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Scientific Heritage of Ulurbek - The Rarest Jewelry in the Treasure of World Science

Kurbonov Nodirjon Mirzokhidovich*

2nd Year Student, Bachelor's Degree, Faculty of Medicine, Bukhara State Medical Institute, Uzbekistan.
*Corresponding Author Email: komnatan704@gmail.com**

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ABSTRACT

Ulugbek's scientific heritage, the rarest masterpiece of the treasure of world science, is scientifically proven in the article. The world's largest observatory, the captain of the scientists of the scientific academy and their students and friends have revealed the inventions and the practice of science. The main part. Ulugbek was compared to Euclid in geometry and Ptolemy in astronomy. This is not without reason, of course. Possessing a sharp mind, Ulugbek built a powerful astronomical observatory, the only one of its kind in the world, gathered around him 200 of the most powerful and scientifically perfect scientists, making an incomparable contribution to the treasury of world science. In the words of Mawlana Rumi, he was a "rich-person", that is, a person who could lead everyone after him to the frontier of knowledge, to the level of a perfect human being. A person who gave all the knowledge he had to others and turned the sea of knowledge into an ocean is a rich-person.

Keywords: Scientific School; Science; Practice; Observatory; Exact Measurement; Astronomical Constants-Strict Standard; Mawlana Rumi; "Miftoh Ul-Hisab"; Measurements; Observations.

1. Introduction

“We live to know the world, to discover its secrets, and to make them serve people [1].”

Central Asian scientists have rendered a great and incomparable service to the development of world science. It is not for nothing that G. Sarton called Khorezmii “the great mathematician of his time”, and the first period of the 9th century the Khorezmii period [2]. G. Sarton rightly called the first period of the 11th century in the history of world science the Berunii period. Without any hesitation, if we see Ulugbek’s scientific achievements and discoveries, we will not be mistaken if we call the period in which Ulugbek lived the Ulugbek period. In the main part of the article, we will try to scientifically substantiate this idea.

1.1. Study Objectives

The great scientists of Central Asia were Abu Nasr al-Farabi, Abu Ali Ibn Sina, Abu Rayhan al-Beruni, Muhammad ibn Musa al-Khwarizmi, Abu Abdullah Jaihuni, Sharaf az-Zaman Tahir Marvazi, Abu Mahmudkhan Khojandi, Abu Sahl Kuhi, Abu Bakr al-Hasib Karhi, Abu Yahya Marvazi, Abulfat Said bin Hafif Samarkandi, Abu Nasr al-Iraq [3], Abu Wafa, Abu Hassan bin Ahmad Nasawi, Omar Khayyam, Nasir al-Din Tusi and others.

The first observatories were also built with the participation of the Asian scientist Abbas ibn Said Jawhari, first in Baghdad and then in Damascus.

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being. A person who gave all the knowledge he had to others and turned the sea of knowledge into an ocean is a rich-person.

What were the distinctive features of Ulugbek's scientific school?

Ulugbek created a powerful astronomical school. The goal of the scientific school was science and practice. The most stringent criterion for appointing a teacher in madrasas was the knowledge of scholars. From this point of view, he selected and gathered the strongest scholars for his school. Ghiyasuddin Jamshid (al-Koshi) came to Samarkand at the invitation of Ulugbek. In Samarkand, together with Qazizoda Rumi, he supervised the construction of the Ulugbek Observatory and Madrasa. In addition to Ulugbek and Qazizoda Rumi, Husain Birjani and Ali Qushji made a great contribution to its perfection. It was in Ulugbek's astronomical school that "π" was determined. Ulugbek's friend and student Kashi wrote the work "Treatise on the Circle" in Samarkand in 1424. Kashi's works "Miftoh ul-Hisab" ("Key of Calculation" in some places "Key of Arithmetic") and "Treatise on the Circle" were first published in Russian in 1956. The work "Treatise on the Circle" consists of 10 sections and conclusions. Kashi was the first to introduce decimal fractions on a positional basis into mathematics. He calculated the number "π" in the decimal system with an accuracy of 17 digits.

"π"=3.14159265358997932

In the following years, the calculator:

"π" =3.141592653589793238.....(2000) numbers.

It is well known that the number "π" is of great importance in architecture and engineering. If we compare the figures of scientists who determined the number "π", which has become an important number in construction and architecture, with the numbers "π" determined by Cauchy, it is incredible how accurately he was able to find this quantity.

