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COMET 1P/HALLEY IN 1910: TALES FROM INDIA

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Abstract: This paper presents observations of Comet 1P/Halley made from India during its apparition in 1910. The comet was well observed from various locations, and newly formed observatories made observations throughout the visibility phase. We also discuss the impact of the apparition on people from different walks of life.

Key words: Comet 1P/Halley, Kodaikanal Observatory, Charles Michie Smith, John Evershed, Nizamiah Observatory, Arthur B. Chatwood, J.F. Tennant, Maharaja Takhtasingji Observatory, Radha Gobinda Chandra, Astronomical Society of India, Reverend John Mitchell, V.B. Ketakar

> … in the Year 1456. in the Summer time, a Comet was seen passing Retrograde between the Earth and the Sun, much after the same Manner: Which, tho' no Body made Observations upon it, yet from its Period, and the Manner of its Transit, I cannot think different from those I have just now mention'd. Hence I dare venture to foretell, That it will return again in the Year 1758.
> (Edmund Halley, 1705: 22).

1 INTRODUCTION

The Great Comet of 1680 (C/1680 V1) was the first comet to be discovered with a telescope, by Gottfried Kirch from Coburg in Germany on 14 November. It proved a milestone in our understanding of comets in more than one way. First, Georg Dorffel indicated that the two bright comets seen in quick succession in 1680 and 1681 were one and the same comet, which appeared before and after its perihelion passage (see Festou et al., 2004).

Secondly, the comet had the attention of Isaac Newton (1642–1727) and his friend Edmund Halley (1656–1742; Figure 1). Newton showed in his *Philosophiae Naturalis Principia Mathematica* (*The Mathematical Principles of Natural Philosophy*; 1687; Book I, Section II) that if heavenly bodies were attracted by a central mass in the inverse proportion to the square of their distance from it, they would follow a path in the shape of one of the conic sections—a circle, an ellipse, a parabola or an hyperbola. Newton had first observed the comet of 1680 with the naked eye, and he then followed it with a telescope. He deduced its orbit by selecting three observed positions, and showed that the orbit was nearly a parabola (Newton, 1687: Book III).

Halley applied Newton's Law of Gravitation to the observations of twenty-four different comets, and he showed that one of these was periodic and therefore its return was predictable. Thus, he saw great similarities in the orbits of the comets of 1531, 1607 and 1682, and regarded these as the same comet that had returned repeatedly, and he surmised that the comet of June 1456 was also a previous apparition. The intervals were similar and if these slightly differed, he attributed this to the influence of Jupiter. Keeping this in mind, Halley (1705: 22) predicted that the comet would return in late 1758 or early 1759. He did not live to see the comet return, but the prediction made it the most awaited apparition in history.

2 COMET 1P/HALLEY IN 1758–1759: POWER TO THE PHYSICAL THEORY

Searches for the comet actually began in 1757. Recounting the comet's story, Dr Dionysius Lardner (1835: 466–467) wrote:

> In 1757, Lalande proposed to Clairaut, the calculation of Halley's comet which was expected to return speedily. They

Figure 1: A painting of Edmund Halley in the National Portrait Gallery: NPG 4393 (Wikimedia Commons).

> were assisted by a French lady, the wife of a chronometer maker. The calculation was enormous, because the orbit must be divided into degrees, and each degree requires as great a calculation as the whole orbit. They tell us, that they were employed from morning to night, not excepting meal hours, incessantly for six months in this computation. Clairaut was so nervous that he hurried his calculation before the Institute, although he had not completed it. He stated, that the comet would reach its perihelion on the 4th of April, but that it might be seen sooner. Voltaire has said, that the philosophers did not go to bed in the beginning of the year, so anxious were they to observe it.

Clairaut referred to above is the distinguished mathematician Alexis Clairaut (1713–1765). Dionysius Lardner (1793–1859) was a science populariser; he was Professor of Natural Philosophy and Astronomy at University College London during 1828–1831, and is best known as the editor of Lardner's *Cabinet Cyclopædia* (Peckham, 1951).

The comet did indeed return. It was recovered by a farmer and amateur astronomer Johann Palitzsch from Prohlis in Germany in the constellation of Pisces on 25 December 1758 with a telescope of eight feet focus (Hind, 1852: 40). But the finding was only confirmed on 20 January 1759. The comet was then well observed by several well-known astronomers. It passed perihelion on 13 March 1759, and on 1 April Charles Messier spotted it in the morning skies a few degrees above the horizon and with a 25° long tail. The comet reached maximum brightness at -0.8^{m} (Yeomans et al., 1986) as it passed closest to the Earth (just 0.1222 au) on 26 April. It continued to be a naked eye object throughout May, gradually slowing down in its apparent motion to become near stationary and fading out to 5.4^{m} by 2 June, when it reached Sextans. A detailed account of the apparition can be found in Kronk (1999).

