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INTRODUCTION OF INDO-PERSIAN ASTRONOMY WITH SPECIAL REFERENCE TO THE INSCRIPTIONS OF QUADRANTS

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ABSTRACT

Indeed the astronomical instruments are considered as pioneer tools to fulfill people's basic astronomical demands. The Indian astronomical literature, as well as instruments, were introduced during the earliest time of Vedic period and some of them are still extant in various libraries and museums of the world. But after the 12-13 century A. D., the Indian astronomy amalgamated with Islamic astronomy that made a catalytic change in the promotion of Indian astronomy. This co-existence of Indian and Islamic scientists followed by a mass production of great astronomical literature as well as instruments, the most popular of them are: Astrolabe, Celestial Globe, Armillary Sphere (Gola-Yantra), Quadrants (Turya-Yantra), Qibla Compass, Sundials and Horary Bowls (Tas e Gharyali) etcetera. This article traces the records of the emergence of Persian astronomy. In India till the decline of Mughals with the special reference of Quadrants (Turya-Yantra). It provides unparalleled information about the specimens of Indian quadrants which were designed with Persian and Sanskrit inscriptions. There are two kinds of Quadrants exist 1: Sine Quadrant and 2: Horary Quadrant. So this study is supposed to explore the shining past of Indian astronomy with a special study of the inscriptions engraved on the existing specimens of Horary and Sine Quadrants.

KEYWORDS: Indo-Persian Astronomy, Quadrant, Sultanate Period, Mughal Period, Shabnuma (Night Pointer)-wa-Roznuma (Day Pointer), Padmanabha & DhruvabhramaYantra

INTRODUCTION

INDO-IRAN RELATIONS

India and Iran are two nations having one spirit, culture and history. Their languages Avesta and Sanskrit are considered as sister languages, astonishingly similar in vocabulary grammar, syntax and meter. These two nations have joined same race and origin as Prof. E. G. Browne has written: "It seems pretty certain that the Indian and Iranian race united in a common Indo-Iranian race."[1]

The Same idea was further explained by Jawaharlal Nehru as he pointed out, "Among many people and races who have come in contact with and influenced India's life and culture the oldest and most persistent have been the Iranians."[2] It is obvious that India and Iran belong to a single family that has been divided as Aryans and Persians before ages but attacks of Mahmood Ghaznavid on subcontinent led a great Persian diaspora and immigrants to India. This migration became a true example of Franklin D. Rooselvelt's quote: "Remember, remember always, that all of us and you and I

[1] : A literary History of Persia Vol-1 Page 265 Pubished By. Gooword Publications
[2] : Page: 146, Discovery of India, J.N. Nehru, Oxford University Press, Printed by Rekha Printers Pvt. Ltd. 1994

especially, are descended from immigrants and revolutionists."[3] Iranians amalgamation in Indian society and culture added more significant features and qualities in languages, literature, arts, music, philosophy, religions and morals of the subcontinent. The catalytic factor of the success of this amalgamation is transforming and exchange of ideas, knowledge, skills and cultural and literary legacy of both nations.

The establishment of first Ghaznavid's court in Lahore (Modern Pakistan) consisting great Persian scholars, poets and saints resulted in first direct social and cultural integration of Indo-Iran people. This court followed a system of love and patronage for nurturing and cultivation of talent and skill. But it was the Mughal dynasty that achieved astonishing achievements in the promotion of Indo-Iran cultural treasure.

In the current article, we have to discuss about the roots of Indo-Persian or Indo-Islamic astronomy so in this context as far as Indian astronomy is concerned its origin is found in ancient Indus civilization period. Dr. Yukio Ohashi divides the history of Indian astronomy into five following periods:

- Indus valley civilization period.
- Vedic Period (ca. 1500 BC-ca 500 BC).
- Vedanga astronomy period (up to 5th century AD).
- Period of the introduction of Greek astrology and astronomy
- Classical Siddhanta Hindu astronomy period (end of the 5th century-12th century AD.[4]

Meanwhile, the emergence of Indo-Persian or Indo-Islamic astronomy could be discovered in the writings of Abu ReyhanBiruni (1050 AD). But the most significant period of the development of the Indo-Persian coexistent astronomy belongs to Tughlaq and Mughal dynasties only.

