

Was the bright comet of 1742 discovered from India?

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In this note, I look into the record of a comet in the writings of an 18th century Indian historian Sayyid Muḥammad ‘Alī al-Ḥusaini, that he says appeared in 1154 AH (1741–42). No astronomical detail of the observation is given. The circumstances suggest him to be an independent discoverer of the bright comet of 1742, now designated C/1742 C1.

Comets, meteors and earthquakes are unpredictable natural phenomena that, together with eclipses, were perceived in various cultures as evil and a threat to the ruler. So, a tradition of tracking such phenomena existed. Records of a number of such events can be found in well-known Indo-Persian texts also. An 18th century Persian scholar and political historian who is astronomically relevant is Sayyid Muḥammad ‘Alī ibn Muḥammad Ṣādiq al-Ḥusaini who in 1759–60 wrote a history of the Timur dynasty, *Tārīkh-i Rāḥat Afzā*, covering the period 1359–1759. From his authorship of another book, we learn that he had been associated with places such as Nishāpūr, in Khurāsān and Najaf, south of Baghdad, Iraq. The family eventually settled down under the patronage of Būrhan-ul-Mulk Saiyad Sa’adat Khān, a noble of the Mughal Emperor Muḥammad Shāh and Governor of Awadh (note 1).

Tārīkh-i Rāḥat Afzā mentions a detonating fireball in 1155 AH (1742–43) and an earthquake in 1171 AH (1757–58)¹. More importantly, it records the occurrence of a comet in the year 1154 AH (1741–42). About the comet, it is stated in *Tārīkh-i Rāḥat Afzā* that¹:

‘In the year 1154 AH, a comet appeared at evening in the West, during the months of *Shawwāl*, *Dhu-al-Qa’dah* and *Dhu-al-Ḥajjah*. Afterwards it made its appearance in the East, during the early morning, for a few days in the month of *Muḥarram* 1155 AH’.

The reference is specifically to a star with tail. Khan¹ consulted Crommelin’s *Comet Catalogue*² and found that corresponding to the mentioned period, there indeed was a large comet, visible in early 1742. No discoverer or date is given in the *Catalogue*, except for two sets of computed orbital elements of the comet and February 8.19637 and February 7.6533 as dates of its perihelion passage.

The comet of 1742

Cross-checking with the cometographies of Vsekhosvyatskii (1964) and Kronk (1999), the most extensive ones till date, there are no records of a comet in 1741. The only comet that can match the description above is the one that appeared in early 1742, now designated C/1742 C1. To that extent, Khan’s identification is correct. Its exact discovery according to Kronk³ ‘is somewhat open to debate’. Vsekhosvyatskii⁴ has referred to the comet of 1742 as the first recorded apparition of the periodic comet Grant-Grigg-Mellish ($P = 164.3$ yrs) that subsequently returned as the comet 1907 II.

The comet C/1742 C1 was a bright one, having parabolic orbit and inclination 112.948° , motion retrograde; it passed its perihelion on February 8.696, 1742 and the closest by the Earth from 0.3334 AU on 7 March⁵. It was noticed first in the southern skies from the Cape of Good Hope⁶, where the first records date 5 February 1742, that also state that the comet had been seen on several nights before³. It showed up in the east in the morning in the constellation of Telescopium, when its apparent declination would be -48° to -50° . The comet was moving northwardly and only by March became visible in the northern skies when it was widely observed. In Europe, the comet was first seen by William Whiston (Isaac Newton’s successor as Lucasian professor of mathematics) in England³ on March 1.2. Grant, an Irishman, observing from Paris found it on 2 March, with a tail $4-5^\circ$ long and as bright as +1 magnitude⁴. By 8 March, it had developed a tail $8-9^\circ$ long with its head at about 2 mag. The comet became circumpolar by 11 March, when it could be seen throughout the night. By April 1742, it became strenuous to view the comet unassisted. It was observed last, telescopically, on 7 May³.

Muḥammad ‘Alī’s sightings of the comet

Let us try to resolve the comet observations recorded by Muḥammad ‘Alī using modern calculations. Apparently, he does not specify any date in *Shawwāl*, so Khan¹ takes the date of the first reported observation as *Shawwāl* 15, 1154 AH. Khan provides all along the corresponding Julian dates as well. The first reported appearance of the comet was in the evening, and the same for the fireball. As the sightings can be after sunset only and knowing that the date changes after sunset, Khan’s converted dates end in error. In what follows, I have made the corrections.

I have chosen to consider comet positions right from *Shawwāl* 1, 1154 AH (9 December 1741 Gregorian, Saturday) itself. Muḥammad ‘Alī’s last recorded sightings are in the (initial) few days of the month of *Muḥarram* 1155 AH, and made early morning. I shall take these to be the few days following first day of *Muḥarram* (7 March 1742 Greg., Wednesday), i.e. from the morning of 8 March.

