Indian Journal of History of Science, **24**(3) : 186–192 (1989)

TRANSIT OF MERCURY 1651 : THE EARLIEST TELESCOPIC OBSERVATION IN INDIA

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(Received 11 March 1988)

HISTORICAL PERSPECTIVE

Life and times of the King-astronomer Jai Singh (1688-1743) constitute a benchmark in the history of astronomy in India. Following in the footsteps of Ulugh Bēg (1394-1447), astronomer and ruler of Samarqand, Jai Singh set out to update astronomical tables Ulugh Bēg had completed three hundred years previously, in the year 1436.

For this Jai Singh built a number of observatories : in 1724 at Delhi ; in 1734 at his newly founded capital Jaipur ; and at Mathura, Ujjain, and Varanasi. These observatories, of which Delhi and Jaipur still survive, consisted of huge, masonary instruments copied or developed from those used by Ulugh Bēg and others of the Arab school.

When Jai Singh made his imposing but pre-telescopic appearance on the astronomical scene, telescopic astronomy had already taken roots in Europe. Galileo used the telescope in 1609. Paris observatory was set up in 1667 and Greenwich in 1675. P. de la Hire (1640-1718) published his *Tabulae Astronomicae* in 1702, and the first part of John Flamsteed's (1646-1719) *Historia Coelestis Brittanica* containing his catalogue of stars appeared in 1712.

Thus chronologically belonging to the 18th century, but intellectually to the 15th, Jai Singh with all his enthusiasm and efforts appears as a historical anachronism.

As we discuss in the next two sections, telescopes had been used in India in the 17th century itself, a good many years before Jai Singh. However, notwithstanding these sporadic uses of the telescope, modern astronomy did not make a systematic start in India till the closing decades of the 18th century.

FATHER RICHAUD'S OBSERVATION AT PONDICHERRY, 1689

A French Jesuit Father Jean Richaud on instructions from the French Academy of Sciences made astronomical observations, beginning 1689 December, at Pondicherry in south India with a telescope of about 12 feet focus.[1] Richaud observed a comet during 1689 December 8-21 in the constellations of Centaurus and Lupus, and while doing so discovered on December 19 that the bright star Alpha Centauri is in fact double. He also estimated the latitude of Pondicherry ; and its longitude from observations made during 1690 of many eclipses of the first satellite of Jupiter, to an accuracy of 1 or 2 minutes.

It has generally been believed[2,3] that Richaud's was the first ever use of a telescope from the Indian soil. As we shall see now, this is not correct and telescope had been used in India 38 years previously at Surat by an Englishman Jeremiah Shakerley (1626-*ca.*1655).

SHAKERLEY AND TRANSIT OF MERCURY 1651

Jeremiah Shakerley[4] was born in 1626 November at Halifax, Yorkshire, England, and became interested in mathematics around 1646.

In 1649, Christopher Towneley of Burnley, Lancashire, well known patron of science in north England, took Shakerley under his wings. The other Towneley proteges included William Gascoigne (1620-1644) who invented telescope micrometer, and William Crabtree.

Shakerley was through self-education well acquainted with the works of Johannes Kepler (1571-1631) and was his enthusiastic supporter. It should be kept in mind that Kepler had not yet won the day against the ancient system of astronomy, and the number of astronomers who comprehended Kepler's work at the time was really small.

Kepler predicted in his *Rudolphine Tables* (1627) the phenomena of transits of Mercury and Venus across the disc of the sun. In 1629, barely a year before his death, Kepler published a pamphlet entitled *Admonitio ad Astronomos rerumque celestium studioses, de miris rarisque anni 1631 phaenomeins, Veneris puta et Mercurii in solem incursu*, in which he predicted a transit of Mercury on 1631 November 7 and of Venus on 1631 December 6. (All dates have been made Gregorian).[5]

The 1631 transit of Mercury was seen by Pierre Gassendi (1592-1655) from Paris. The 1631 transit of Venus, unknown to Gassendi, occurred at night and so went unseen.

Jeremiah Horrocks (1619-1641) using Kepler's and other tables and his own observations predicted another transit of Venus on 1639 December 5, and observed

it using Gassendi's method, who had projected the sun's image on a circle whose circumference was divided into 360° and diameter into 60 parts (ref. 5).

After Horrock's untimely death his papers were acquired by Towneley and were available to Shakerley.

Shakerley published three books : (i) A criticism of Vincent Wing's book Urania Practica titled *Anatomy of 'Urania Practica'* (London, 1649) ; (ii) An almanac for *1651 Synopsis Compendiana* (London, 1651) ; and (iii) *Tabule Britannicae* (London, 1653).

His 1651 almanac included a supplement where he predicted a transit of Mercury on 1651 November 3. Shakerley described, citing Horrocks, how best to observe it using the projection method and enumerated the new astronomical data that could be obtained by the observation. As the 1651 transit would occur during night at European latitudes, Shakerley stated that it would be best observed from eastern countries.