During the Tughlaq rule, Firoz Shah Tughlaq is the first name that comes to mind as a great patron of Indo-Islamic astronomy. He encouraged a number of Indo-Persian scientists to develop astronomical literature as well as instruments. One of his major achievements is Designed and Installation of Tas-e-Gharyali.

Tas-e-Gharyali

In the old days in India, people used a simple device to measure time. It consisted of a small bowl with a hole in it. When placed on water in a bucket or water entered the bowl through the hole below. When the bowl is full, it sank into the bucket or the time is taken form the bowl to sink is generally 24 minutes. This period is called Ghati or Ghari.

Firuz Shah Tughlaq also utilized with the same device but as per the historic evidence this device was not an ordinary device, but it was pretty advanced that was able to tell the time in seven different ways. These ways are detailed in "Tarikh-e-FirozShahi from page 254 to 260. The design and installation procedure was described in Tarikh-e-FiruzShahi

[3] : Page, XIX, Memories of Corolinian Immigrants, Autobiographies, Diaries and Letters edited by AudreasLixi, University Press of America, ISBN 978-0-7618-4413, 2009, Maryland

[4] Page: 50, Introduction of the Persian astronomy into India, Dr. Yukio Ohashi, Tarikh-e-Elm: Iranian Journal for the History of Science vol: 6 (2008), Tehran.

by Shams SirajAfif:[5]

"When Sultan Feroz Shah returned to Delhi from the victory of Thatta. He lifted his hand in propitiating of divine works. He decided to install Gharyali bowl and spent few days with his colleague astronomers for the same goal finally they got to succeed. When the rings of Gharyali bowl reached to the ears of people they flocked in many groups to have a look of Gharyali bowl. Whole worlds from an infant too young, young to old and younger and older all gathered to see that. The Gharyali bowl was installed on the upper side of the royal palace. People used to come here to see that and soon it gained so much popularity and considered one of the crowned coins and emperors specimen. It has much importance than a coin because without a king there is no worth of coin, but Gharyali bowl has been the center of a number of kings through ages. This was a little introduction to Gharyali bowl.

Mughal Period

Mir Fathullah Shirazi, who had emigrated from Iran and had reached the Mughal court by way of the Deccan. His expertise in astronomy made him the best candidate for the invention of the new religious calendar of Emperor Akbar. The "Ilahi" (Divine) was a solar calender based on old Persian zodiacal months.[6]

Mughal ruler Shah Jahan (1628-1658) ordered his wazir Asaf Khan (1641) to construct a new Zij (astronomical table) that must be as advanced as Ulugh Beg'sZij. Asaf Khan asked a very competent astronomer by the name of al-Dihlawi to construct a new Zij based on Ulugh Beg'sZij but a new calendar that would celebrate the new ruler, Shah Jahan. Asaf Khan was so impressed by the result that he gave it to another scholar Nityanand a Brahman living in Delhi, to have it translated into Sanskrit. His work was apparently completed in 1630, but it was not well received by the Hindu astronomers.[7]

Astronomical Literature during Mughal's Period

Oldest Persian-Sanskrit Dictionary

The oldest Persian-Sanskrit dictionary that we have constituted the first Prakarana of the Parasiprakasa composed by Bihari Krisandasa Misra in the late sixteenth century for the Emperor Akbar. It contains a number of words that occur in astronomical texts. More detailed information concerning of Persian calendar, and after an excursus on technical terms of astrology, the Persian words used in arithmetic, trigonometry and astronomy can be found in a second Parasi prakasa that was twitten by Malajit in 1643, a work for which the title of Vedangaraya was bestowed on him by Shah Jahan.[8]

Maktabkhana

This was an institute established by Mughals As Prof. Sarma explores it "The meagre information we have about the method of translation at the Maktabkhana of Mughal emperor Akbar, where a large number of Sanskrit works were