In light of the history of observations of the comet made from the Cape and Europe, Muḥammad ‘Alī’s initial observations assume significance. These are also critical to the observer’s location. Muḥammad ‘Alī recorded occurrence of a meteor in the first quarter of the night of *Muḥarram* 6, 1155 AH¹ (12 March 1742 Greg., Monday). It was a large meteor, shooting from the east to west and ending with a loud sound which may have been caused by the bursting of the fireball and crashing of meteorites into the ground. One may note that there are no major meteor showers in the months of February–March and so, what Muḥammad ‘Alī recorded may have been a stray event only, though exceptionally bright. Meteors brighter than any of the planets, say mag. -4 , are called fireballs,

whereas those brighter than -14 are bolides. The observation was made from Burhānpur (in modern Madhya Pradesh). We may consider that the comet observations also may have been made from the same location. In that case, the evening observations of the month of *Shawwāl* run into a problem.

At Burhānpur ($21^{\circ}25'N$, $76^{\circ}19'E$), where in the sky was such a naked-eye comet located during the period 9 December 1741 to 4 February 1742, i.e. before its reported discovery on 5 February from the Cape of Good Hope? The comet was then at large southern declinations, approaching the inner Solar System about vertically and trailing the Sun. It began to lead the Sun from 7 January, 21:00 UT onwards and would have risen above the horizon before sunrise in the last days of January only. Until then, there are no observations reported from anywhere else. In fact, after its discovery from the Cape, there were hardly any observations in the month of February^{3,7}.

It is necessary to ascertain if the comet was observable so early, i.e. 9 December onwards. I have computed positions of the comet for the relevant period, using the Jet Propulsion Laboratory's Horizons system⁵. Its long-term planetary ephemeris DE-406 duly incorporates the gravitational attraction of the major bodies in the Solar System on the trajectory of the target body and other corrections, and suits our purpose well, being accurate over the interval 3000 BCE–3000 CE (ref. 5). The comet positions are apparent, with respect to the Earth's true-equator and the meridian containing the Earth's true-equinox of date, and refer to the comet head centre. I have also considered the positions of the Sun and the Moon that are necessary for reference; New Moon occurred on 8 December 1741, 5 February 1742, etc.

From the computed positions, I conclude that Muḥammad 'Alī's first recorded sighting would have to be before mid-December. However, the comet–Sun altitude difference was not favourable then. On 9 December 1741 itself, the moment the comet reached the horizon toward the southwest (12:38 UT), the Sun had descended just $\sim 6^{\circ}$ below (sunset: 12:12 UT), the respective S–W azimuth difference being 46° . That is just when the civil twilight is ending. There is a so-called frost line from the Sun, between 2.5 and 3.0 AU, where the water ice of a comet begins to sublimate. The

comet had arrived well into the range. It may be presumed that it had developed some fuzziness and tail. Ironically, its visual brightness that evening worked out to be disappointingly low, at 6.4 mag (note 2). That is fainter than the faintest star a normal human eye can see in a clear, dark night. In the next few days, the altitude difference between the comet and the Sun made things worse, as it diminished each day that followed. Thus, naked-eye observation in *Shawwāl* is not possible at all. Observation from another location, say from latitudes due south of Burhānpur, provides no help. The heliocentric and geocentric distances to the comet are no solution either. Through the first week of the month of *Shawwāl*, the geocentric distance of the comet decreased from 1.84 to 1.82 AU and the heliocentric distance from 1.37 to 1.27 AU, only so that the resulting changes in brightness were hardly any for the better. The only way out is if the reduced magnitude of the comet were on the brighter side and by several magnitudes (note 2). However, that would not be consistent with first observations of the comet reported from other places. I shall return later to this. Being summer down south, the days at the Cape were longer than in Europe where nights would be longer. The comet altitude, say on 9 December 1741 would be $\sim 40^{\circ}$ at the time of sunset (17:49 UT). However, being faint, the comet would escape detection by the naked eye at the Cape also. It was missed in Europe for long because of a very low declination that ranged from around -60° in December 1741 to -50° towards end of January 1742.

What is the situation in the months of *Dhu-al-Qa'dah* (beginning 7 January 1742, Sunday) and *Dhu-al-Hajjah* (beginning 6 February, Tuesday)? To illustrate this on 1 February 1742, the comet would have risen at Burhānpur at 00:50 UT, with the Sun at an altitude $\sim 10^{\circ}$ (sunrise 01:35 UT). By this time, the comet should have brightened up to 2.9 mag. Thus, in the last week of *Dhu-al-Qa'dah*, the comet would rise in the nautical twilight, but no longer a challenge to the unaided eye. On 5 February, it would have risen a half hour earlier, at 00:22 UT, when the estimated visual magnitude improved further to 2.7 mag. With the Sun still 16° below horizon, the sky would have been dark and a view of the comet in the astronomical twilight would be surely possible, it being a New

Moon that day. At the time the comet rose that morning, Corona Australis had risen and the comet and the stars α -Sagittarii (Rukbat) and β -Capricorni (Dabih) roughly defined the eastern horizon.

