
MIRZO ULUGBEK: SHAPING THE GOLDEN AGE SCIENCE IN CENTRAL ASIA

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ANNOTATION

Mirzo Ulugbek (1394-1449) is a famous astronomer and mathematician of Central Asia who lived in the 15th century, ruler of the Timurid dynasty. Born in Sultaniya, Iran, and raised in Samarkand, Ulughbek was the grandson of Amir Temur, known for his contributions to science and art during his reign. Among his notable achievements was the construction of the Ulugbek observatory in Samarkand, where he conducted astronomical resources and calculations, greatly improving knowledge in this field. His star catalog *Ziz-i Sultani* meticulously recorded the positions of more than 1,000 stars and remains one of the most accurate star catalogs of the medieval period. Ulugbek's activities in trigonometry and astronomy have influenced the scientific thinking of centuries and have a lasting impact.

Key words: Mirzo Ulugbek, Timurid empire, astronomy, Ulugbek observatory, *zij-i sultani*, Samarkand, star catalog, medieval science, trigonometry, history of Central Asia, , mathematician.

INTRODUCTION

Mirzo Ulug'bek, born in 1394, was one of the most influential figures in medieval astronomy and mathematics and a prominent ruler of the Timurid Empire. As the grandson of the famed conqueror Timur, Ulug'bek was not only a leader but also a visionary scientist who dedicated his life to expanding human knowledge. He established the Ulugh Beg Observatory in Samarkand, a center for advanced astronomical research that became renowned across the Islamic world and beyond. His major work, the *Zij-i Sultani*, meticulously cataloged the positions of stars with unprecedented accuracy for its time, laying the groundwork for future developments in astronomy. Ulug'bek's contributions to science, especially in trigonometry and astronomical observation, remain celebrated centuries after his death, marking him as one of the medieval world's great intellectual figures. Despite the brilliance of his work, his rule was fraught with political strife, ultimately leading to his assassination. Nonetheless, Ulug'bek's legacy endures, bridging cultures and advancing the pursuit of knowledge.[4]

LITERATURE REVIEW

The scholarly examination of Mirzo Ulug‘bek’s life and work spans several disciplines, including history, astronomy, mathematics, and Central Asian studies. Researchers have widely studied Ulug‘bek’s *Zij-i Sultani*, a star catalog that recorded celestial coordinates with unprecedented accuracy, with works such as Kennedy (1960) and Saliba (2007) analyzing its impact on medieval Islamic astronomy and later European scientific thought. Historians such as David King (1992) highlight the significance of the Ulugh Beg Observatory in Samarkand, one of the most sophisticated observatories of the medieval world, where Ulug‘bek and his team conducted systematic observations and calculations. This institution, along with its observational instruments, is often studied to assess its influence on later Islamic and European astronomy.[3]

In studies focusing on mathematical contributions, scholars like Berggren (2003) emphasize Ulug‘bek’s advancements in trigonometry, particularly his calculations of trigonometric tables with remarkable precision for the era. Historical studies often explore how these mathematical and astronomical contributions positioned Samarkand as a critical center of scientific innovation. Political and cultural analyses, such as those by Allsen (1996), examine the challenges Ulug‘bek faced in governing a region steeped in traditional values, which often clashed with his scientific pursuits and reformist ideals. These works collectively position Ulug‘bek as a pivotal figure whose scientific achievements were inseparably intertwined with the cultural and political currents of the 15th-century Timurid Empire.[1]

METHODOLOGY

The research on Mirzo Ulug‘bek’s contributions utilizes a multidisciplinary approach that combines historical analysis, mathematical evaluation, and textual examination.[5]

1. **Primary Source Analysis:** The primary method involves an analysis of *Zij-i Sultani*, where Ulug‘bek’s astronomical observations are cataloged. By examining the tables, star positions, and trigonometric values, researchers can assess the level of precision achieved and compare it with other astronomical works of the period. Secondary sources, including historical translations and commentaries, provide context for interpreting Ulug‘bek’s findings.
2. **Comparative Historical Study:** This study compares the design and function of the Ulugh Beg Observatory with other medieval observatories, such as those in Maragheh and Cairo. By evaluating the instruments and observational techniques used, researchers assess the technological advances and scientific methodologies that distinguished Ulug‘bek’s observatory from others of his time.
3. **Mathematical Analysis:** To understand Ulug‘bek’s trigonometric advancements, researchers replicate his methods of calculating angles and distances, enabling a quantitative

comparison between his calculations and modern equivalents. This mathematical analysis serves to highlight Ulug‘bek’s innovations in trigonometry.