2. Literature Review

The value found by Cauchy for "π" was found again in 1597 by Van Rommen using 230 regular polygons. In 1873, W. Shanks calculated the value of "π" to 708 decimal places. Currently, 2000 of its decimal places, found using an electronic calculator, are known. The fact that the architects of "Palace" were able to materially incorporate the two fractional (irrational) numbers "π" and "φ" into the dimensions of the building is astonishing. When this monument was analyzed, it was found that it also contained information on astronomy. The "golden ratio" and "π" numbers used in the measurements of the Amir Temur Mausoleum in Samarkand, the Bibi Khanum Mosque, and the Ismail Somoni Mausoleum in Bukhara were identified. In particular, the Amir Temur Mausoleum contained more than 20 of the "φ" and "π" numbers, while the Bibi Khanum Mosque remains contained 8 of them, and the Ismail Somoni Mausoleum in Bukhara contained 12 of them [5].

The most unique quality in the Ulugbek scientific school - the most subtle aspect of the work is that the difference between measurement and norm, which is of great practical importance in construction and architecture, was distinguished by scientists in his time. Regarding the differences between measurement and norm, Koshi wrote:

"There is verification in arithmetic: only through verification, only through measurement, is it determined whether the calculations are correct or, conversely, incorrect.

Measurement is a method of knowing truth and error, accuracy and uncertainty," Koshi writes. Measurement is a specific function of the norm. There must be no error in measurement. Quality is determined through quantity, and measurement processes begin through quantity and quality: measuring a triangle; measuring a square, polygon, circle, cylinder, sphere, etc. Only after such measurements can buildings, structures, domes, and domes be measured, and their corresponding heights be measured. In Al-Koshi, measurement proceeds from simple to complex, and only after knowing one criterion does one proceed to determining - finding an integral system of criteria. This is the basis for the perfect origin of construction.

When determining the location of the skylights, each scientist repeatedly checked his scientific evidence, the object was repeatedly measured, and finally all the data obtained were comparatively analyzed. After that, Ulugbek personally measured and checked several times, and removed any shortcomings and errors. Only after that was it included in the scientific treasury - books.

The fourth book of the work “Miftah ul-Hisab” entitled “About Measurements (“Architecture and Related Geometric Information”)” [6] is considered the most unique scientific source for understanding the history of Middle Eastern architecture and the standards of ancient buildings. In the above-mentioned book, the determination of the dimensions of architectural forms and structures, arches, domes, cupolas and muqarnas, which were widely used in the construction of monuments of the Near and Middle East, is very clearly and comprehensively explained. What is muqarnas? Muqarnas is a type of ornament characteristic of Central Asian and Eastern architecture. Muqarnas appeared in the 7th-8th centuries and became widespread in the 15th-12th centuries.

3. Methodology

This study used scientific methods of knowledge such as comparative analysis, analysis and synthesis, retrospective analysis, dialectical analysis, and a systemic-functional approach.

Muqarnas (stalactite), that is, a type of decorative ornament (pattern) intended for decorating the inside of a dome. Muqarnas are also used to give the top of a mihrab, tahmon, or portico, which have 4, 6, or 8 corners, a semi-dome. Muqarnas come in various complexity depending on where they are made. Muqarnas come in several forms. Head muqarnas - if the pattern is around a center, then the muqarnas is called head. In a muqarnas, the overall composition is divided into equal parts (8, 10, 12, 16, 20, 24, 32) as the artist wishes, and he draws a repeating pattern on one of these parts. For example, here the stars (which can be 5, 6, 7, 8, or 9-sided) do not always connect with each other at their ends, but often have a certain distance between them.

4. Analysis and Results

Having studied the science of muqarnas in depth, Kashi went ahead of the scholars of his time, showing the quantitative and qualitative differences between muqarnas, and dividing them into four groups:

1. A simple muqarnas (or, as builders and architects would say, a muqarnas with a pulpit);

2. Clay-clay muqarnas; (Another name for this is at-tiyn-kuloliy muqarnas);

3. Bowed muqarnas; (Al-qaws - bow-shaped muqarnas);

4. Shiraz muqarnas [7]; (ash-shirozi Shirozi muqarnas).

5. Discussion

Cauchy also showed the procedure for making the repeating part of the muqarnas bowl. “Know that,” writes Kashi, “master builders take the base of a right quadrilateral equal to the muqarnas scale (module), and determine its height twice as long” [8]. We saw another practical demonstration of the incomparable beauty-norm of quantitative proportions in Kashi’s application in theory and practice. Kashi’s method of determining a straight line corresponds to the method of Archimedes, and the method of determining points, lines, and heights corresponds to the method of determining Euclid. Ulugbek knew these methods very well and taught all the scholars of the madrasa that they should be deeply mastered, which is why he was likened to Euclid. The one who mastered this method most deeply was his student and friend Kashi.

