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An Inquiry into Maragheh Observatory: The First International Scientific-Research Foundation of the Ilkhanid Era

Javad Shekari Niri[1]

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Abstract

The Maragheh observatory site was excavated in 1970. Prior to the excavation, there was very little known about this architectural masterpiece. The observatory was constructed on the top of a hill called "Rasad Dāghi". In fact, Samarkand and Jaipur observatories had derived the idea and astronomical units from the Maragheh construction. So, we can use those as comparisons while aiming to better understand and interpret the existing works in order to properly reconstruct the Maragheh observatory. Compared to similar monuments in India, the Maragheh observatory can be renovated only using the Maragheh architectural units. Comparing existing evidence of observation, including archaeological, historical and scientific evidence, will lead us to better understand the realities of the original design. With the reference to the architecture of the existing ancient observatories, the hypothesis was that through a comparative study, an architectural algorithm/pattern could be found and used to determine the shape and arrangement of the Maragheh observatory. The main objective here is to compare the historical and archaeological evidence of Iran's observation instruments with other countries in order to develop the knowledge of Archaeoastronomy. The sky and astronomical phenomenon provided the tools for time reckoning, calendar organization and celestial navigation that supported those human voyages.

Keywords: Maragheh Observatory, Jantar Mantar, Samanid Temple, Archaeoastronomy, Samarkand Observatory.

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Introduction

The main queries that this research tries to answer are: What has rock architecture (Figs. 8-9) got to do with astronomy? Can Maragheh astronomical units be used for reconstruction? The research method uses survey, comparison, and analysis.

The great training-scientific complex of the Maragheh observatory was constructed on the top of a hill located on the western side of the city of Maragheh and under the supervision of the era's famous scientist, Khawaja Nasir al-Din al-Tusi, known as "the king of scientists" in 657 H/1258 CE (Fig. 1).

Though, there were lots of famous schools in Maragheh before the construction of the observatory, its unique construction in the Azarbaijan province spread its glory throughout the world. While currently, most advanced scientific centres and equipped observatories are located in the West, it is important to note that the Maragheh observatory was constructed when people did not even know of America. Undoubtedly, it was the most perfect and advanced observatory at that time. Some engineers, scientists and astronomers, such as "Mohy al-Din-e Maghrebi, Fao Moon G.," and others, especially four scientists such as "Fakhr al-Din-e Maraghi, Najm al-Din-e Dabirān-e Qazwīnī, and Najm al-Din-e Akhlāti, "Moid al-Din Orozi-e Dameshgi" invented new astronomical tools (Figs. 4, 12, 13) or improved the efficiency of previous tools. This is confirmed by historical narratives and available documents (Fig. 1).



Fig. 1. Astronomers in the Maragheh Observatory, Drawn by Behzad (jamjamshid.com, 2014: 1).

The celestial globe, which was invented by "Orozi", is kept at the German Dresden Museum, and the compass of the Maragheh observatory is also kept at an English museum (Varjavand, 1987: 329 & 322). Some historians believe that the observatory was constructed under the command of King "Holago" while some attribute its design and construction to "Khawaja Nasir al-Din Tusi". However, it's clear that the design was executed by the first shining star of science during the Ilkhanid era, "Khawaja Tusi". Its construction lasted for 15 years and "Khawaja" compiled his astronomical surveys in a book called "Zig-e Ilkhani" (Halabi, 1971: 52). The need for studying the Maragheh observatory arises because its construction is a scientific event in the Ilkhanid era in Azarbāijan. Also, it is both a training and research complex comprising Astronomy College as well as basic sciences colleges, particularly dealing with mathematics, geometry, and medical sciences. This observatory is well-known throughout the world and professors and students from different parts of the world—from China to the western countries—have studied and learned and researched here. The Maragheh observatory, therefore, was an international scientific centre. Then, its management methods included financial and scientific characteristics. It was similar to the "Rab-e Rashidī" training-scientific complex, which was constructed some 50 years later. Every discipline was studied in the latter complex excluding astronomy and philosophy. Further, the effects of the former complex were considerable to develop human sciences in the world through exchange and dissemination of sciences. Scientific attainments of this complex were considered as reference throughout the world, from Asia to Europe.

Before Mongols attack, Maragheh was a shining scientific centre in contrast to others with tedious religious disputes. According to historical evidence, there was a minimum of seven major schools before the 7th century: 1) "Mohy al-Din" School concurrent with the" Baghdad Niamey-e school" (second half of the fifth century Hijri); 2) Mohy School (end of the fifth century); 3) Atābak School (sixth century); 4) " Ezzyi-e school" (sixth and seventh centuries) [this school was active while the observatory was being constructed and many professors attended it, such as "Moayyd al-Din-e Orozi-e Dameshghi" who was a great engineer, physician, and mathematician, and he made many tools for the observatory]; 5) Sadrieh School: this school was active at the time of construction of the observatory and mentioned in the old book (when "Fakhr al-Din Abu Masood Mansūr ibn-Mohammad Kazeroonī", famous scientist and physician of his century, came to Maragheh in 664 H/1265 AD, "Khawaja Nasir al-din Tusi" thanked him and directed him to the school); 6) Mojahedieh School (active in the seventh century); 7) Ghāzi School was active in the sixth and seventh centuries and some of its graduates were "Imam Fakhr -e Rāzi", "Sheikh-e Eshrāgh", and "Sohravardi". It's interesting to note that a Jewish student called "Samuel ebne Yahodie Maghrebi" was one of its professors. He was from "Andalusia" and was a great scientist, physician, and mathematician. He was famous throughout the world for maths and compiled many books on mathematics and geometry, and passed away in Maragheh in 570. He, of course, converted to Islam later (Tayyar, Maraghi, 1996: 75-77). The name of a scientist from a western country called "Mohayy al-Din Yahiya Maghrebī" could be