Over the years Shakerley had been receiving patronage from the London astrologer William Lilly, with whom he was in correspondence (1648-1650). However, as time progressed Shakerley became increasingly sceptical about astrology and with his attack on Vincent Wing came his break with Lilly. Presumably because of his bleak prospects at home, Shakerley emigrated to Surat in India. East India Company had set up its first trading post (then called a factory) at Surat in 1612. Fort St.George Madras was founded by the company in 1640, Bombay would be acquired in 1660, and Calcutta founded in 1690.

It was from Surat that Shakerley observed the transit of Mercury predicted in his almanac.

The details of Shakerley's telescope and time-keeper are not available. But in keeping with the times his telescopes would have had a small aperture, long focus, single lens as its object glass. We, however, do know about the telescope Horrocks had used for his observation of the 1639 transit of Venus. Horrock's was a telescope magnifying 10-12 times and making an inverted image of the sun 5—5½ inches in diameter on an opaque screen.[6]

Because of the proximity of adjacent buildings and other demands on his time, Shakerley could make only one sighting, at 6.40 A.M., and even this was hampered by his lack of adequate instruments. Mercury appeared to be brownish black, and was less than half arcminute in diameter. Shakerley's obsevation is described by Vincent Wing[7] who called him 'the very learned astronomer'.

'now at 6^{hr} 40^{min} he noticed Mercury inside the circle of the solar disc through the telescope between north and west, as earliest it had been situated between south and east, and it was away from the centre of the sun exactly 10'. (Shakerlev also figures in the appendix to Edward Sherburne's *The Sphere of Marcus Manilius*, London, 1675,[4]

Figure 1 shows the track of the 1651 transit, mid-transit occurring at 1 A.M. UT.[11] Shakerley's observation is marked in the figure. Mercury's ingress took place at about 4.05 A.M., much before sunrise (6.05 A.M. local time) at Surat (long. 72.52°E ; lat. 21.12°N).

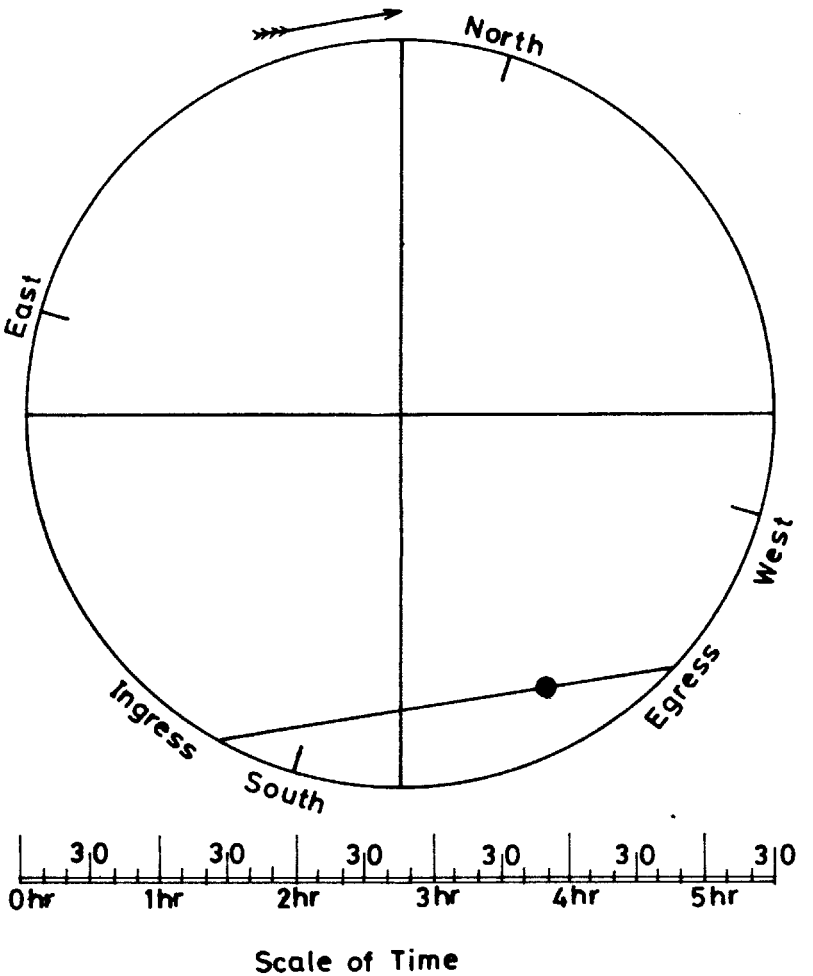

Fig. 1. Track of 1751 transit of Mercury adapted from ref. 11. The mid-transit occurred at 1 A.M. (UT). Shakerley's observation is marked.

