

THE MARAGHA OBSERVATORY INSTRUMENTS (XIII c.)

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Abstract. *The article deals with the matter of the astronomical instruments of the Maragha observatory which was discovered in a translation of Urdi's treatise found in France by the orientalist A. Jourdain. Urdi's treatise is the single work regarding the astronomical instruments of the Maragha observatory which comes down to us.*

Keywords: *observatory, quadrant, Tusi, Urdi, equinox*

Science is an equivalent of civilization. Researching the definite stage of mankind evolution it is necessary first of all to note the level of science development. Education is included into science and which in its turn is the source of education, literature, medicine, industry, technology, trade, and etc. It is a complicated and interesting structure. If constructed, programmed and used well the structure can open the gates of the wonder world.

During the medieval period the science was mostly developed in the East. One of the ancient sciences was astronomy. The Maragheh observatory, the Maragheh academic system, the scientific center left their traces in history. The founder of that system was the Shah of science, as he was called, an outstanding scientist-encyclopaedist Nasir ad-Din ad-Tusi (1201-274). Under the patronage of Chinghis Khan's grandson Khulagu Khan they began building the observatory in Maragha in 1259. The location site to observe was chosen by Tusi himself.

The chief engineer to build the observatory and make tools was Muaiiad ad-Din al-Urdi (1200-1266). The project was headed by Tusi. Syrian scientist Urdi came to Maragha from Damask at the invitation of Tusi. He developed the Damask water system.

Before the observatory building a group of scientists and engineers was gathered to construct the tools. The observatory tools were placed on the earth surface, the observatory dome and in the definite depth of the observatory. Using the scientific material of the ancient science the already known tools were used and new ones were also created. They were five versus five. Hoja Nasiredin (Tusi) trained scientific personnel in the special school at the observatory. Among people working in the observatory were two Urdi's sons. Nowadays in Dresden Maathematisch-Physicalisher Salon - a science museum is kept the globe constructed by Muaiiad ad-Din al-Urdi's son, Mohammed ben Muaiiadaddin. It is marked on the globe. The stars are marked very accurately with account of the annual precession. The globe was constructed in 1279. It was a star catalogue.

There is little material about the tools of the observatory. One of the treatises of Urdi was found in Paris National library, in the East department in 1809. (№1156). The researcher of this treatise A. Jourdain translated the document from Arabian into French. This material is the single existing one about the Maragha tools. Later the manuscript was translated into German.

We received from Paris national library a copy of the French translation of the manuscript – Jourdain's translation with his commentaries. It says that "... to build the observatory Nasireddin chose the mount top near Maragha in the direction of the Sun setting. The building was constructed so that every morning the rays of the rising Sun passed through the dome opening and lighted all walls. With the help of those rays they detected minutes and degrees of the Sun medial movement, its altitude in every season and number of hours. Inside the building it was possible to see planets, epicycles, waves and circles showing 12 zodiac signs. We can distinctly see the form of the Globe, difference of seven climate zones in its fourth part where people live, the day length, countries' latitude, and islands and seas forms. There were many tools in the building and before every new observation Nasireddin asked Khulagu Khan more finance to improve the necessary devices..." There were 10 main devices for observation in the Maragha observatory. The treatise reads the structure of the devices and the way they work. 5 tools are devices of the ancient scientists, 5 – made by the Maragha scientists. The Maragha observatory scientists constructed and improved the methods and ways of tools measuring. The observatory devices were :

1. Quadrant Muralis;

2. Device to detect ecliptic tilt;
3. Device to detect equinox moments;
4. Device to detect degree of eclipse;
5. The Armillary sphere;
6. The Rotating quadrant;
7. The Device of two columns;
8. The Sine instrument - I;
9. The Sine instrument –II;
10. The Perfect instrument.

It was written earlier that the diameter of the Muralis quadrant, the biggest instrument of the Maragha observatory, was 4,5 meters but excavations which were held in 1978 proved that the the Muralis quadrant diameter was 36 meters.

Jourdain highly appreciating the invention of the Maragha astronomic devices says that to achieve professionalism in astronomy one must possess rich knowledge in mathematics and metaphysics.

Urđi writes «...The ancient inventors created different devices but they either did it inaccurately or could not receive the expected results». This conclusion was made when inaccurate measurement data and observations of the ancient scientists was found.

The rotating quadrant gave a possibility to detect the horizontal coordinates of the celestial objects. In the following centuries the rotating quadrant was transformed into a universal portable instrument. A noted scientist A. Berry in his "A short history of astronomy" writes «Here a great number of astronomers worked under the supervision of Nasireddin. The instruments used by them differed by their size and solid structure and were apparently better than those used during Copernik time; they were first exceeded by the instrument of Tige Brahe.» (А. Бери "Краткая история астрономии", перевод с англ. яз. М - Л. 1946, с 79)

The astronomical instruments of the Maragheh observatory found their usage in many observatories of the world. One should note Tabriz, Beijing, Samarkand observatories, the observatory of Tige Brahe among them, and etc.

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