With this return as predicted, the comet provided the most cogent proof of the strength of physical theory—the Law of Universal Gravitation. The reader can find a poetic echo of an astronomical prediction proven correct in the first lines of the poem by Victor Hugo (1802–1885) titled “La Comète, 1759” (XVI in “La Légende des siècles”; “The legend of the centuries”), reproduced by *The Observatory* in its August 1910 issue on pages 341–342:

> Il avait dit:– Tel jour cet astre reviendra.
> Quelle huée! …
> The English translation is:
>
> He said:– Such a day this star will return. What a hoot ! ...

As for naming the comet after Halley, the honours were conferred by the French astronomer Abbé de La Caille (1713–1762), sometime in May 1759. A decade later, Charles Burney (1726–1814), the music historian best known for his *History of Music*, had this to say: “The comet of 1759 is known throughout Europe by the name of Dr Halley’s comet.” (Hughes, 1987: 360).

Halley’s Comet is now known as Comet 1P/Halley. It has an orbital period of 75.91 years, with a perihelion q = 0.574716 au, aphelion Q = 35.28092 au, e = 0.96794, t_P = 08.649 February 1986, i = 162°.188, motion retrograde (JPL, 2023). For its inclination, much of its orbit lies south of the ecliptic. It is one of the very few periodic comets that gets visually bright, enough to secure a place in history. In the last few thousand years, its absolute luminosity, at a mean of $+ 5.40^{m}$ between the 12 BCE and 1910 apparitions, has not declined very much. The decrease is estimated to be only $+0.014^{m}$ i.e., about 1.3%, over that period. Its visual brightness at each apparition has therefore depended upon how it was positioned in its orbit with respect to the Earth during the times of its maximum activity (Hughes, 1987). Since the eccentricity is large, the comet has a high velocity relative to the Earth—e.g., it was 70.56 km/sec in the 1910 apparition. Due to planetary perturbations, the comet’s period has fluctuated by as much as 2.5 years about the oft-quoted period on its successive returns. In Yeomans’ (2007) list of ‘Great Comets’, 1P/Halley has figured as such on 22 of its 27 apparitions that took place between 87 BCE and 1910 CE.

Comet 1P/Halley has a nucleus shaped like a peanut, with dimensions of 15 × 8 × 8 km, which is rather large compared to the nuclei of other comets. It has a density of 0.6 gm/cm^3, and a mass 2.2×10^{17} gm ($M_E = 5.9736 \times 10^{27}$ gm). It has a low geometrical albedo of 0.04, as deduced from observations made by the Vega spacecraft on their 6 March and 9 March 1986 flybys (Sagdeev et al., 1986), i.e., the nucleus has a very dark surface. The Eta Aquariid and Orionid meteor showers seen in May and October respectively are both associated with Comet 1P/Halley.

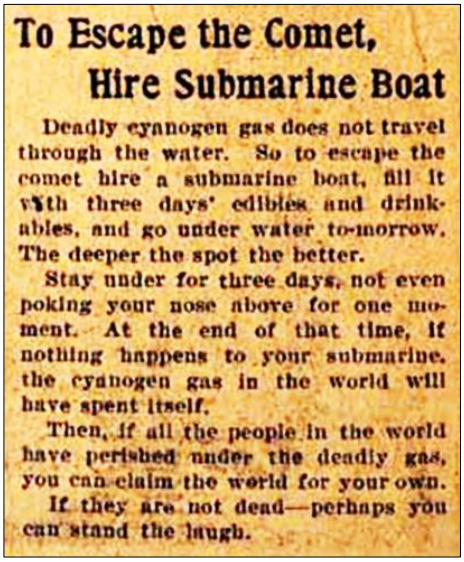
This paper presents selected observations of Comet 1P/Halley made from India in 1910.