Shakerley's calculations are reproduced in Table 1. Shakerley communicated his results among others to his patron Christopher Towneley and to Henry Osborne (in 1653 January) who also received a drawing of the solar disc with mercury marked on it.

TABLE 1

CALCULATION BY SHAKERLEY

Longitude of ascending node	43°	51'	17"
Mean anomaly*	159°	48'	9"
Correction (subtract)	10°	56'	2"
Longitude of aphelion	251°	32'	52"
True longitude of Mercury in orbit	40°	24'	59"
Reduction to ecliptic (add)		1'	30"
Heliocentric longitude of Mercury	40°	26'	29"
Southern latitude		11'	25"
	hr	min	sec
Time of observation at Surat*	18	40	0
Calculated time of conjunction of ascending node with solar centre	19	27	52
Meridian difference between Surat & London**	6	0	0
True time of conjunction at London	13	27	52
Equation of time (subtr)		9	44
Mean time of conjunction at London	13	18	8

* measured from mid-day at London

** This is wrong. It should have been $4^{hr}\ 52^{min}$

Apart from description of the transit, we learn from his letter to Osborne that Shakerley also observed a comet in 1652, which would thus be the first telescopic sighting of a comet from India. While in India, he became keenly interested in Indian calendars.

The letter gives no indication about Shakerley's occupation in Surat, but it is certain that he did not make the voyage merely to see the transit, as Vincent Wing suggested in 1669. It is likely that Shakerley was an employee of the East India Company although there is no mention of his name in the company's records for the early 1650s (ref.4).

Shakerley died presumably in 1655, in India.

ADVENT OF MODERN ASTRONOMY IN INDIA

Not surprisingly, these sporadic uses of the telescope in India in the 17th century—by Shakerley in 1651 and by Richaud in 1689—did not make any impact on the astronomical scene. Indeed, as we have seen, Jai Singh's masonary observatories came up more than three decades after Richaud.

While Jai Singh was busy updating Ulugh Bēg's astronomical tables, the empire set up by Bēg's descendants in India was tottering. The last great Mughal emperor Aurangzeb died in 1707 an the resulting political vacuum was eventually filled by the East India company.

Telescopic astronomy could make its systematic appearance in India only in the later part of the 18th century when the company officers mostly on their own initiative used telescopes to measure latitudes and sometimes longitudes of places in the vast territories they increasingly came to control.[9] The transits of Venus 1761 and 1769 brought to India many astronomical instruments but a modern astronomical observatory did not come into existence in India till 1786, when William Petrie (*d.*1816), an enlightened officer of the East India Company, set up a private observatory at his residence at Madras. It was taken over by the Company in 1790 and led to Kodaikanal Observatory (1899) and Indian Institute of Astrophysics (1971).[10]

ACKNOWLEDGEMENT

The author thanks the Archivist of Royal Greenwich Observatory for copies of excerpts from *Astronomica Britannica* ; Ms Viviano Ibrahim and Christ College, Bangalore for translations of the Latin text ; Dr. D.C.V. Mallik for help ; and Messrs A.V. Raveendran and S. Mohin for discussions. He also thanks Dr. Michael Hoskin for his comments on an earlier draft.

REFERENCES AND NOTES

[1] *Memoires de l' Academie Royal des Sciences,* Tome VII, pp.741-852. (Astronomical observations made in India and China by Jesuits).

[2] Bappu, M.K.V., *Society & Science,* vol.2, *J. Nehru Centre,* Bombay, 1979, p.1.

[3] Rao, N.K., Vagiswari, A. and Louis, C., *Bull. Astr. Soc. India,* **12**, 81, 1984.

[4] Chapman, Allan, *Dictionary of Scientific Biography,* p.312.

[5] Grant, Robert, *History of Physical Astronomy,* London, 1852, pp.415-417.

[6] Gaythorpe, S.B., *J. Br. Astr. Assoc.,* **47**, 60, 1936.

[7] Wing, Vincent, *Astronomia Britannica*, 2nd ed. London, 1669.

[8] It was customary to measure anomaly in an elliptic orbit from aphelion. As late as 1809, following the lead of 'the most recent French astronomers, Gauss was pleading for measurement for perihelion to ensure analogy among all conic sections (Hyperbola and parabola do not have aphelion). *See* Karl Friedrich Gauss, *Theoria Motus*, 1809 ; (Engl. tr. by Charles Henry Davis, Dover, Reprint 1963, p.6).

[9] Kochhar, R.K., *Indian Institute of Astrophysics News Letter* **1**, 27, 1986.

[10] Kochhar, R.K., *Bull Astr. Soc. India*, **13**, 162, 1985 ; 287 ; *Indian Institute of Astrophysics*—a brochure, 1986.

[11] Ashbrook, J., in 1970 *Yearbook of Astronomy*, ed : Patrick Moore. Sidgwick & Jackson, 1969, p.112.