

## The Role of Celebrities of Ebn Saatie Khorasani Clan in Expending Watch-making Industry

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**Abstract** In Islamic civilization Era, Iranian scientists played a prominent role in making watches and different chronometers, which could move by applying water- pressure, mercury- pressure, the pile heat, or the special standard weights. Iranian mechanics engineers had a plentiful trend to make automatic machines and also make some attempt to build chronometers, which were automatic machines with regular movement in Islamic era (12-13th century A.D) at this time , the celebrities of Ebne Saatie Khorasani 's clan had an important role and activity to develop the industry of watch making, and has made some watches in 6<sup>th</sup> and 7<sup>th</sup> century A. H. In this family, there are three most famous scientists, having the honorific title "saatie" including Mohammad Ebne Ali named Saatie Khorasani, Abol Hassan Bahaeldin Ali ebn Mohammad ebn Ali celebrated into ebn saatie, and FakhreAidin rezvan ebn Mohammad ebn Ali ebn Rostam named ebn saatie. In this paper, we have dealt with the way of life and works of these scientists, particularly, we defined Ebn Saatie's valuable book as "Elmolsaat v Alamal Beha" about watch making.

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### 1. Introduction

In Eslamic civilization era, the industries on chronometers and watch making had an impressive growth and development. Knowing the knowledge of times for the five prays, which the Muslims accustomed to and do it every day, the necessity of producing the precise tools to define the praying times felt and developed. Therefore, in this dimension , many books were also compiled and published the Eslamic Jurisprudence books like "Mavaghitsalat," "Esteghbal Algebleh" , which was a new chapter in this era (Karimyan Sardashti, 2005 , p.211).

One of these well- known book is "Ketab Alsaat" written by Abo Omar Mohammad ebn Abdol Vahed ebn Abi Hashem Almotrez named "Zahed" (ascetic), the person who Ebn Nadim (Mohammad ebn Eshagh) mentioned of him in his book , "Alfehrest". (ebn Nadim 1971 , p.83). In the direction of chronometer knowledge and making watches , expanding the same sciences seems essential among Muslims, such as "Elm Albenkamat" , "Elm Alat Al saat" , "Elm Alut Alrohanie" , and "Elm Alhiel" . The tools made included pangram, watch box (water-watch) , sandy watch, solar- watch , Jamoladle and Jamoljore, Tarjahareh (Haje Khalifeh, 1967, pp. 255-256). Regrading Iran, from ancient time, Iranians have been familiar with time scales and divided the time into unique pieces. "pass" or "a while of time" is one of the main scales for time piece or 24 hour chronometer , and in the study of Ferdosi's poems, we can find this term showing that each pass is equal

to 1/24 of 24 hour or today's an "hour"(60 min). (Joneidi , 1983 , p.160). One of the first Iranian chronometer machine is "pangan" (or cup), which has been used for dividing water for irrigation and agricultural affairs. The remained evidence and documents from the texts of Islamic Era show that Iranian people has been familiar with chronometer tools and devices before the Islamic period and had have their special innovation and creativity in this field. (George 1972; Lents , 1972). Further, in Ashkhanian and Sasanian, People used chronometer tools for astronomic usage and punctuality (Saelebi, 1960; Cristiansen , 1993). Also, the activity of Iranian after the advent of Islam , in the field of innovation and compiled works on watch-making industry has been developed quickly.

### 2. The significance of the study

Everybody knows that the use of chronometers and its elated devices are very important in human life, Therefore, they have developed various tools and devices to evaluate time for a long time in the orient or east region. These inventions and innovations in different periods of time since Archimedes period till recent century have shown themselves in practical and scientific works format. One of the most important and valuable works, that has revealed in making watch and chronometer industry in 12<sup>th</sup> and 13<sup>th</sup> century A.D was the scientists' work of Ebn Saatie's clan, which was written in two fields including "mechanically making- watch" and authorship and compilation of watch's book" that are a precious heritage for the

next generation. This work in the history of human industries and worldwide-Islam has a special significance and value, particularly in theoretical basics, anatomy and explanation of mechanical watches. Definitely, these works in this period of time can prove the date of industrial developments for us.

