow" as s and the "reflected shadow" as $\bar{s}$, then the Khorezmi rules

$$s = 12 sin(90^0 - h)\sin h = 12ctgh$$

$$\bar{s} = 12\sin h / sin(90^0 - h) = 12tgh$$

can be expressed in forms. In Latin, the word "flat" is transliterated from the Arabic word "al-mustavi" and it is called elmustewia. This chapter refers to the "table of shadows".

In chapters 29-30, Khorezmi dwells on specific issues related to the movement of the planets. Chapter 29 is titled "True Action and How It Is Determined." He defines the real movement, i.e. the gulf (Latin elbuht) as follows: "Gulf is the segment of a circle through which a certain planet passes at a given time." In the following centuries, Eastern astronomers interpreted the gulf in a broader sense. Chapter 30 is called "About the size of the solar disc", and Khorezmi gives the rule for determining the size of the solar visible disc.

Chapters 31-32 are devoted to astronomical issues in astrology. Chapter 31 describes the conjunction and opposition of the Moon and the Sun. Chapter 32 is entitled "Determining the degree of culmination and equalizing the 12 houses". It focuses on the astronomical act of equalizing houses. This action is one of the main operations of astrology, and its rules are important in astrology.

Chapters 33-35 discuss solar and lunar eclipses and parallax issues. Chapter 33 is called "How Solar or Lunar Eclipses are Determined," and the amount of the eclipsed portion of the luminary is determined using tables. Chapter 34 "Parallax of the Moon expressed in hours in longitude and parallax in latitude, where the lunar parallax is determined using tables. Chapter 35 is called "Parallax in Solar Eclipses" and describes the calculation of parallax for solar eclipses.

In chapters 36-37, Khorezmi again approaches issues related to astrology. Chapter 36 is "On the Equation of the 12th House," which deals with the "equation," i.e., correction, of equalizing the houses using the chart. Chapter 37 is titled "How to Determine the Hexagonal, Quadrature, and Trigonal Aspects of Luminaires." It shows the aspects of the luminaries and the astrological operation of projecting the rays in each aspect.[1]

DISCUSSION

There is no doubt that there were astronomical works in the caliphate even before "Khorazmi Zizi". However, this "Zij" with its originality and novelty has squeezed all of them. All previous astronomical works were either 1) translations of Indian astronomical works such as al-Fazari's "Siddhontakhta" or Ya'qub ibn Tariq's "Structure of the Celestial Sphere", or 2) reworked copies of the Iranian astronomical work "Ziji Shahriyar", or 3) were revisions of copies of Ptolemy's Almagest. Khorezmi created an original work that incorporated the best aspects of the astronomical works of his predecessors in these three directions.

CONCLUSION

Khorezmi's great service in the field of astronomy, such as arithmetic and algebra, is that he created a work when the need arose, which standardized astronomy until the time of Ulugbek, that is, for several centuries. After Khorezm, all astronomers took his "Zij" as a model for their zij.

REFERENCES

1. S.H.Sirojiddinov. Muhammad ibn Muso al-Xorazmiy.Toshkent.1983.