4. **Cultural and Political Analysis:** The final component involves studying historical records to understand the social and political pressures Ulug‘bek faced. This includes analyzing Timurid administrative documents, accounts of his governance style, and chronicles that document his interactions with religious and political factions. This method offers insight into how the socio-political environment may have influenced or hindered his scientific endeavors.

DISCUSSION

The investigation into Mirzo Ulug‘bek’s scientific contributions reveals the remarkable depth and breadth of his influence on astronomy and mathematics in the medieval Islamic world. His *Zij-i Sultani* stands out as one of the most detailed and precise star catalogs of its time, indicating a high level of technical knowledge and observational rigor. The accuracy of the celestial coordinates listed in the catalog reflects the advanced capabilities of the Ulugh Beg Observatory in Samarkand. This observatory, with its large meridian arc and other specialized instruments, facilitated a level of observational precision that was rare in the medieval period, rivaling even contemporary observatories in Maragheh and Cairo. Comparisons with modern data show that Ulug‘bek’s recorded positions for over a thousand stars were highly precise, demonstrating that his team’s methods of observation and documentation were far ahead of their time.[6]

In addition to his astronomical observations, Ulug‘bek made notable advancements in trigonometry, including his calculation of sine and tangent tables that displayed unprecedented accuracy. These calculations allowed him to refine models for celestial movements and provided later Islamic and European astronomers with valuable data. This mathematical work not only illustrates Ulug‘bek’s intellectual depth but also highlights the sophisticated level of mathematical knowledge in Central Asia at the time. By analyzing Ulug‘bek’s approach to trigonometry, it is evident that his work bridged ancient Greek mathematical traditions with the more precise methodologies that would characterize the Renaissance period.

However, Ulug‘bek’s scientific pursuits were not without their challenges. His commitment to intellectual and scientific exploration often clashed with conservative religious factions and political rivals who perceived his work as a threat to established social and religious norms. This tension ultimately contributed to the political instability that marked his reign, culminating in his assassination. The socio-political pressures that Ulug‘bek faced underscore the complexities of pursuing science and knowledge in a political environment resistant to

change. His tragic end is a reminder of the difficulties faced by historical figures who sought to advance human knowledge in conservative or volatile climates.[2]

RESULTS

1. **Astronomical Observations:** The analysis of *Zij-i Sultani* confirms that Ulug‘bek’s observations were not only accurate but also systematic, with a precision that surpassed most medieval star catalogs. The catalog included measurements of over 1,000 stars, which were later validated and became influential in subsequent astronomical research.
2. **Trigonometric Advancements:** Ulug‘bek’s trigonometric tables were more accurate than those of previous astronomers, demonstrating his advanced understanding of mathematical principles. The tables were instrumental for astronomers and navigators, who used them to calculate celestial movements with greater accuracy. This achievement shows Ulug‘bek’s significant contributions to both theoretical and applied mathematics.
3. **Impact of the Ulugh Beg Observatory:** The structural and technological analysis of the Ulugh Beg Observatory indicates that it was one of the most advanced observatories of its time. The instruments, particularly the meridian arc, enabled precise measurements and supported a systematic approach to astronomy that later influenced other observatories.
4. **Socio-Political Challenges:** Historical documents and chronicles reveal the political difficulties Ulug‘bek encountered, especially in balancing his roles as a scientist and a ruler. His assassination highlights the complex interplay between intellectual ambition and political authority, showing that his scientific endeavors were ultimately constrained by the socio-political environment.

CONCLUSION

Mirzo Ulug‘bek’s life and work demonstrate the profound impact of scientific curiosity and intellectual rigor in medieval Central Asia. His achievements in astronomy and mathematics positioned him as a pioneer whose legacy would extend well beyond his lifetime. While his life ended tragically, his scientific contributions, particularly through the *Zij-i Sultani* and his advancements in trigonometry, left an indelible mark on the history of science. His experience also serves as a compelling case study on the challenges faced by scientists working under political constraints, underscoring the delicate balance between intellectual freedom and political authority in historical contexts.

a) in this article, we can suggest that Mirzabek Ulugbek not only learned about the stars, but also their location in the universe, and even found the difference between their number, order, and one kilogram, and laid the foundation for the formation of the science of the Golden Age of Central Asia.

b) we suggest that in addition to the Ulugbek observatory, we should compare the design and functions of the historical monuments of this century, such as the Maragheh and Misr observatories, and evaluate the instruments and techniques in them.

c) from our political and cultural research, we can suggest that Mirzabek Ulugbek built his own observatory and madrasa together with the development of literature and history from the cultural side, and we mentioned that he continued the Timurid dynasty with his own state management system, and we analyzed this through cultural and political sources. we considered it permissible to study it more deeply

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