### 3. Hypothesis or inquiry

The main hypothesis and inquiry is that how much Iranian has been involved in developing , compilation, and authorship of books on making – watch and chronometers tools, what and how much they played a role in progressing applied and practical sciences, which rank or classes has been their performance in the time between 12<sup>th</sup> and 13<sup>th</sup> century on, and finally how Iranian scientists endeavored on this knowledge after AboRayhan Bironi (5<sup>th</sup> century A.H , 11<sup>th</sup> century A.D). These questions have formed the basis of our research and study and this paper is going to answer these questions.

### 4. Research background

The oldest reference – book in Iran about making – watch or manufacturing chronometers , is on mechanical devices such as chronometer devices or water – watch , which has opened a new scientific field in this dimension, “Alheil” , written by the son of Mousae Harazmi. Of course , he has used Greek texts which has been translated into Persian language, too. (Monzavi , 1977, pp.354-358). Later , in according to these books in the “Jameoloom Emam Fakhr Razi” (the section of Elmolanfah and elmolalat Alhroob) and “Nafayesolfonoon , Mohammad Amoli”, a report was also published including some options of this art. The sons of Mousae are the most famous figures , who had an important role in changing the Islamic engineering and science. Their father was Mousae ebn Shaker , who was a famous astronomer and one of the intimate friend of Khalifeh Mamoon. Three brothers named Mohammad , Ahmad , and Hassan , after the father’s demise , they grow up in Mamoon’s court , and were educated there. They were the supporter of science and culture and by their encouragement and inspiration , the famous translation institute (Bietol Hekmah) was established in Baghdad (Karimyan Sardashti , 2005, pp 297-298)). One of the specialist, who was expert in producing watches and also astronomy in second and third century was Habash ebn Abdollah Marvzi , having the honorific title , “Habash Haseb” , who is well-known in “Baghdadi”. (Ebn Nadim, “Alfehrest” , 1971, p.334). Among the scientists in 3<sup>th</sup> century , who was mentioned in Ebn Nadim and Gaffi , is Mohammad ebn Kasier Forghani , the person who was skillful in astronomy science, as well as the skill of making-watch and information about watch and

chronometers (Karimyan Sardashti , 2005, p.300). In 4<sup>th</sup> century, in Iran, making “Astrolabe” was developed as an astronomical tool and chronometer. According to Ganter’s book , “the world Astrolabes” , the most ancient available Astrolabe in the world is a device , which has been made by Ahmad & Mohammad , the son of Ebrahim in Esphehan city in the year of 374 A.H. without any doubt , we could say that making such precise scientific device in Iran has had a long background (Ganter, 1982 , p.114).

In early 5<sup>th</sup> century, the most prominent Iranian scientist, “AboRayhan Birooni”, in his famous book , “Altafhim” , has referred to making water-watch and sandy-watch. In this book, in the section of “Astrolabe” , has been written like this “since you want to know the time from the day before , which reveals by water or sandy – watch , so ...” (Birooni , Altafhim, 135 , p.356). In the 6<sup>th</sup> century, simultaneously with the advent of ebn Saati’s clan, Badielzaman Esmael ebn Razaz Kord Jazari (from the habitant of Jazir kordestan) had an excellent brilliance in “Elmolheil” and the book of “Ketabon fi marefato Alheil Alhendeseih ya Aljame beinolelm V ALAmal alnafeh fi sanaet alheil” , which has referred to how to make watch and water – watch application , is one of his invention. Jazari has called this water, “tarjehar” , that in strong possibility , it was the basis of Khalil ebn abi Bekr Amoli’s activity to make “observatory of time and hour in Yazd” in 8<sup>th</sup> century (Karimyan Sardashti , 2005, p.298). In 7<sup>th</sup> century , ebn Saati’s clan in Khorasan has appeared and lived in Atabakan Zanghi’s royal court , and clan’s Korde Ayubi , particularly , in “Salehaldin Ayubi” era in Damascus , who was involved in scientific services and expanding watch-making knowledge. In addition, he presented a lot of scientific works and authorship of his good models on building and exposition the mechanical watches.

### 5. The celebrities of ebn Saati’s clan

In this family , there are 3 scientists , who are more famous. In this paper , first, we talk about their condition , life , and works , and then we mention Fakhre Aldin Rezvan ebn saati’s innovation in watch-making knowledge and the book written by him in this area.