[5] : Page 260, Tarikh-e-FiruzShahi by AfifSiraj Shams, Edited by MaulaviWilayatHussain, Published by Post Mission Press Calcutta, 1890 AD

[6] Page 224, Dialogism and Territoriality in a Mughal History of the Islamic Millennium by Anooshahr, Ali, Journal of the Economic and Social History of the Orient 55, 2012

[7]:Page 70, Scientific enterprise in Islam, by Toby E Huff, The enterprise of science in Islam. New Perpective edited by Jan P Hogendijk and Abdelhamid I Sabra, MIT Press Cambrigde ISBN 0-262-19482-1

[8]: Page 129, Persian-Sanskrit Lexica and the Dissemination of Islamic astronomy and astrology in India by Sarma, R. S., Kayd, edited by GherardoGnoli and Antonio Panaino, InstitutoItaliano, Roma, 2009, ISBN 978-88-6323-272-1

rendered in to Persian vise verse."[9]

Astronomical Dictionary

Vedangaraya proceeds to teach the method of converting the Saka dates into Hijri dates and vice versa[10]. As an example, he converts the month Saravan in the Saka year 1565 to the month Jamad al Awwal in the Hijri year 1053.

There was the brief history of the development of Indo-Iran or Indo-Islamic astronomy. After that, we are obliged to talk about mail goal of the paper and that is Sine Quadrant.

The Sine Quadrant

The sine quadrant was transmitted to India along with an astrolabe from the Middle East sometime in the early medieval period. In India, the sine quadrant is often incorporated on the backs of Indo-Persian as well as Sanskrit astrolabes. The universal horary quadrant, on the other hand, is occasionally included on the back of the Indo-Persian astrolabes, but rarely on the Sanskrit astrolabes. Because the quadrants are invariably included on the back of astrolabes, independent quadrants are rather rare. Just four independent specimens of Indo-Persian quadrants are known to be extant two of these are (PIC 1 & 2) are particularly valuable as they carry the names of various elements on the sine quadrant.[11]

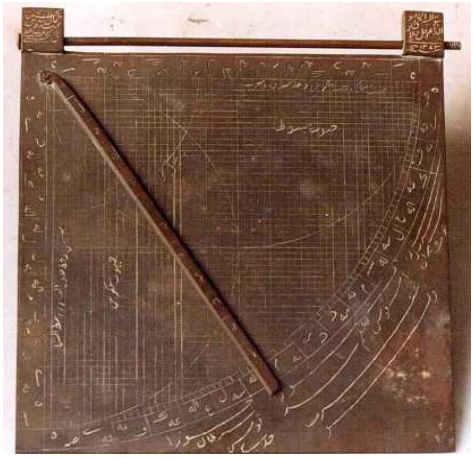

Figure 1

(Pic 1 Front Side, Sine Quadrant by Jamalluddin Mohammad Ali Alhussaini 1273 AH (1856-57 AD)

Figure 2

[9] :Page 130, Persian-Sanskrit Lexica and the Dissemination of Islamic astronomy and astrology in India by Sarma, R. S., Kayd, edited by GherardoGnoli and Antonio Panaino, InstitutoItaliano, Roma, 2009, ISBN 978-88-6323-272-1

[10] Page 135, Persian-Sanskrit Lexica and the Dissemination of Islamic astronomy and astrology in India by Sarma, R. S., Kayd, edited by GherardoGnoli and Antonio Panaino, InstitutoItaliano, Roma, 2009, ISBN 978-88-6323-272-1

[11] : Page 3340, Sarma, R. S., A Descriptive Catalogue of Indian Astronomical Instruments, Duesseldorf, Germany

MohdJamaluddin Ali Alhussaini may be forgiven by his God, Allah the living and eternal, may his glory will be exalted

Figure 3

((Capricorn) (Sagittarius) (Cancer) (Gemini))

((Taurus) (Aquarius) (Cancer) (Sagittarius))

((Virgo) (Pisces) (Libra))