3 COMET 1P/HALLEY IN 1910: A FEW DROLL STORIES

When Comet 1P/Halley returned in 1910 it was its twenty-ninth recorded visit (1P/1909 R1; perihelion on 20.179 April). The predictions about the comet's apparition this time were supposedly far more accurate as there did not seem to be any hidden body in the Solar System left to perturb its motion (Pluto was not yet known). The comet was discovered on 12 September 1909 by Max Wolff in Heidelberg (Kronk, 2007). Its magnitude was then about 16^m, but by the end of January 1910 it had brightened to 9.3^m. On 11 February, Wolff saw it with the naked eye, while some other observers noticed a multiple nucleus in February (Vsekhsvyatskii, 1964). It was on this apparition that Comet 1P/Halley was photographed for the first time. The comet began to trail the Sun from 19 May 1910, then shining at a visual magnitude of 0.97^m. It passed closest to the Earth the following day, on 20 May 1910. Detailed accounts of its photometric, photographic and spectroscopic observations can be found in the technical literature and popular books, and Kronk (2007) and several other works present the story of the comet's 1910 visit in great detail.

Over the ages, the sight of a comet evoked fear and awe in diverse cultures as harbinger of famine and pestilence but also invited extraordinary cultural expressions. In 1910 Comet 1P/Halley generated excitement among astronomers and the public the world over, like never before. It secured newspaper space repeatedly and was imprinted on artifacts, utility items and souvenirs, and it influenced the social scene for both the right and the wrong reasons. On one hand there were record sales of telescopes, while on the other hand the media reported of the scare the celestial visitor was causing. Of these the most scaring was that of the possible wiping out of all life when the Earth would pass through the cyanogen-laden tail of the comet on 19 May. On 7 February, *The New York Times* front-paged a story that the "… astronomers at the Yerkes Observatory had identified bands of poison gas in the comet." Such reports created fear (e.g. see Figure 2), although astronomers were generally of the opinion that the comet's tail was too rarefied a medium to affect the Earth's atmosphere.

During May, the *New York Times* carried reports about the terror the comet was causing, as echoed on 9 May when it said: "Bermuda Observers Report Comet Acting Strangely Following King Edward death." (Siddiqui, 1985: 28). People also were cashing in on the superstitious fears of the peasantry in southern Russia by collecting money on the promise of solemnization of masses. And a schoolboy in Bavaria in his essay on the comet gave his impression of the apparition thus: "In this country the Comet has already caused a rise in the price of beer, but it may cause even greater misfortunes in other countries" (*The Observatory*, 1910: 226). The Maltese experience of the comet in 1910 is nicely described by Galea (2009). One may see Evans and Bartholomew (2009: 242–244) for more such reactions to the possible disaster. Many gathered in churches and prayed, others hoarded oxygen cylinders, and peddlers sold anti-comet pills and gas-masks (Moore and Mason, 1984), but during its eight-hour journey on 18 May 1910 the Earth passed through the tail unscathed, contrary to the fears of the toxic effects from the cyanogen rich medium (Figure 3). In a wonderful exposition on the comet, the Columbia astronomer Professor S.A. Mitchell, while speaking at a dinner meeting of *The Thirteen Club* on Friday 13 May (Black Friday), dismissed any misgivings about the cyanogen tail of the comet that people nurtured and emphasized how rarefied it was, vide:



To Escape the Comet, Hire Submarine Boat

Deadly cyanogen gas does not travel through the water. So to escape the comet hire a submarine boat, fill it with three days' edibles and drinkables, and go under water to-morrow. The deeper the spot the better.

Stay under for three days, not even poking your nose above for one moment. At the end of that time, if nothing happens to your submarine, the cyanogen gas in the world will have spent itself.

Then, if all the people in the world have perished under the deadly gas, you can claim the world for your own.

If they are not dead—perhaps you can stand the laugh.

Figure 2: Comet 1P/Halley and the 'Cyanogen Effect' (news report in an unidentified newspaper (courtesy: IIA Archives).

> It would, in fact, be very easy, he declared, to ball up the whole tail of the comet and stuff it into one of the handbags which the women so frequently forget and leave on the store counters or in Subway trains. (*The New York Times*, 14 May 1910, page 7).

With just a few days left to the Earth's passage through the comet's tail, while the *Washington Post* and *Harper's Weekly* were

2 THE SAN FRANCISCO CALL, THURSDAY, MAY 19, 1910.

Earth Passes Unscathed Through the Tail of Halley's Comet

EPOCH EVENT IN THE SCIENCE OF ASTRONOMY

Valuable Knowledge Secured by Observations Of Comet's Transit Across the Blazing Face of the Sun

NO UNUSUAL PHENOMENA NOTED

CATCHING TAIL OF COMET IN BOTTLES

YERKES OBSERVATORY TAKES PHOTOGRAPHS

REJOICING SUPPLANTS TERROR OF MEXICANS

MAY 21 MAY 20 MAY 19 APR. MAR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC. SUN

Diagram showing the path of the earth and how the orbit of Halley's comet crosses it as the great sky torch passes between our globe and the sun.