#### 5.1. Mohammad ebn Ali ebn Rostam ebn Hardoz khorasani (well- known as “Saati”)

He is one of the most celebrated maker – watch in 6<sup>th</sup> century from Khorasan, an expert in astronomy and stars sciences, as well as in making-watch in his era. He moved to “Sham” from Khorasan , and reside in Damascus and involved in making watch, and finally died there.

In governance era of Malakol Adel Noreldin Mahmood ebn zangi (541-569 A.H), he made the entrance watches of Damascus’s big comprehensive

Gate, and was in honour and caressing by Noreldin Mahmood, Then, he became one of his colleagues and received a lot of robe of honour while his rank and merit was developed because it was a befitting level for him. Mohammad ebn Ali saati was the responsible and protector of Damascus's big comprehensive Gate (ebn Abi Osaibeha, 1957; Dehkhoda, 1960).

### **5.2. Abol Hassan Bahauddin Ali ebn Mohammad ebn Ali ebn Rostam (ebn saa'ti)**

Abol Hassan Ali (1779-1829) had a son named Mohammad ebn Ali, well-known as "sati", Iranian descent poet, but Arab language scientist contemporary Ayobian.

This available source is not a complete biography of him and in most of the written text of various writer, has mentioned less, or just mentioned a name or a few narrating of some of his poetries. Ebn Asiebea and ebn Khallakan were the first people, who had dealt with this poet's biography. But, their explanations is just a few lines. Ebn sautie's biography in his books, "Tajol Maejem", and "history of Halab", had pointed to this information, too (Ebn Saied Andelcy, 1967; Vakili, 1990). Some other writers also added a few notes to the first source contents.

Bahaldin was born in Damascus and spent the half of his life there and the other half of his life was spent in Cairo, and in his son's dictum, he demised there, and was buried in "Safholmoqtam" in Cairo. (ebn Khallakan, 1931; ebn Saied Andelcy, 1967). Regarding ebn Zafer Azdi, he was a very handsome in youth and when he was with some of his erudite friends in a meeting, some of them begin to joke and pleasantry with him such as Ziaeldin Horani, who was in infatuated by him, was involved in a quarrel, then they were asked to compose a piece of literary work to explain this event. (ebn Zafer Azdi, 1970, p.262). Ebn Saied also has said that in Ebn Saatie era in Damascus, no one had seen a person as nice and handsome as him (Ebn Saied Andelsi, 1967, p. 118). According to Safdi's saying, his figure was so charming and cute that 40 poets were infatuated of his face and beauty, and read his odes for them, while they were editing them. As a result of this performance, his poem had got a complete maturity (Safdi, 1983). In narration of ebn Saied, at first in Amed (Bakr territory), he has been one of the students of Badie ostrolabei (Ebn Saied Andelsi 1967, p.119), but this information is apparently unfounded because Badie Ostrolabi or AbolGasem Hebatellan ebn Hossien, was a philosopher, physician, literary scholar, and astronomer, and was skillfull in making firmament instruments. While he was living in Baghdad, he demised in 534 A.H (140 A.D) (ebn Khallakan , 1931, pp. 50-52).

### **5.3. Fakhreldin Rezvan ebn Mohammad ebn Ali ebn Rostam (ebn Saatie)**

Fakhreldin Rezvan ebn Mohammad ebn Ali ebn Rostam ebn Hardooz khorasani (deceased 618 A.H/ 1221 A.D) was a physician, literary scholar, acquainted with music sciences, logic, metaphysics, and mechanic. He was in Damascus and began to learn medicine beside Razieldin Abolhojaj yoseph ebn Heidar Rajabi and also sheikh fakkeldin Mardini in the same city, but Lerner Arab literature beside tajeldin Zied kandy (Yaghoot Hamavy, 1925; ebn Osaibeha, 1967; Sadi, 1983; Vakily, 1369). He has been an expert physician, literary scholar, poet, musician who could play "Oud" (kind of music instrument) well, and also had a nice handwriting. Further, he had some beautiful quatrain , which has acquired this skill with a long effort, and causes people feel jealousy toward him. Almost all the sources have mentioned of him as a literary Scholar and poet, but there is just a few quatrain, which, Yaghoot Hamavy pointed to it (yaghoot Hamavy, 1925, pp.142-3). Ebn Saatie besides his scientific rank, was the responsible of having two position of ministry in Ayobi's kings (emirs) named "Malak Faez" and "Malak Moazam" (ebn Abi Osaibeha, 1957; Safdi, 1983).