Architects Ismail ibn Tahir ibn Mahmud Isfahani and Najmiddin Bukhari built a madrasah in Bukhara in 1417-1419 by order of Mirzo Ulugbek. On the wooden gate of the madrasah is written: “Talabul ilmi farizatun alo kulli muslimin wa muslimatin,” that is, “Seeking knowledge is obligatory for every Muslim man and woman,” and on the iron ring of the gate are inscribed the words characteristic of the spirit of the ruler Mirzo Ulugbek: “May Allah open the doors of mercy to those who enjoy the jewels of knowledge.” These words indicate that, according to the true creed of Islam, a learned person is honored, and the pursuit of knowledge is obligatory for both women and men. It was believed that it was necessary to create conditions for learned people to acquire knowledge. From time to time, Ulugbek would evaluate the knowledge of the students of the madrasah in Bukhara in the form of questions and answers, and would award 312 gold coins to the student and his teacher who answered the questions clearly and correctly [9].

6. Conclusions

1. The main purpose of the main instruments in the Ulugbek Observatory was to determine the main constants in astronomy, that is, the norms for the following astronomical objects:

A) the inclination of the ecliptic relative to the equator;

B) the duration of the tropical year;

C) the declination of the Sun by observing them. In other words, Ulugbek determined the main astronomical constants - norms - with unprecedented accuracy for his time.

2. In the cities of Bukhara, Samarkand and Khiva, muqarnas were widely used in the decoration of minarets, porches, and columns of madrasas. Muqarnas were also very widespread in the architecture of the Timurid period. The magnificent examples of muqarnas in the Mir Arab and Abdulazizkhan madrasas in Bukhara, Ulugbek madrasas in Samarkand, the Amir Temur mausoleum and the Shahi Zinda ensemble are a vivid proof of our idea. The muqarnas, which Kashi distinguished qualitatively, were later widely used in madrasas. During the reign of

Timur and the Temurids, the use of a star-shaped ornament - muqarnas, which was known in Central Asian and Eastern architecture long before (VII-VIII) centuries, mainly used to decorate the interior of domes, became widespread. The Mausoleum of Guri Amir and the Shodimulk mausoleums in the Shahi Zinda complex are unique examples of muqarnas. The muqarnas in the Abdulazizkhan Madrasah in Bukhara, built in 1652, has not lost its beauty and uniqueness to this day. The Mir Arab Madrasah in Bukhara - this madrasah was built by the Yemeni sheikh Abdullah in 1530-1536 with funds donated by the Bukhara Khan Ubaidullah Khan. The monument was named Mir Arab after his nickname. The complex and elaborate muqarnas in it beautify the architecture of the madrasah. Muqarnas are also used in the architecture of modern buildings. For example, they are widely used in the decoration of the Alisher Navoi Theater in Tashkent, the former Ministry of Agriculture building, and subway stations (Alisher Navoi Station).

3. It is noteworthy that the works of Central Asian thinkers on architecture and construction show the importance of natural constants, constants in the existence of nature, which are important in the creation of perfect and durable structures. Al-Kashi noticed that the basis of perfection in architecture is the norm, especially the priority of its quantitative and numerical moments. Unlike other thinkers, he was able to distinguish between theoretical and practical norms and show that they are inseparable from existence. The analysis of ancient monuments, the manifestation of geometric rules in their facades, domes, porches, corners, and ceilings in the form of strict norms, was clearly demonstrated in his time by representatives of the Ulugbek school of astronomy in their works. He identified the types of exact quantities and proportions in construction based on examples. Measurement is a measure to prevent errors. Measurement is the criterion of truth. He highlighted its great importance in architecture [10]. They showed not only a strict norm in architecture, but also a system of norms. The qualitative relationship of a certain number with another number; and the ability to show their system - (modular) indicates the strength of his depth of thought.

4. One of the forms of the norm in architecture is the girih. Internal girih and external girih are distinguished. The “kundal” style in architectural sculpture is also one of the forms of the norm in architecture, more precisely in Islamic architecture. The “kundal” style emerged in the second half of the 15th century. In architectural sculpture during the reign of Timur and the Timurids, Amir Timur advised to use more gold and blue colors, while white and blue colors prevailed in the architectural monuments built by Ulugbek.

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Competing Interests Statement

The author has not declared any conflict of interest.

Consent for publication

The author declares that he/she consented to the publication of this study.

Authors' contributions

Author’s independent contribution.

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