seen amongst those of others in the Maragheh observatory (Halabi, 1971: 52).

A great scientist in this city indicates that the place was a scientific base of Iran in Azarbaijan even before construction of the observatory. The observatory was constructed on the top of a hill called "Rasad Daghi" (Fig. 2-3). To understand the importance of archaeoastronomy, we need to know that its goal is to understand how sky-watchers of the past fashioned and refined systems for regulating their primitive calendars and for memorializing celestial events, both cyclical and unique. Often they relied on sunlight and shadow plays striking and passing across targets and designs aligned with the Grand Octal. Sometimes the celestial cycles of the Moon, Venus and Mars captivated their attention, too. However, knowing seasonal durations and transitions were vital to success in hunting migratory prey, planting crops and harvesting them. Archaeoastronomy draws on several scientific disciplines, primarily astronomy, archaeology, anthropology, psychology and epigraphy, the decoding of ancient inscriptions (Fell, 2018: 1).

Background

Despite the existence of valuable resources and reports on astronomical activities of Iranians, there was no specimen of an observatory, until the archaeological excavation, removed the amnesia from its ruins. The ruins of the discovered works make it possible for us to embody the original design of the observatory (Fig. 10). In recent archaeological excavations, the construction of observatories at the archaeological site of Sassanid and early Islamic periods was discovered. An example of this is the astrophysical effect that Dietrich Huff discovered during the 2005 excavations in the remains of the circular city of Firoozabad (ShakiriNayeri, 2017: 93). Recently, an observatory building was discovered during excavations in Bushehr. One of the oldest examples of astronomical objects excavated in the hill called Tonb-e Pargan, Jinnah City, an inner circular structure, and an adjacent fence around it, finally a gutter that surrounds the entire complex (Fig. 5). According to the exploration supervisor of Tonb-e Pargan, the main part of the inner circular structure consists of a structure created with 20 rock masses, which was completely revealed in the recent explorations. He said the diameter of the structure was 16.80 meters (Fig. 5). Between each of the building blocks, a port is located at an average height of 60 cm, except for the distance between the two sides, which is located on the south of the circular structure has a double width of the other ports, and is likely to be a circular structure input. A smaller circular space of 14 rock masses is also built in the middle of the main circular structure. At the central point of both circular spaces, a round column with a 160 cm diameter and a surviving height of 50 cm, whose outer surface is lined with plaster molding, is shown (Asadi, 2018).This device is very similar to the Ram Yantra at the Delhi Observatory (Susan, 2011: 145). The Iranian calendar and its history are widely scrutinized by Arabic and Persian sources. These data mostly concern the Iranian calendar assumed during the Islamic age, that is, the Yazdegardi calendar (Cristoforetti, 2014: 145). There are many historical sources on the history of the observation facility since the early Islamic period in Iran. In the year 950 AD (329 AH), a hugeparietal quadrant, was established near Rey. At the time of Azd al-Dawlah

Dailami in Shiraz, a number of astronomers, including Abdul Rahman Sufi Razi (from Rey) conducted observations. In 994 AD, Khojandi, a 20 meters radius of meridian radical, was used to measure the deviation of the altitudinal section on Mount Tabarak near Rey, which was named after Fakhr al-Dawlah "Sades Fakhri" (Mozafari, 2009: 63-64). In 660 AH, the construction of the Observatory's instruments was completed and scientists commissioned the recording of the observation data, which was the result of a well-documented report called: Zij-e Ilkhani. This zij is one of the scientific achievements of the observatory. Zij-e Ilkhani had for centuries a special reputation in many of the territories - including China - and was translated into European language in 1997 (300 years after Tusi's death). The oldest version of this zige is kept at the National Library of Paris (Big Bappaup, 1391, Introduction). The Marâgheh Observatory was built about twenty years before the Beijing Observatory of Yuan era. In 1267, Kublai Khân seems to have received an astronomer and instrument maker called Jamâl al-Dîn (Chinese transliteration of Zhamaluding). He offered models or depictions of seven astronomical instruments of Islamic type (Chapman-Rietschi, 1994: 27). Hartner tried to identify the influence of Persian Astronomy in China during the Mongol era, carrying out the construction of astronomical observatory in China (Hartner, 1950: 41). The celestial sphere made by Muwayyad-al-Din-al Urdi, is one of the oldest kept at Dresden museum (Fig. 4) belonged to the observatory of Marâgha. Al-Urdi was responsible for the construction of astronomical instruments and wrote a treatise on the use of the celestial globe (Oesmann, 1997: 291-2). The Marâgha Observatory was built about twenty years before the Beijing Observatory of the Yuan era. In 1267, Kublai Khân seems to have received an astronomer and instrument maker called Jamâl al-Dîn (Chinese transliteration Zhamaluding) He offered models or depictions of seven astronomical instruments of Islamic type (Chapman-Rietschi, 1994: 27). However two observatories in the Islamic period occupy a special place in the history of astronomy: the Maragheh Observatory built in 1259 and the Samarkand Observatory of 1424. The Samarkand observatory which was based upon ideas from the Maragha Observatory, in turn became a model for an observatory built by Taqi al- Din in Istanbul in 1575 and a group of observatories in north India (Fig. 11) in the 1720 (Heidarzadeh, 2009 : 160). The revealing of the dimensions of the Maragheh observatory is owed to the archeological excavations of Parviz Varjavand (Varjevand, 2003).