The works attributed to Ebn saatie include the following:

- Complete of "katab alghouleng", Ebn sina, named "Alghouleng V Anvaeh V Modava".
- "Havashi ala Alghanoon la ebn Sina" in physician.
- "Almokhtar men Alshoar", or "Almokhtarat fi Alshoar".
- Hereupon on Ebn sin's "zokam" (coryza) thesis (Yaghoot Hamavy, 1925; Ebn Osaibeha, 1957; Haji khalifeh, 1967; Esmail Pasha, 1951; Sarten, 1357).

However, we are not sure whether the following narration is true or false, which Ebn Saied has told about missing 1000 dinars belonging to Ebn Saatie in Badiostrolab's house, or at least, and how it is related to Badie? So, probably, it is wrong and we should deny it. Of course, Ebn saatie has referred to this matter in a ode, which has composed for praising Salaheldin Ayobi, because of the Bietolmoghada's victory (583 A.H.D, 1187 A.D), and referred to the missing of his property and wealth. However, it is not clear what has been the cause of or source of this event, and whether there is any relation between this event with that narration or not. In saying of Ebn Saied, he was expertise in script, poem, chess and backgammon and horse- riding at his youth period, also was in associating with important persons and the governors since he overtook most of the people working in rulers' court (Ebn Saied Andale ,1967,

p.118). In this recent source, nothing has been mentioned about the date of his emigration to Cairo, but from his ode, which is composed to praise Amir saiefeldin, we can result that whether the pronoun source of this phrase is about himself, not Amir Salefeldin. Therefore, he has been in Damascus in 583 A. H, and at 585, he has been in Cairo, also he has referred to this matter in 585 A.H in his book, "In Moghodameh men Alsham". In Damascus, he was involved in composing the Salehldin's eulogy, in which he had written some odes in Egypt such as an ode for Judge "Mahieldin" in addition to the Chief Judge of Egypt, "An ice Moghadas", who made him to migrate into Egypt because liked to have a better life, and more wealth to live easier, that has referred to it in some of his odes himself, and said that because of poverty and ignoring some of his compatriot, he had experienced a hard and degradation life (Ebn Saatie, 1938, pp.15-16). Although it seems to be true and may this condition has been right when he migrated to Egypt. However, according to "Moghadas" the question raised here is that why and how he had not obtained wealth and money during his staying in Damascus in spite of having relationship with most of the rulers and "Ayobi's kings", governors, famous people in his era, or from the praising them (Ebn Saatie, 1938, p.16).

It is not suitable that he would refer to this matter or to prove his vision in his odes. Although, in quatrains in praising "Salehaldin Ayobi", has referred to his misfortunes, and whatever had happened in his wealth. Moghadasi adds that the nature of this event is not clear, but according to his odes, it seems that such an incident, which had a undesirable impact on his life, might talk about these difficulties in his own odes (ibid, 1938). The other distiches, which "Moghadas" has referred to is not related to the mentioned period, and originally, we can imagine that material difficulties in poet's life had begun about 583 A.H. Moreover, depending on social position of this top-notch Poet, he should not confront with such a poverty and difficulties in his life. However, Ebn Saatie, apparently, decided to migrate to Cario and stay there because of missing wealth and obliviousness or inattentive people in his era.

The poet's biography in Cario is not either clear, but merely from his poem, we can find that he has lived in "Almahaleh Olkobra" region, and his financial condition, especailly, in the last 10 years of his life has been good and enough. Although, his three sons, as "Modood", "Mahmood" (595 A.H/ 1199 A.D), and "Eisa" (596A.H/ 1200 A.D) were deceased at that city, and then this poet was so sad and deeply offended in his last 8 years of life (Ebn Saatie, 1938, as cited in Ebn Khallakan). We also

found that this poet had another son, who lived after the father's death because we have heard the news of the date of his deceased from the mouth of his son (the fourth one) (Ebn Saatie, 1938, as cited in Ebn Khallakan, 310 A.H).

Ebn Saatie has been one of the most famous people on his era in so far as the authors of literary and historical contemporary books and the other authors close to his period in any relevance to the occasions has mentioned of him and his poems.

Ebn Abi Osaibeha has called him, the best poet in his era, and considered him a unique poet in these techniques (Ebn Khallakan, 1931; Safdi, 1983).