HUGE SPOTS APPEAR ON SURFACE OF SUN

Tremendous Disturbances in the Orb of Day Probably Not Caused by Any Influence Of the Comet

EXTENT OF MONSTER CAVITIES

SIX TO BE CONSECRATED BISHOPS AT SAME TIME

Impressive Ceremony Takes Place Today at St. Paul

NANKING SITUATION REPORTED SERIOUS

Disquieting Anti-Foreign Rumors Exist, Says Calhoun

Fog Prevents Observations

EXCURSION BOAT SINKS, IMPERILING MANY LIVES

WHEN YOUR MEALS DISAGREE

Figure 3: *The San Francisco Call*, dated 19 May 1910, reporting on page 2 the safe passage of the Earth through the tail of Halley's Comet on 18 May 1910 (IIA Archives).

presenting mixed impressions about the possible impact (Evans and Bartholomew, 2009: 242–244), there also was this Eastern weekly, *"The Singapore Free Press and Mercantile Adviser*", that in its issue dated 19 May 1910 front-paged an account on Halley's Comet, itself datelined 13 May, scientific to the core. Here is an extract from the said issue:

> The appearance of that remarkable visitant is now very striking. From a well defined uncleus [sic], equivalent at least to a first magnitude star, there streams almost vertically aloft a tail which now extends over a matter of at least 30 degrees ... Next Wednes-day, the 18th inst., the comet and the earth, - the former on an inner right hand curve, and the latter on an outer left hand curve, - will have reached the nearest point of approximation … On the following day, Thursday, May 19th, early in the day, the earth, the comet, and the sun will be in a line, and the comet will pass directly be-tween the earth and the sun, the actual transit across the sun's disc oc-curring between 9.22 am. and 10.22 am … the earth should pass through the tail on the occasion. A watch should therefore be kept by observers for any abnormal atmospheric pheno-mena during the period extending from the 18th to the 20th May. This is suggested because when the earth last passed through the tail of a comet, in 1861, very remarkable glows were seen in the sky, due to minute particles of cometary matter intermingling with our atmosphere. (*The Singapore Free Press*, 1910: 1).

The writing was lucid, only the author's name was not given. The 29 May edition of *The New York Times* reported on page 2 that "Pope Not Impressed by Halley's Comet". The Pope Pius X was visiting the Observatory in the Vatican Gardens to have a glimpse of the comet and remarked that "It Does Not Seem to Justify Commotion It Has Caused." Later, in the 3 July edition, *The New York Times* carried Mary Proctor's (1910) account of the results of the work on the comet done so far, headlining, "The Work of the Observers has Separated Fact from Fiction About the Celestial Visitor and Here is the Truth About It".

However, a story in *The Times of India* on 2 June brought out the bizarre side of the apparition's effect where a young Bengali *sadhho* (ascetic) formally petitioned a police magistrate

> … to grant an order to have my wretched life sacrificed before our goddess Kali Matta for the benefit of the Government and also for the people of Hindustan …

Naturally, the Magistrate declined to comply with the request and told the *sadho* to go home and pray, which act could be more efficacious than self-immolation for mankind, for, such acts

were forbidden by law anyway (Padgaonkar, 1985: 35).

4 COMET 1P/HALLEY: OLDER INDIAN TALES

There are two celestial occurrences that find a place in the incidents related to the great poet-saint Guru Nanak (1469–1539 CE), founder of Sikhism, or in his teachings. The first one, referred to as *lamma tara* (long star), figures in a hymn in the *Sri Guru Granth Sahib*, the sacred scripture of the Sikhs, and the other a solar eclipse, most likely on 13 January 1507, that occurred while Guru Nanak was visiting Kurukshetra. The long star must be Comet 1P/Halley during its apparition of August 1531. This is significant considering that the record of a sighting of a comet in an Indian scripture has thus far not been identified (see Kapoor, 2018). Comet 1P/Halley next finds a place in Indian records in its apparition of 1758–1759.

With its return in late 1758 as predicted, the comet became the astronomers' delight. In India, French Jesuit Gaston-Laurent Coeurdoux (1691–1779) had observed the Comet from Pondicherry first early in the morning of 28 March with a semi-circle 10 inches in diameter placed perpendicularly on a circle of the same size, and using an 18-inch telescope (Coeurdoux, 1760: 458–460; Kapoor, 2018). Notably, Coeur-doux's communication nowhere relates the apparition of the comet to Halley's prediction nor does it use the phrase "Halley's Comet". The Comet was noticed also in Assam and is mentioned in the *Ahom Buranji*, the Royal Chronicle of the Ahom rulers (Kapoor, 2021). When the Comet returned in its 28th recorded apparition in 1835 ((1835 III, 1P/1835 P1; perihelion 16 November), it became a most eagerly awaited apparition, spurring a series of predictions that included possible effects of the gravity of Jupiter, Saturn and Uranus on its orbit. While writing the story of Halley's Comet for "The Nineteenth Century", September 1909, page 530, E. Vincent Heward described the Comet's 1835 apparition thus: "It glowed like a red-hot coal of oblong form. It appeared like a blazing rocket." (Modi, 1917: 72).