Materials and Methods

This research method of study was archaeological and historical documentation, analysis and comparing of astronomical works and remains. This study surveyed Iranian astronomical monuments, which are located in many geographical locations, especially in the city of Maragheh. A glance at the Maragheh and Jaipur astronomical monuments, and historical documents, many similarities can be seen. Today, archeology faces unknown issues that must be discovered. An analytical comparison in this regard is currently the best practice. As such, the sources of this research is based on the study of historical discoveries of astronomical architecture, sources and historical texts of the past scientists in this field, and studies of today's

scholars and the use of the World Wide Web. Using comparative study as the research methodology, the study will focus on "historical sources" and "detailed plan" as two main architectural unites in Iranians observatory, other supporting instruments.

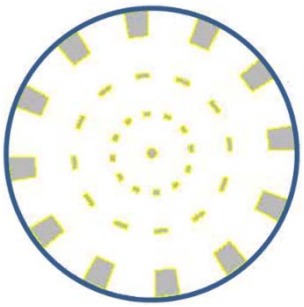
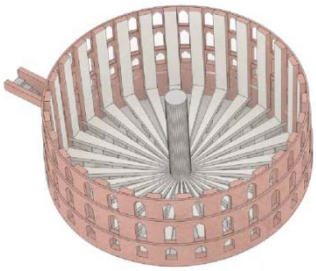
Innovations and Research-Scientific Scope of Maragheh Observatory

Some researchers believe that the Maragheh observatory was the greatest scientific phenomenon before the Middle Ages Europe. Renowned scientists such as Professor "Abdūl Salam" and others say that this institute is the first real world observatory (Tayyar, Maraghi, 1986:77).

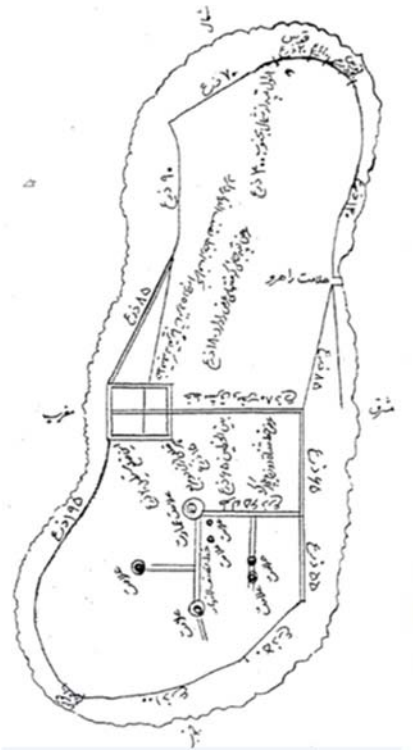
As we know, the Maragheh observatory is the first Islamic institute which was sponsored by endowed properties. Other big observatories that fell in the same league were the "Shanb-e Ghazan" observatory in Tabriz, "Ulugh Beg" observatory in Samarkand, and "King Morad" observatory in Istanbul.

Back then, the Maragheh observatory resulted in a new fashion. It's said that one-tenth of endowed properties in the "Holago" era was expensed in the Maragheh observatory (Varjāvand, 1987:380). Another major characteristic of this observatory was teaching activities. Though the teaching method of astronomers in old observatories was as master and pupil, the Maragheh observatory had a special approach and close attention was given to theoretical and math sciences as the base of astronomy (Sayili, 1977: 66-61).

Table. 1. The Similarities of Iran and India's Astronomical Instruments (Author).

Ancient Sassanid Astronomical Device at Tonb-a Pargan, Bastak, Hormozgan Province	Jaipur Astronomical Instrument Ground Plan, 1720.	Delhi Jantar Mantar, Ram Yantra
		

The above-mentioned statements obviously represent that the scientific activities of the Maragheh observatory didn't restrict itself to the identified and discovered construction on the "Rasad daghi" hill but it included some schools and active academic centres as a part of the observatory central core. His writings declared that the Moghuls arrived in Tabriz in 618 H/1221 CE. People, however, gave them gifts to appease and thereby saved themselves. They, therefore, moved ahead to western regions and "Azarbaijan".