This poet himself has referred to his honour, genuineness, the family, and poems, while he has called himself as the chief of Verse and prose. He was loyal to protect his honour and high validity so that he was so sensible against competitors and envious people and struggled against them.

Ebn Saatie had a delicate and epicurean temper while, in the hard condition and vicissitudes of life, he took shelter in wine, dance, and being with women. He has told himself in an ode that tries to acquire money and wealth to spend it for reaching to his will and dreams, as well as the enjoyment of joy and mirth instruments (Ebn Saatie, 1938). But, apparently, unexpected death of his sons in Cario had a strong impact on his personality. Therefore, it made a considerable changing thought on him in so far as it made him to be a calm, in a dignity manner man, who thinks deeply with a suitable behavior. The composed poems, after the demised of his sons, showed the way of changing new thought in the last 8 years of his life. For instance, he was the person who wanted money for reaching into his will and dreams, as he says in the poem: "The money and wealth without excellence is poverty, and the life without superiority is the death." (Ebn Saatie, 1938, p.234).

Ebn saatie is the owner of a "collected works of poems" (Divan) in two bounds. Also, he has some praising in dignity of the first Imam (Ali), and another "Divan", as "Moghteatolni" that is not available now, but from the indications, it seemed that it included some of his elected poems which he had chosen them himself (Ebn Khallakan, 1931; Haji Khalifeh, 1967). Ebn saatie's poems include praising, honour, syllable, mourning, humorous writing of a lewd nature, as well as describing it. He had a trend toward sonnet but most of the time used them with description, and the other the same concepts, as relativity in the beginning of praising words. He often has used the art of flowery language and figures of speech, that at that period has developed extremely and was on top elevation like "Ebn Farez", in this field, so embraced into overdoing and excess, that in spite of his fluency, rhythmic, and the power of his

imagination, remained in the restricted framework of verbal figures of speech. For this reason, sometime, his poems are lack of any delicacy. Ebn Saatie is very expertise in using words to explain his final meaning and purposes. Therefore, in the panegyric, it is especially equivalent with the first level poets in Abasi era (Ebn Saatie, 1938, pp. 29-44).

Ebn Saatie has made praising for most of his own important men such as "Salehdin Ayobi" and his sons, other rulers and kings in this family, as well as the governmental officials and statesman of Ayobi's government including ministers, authors, and commanders or leaders. In addition, most of Islamic Jurists, scientists, and judges were under his praising. At 582 A. H, he has been an ode in praising of Khaliefeh Abasi, "Alnasereldinellah", that sent it to him (Ebn Saatie, *ibid*). It is worth mentioning that "Khanbaba Mashar" in his book, "authorships of printed books" has referred to a brief biography of Bahaeldin Abol Hassan, and reported that he and his brother, Fakhreldin Rezvan, are the son of Rostam Hardooz Khorasani (Khubabamashav, 1963, p. 247). Anyhow, it is clear that Rostam Hardooz Khorasani was their grandfather and their father was "Mohammad", and Rostam was Mohammad's grandfather (Karimyan Sardashti, 2005, p.307).

#### **5.4. Ebn Saatie and watch making (Review of the book of *elmolsaat V Alamalo Beha*)**

Fakhreldin Rezvan, who was the son of Mohammad ebn Ali ebn Rostam Khorasani, well-known as Saatie, has learnt this skill from his father undoubtedly and was very sensible to this technique more than his brother, Baheldin Ali, and this theorem can prove from his works. Of course, none of his early sources of Fakhreldin authorships in "Elmolsaat" has not referred to his knowledge of watch – industry, but there is a book on this field, named "Elmolsaat V Alamalo Beha" written by him, which is available and talks about the way building, fixing and correcting the watch. His father has also made it on 540-564 A. H (1145-1169 A.D), which has been on "Jieron gate of Damascus", called "Babolsaat". Apparently, the book of Ebn Saati is illustrated by the figure and pictures of pieces and components of watch with the name of each piece, its action, and the place of them. A sample of the manuscript of this book is in "Khadivieh" library. For example, "Ebn Jobair" in his travelogue (Ebn Jobair, 1964, pp. 243-4), Ebn Betoteh in his travelogue (Ebn Betoteh, 1348, A.H.S, p. 90), and Zakaria Ghazvini in his "Asarolblad" (Zakaria Ghazvini, 1404 A. H., p.189) have focused on describing watch and its technical characteristics (Sarton, 1978, p.1807).