In its 1835 apparition the comet was observed at Madras Observatory by T.G. Taylor (1835; 1836). G. Venkata Jugga Row (1817–1856), an affluent *zemindar* (landlord), had worked with Taylor and provided assistance in computations and possibly in the observations too (Kameswara Rao et al., 2011: 1576); see also Kapoor (2014). Jugga Row's personal interest saw the erection of a private observatory in the backyard of his residence at Daba Gardens in Vizagapatnam in 1840 that continued to function even under his descendants until the late nineteenth century (Kameswara Rao et al., 2011). The observations by the noted astronomer Rājā Ratan Singh Zakhmi (1782–1851) also need to be mentioned. He first saw the comet on 15 October near the constellation of Corona Borealis, describing it as having a 29º–30º tail. According to Ansari (2010, pers. comm.), Rājā Ratan Singh had carried out his observations "… using a telescope." Recall the astronomical observatory in Lucknow, established in 1832 by Naṣīruddīn Ḥaidar Shah (1803–1837), Nawab of Oude (Awadh), with the intention to advance science in India (Ansari, 2011; Kapoor and Orchiston, 2023b). Rājā Ratan Singh had joined the Awadh court in 1815. He was from a family of scholars who had served the Awadh State for some generations. He wrote two works on astronomy in Persian. Among these, *Hada'iq al-Nujum* (*Gardens of Astronomy*), which was first published in 1837, is a unique treatise that introduces the reader to modern concepts and discoveries in astronomy (Ansari, 2011: 359). He illustrated the disc of the Sun with sunspots, and mentioned three comets, those of 1819, 1832 and 1835 (this last one being 1P/Halley). In a section devoted to Comet 1P/Halley, Rājā Ratan Singh mentioned the earlier apparitions and cited its period as 76 years 248 days.

When Comet 1P/Halley returned in 1910 it was observed from many places in India, including from the newly formed Kodaikanal Observatory, Nizamiah Observatory and Maharaja Takhtasingji's Observatory. This time, too, it caused concern and evoked reactions from those in different walks of life.

Following information on the founding of Kodaikanal Observatory are accounts of the 1910 apparition of Comet 1P/Halley as viewed from India. To retain the historical flavour, the old names/spellings found in the original historical accounts have been used.

5 THE FOUNDING OF KODAIKANAL OBSERVATORY

Late in the nineteenth century, an Indian Observatories Committee was formed in England to assess the work of Madras Observatory and deliberate on its future. In 1882, Norman Pogson (1828–1891), the Government Astronomer at Madras Observatory, had proposed the acquisition of a 20-inch telescope for solar and stellar photography and spectroscopy, with the new facility preferably located at a southern hill station. Subsequently, the emphasis veered towards observations of the Sun in the tropical Indian skies, and a quest began to find a suitable site. At a meeting held in 1893, the Comm-

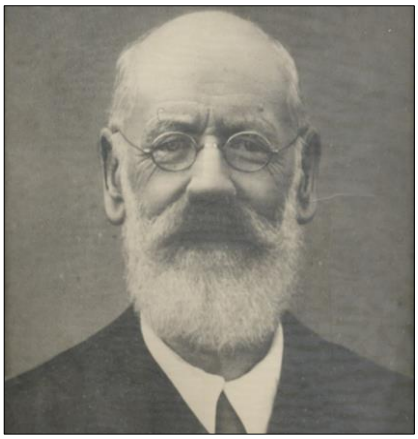


Figure 4: Charles Michie Smith (courtesy: IIA Archives).

ittee decided to establish a solar physics facility at Kodaikanal in the Palani Hills in southern India, under Charles Michie Smith (1854–1922; Figure 4), who was at that time the Government Astronomer at Madras Observatory.

By 1899, Michie Smith had shifted the astronomical activities from Madras to Kodaikanal. The Observatory officially started to function from 1 April 1899, though construction work went on until December 1901 (Figure 5). Michie Smith served as Director of both Kodaikanal and Madras Observatories from 1891 to 1910. Equipped with new instruments, clear skies and a favourable ambience at an altitude of 2343 m, Kodaikanal Observatory began work, centred on solar astronomy. Madras Observatory now focused on meteorological work, and the only astronomical work that continued there—up until 1931—was conducted in order to provide a time service.