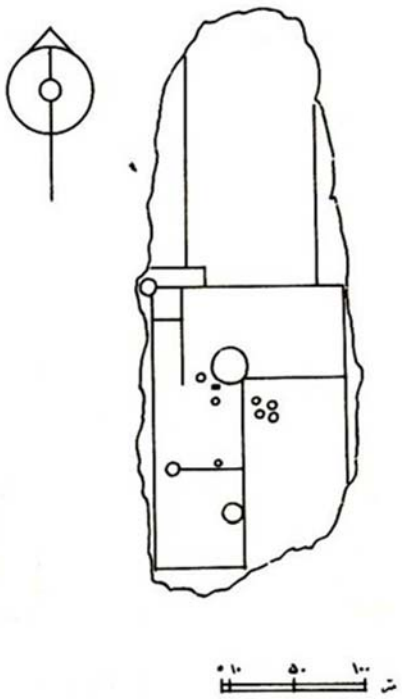


Fig. 2. Drawing Plan of Maragheh Observatory.
Fig. 3. Drawing Plan of Maragheh Observatory by Etezad al-Saltaneh in 1859 (Rafiee, 1995: 447).
Schindler, A.Houtumin 1880 (Wilber, 2003: F. 5).

Mongols, "Yaghout Hamavi" stayed there and hoped to develop their territory and chose it as their capital and therefore, Azarbaijan and its surrounding turned into the greatest centre of culture and civilization in Iran (Abbasi, 1995: 75). As evidence shows, "Khawaje Nasir al Din" was appointed to establish the observatory and scientific centre. It was a great scientific institute on astronomical activities and other scientific researches, for example; teaching maths, geography, and intellectual sciences. It also included a library with over 400,000 volumes. There is a written document that confirms its presence in the "Oljaito" kingdom. "Khawaje Rashid al-Din Fazl Allah" in this document expresses: [But the author (Moharrer) says that Fadhl Allah ibn Abi al-Khayr ibn Ali..., Islamiv king took a decision to go to Maragheh from "Ojān" for hunting in 708 H/1308 CE. and he arrived safely with a number of waiters. During his disputes, it was said that 12 is a more valuable number amongst other numbers...] (Rashid al-din Fadhl Allah Hamedānī, 2535/1976: 773). Further, the Maragheh observatory was demolished after the attack of "Agh Ghoyūnlū & Ale- Jalāyer" in "Azarbaijan" and its library was plundered too. "Hamd Allah Mostoufi", for instance, visited the Maragheh observatory in 740 H/1339 CE and wrote that the construction was demolished. The construction of Samarkand observatory was started during the kingdom of "Ulugh Beg", son of "Shahrokh Teimourid" in 824 H/1421 CE. (800 solar calendar), and lasted for three years. During his rule, Iran and Central Asia experienced a second period of the Eastern Renaissance.

According to a report of "Ghiyāth al-Din Jamshid Kāshāni", a well- known Iranian mathematician and astronomer, he was appointed by King "Ulugh Beg" for

"Samarkand" in order to complete the construction of its observatory. Letters which Kāshāni wrote to his father have survived. These were written from Samarkand and give a wonderful description of the scientific life there. The contents of one of these letters, has only recently been published. (Bāgheri.1992:241-256).

His report indicated that some elements of the Maragheh observatory were available at that time: [nobody informed me that why this"geometrical chair" is located in the middle of the Maragheh observatory and what does it do? (Rafiee, 1995: 442-447). In 1019 H/1610 CE, Shah Abbas appointed some scientists and astronomers to observatory in "Delhi" and "Jaipur"



Fig. 4. Maragheh Observatory Celestial Globe at Dresden Made by Urdi (Oesmann, 2002: 295).

"Khawaje Nasir al-Din Tusi" was born in "Khorasan" in 597 and passed away in 672 H/1274 CE in "Baghdad" and his tomb is in "Kazemein" near the tomb of Imam Mosa Kazem (Peace be upon him). Old texts indicate that he was taught by "Bahmanyar Ibn Marzban Azarbaijani", one of "Ebne Sina pupils" (Halabi; 1971: 52). (According to the statements of Abdullah Ghochani and a document from "Ebne Fouti", librarian of the Maragheh observatory, it is possible that Khawaje Nasir al-Din killed himself and this is because he has used the Arabic word "Entahara".

Rock-cut Architectural Units of Maragheh Observatory Hill

Some excavated spaces inside the rocks are obvious evidences located on the west side of the Maragheh observatory hill (Fig. 6). "There is a big crypt on the hill which opens toward the west. There are many holes and paths inside the crypt and there are also two big plates, which include tomb symbols"

(Rafiee, 1995: 457- 460). With regard to the architectural units of Maragheh observatory's rock hill, he mentioned two volumes inside the temple with two-pitched roof. He also mentioned a tomb symbol which is a platform for religious formalities (Fig.7). They may frequently be seen in temples in China and India and activities like gift presentation and incense burning are conducted there. Since this platform was an integrated volume with its bottom inside the rock, it produces were located on two sides.