Ebn Saatie in the beginning of this book says that "the watches, which has belonged to his father, these were to be break-down after his father's death for a

short time. It means that they were in risk of annihilation. The night-watches were out of order and the day-watches were broken." He explained the causes of these disrupted because of four following persons, who were responsible of protecting the watches after his father's death. Ebn Saatie has called three of them, Ironic, "the most learned man on earth", and strongly criticized them. (Ebn Saatie, 1981, pp.3-11). These people included the following:

- Ebn Naghsh Mohazebldin AbolHassan, Physician, literary scholar, specialist in Arab literature, who was speaking Persian
- His student, Mohazebldin Ahman ebn Hajeb (Ebn Abi Aslebeh, pp. 162, 181- 2).
- Moaedaldin Abolfazl Mohammad ebn Abdolkarim ebn Abdol Rahman Hareci, engineer and Physician (Ebn Abi Aslebeh, *ibid*)

Ebn Saatie has not referred to the fourth person because he was not an important person. He then adds that my father, who I should obey him, ordered me to reform and correct this works, so I did this duty for reviving my father's name and also Its bonus and reward.

I did except this affair and correct it as before. Then, I decided to write a book about the building, components, and its characteristics in order to refer it in any necessary circumstances (Ebn Saatie, 1981, pp.11-13). His book was written in five chapters as follow:

Chapter one is about the early scientists and inventors of watches such as Archimedes and Hormoz from Iranian people, then it was transferred to Greece, and from there to Rom and Arabic countries. He has discussed on inventing the pieces of watch, and completing them by his father. He has made a list of the watch components. (Ebn Saatie, *ibid*, pp. 15-38).

In the second chapter, he has described all the components of any watch completely. (Ebn Saatie, *ibid*, pp.39-73).

In the third chapter, the quality of the action of each component was taken into account by drawing its figure and compound separately, along with their characteristics such as, length, width, acreage, density, and the relation of each piece with other parts (Ebn Saatie, *ibid*, pp. 74-231).

Chapter Four has discussed the how and use of watches, their run, and the needed condition (Ebn Saatie, *ibid*, pp.231-273).

Last chapter was dealt with problems and dysfunction, which may happen in each component, and talked about how to determine and identify these disruptions, and the way of fixing them, in case of breakdown) (Ebn Saatie, *ibid*, pp. 274-313).

According to his note in the last section of book, he has finished it on Moharam 600 A. H (ibid, 1981, p.290). In the viewpoint of “Sarten”, this book, after the book of Jazari (Badielzaman) Esmael ebn Razaz, the author of book, “Fi almare fat alhiel alhendese in 602 A. H/ 1206), is the most important source for researching about Islamic watches/times.

The concise translation of this book was published by “Vidman” and “Fertise Havzer” in Germany language, which is about watches in Islamic civilization Era.

The criticized print of this work in 1402 A. H (1981), was published by “Mohammad Ahmad Dehman” in Damascus, with an introduction and following essays in 313 pages (ebn Saatie, 1981, pp. 89-94). Ebn Saatie died, as a result of jaundice disease in Damascus, and his death was recorded at 627 A. H., but in some of the important book, it was recorded at 618 A. H. (Karimyan Sardashti, 2005, pp. 302-310).

## 6. Conclusion

The family of Ebn Saatie Khorasani, especially, “Fakhreddin” Rezvan has a major role in developing the scientific and practical field in watch-making industry in Iran and “ancient Sham”, through writing the book “Elmolsaat V” Alamalo Beha”. He is the first scientist, who in a distinct assay has dealt with the techniques, the way of building and making watch industry so that the future scientists, after him, could not write as more complete or comprehensive book as his about this industry. It is worth mentioning that all the published book of Ebn Rezvan are in an excellent level, except whatever Mohamma Ahmad Dahman has edited, which has a criticized print. Writing the history of manufacturing- watch is indebted to the efforts of the clan of Ebn Saatie Khorasani (6/7<sup>th</sup> century and 12/13<sup>th</sup> A. D), and its scientific consequence is unique and universal. We cannot learn about mechanical watch-making industry in orient, and searching and investigating in this matters will be impossible.

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