John Evershed (1864–1956; Figure 6) joined Kodaikanal Observatory on 21 January 1907 as Chief Assistant to the Director, and subsequently served as Director from 1911 until 1923.

Kodaikanal Observatory has now been active in solar research for more than a century. Since 1904, a spectroheliograph has been in operation to take photographs of the Sun on every clear day in a narrowband centred around the K-line of ionized calcium. Evershed also introduced a second spectroheliograph, which worked at the wavelength of the Hα line. While the former provides information on the upper layers of the chromosphere of the Sun, the Hα photographs help us know more about the lower chromosphere.

The wealth of the photographic material collected at the Observatory has great archival value since it covers ten sunspot cycles each of 11 years period (e.g. see Chatzistergos et al., 2019). Only at the observatories in Paris and on Mount Wilson do comparable records exist. The extensive data spanning such a long period provide an excellent opportunity to study variations in the solar rotation rate using sunspots and calcium K-line plages and variations in supergranulation size with solar cycle phase. In 1934, the Observatory received as gift a spectrohelioscope from Mount Wilson Observatory which has been used for visual observations of the Sun. A new Solar Tower Telescope was acquired in 1958 that has served as a premier

Figure 5: Kodaikanal Observatory in 1905 (courtesy: IIA Archives).

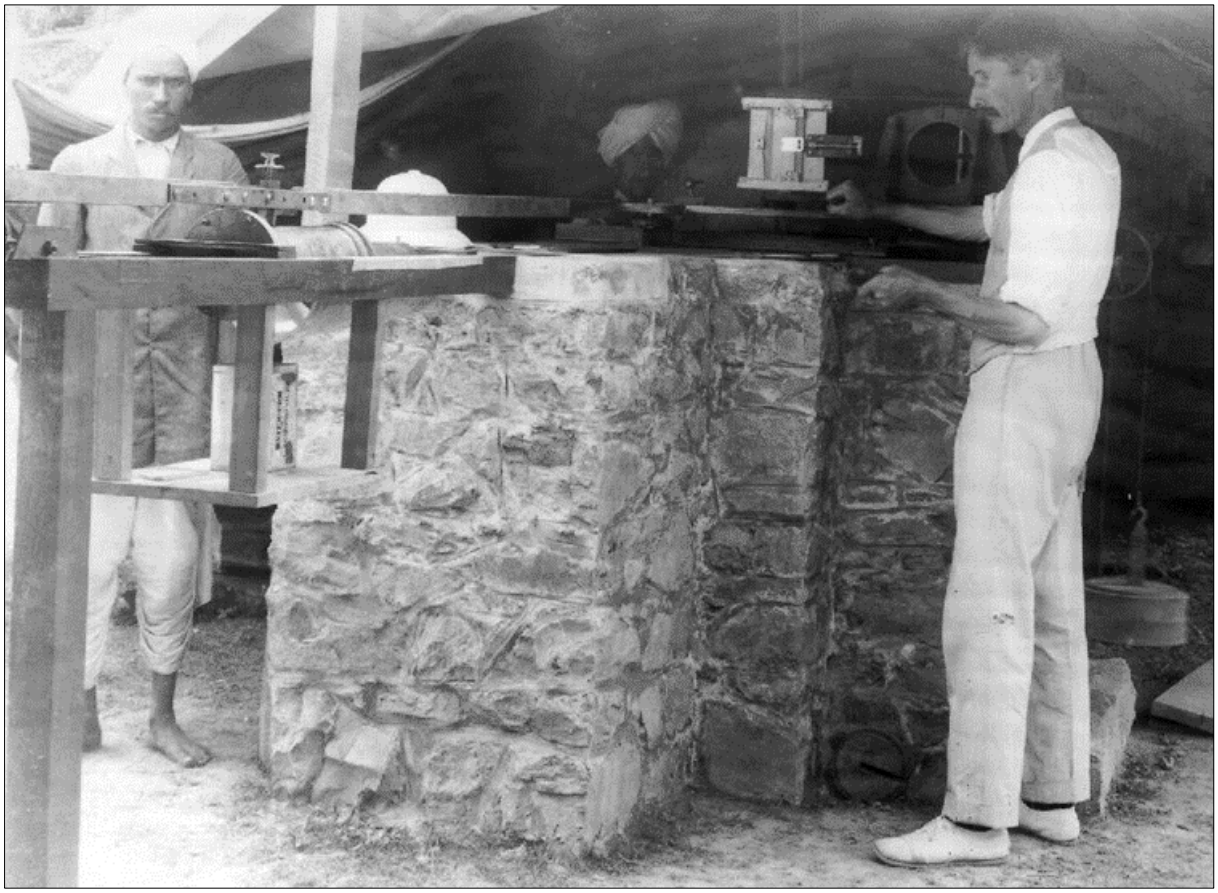


Figure 6: John Evershed working with his spectrograph (courtesy: IIA Archives).