Fig. 5. Tonb-e Pargan, Bastak, Sassanid Era, (Memarabashi, IRNA, 2017).



Fig 6. Entrance View from Rock Hill.



Fig. 7. Indoor Space of Temple, West Side.

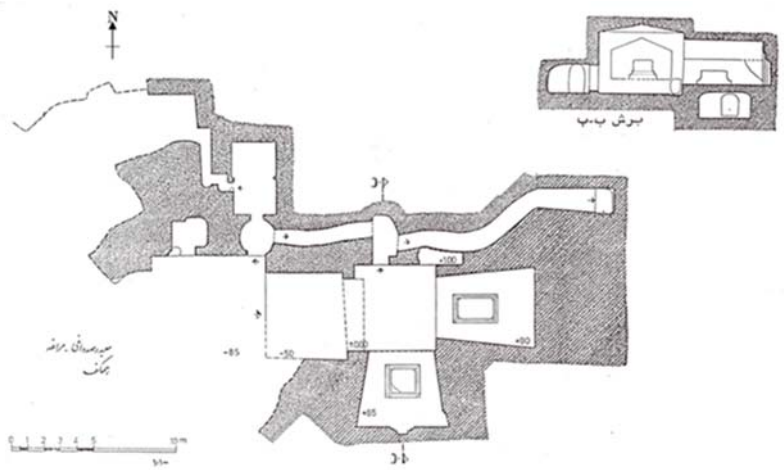


Fig. 8. Plan of "Rasad Daghi" Rock Temple - First Floor.

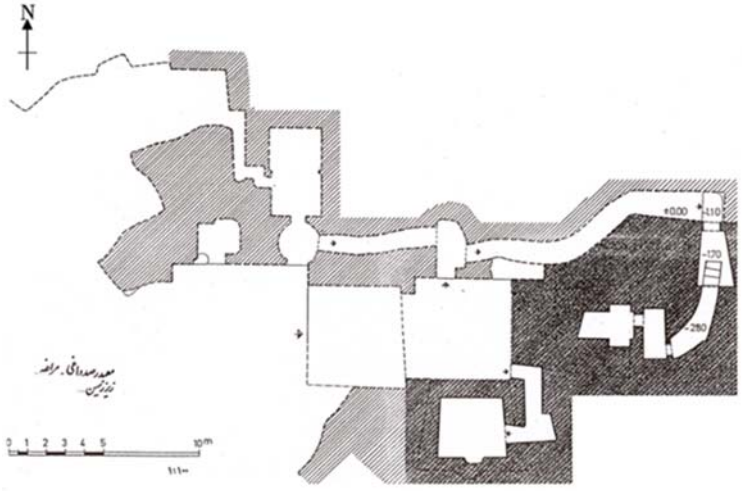


Fig. 9. Plan of "Rasad Dāghi" Temple's Basement.

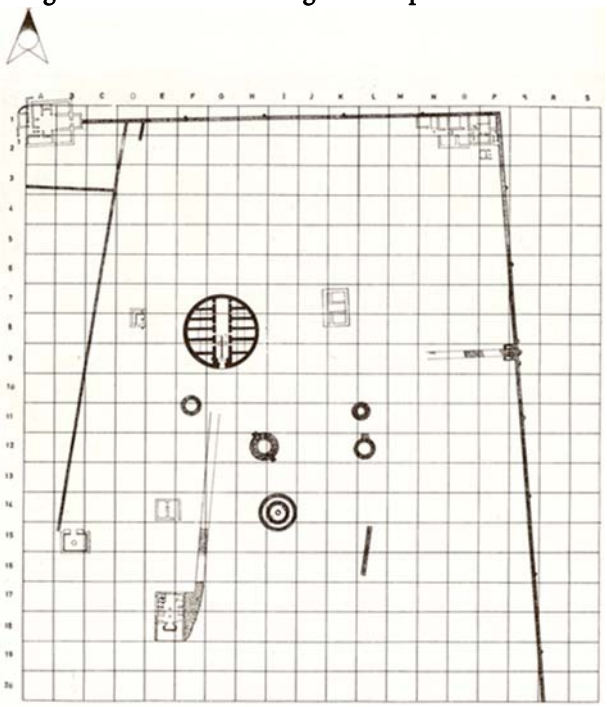


Fig. 10. Site Plan of Maragheh Observatory 657H/1259CE) (Varjavand, 1977: 169).

