SOME SAMPLES OF THE SCIENTIFIC ACTIVITIES IN THE FIRST HALF OF THE NINTH CENTURY*

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The main scientific studies began in the half of the ninth century in the Islamic World. Even we can say that those activities were superior in almost every aspects. Among the scientist who flourished in this period of time were al-Fargani, al-Khwarizm and Sons of Musa.

As is known that certain Abbasid caliphs supported scientific activities and among them can be mentioned al-Mansur, Harun al-Rashid, Mutevakkil. The seventh Abbasid Caliph, al-Ma'mun (813-833) was a great patron of letters and science and even he supported those activities more than the others, even more that Harun al-Rashid who was the founder of a scientific academy in Baghdad where large number of the scientific works were translated from Greek, Sanskrit and some other languages, and the knowledge which came through this interpretation was assimilated well and became the roots of the scientific foundation of Muslim science.

We can mention following scientist-translators among them: Abu Yahya al-Batrik (d.796/806); Yuhanna b. Maseveyh (d.857); Hunayn b. Ishak (809/10-877); Sabit b. Qurra)d.901); Haccac b. Yusuf al-Mattar (786-833). One of the earliest translation of an astronomical work was Sind Hind (Siddhanta) was translated from Sanskrit by Ibrahim al-Fazari

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(d.806). This work was only astronomical source for the field up till al-Ma'mun's period. But as known that, Ptolemy's famous work, Almagest was translated by Sahl al-Tabari at first time at the beginning of the first half of the ninth century and the following interpretations of this work belonged to Haccac b. Yusuf al-Mattar and Huneyn b. Ishak. The latter was mostly preferred by the astronomers.

Al-Ma'mun founded two observatories; one of them was Shammasiye in Baghdad and second was Kasiyun in Damascus.[1] Kasiyun was founded for only observation of the Moon and Sun. However, the famous Turkish scientist, Biruni also mentioned them and said that those observations were made between 831-832, but not completed. There were a lot of astronomers and mathematicians studied in these observatory whom also worked in the House of Wisdom (Beyt al-Hikme).

Among the astronomers who studied in Shemasiye can be mentioned Yahya Abu mansur, Sened b. Ali. İncluding in the famous Turkish mathematician and astronomer, Khwarizmi. In this observatory the astronomers focused on the observation of the ediptics and the diameter of the Earth. He used tanjent function as well as sine. His astronomical book was revised by Maslama al-Majriti (X.cent.). He also made certain addition to Ptolemy's geography in his *Surat al-ard.*

In this period of time scientist were mostly interested in astronomy. A very large amount of mathematical and astronomical works were written during this period and the writers were chiefly Muslims.

It is diffucult to seperate mathematical studies from astronomical studies and most of the astronomer were also interested in mathematics. Almost all astronomers were mathematicians as it happen in the following centuries; for example Gauss was a great mathematician and astronomer too. For that reason it can be said those studies overlap one another in some way.

The great mathematician, Khwarizmi was interested in mathematics as well as astronomy. Although we do not have any Arabic coipes of his book on astronomy in hand its Latin version was well-known by European writers and used extensively.

[1] A. Sayılı, Observatory in Islam, TTK, 1988, p.19

His arithmetic let Muslim World and then Europe know Hindu numeration.[2] His book, *Kitab al-Muhtasar fi Hisab al-Hind* was also translated into Latin in twelth century. It had also great influence on European mathematicians and that calculation system was called algorism refering the name of its founder, Khwarizmi.

He also wrote a book on algebra and the name of the book became the name of this branch of mathematics. In this work, *Kitab al-Cebr va'l-Mukabala*, Khwarizmi gave analytic solutions (with figures) of linear and quadratic equations. For instance $x^2+10x=39$ was one of his equations. He also gave the geometrical solutions of those equations. He also mentioned binom formulas as well. For that reason, he was called founders of algebra as distinct field from geometry. His quadratic equations were generally repeated by the later mathematicians.

In the same period of time astrological studies were highly popular. Although astronomy is important for the progress of the history of science, astrological studies also helped great in order to improve astronomical knowledge.

In addition to these studies in this period, al-Ma'mun ordered to be done geodesic measurements to determine the size of the earth and the direction of Kible. A group of astronomers and mathematicians worked hard in order to give best results. One of them was Khwarizmi.

Among the astronical and mathematical studies can be mentioned some other names as Habash al-Hasib, Ali b. Isa Usturlabi, Dinawari, etc. But al-Farghani had an different place among them. In Latin he was called Alfraganus. His full name was Abu'l-Abbas Ahmad ibn Muhammad ibn Kathir al-Farghani. Although we do not know when he was born and when he died, we are quite certain that he lived in Transoxiana and was trained in Farghana in this region. After that, he went to Baghdad, the place where was accepted as cultural and scientific centre at that period of time. He flourished under al-Ma'mun. He was one of yhe great astronomers of al-Ma'mun and al-Mutavakkil. Although he lived during Mamun's dynasty, there was no record about whether he

[2] G. Sarton, Introduction to the History of Science, Baltimore (USA), 1927, v.I, p.563.

worked in one of the observatory which were founded by al-Ma'mun.

Tagribi said that Farghani worked for the making of an astronomical instrument which was called new nilometer. However this instrument was also called as *al-mikyas al-kebir (grand nilometer).* Ibn Hallikan also mentioned the same instrument and the same measurement. He gave the name of engineer who was the director of his work as Ahmad b. Muhammad al-Qarsani.[3] Here, Qarsani should have been Farghani.[4] Nilometer was an instrument which was used to measure the level of the Nile. Its level used to be measure every day by an officer.