equipment for spectroscopic studies of the Sun. Apart from other astronomical programmes, observations of comets too were undertaken at Kodaikanal Observatory that included the most spectacular ones in recent history. The work at the Observatory is too extensive to even briefly describe here. This is borne out by the Annual Reports over the years, accessible on the website of Indian Institute of Astrophysics (see, also, Kapoor and Orchiston, 2023a).

6 INDIAN OBSERVATIONS OF COMET 1P/ HALLEY IN 1910

6.1 Kodaikanal Observatory

Halley's Comet was keenly followed at Kodaikanal Observatory by Charles Michie Smith and John Evershed. It made a spectacular display in the first two weeks of May. Evershed (1910b: 605) observed it first on the morning of 18 April at 04h30m IST, when it appeared as a star of second magnitude, with a tail 5º long. In the "Kodaikanal Observatory Annual Reports" for the year 1910, Evershed (1910a: 9) wrote about the arrangements for direct photography, spectrum photography and visual observations.

A detailed account of the observations was published by Michie Smith and Evershed (1910) where they also mention S. Sitarama Aiyar (First Assistant) and G Nagaraja Aiyar as the other observers. They had a 4-inch portrait camera attached to the North Dome equatorial at the Observatory. For larger scale photography, they also constructed a teakwood horizontal telescope with a 9¼-inch mirror and set up a 16-inch coelostat to supply light to it and to the guiding telescope. They could obtain good photographs on fourteen days between 21 April and 17 May. The photograph of 30 April taken by S.S. Aiyar with the Lerebours and Secreten equatorial showed many distinct tails. With a sector used for determining altitudes, on 12 May Evershed (1910b: 610) measured the tail and found it to be 60º long.

Evershed (1910b: 606) commented that the most interesting plates were those taken on 22 April and 13 May. The image of 22 April shown in Figure 7 is adopted from *Journal of Astronomical Society of India* (JASI: 1910–1911: Volume 1), which also included an image taken on 3 May. The photograph of the comet taken on 13 May is shown in Figure 8, and reveals a well-defined coma and straight streamers in the tail. Note that many background star trails can be seen through the tail.

An exciting event occurred during this ap-

Figure 7 (left): A photograph of Comet 1P/Halley taken at Kodaikanal Observatory on 22 April from 0444 to 0517 Standard Time (after *Journal of Astronomical Society of India*, 1910–1911: Volume 1).

Figure 8 (right): A photograph of Comet 1P/Halley taken at Kodaikanal Observatory on 13 May (courtesy: IIA Archives).

parition when the comet transited the Sun on 19 May 1910. Such transits were not common and this one evoked great interest among astronomers as the event presented an opportunity to get some idea of the constitution of the comet's nucleus, etc. In her article for *The New York Times* carried on 3 July 1910 about American efforts to observe the expected transit of the comet across the solar disk, Mary Proctor (1910) noted that

> … elaborate preparations were also made at another station particularly well situated for the transit, the Government Observatory in Pallni Hills of South India, but with good weather, no visible evidence of the comet could be obtained.

Michie Smith and Evershed (1910) also provided an account of their attempt to observe the transit of the comet across the disc of the Sun. They had drawn up an elaborate programme for photography and spectroheliography set at the 3883Å line of CN and at the K line of Calcium to take longer exposures before ingress and after the egress, and short ones during the transit. Their calculated time of the ingress was 7h 50m but the sky was nearly overcast around then. A telegram from Kiel, received at 8 am gave them the corrected timings as 8h 59m and 9h 59m IST. Clouds notwithstanding, the observers got some clear moments and plates were taken. However, these did not show the comet. A bright Sun washed it out. On 17 May, Evershed had noted that the comet was 20 million miles from the Earth (Evershed, 1910b: 606–607),

> … but on May 19, the day of transit across the Sun, the distance would be reduced to about 15 millions. If the actual dimensions of the comet remained the same, the condensed region of the comet would have covered two-thirds

Table 1: Apparent positions of Comet 1P/Halley and the Sun on 19 May 1910 at 00:30 UT.