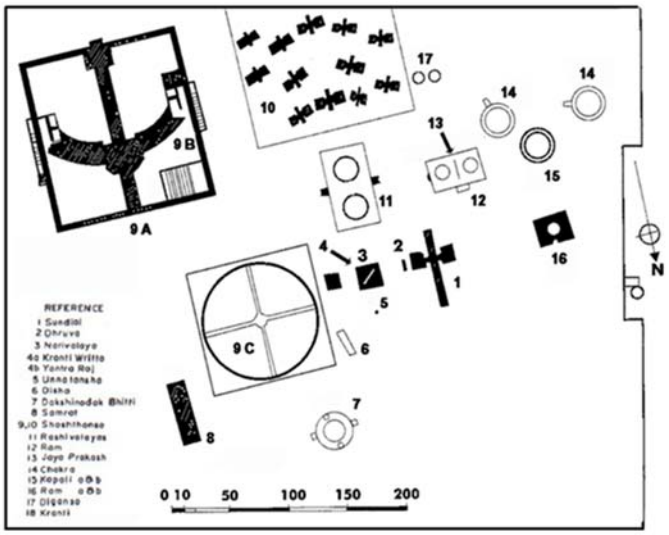


Fig. 11. Site Plan of Jaipur Observatory in India (1727 AD) (Rajavat, 1995: 38).

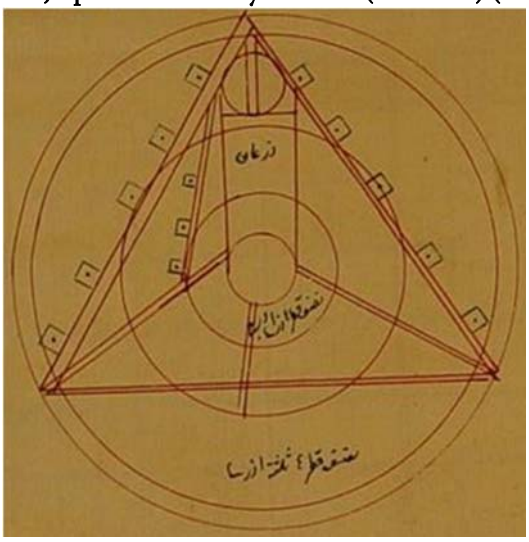


Fig. 12. Circles Around the Foundation of the Instrument No. 11.

About two volumes of rock temple, one of them is toward the west and the other toward the north. They are now intact due to their rock structures (Fig.7), and have always been, the most important places to visit amongst the remainders of observatory after its destruction (Fig. 8). What is interesting is that both the aforesaid volumes have a tunnel shape entrance as a steep and spiral path. These paths have been excavated in the form that turns around the temple and ends into a small space with pitch darkness. The western underground path is more complex and is located three meters below the temple (Fig. 9). Such spaces don't have any specific functions. Meandering underground corridors have no direct connection with the observatory. Since the overall design and interior volume of these temples are non-traditional, they certainly may be the outcome of excavation (Fig. 3&6).

The northern space includes an adytum inside the south wall and it might have been constructed next. There are cavities of the size of a common bowl in the box-form volume and in the middle of volumes which the author had seen on its burnt walls in 1992. Though various tribes and religions cooperated on scientific

activities in this complex (Christians, Jewish, Buddhist, and Muslims), these spaces are related to religious architecture of China and Mongol in east. These spaces might not have had any scientific functions but witnessed old religious actions, beliefs, and astronomy such as projection etc., which are considered non-scientific aspects of astronomy science. They, however, were constructed necessarily and under request, order, and requirement of the dominant tribe. A long them, there are many tombs and a well, which is over forty metres deep. The attendance of religious followers of China and Khatā'ī Moghols was inevitable during the Ilkhanid era. History also confirms their attendance. China and Mongol formalities involve special spaces and specific customary rock temples that can be found a lot in India and China for Buddhist religious formalities. The presence of a platform in the middle of the space indicates religious formalities of Buddhist religion (Fig. 6).

The presence of adytum inside a space also indicates its application by Christians and Iranian Sufis. There are many reports in various historical books about the Buddhist clergy attendance in the Moghul court, and the first Ilkhanid kings were Buddhist until the "Arghoon" period.

One of these reports is available in the books "Jame al-Tavarikh" and "Latayef al -Haghayegh". Papers of "Rashid al-Din" indicate his indignation for traditions and beliefs and the behaviours of "Bakhshian" *[The fourth "Arghun Khan" came to Maragheh in 688 and went to the observatory and started taking black drug] (Rashid al-Din; 1994:1176). This statement of "Rashid al-Din" about a "Bakhshi" (Buddhist clergy) indicates the presence of a famous Buddhist clergy and scientist in this centre. "Rashid al-Din" continued his story about the sulphurous drugs and how "Arghun Khan" took quicksilver owing to order of "Bakhshian",* and the beginning of his ailment: "Arghun" strongly believed in "Bakhshian" and their methods, and he always encouraged them. One day, a "Bakhshi" came from India and claimed that he could increase one's lifespan. On asking about its method, he took the name of a special drug. "Arghun Khan" again asked him whether the drug was available there. He answered: yes. So he ordered for the drug to be prepared. So the "Bakhshi" composed a drug from sulphur and quicksilver and he took it for about eight months and ... (Rashid al-Din, 1994: 1179). Rashid al-Din also reminds us about a discussion with a Buddhist clergy in the "Arghun" period indicating their attendance and power in the Ilkhanid (Mozaffari& Zotti, 2013: 79). court [One day, a "Bakhshi" who was the attendant of the great King "Arghun Khan" asked me whether chicken was derived from egg or vice versa. He intended to test me and thought I don't know its answer. While I never heard such a question before, I stopped for a while and answered him correctly, thanks to god's blessing. (Rashid al-Din; 1994) & (Latayef al-Haghayegh: 261).