SANSKRIT QUADRANTS

In Sankskrit the quadrant is called Turiya-Yantra or Turya-golakayantra. It is mentioned for the first time by Brahmagupta in his Brahmasphuta-siddhanta of 628 under the name Turya-golaka-yantra. Brahmagupta discusses the three instruments Cakra (circle), Capa or Dhanus (Lit, bow, semi-circular) and Turyagolaka or (quadrant) which are closely related in shape and function. Cakra is a circular wooden plate with its circumference graduated into 360 degrees, Dhanus is its half, and Turagolaka the quarter.[12]

Following him, Padmanabha is known is first to describe the sine quadrant in his renowned work Dhruvabhramanadhikara of 1423. In this work, he describes a new instrument to use in the night called DhruvabhramaYantra consisting of a rectangular plate and adds that the reverse side of this plat should be fashioned as a sine quadrant for use in daytime.[13]

In designing of DhruvabhramaYantra, Padmanabha advanced its technology by adding several innovative features like usage in the daytime, measuring the sun's altitude and since it determines the true solar time, at night, measuring the altitude of a lunar mansion and since it determines the sidereal time likewise it teaches the procedure how to obtain the time at one's own latitude from the time measured with an instrument calibrated for another latitude. One of the key advantages of DhuvabhramaYantra is, it does not imitate other instruments to dig details like following of the Sun and Fixed stars, but it works by using of Polestar and Polar Fish.

Here is a photo of this instrument that was taken by Prof. Sarma:

[12] : Page 3355, Sarma, R. S., A Descriptive Catalogue of Indian Astronomical Instruments, Duesseldorf, Germany
[13] Page 3356, Sarma, R. S., A Descriptive Catalogue of Indian Astronomical Instruments, Duesseldorf, Germany

Figure 4

But the main object of this article lies only to study the side quadrant. So the side quadrant of this instrument is designed on the back side of the instrument.

The design of DhruvabhramaYantra led flocks of Indo-Persian astronomers towards the enrichment of the design and technology of side quadrant. The Muslim astronomers of India have also adapted DhruvabhramaYantra with Arabic/Persian legends. Two specimens have come to light so far, one at the KhudaBakhsh Oriental Public Library of Patna and the other at the Raza Library in Rampur. In these versions, the observe side, calibrated as the nocturnal, is called Shabnuma (Night Indicator) and the reverse side with the quadrant is called Ruznuma (Day Indicator). These two specimens are manufactured in the eighteenth century, but there must have been forerunners in earlier periods of which we do not yet know. 14

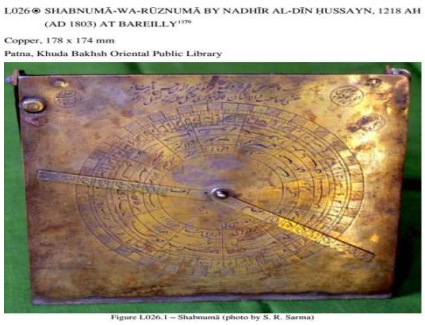

Figure 5

At the top:

Nadhir-ud-Din Husain (forgiven by his god) has designed the Sha bnuma to fulfill the order of Munshi Lala Bihari Laal in order to project light.

Figure 6

[14] : Page, 3417Sarma, R. S., A Descriptive Catalogue of Indian Astronomical Instruments, Duesseldorf, Germany

(The Capricorn famous as Pole)

(The Brightest Guards)

There are six circles first and shorter one consists the Iranian month name while next circle includes the equal lunar mansion and third and last circle has ascendants

Figure 7

First circle

(The beginning of solar year)

Second Circle

The Iranian calendar

Farwardin, Urdibahesht, Khordad, Tir, Mordad, Shahrivar, Mehar, Aban, Azar, Di, Behman, Isfand

Third Circle

‹(Aquarius) ‹(Capricorn) ‹(Sagittarius) ‹(Scorpio) ‹(Libra) ‹(Virgo) ‹(Leo) ‹(Cancer) ‹(Gemini) ‹(Taurus) ‹(Aries) (Pisces)

Fourth Circle

‹(Leo) ‹(Cancer) ‹(Gemini) ‹(Taurus) ‹(Aries) ‹(Pisces) ‹(Aquarius) ‹(Capricorn) ‹(Sagittarius) ‹(Scorpio) ‹(Libra) (Virgo)

Fifth Circle

It has (Degree)

Sixth Circle

It contains (Ghatis/Degree). Time unit of that period.