However there were various kinds of nilometers, and one of them was made for Mutavakkil which was called 'Grand Nilometer' or 'New Nilometer'. This was the nilometer which was erected by Farghani.

Farghani was also one of the responsible person who was charged to build a canal, called 'Caferi Canal'. The Caliph, Mutavakkil ordered to be built a canal and charged this job to the two sons of Musa b. Shakir. Although at first, they thought to give this job to Sened b. Ali as an engineer, but, after then, they let Farghani built this canal. It was at Tigris and went through the city which was called Cafer. Certain sources said that Farghani made a mistake to let the bed of the canal deeper than the beginning of it. Yakubi said that he did it in that way because of the structure of the bed of the canal; it was stony and very hard.[5]

Some of the historians mentioned different names about the engineers who were responsible of this matter. For instance Abu'l-Farac said that Ahmed b. Kasir was the director of the construction of the canal in his work, and Ibn Kifti said that there two brothers who were responsible of this matter, but this could not be correct, because they lived before the data of the canal's construction. They lived during Ma'mun's dynasty and the canal was constructed during Mutavakkil's dynasty.

Ibn Nadim mentioned Farghani's two wprks. One of them was named *Kitab fi Harakat al-Samaviya wa Javami Ilm al-Nujum.* This was

[3] Ibn Hallikan, Wafayat al-A'yan, Cairo, 1882, v.I, pp. 483-485.
[4] Sabra, A. I.al-Farghani, Abu'l-Abbas Ahmad Ibn Muhammad Ibn Muhammad Ibn Kathir, Dictionary of Scientific Biography, v.4, 1971, 541.
[5] Y. Unat, Al-Farghani, Harvard 1998, p.14.

written depending mainly on *Almagest*, the famous book of ptolemy. This book was also called *Elements of Astronomy*. It was so many different names. Some of them can be given as *Kitab al-Fusul, Ilm Hey'et al-Eflak ve Harakat al-Nucum, Kitab al-Fusul al-Selâsin, Kitab Ilal al-Aflâk* etc.[6] It was translated into Latin by John Hispalensis and Gherardo Cremonese. Hispalensis' translation which was named as Compilatio astronomica was published in Ferara in 1493. And then, it was edited again by the famous mathematician and astronomer, regiomontanus in Nürinberg in 1537. In the following years it was published in different places in Latin and Arabic.

Farghani's book named the elements of Astronomy was accepted as a summary of Ptolemy's Almagest, excluding the first chapter. This chapter is about the Arabic, Persian, Syrian calender etc., and their principles. In the following 29 chapters, Farghani explained the motions of the Sun, the Moon and the other celestial bodies. His explanation were so clear and understandable that this book, the Elements of Astronomy was accepted as a handbook in this field until fifteenth century in European countries and many times was translatred as was mentioned before.

Farghani's certain astronomical values different from Ptolemy's. For instance, Ptolemy gave the diameter of the episicle of the Moon as 6.22 degrees, but Farghani's values were 6.33 degrees; we can add some other examples in addition to this. For example Farghani gave the value of the angular inclination of ecliptic as 23 degree 35 minutes. As is known that this value was given as 23 degree 34 minutes by Betyruni, nearly two centuries after Farghani.

Farghani also tried to correct Ptolemy's some faults depending on the results of recent observations and their calculations. For instance, he did not accepted that solar ecliptic was fixed (unchageable), and claimed that the solar apoje moved together with the fixed stras and as a result of these precessions occured.

[6] C. Brockelmann, Geschiche der Arabische der Literatur, Leiden, 1937- 1949, GAL., I,p.221 and Supp. p.392.

Farghani also completed certain lackness of Ptolemy's values and explanations. For instance, ptolemy gave only the distance and measurements of the Moon and the Sun, but Farghani added the values of the other celestial bodies. Those values were accepted and used by European astronomers until Copernicus's studies.

As a conclusion we can say that Farghani's Elements of Astronomy is not merely a summary of Almagest, but it made valuable contributions to the astronomical knowledge.

The second one was *Kitab al-Amel al-Ruhamat*. It is about sundial and its construction. He also wrote a book on astrolabe which was named as *fi San'at al-Asturlab*.

Although we do not have any copy of Khwarizmi's astronomical work, *al-Zic*, we learn about that work through Farghani's commentary on it. Farghani named his work *Ila Zic al-Harezmi* and gave us explanation about the astronomical tables which were given in the Khwarizmi's work.

Among Farghani's other works can be mentioned *al-Kamil fi al-Asturlabe,*[7] *Cedvel al-Fargani,*[8] *Risâla fi Ma'rifet al-Evkât elleti al-Amer,*[9] *Hesab al-Akalim al-Seba.*[10]

As a conclusion we can say that the ninth century contains full of very precious scientific studies, and especially it is important from the aspect of astronomy and mathematics which were carried by muslim scientist. Among them can be met Turkish scientist as Khwarizmi and Farghani. Their studies kept continue their influence through the ages and prepared the foundation of modern science in the following centuries.

[7] Ibid., GAL., v.1, p.221.
[8] Panta II, 336, 2520, 8; ibid., p.221.
[9] Ibid., Supp., I,p.392.
[10] Y. Unat, p.15.