"Rashid al-Din" frequently confirms the attendance of Buddhist clergy in the Maragheh observatory. Rock-architectural designs on the "Rasad Daghi" skirt relate to religious formalities and customs of "Bakhshian" (Fig. 8, 9).

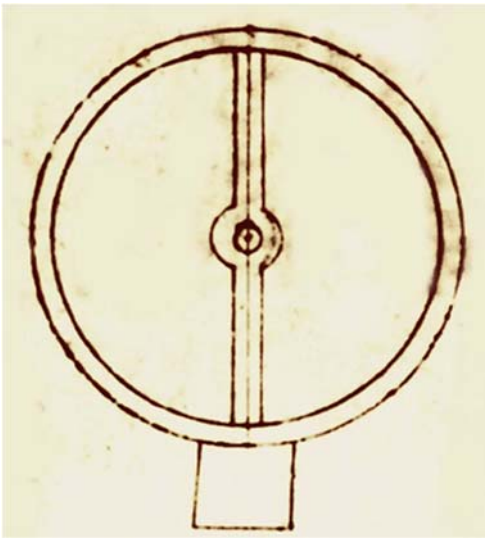


Fig. 13. Urdi's Book, Observatory Divice, MS Istanbul, Ahmet III, 3329 (Sezgin, 2010:41).

Finally, we touch upon the topic of "Vinson's" visit from Maragheh rock temple during Naser al-Din Shah (a Qajar king) in 1880 and his thesis about its rock temple. What is more interesting is his thesis was well-known among Muslims and Christians of "Maragheh" and the Christian clergy lived there for a while too. He wrote:[It was concluded from various references that "the Nestorians" tribe had an institute in this city during the rule of the "Timor". I went to visit the greatest rock temple; the first room's size was 40 steps by 15 steps. There was a stone rock at the end of a room and there was a big adytum on it. I guessed this was temple's prayer space. There are also some rooms along the aforesaid prayer place and some of them were drawn toward many other small rooms (Fig. 8). I crawled inside one of the spiral corridors, 60 steps downward. The corridor ended to a room which seems to be an old monks' place (Taheri, 1968: 169-170). Wilson describes his visit to corridors and rooms under the small rooms inside a soft rock under the surface temple.

Underground spaces were located around a vertical axis. It is a terrific construction of these two rock temple, which includes spiral corridors spaces along a vertical axis or gravity centre with some metres of thickness inside the rock. The corridors ended to the last underground room and were so narrow that one has to cross it crawling. What are interesting and surprising are the digging and routing operations in these narrow and dark corridors, and transferring constructional materials in those days (Fig. 6). Though its plans were discovered through archaeological excavations, its architectural design was unclear. Recent findings were achieved through the comparison of some available astronomical constructions in the Samarkand and Jaipur observatory of India (Table 2). It resulted in the idea that since the Maragheh observatory was constructed five centuries ago, its astronomical designs were modelled in other places including the Samarkand and Jaipur observatory of India (Table 1). Its complete results will be published in the near future.

Conclusion

This research concluded with three results expressed below briefly:

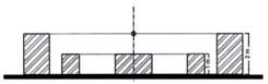
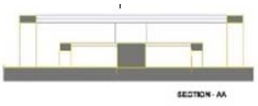
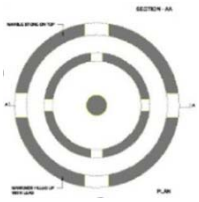
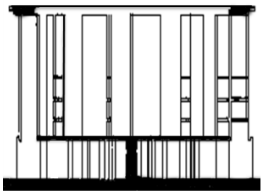
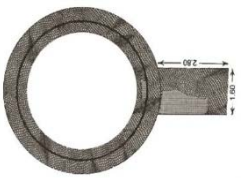
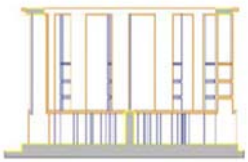
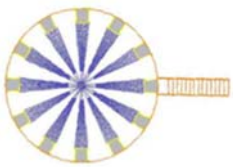
The Moghols selected their capitals precisely and they commonly considered technical studies and basic principles while selecting a place as capital. So, it is necessary to reconsider traditional and weak comments. For instance, Maragheh was selected as the capital because it was close to develop conquests in the west territory, while in fact there were many other such cities than Maragheh.

Before Moghols attack, Maragheh was seen as a scientific centre and it, therefore, was selected as an observatory owing to a great location to observe the sky and stars.