A part of this, it has a plumb line with two indices:

Figure 8

This plumb line has six sections indicating separate functional sign for all six circles. The inscriptions are engraved with their specific circle in following manner.

First Circle: Beginning

Second Circle: Solar Months

Third Circle: Changes

Fourth Circle: Ascendants

Fifth Circle: Degrees

Sixth Circle: Ghari the time units

To be placed on the degree of sun's longitude

On opposite side or the second half of same plumb line the inscriptions are engraved in following index

First Circle: End

Second Circle: Solar Months

Third Circle: Changes

Fourth Circle: Ascendants

Fifth Circle: Degrees

Sixth Circle: Ghari the time units

To be placed on opposite of the degree of the sun's longitude.

Figure 9

The reverse side of the instruments is known is Roznuma (Day indicator).

At the top of the quadrant it is detailed that how to utilize this instrument for non-designed latitudes.

Day indicator to show the time of other latitude

On the other regions their latitude is less than designed latitude the amount of the deficiency should be added to the maximum altitude up to a sum of 90 degrees in case if surges over it then it should be reduced till 90 degrees.

Belo the arc to the right of the two scales the date and city of this instrument is mentioned

In 1218 Hijri at his own city Bareilly.

Figure 10

ShabnumawaRoznuma observe showing the Shabnuma

Raza Library, Rampur.

In the middle of this specimen the inscriptions are so:

The method to observe at night, it is that the upper edge of the night indicator is to be aligned with the pole and one of the two guards, which is closer to the pole, so that the two points are seen in one direction. Then one should see in which line the plumb line reaches and should keep it. Then one should start counting the Ghatis, which are alternatively black and white from the relevant degree of any of the twelve zodiac signs where the sun lies up to where the above mentioned plumb line reaches: exactly the same amount has passed from the night or remains from it. The zodiac belf and the celestial equator are taken from the back of the mater of the astrolabe and registered on this board. Designed by MirzaFazl Ali Amil.

On the reverse side there are seven Ghati scales having certain solar month with particular ascendants.

- Cancer, 1-17 Ghatis
- Gemini and Leo, 1-17 Ghatis
- Taurus and Virgo, 1-16 Ghatis
- Aries and Libra, 1-15 Ghatis
- Scorpio and Posces, 1-14 Ghatis
- Sagittarius and Aquarius, 1-13 Ghatis
- Capricorn, 1-12 Ghatis.

The non-literary texts are rarely taken up. The texts of Historical importance are considered to be a task of the scholars of History, and now a day very few students from History learn Persian and Arabic. They often rely just on the translations. Same is with the MSS of medicinal science or astronomical sciences. If one counts the number of manuscripts in these two fields, will find an unaccountable number of these. There is a big scope for scholars to study astronomical instruments with their inscriptions in order to find a hidden knowledge of history.

CONCLUSIONS

The design of DhruvabhramaYantra followed by a number of global scientists beyond the limitations of race, creed and geographical boundaries. The innovation of Shabuma and Ruznuma also was inspired by Padmanabha's design but a model of Nadhir-ud-Din Husain has some advanced features like usage in multi-geographical altitudes as well as night time, its Persian and Arabic inscriptions led multiple designs based on same technology with modern technics. As per the inscriptions found in preceded quadrants, all of them explain that all the quadrants developed by Indo-Persians astronomers have some fundamental rules to explain the time, date, horoscope, geographical altitude etcetera. After reading and comparing these inscriptions somebody can understand easily that design of quadrant had been equipped with modern ideas and tools during mediaeval period with collaboration on Indo-Iranian astronomers.