Records of a number of occurrence of comets, meteors and earthquakes can be found in some other well-known Indo-Persian texts^{8,9}. Whether Muḥammad 'Alī took these events to be signs in the sky, given the uncertain times under a weakening Mughal Empire and the ripples of the recent invasion of Delhi in 1739 by Nādir Shāh lingering still is difficult to say. The manner in which he reports the natural occurrences, Muḥammad 'Alī comes across more as representing a totally independent cultural tradition. The reference to an evening sighting of a star with tail followed by another apparition in the mornings can come from actual observations only. It implies that Muḥammad 'Alī had some exposure to the relevant literature. More importantly, the observation that it is the same comet suggests of a rare perception. It overarched canonical knowledge and whatever practical astronomy he may have known, for, the inference is independent of the Western tradition. Only, his description has turned out to be correct selectively as somewhere it runs counter to the brightness estimates.

On the face of it, the *Shawwāl* observation is perplexing. However, I can explain it in one possible way. Comets can be unreliable in respect of their activity (read brightness) in their first pass through the inner Solar System. In the first week of *Shawwāl*, the comet lay at distances less than that of Mars to the Sun and well within the frost line. The extrapolation of the brightness of the comet to this period is built upon estimates that are mostly post-perihelion. It gives a fair idea of how the comet was brightening up, due to its normal activity and a changing geometry – the diminishing distances, more because of the geocentric than the heliocentric one. However, did the comet go through some sudden spurt in activity (and brightness) in the month of *Shawwāl* by several magnitudes that subsided in a matter of days to weeks? Quick outbursts in comets are rare but have been observed just as it happened in the case of the periodic comet 17P/Holmes. It is a faint comet, with a period of 6.9 years. It was discovered by Edwin Holmes on 6 November 1892. In January 1893, it had brightened

up a hundred times (i.e. by five magnitudes). More recently, between 23 and 25 October 2007, it brightened up from 17 to 2 mag (i.e. a million times)¹⁰, while it was 2.44 AU from the Sun. It is true that no two comets can ever be alike, but it is also possible that something of the kind happened to the present comet. That makes it equally noticeable in the month of *Shawwāl* from the southern hemisphere.

Must we take Muḥammad ‘Alī’s first sighting of the comet only in 1742, it is likely to have been around the times it was first recorded – on 5 February 1742 at the Cape. That is as far as I can conjecture. Be that as it may, Muḥammad ‘Alī is an independent discoverer of the comet. The next reported sighting of the comet in February was on the 27 and 28 only, by two Dutch navigators⁷ on a ship in the Indian Ocean³. It would have been easier had Muḥammad ‘Alī mentioned also the constellation or any bright star in the vicinity. On the evening of 9 December 1741, the comet lay in the constellation of Pavo, near the border with Indus and Telescopium, with Venus high up in the sky. On the morning of 5 February 1742, the comet lay in Telescopium, south of Corona Australis, with Venus set. On 8 March 1742, the comet lay in Lyra, near β -Cygni, with Venus set, etc.

I have not been able to access a copy of Muḥammad ‘Alī’s book. His records¹ do not have the astronomical detail but his dates can be relied upon. Muḥammad ‘Alī has been acknowledged for detail in his personal observations¹¹. There is no record in the modern cometographies of any comet in 1741 (refs 3, 4). In 1742, there did appear another one³, but it did not fit Muḥammad ‘Alī’s description. Could it be some other comet – say, the multiple-tailed Chéseaux Comet (C/1743 X1), one of the most beautiful comets in history that at one time had so much brightened up as to be spotted in daylight³? It appeared in the months

Muḥammad ‘Alī refers to, first in the evening and then in the morning skies and displayed long, six-forked tails emerging from the horizon in a unique fan-shaped formation. His *Hijri* year in that case would have to be 1156 AH, but, importantly, his tale would have carried reference to the spectacular forked tails. Muḥammad ‘Alī’s book does not mention the appearance of other comets in his lifetime, though some reached naked-eye visibility.

Notes

1. Muḥammad ‘Alī was a Persian scholar. The book *Tārīkh-i Rāhat Afzā* is a history of Tīmūrīds from 1359 to 1759 that he finished in 1759–60. Muḥammad ‘Alī’s forefathers at one time held good positions in Iraq and Khurāsān (ref. 1, p. 190). He is credited with another book, *A History of Burhānpur*. It carries his name as Muḥammad ‘Alī bin Muḥammad Sādiq Husainī Nishāpūrī Najafī Burhānpūrī. The many suffixes to the name indicate that his family had drifted through a number of places (Nishāpūr, in Khurāsān and Najaf, south of Baghdad). The family eventually settled down under the patronage of Būrhān-ul-Mulk Saiyad Sa’adat Khān, a noble of the Mughal Emperor Muḥammad Shāh and Governor of Awadh (ref. 11, p. 368).
2. The visual brightness m of a comet can be expressed empirically as a function of its heliocentric distance r and geocentric distance Δ thus⁴:
$$H_{10} = m - 5 \log \Delta - 2.5n \log r.$$
The distances are in astronomical unit (AU), the quantity H_{10} is the reduced magnitude of the comet when at $r = \Delta = 1$ (AU) and n an index; $n = 3-5$; it is generally taken equal to 4. The reduced magnitude H_{10} of the comet C/1742 C1 has been quoted as 3.7 (ref. 4) and 4 (ref. 3).

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