Historical documents indicate that there were five tomb towers in "Kaboud Gonbad Maragheh" and some of them were Abbasi Caliph's tombs. As per my recent archaeological findings and dialogues between authors and "Dr. Noubari", they confirmed the above-mentioned evidences. These, however, are evidences of Maragheh's political position before Moghols attack. Well-known scientific schools inside the city indicate scientific position of the city before the "Hulaku Khan" kingdom. This study sheds light on the complete design of the "Maragheh" observatory as well as functions of its astronomical units. The observatory was equipped with a variety of instruments, which accounted for the largest part of its scientific measurement. The Maragheh Observatory is the oldest and largest one in the Ilkhanid era. The Maragheh Observatory has had a great impact in the astronomy world like the one in Samarkand.The Samarkand observatory was much more important for its influence on astronomy in Mughal India like, the Jaipur, Delhi and Ojin. Astronomical designs were modelled in other places including Samarkand and Jaipur. Its complete results will be published in the near future.

Though functions of rock architectural units on the western side of "Jame al-Tavarikh" indicated similarity with temples in the east and south Asia and India, for instance, the forty nights' residence of "Arghun Khan" and taking long- life drugs under the prescript of a "Bakhshi" (Buddhist clergy) resulted in his death after eight months. These documents indicate the function of this place as a temple for traditional religious and strange practices among the Mongols. This temple contains two completely dark spaces of residence for forty nights and they include spiral corridors, which were located precisely in the gravity centre of the foresaid temple. These are completely light-isolated places indicating that ceremonies were held in perfect darkness by "Bakhshis" or followers of the "Shaman" religion. Astronomical research and scientific units of the Maragheh observatory were located on the hill.By incorporating archaeological evidence, the main scientific manuscripts like Kashani and the transverse and compared with existing observatories like India, we can rebuild scientific destruction centers like Maragheh observatory. By incorporating archaeological evidence, the main scientific manuscripts like Kashani and the transverse and compared with existing observatories like India, we can rebuild scientific destruction centers like Maragheh Observatory.

Table. 2. Comparison of Circular Astronomical Observatory Architecture's Maragheh Materials with Similar Units in Indian Jaipur Observatory known as "Digansa Yantra" and "Ram Yantra".

Astronomical Units	Image	Section	Plan
Maragheh Observatory (Dhā al- Ostuvānateyn) (Diameter: 8/35 m) Construction date: 657 H/ 1258 AD Owning two cylinders			
Jaipur Observatory Digansa Yantra (Diameter: 8 m) Construction date :1718-28(Sharma,1995:121)			
Maragheh Observatory Dhā al-Samtewa-l-Ertefā' (Diameter: 4.10 m) Date of construction of 657 H/ 1258 AD			
Jaipur Observatory Ram Yantra (Diameter: 6.95 m) Date of construction: 1718-28			

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جستاری در بقایای رصدخانه مراغه
نخستین بنیاد بین المللی علمی پژوهشی عصر ایلخانی

جواد شکاری[1]

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چکیده

رصدخانه مراغه بر تپهٔ بسیار وسیع و مرتفعی بنا شده است که در محل، بدان «رصد مراغی» به معنی کوه رصد اطلاق می‌شود. واحدهای نجومی و یک سری آثار معماری صخره‌ای در آن مکان یافت .اما تفسیرهای متفاوتی دربارهٔ آثار یافت‌شده ارایه می‌شد. در ساختمان این رصدخانه و امورات آن دانشمندان بزرگی از سراسر جهان از مغرب و اندلس تا کشور چین مشارکت داشتند و به‌دلیل تکامل و پیشرفت‌های آن در عرصهٔ علم نجوم از طرح‌های نجومی آن در ساختمان بسیاری از رصدخانه‌های جهان الگوبرداری شده است ازجمله رصدخانه سمرقند و رصدخانهٔ قرن ۱۷ جیپور هند که نمونه‌های بارز و اثبات شده‌ای هستند. با انجام مقایسه‌های لازم طرح کامل پلان‌های کشف‌شده نمونه‌های مذکور، برخی از واحدهای رصدخانه مراغه قابل بازسازی بوده و کاربری واقعی آثار نیز قابل بازشناسی شدند. این رصدخانه برخلاف همزاد خود در سمرقند و جیپور کمتر به جهانیان معرفی شده است. رویکرد این پژوهش تحلیلی مقایسه‌ای مبتنی بر بررسی‌های باستان‌شناسی جهت بازشناسی برخی از واحدهای نجومی رصدخانه و شناخت کاربری واقعی آثار و بقایای آن به‌ویژه واحدهای معماری صخره‌ای است. مقاله سعی دارد به سئوالات متداول دربارهٔ نوع و وسعت کاربری واقعی آثار و ماهیت و چگونگی آنها بر اساس اسناد و مدارک باستان‌شناختی پاسخ دهد.

واژه‌های کلیدی: رصدخانه مراغه، جنتر منتر، معبد صخره‌ای بخشیان، باستان‌ستاره‌شناسی، رصدخانهٔ سمرقند.

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