Object	RA	Dec	Az N-E	Al	Tmag	Ang Dia (″)	*r*	Δ
Comet	03 31 27.59	+19 29 24.9	70.45	1.45	1	0.09	0.848	0.164
Sun	03 39 28.36	+19 31 59.9	70.06	0.39	–26.7	1896.86	0.000	1.012

Figure 9: South- (left) and North Domes at Kodaikanal Observatory (courtesy: IIA Archives).

of the Sun's disk during the transit, whilst the coma would have extended considerably beyond the Sun's limb on all sides. It was therefore realized, on seeing this photograph, that the transit would be, so to speak, a total eclipse of the Sun by the comet.

The apparent positions of the Sun and the comet on 19 May computed with the Horizons System (JPL, 2023) as at Kodaikanal suggest that the comet was quite close to the Sun even at sunrise (00:30 UT), with the Sun and the comet near-aligned (see Table 1).

In Table 1, the RA and Dec values of the comet and the Sun are apparent. The azimuth (Az, measured N-E) and the altitude (Al) are the respective airless apparent azimuth and elevation of the target centre, in degrees, as at Kodaikanal Observatory (10.232° N, 77.465° E; 2343 m). *Tmag* is the apparent visual total magnitude of the comet. The angular diameters are in arcseconds. The Heliocentric (*r*) and the Geocentric (*Δ*) distances are in au.

The North- and South Domes are located at the hilltop, adjacent to the Main Hall at the Observatory. The North Dome, on the right in Figure 9, houses a 6-inch refractor through which white light images of the Sun are taken. The South Dome houses an 8-inch telescope which is used to view the stars. From here, the eastern sky is visible, but the horizon is difficult to view due to the trees that have grown tall. However, at least 2–3 frames of the Sun are taken on a clear day at around 7.30–8.00 a.m. Because of a 2343 m elevation, the sunrise is a few minutes earlier than the computed time of rise. The Spectro Building is at a lower location on the Campus. From here, the horizon is not visible and the Sun must attain an altitude of 10º before one can commence its diurnal observation.

Evershed (1910c: 207) presented in detail his observations of the comet's tail before and after the day of the transit to underline how extraordinary the spectacle was. On the morning of 17 and 18 May, between 4 and 5 am, the comet presented a magnificent tail 90º–100º long and about 6¼º wide. On 19 May, the sky was much covered with hazy clouds though through these, the tail could still be noticed. On the morning of the 20th, Evershed, then travelling, found the sky overcast at the place of observation, near Kodaikanal Road Railway Station. That same evening, while at sea off Tuticorin, he found the comet's head was vis-

ible shortly after sunset. On the 21st, while nearing Colombo, Evershed observed the tail in the east at 4:30 a.m. again:

> It seems remarkable that the tail should have remained visible in the morning sky as a narrow band of light nearly two days after the head of the comet had passed to the other side of the sun. A part of the tail on the 19th must have been rapidly approaching the earth and it might have been expected to widen out and disappear, since it must have enveloped the earth on the 20th at least.

Figure 10: "Nawab Zafar Jung with astronomy experts", Nizamiah Observatory, 1904; Source: http://archives.deccanchronicle.com/130203/news-current-affairs/gallery/peek-hyderabad%E2%80%99s-rich-past (Wikimedia Commons).

> At 4h30m IST on the 21st the comet head had passed far to the east of the sun and was presumably developing the tail seen the previous evening in the normal position, i.e., directed away from the sun and towards the east. Yet the greater part of the tail remained on the west side of the sun, apparently still many millions of miles from the earth judging by its small width. If continuous with the head it must have passed right through the sun's position and might have been expected to appear as an abnormal tail on the sunward side of the comet. No trace of a tail directed towards the sun could be seen on the evening of 20th (or on the 21st) although specially looked for, but the sky was very bright with the evening twilight and with moonlight. The extraordinary persistence of the light in the eastern sky may perhaps be explained by supposing the tail to be strongly curved and very broad in the direction of the comet's motion although narrow and straight in the direction at right angles to this. If so, the passage of the earth through the tail must have occupied much more time than a single day. (Evershed, 1910c: 207).

Evershed (1910b) presented these observations also in the June 1910 issue of *Monthly Notices of the Royal Astronomical Society*, with the comet photographs and information about the spectrum. He found the comet's whole spectrum to be identical to that of Comet C/1907 L2 (Daniel).

As an aside, the Kodaikanal Road Railway Station is about 35 km from the foothills and 84 km from the Observatory. Interestingly, the Observatory used to maintain a stable. People rode to come down to the plains through shortcuts in the hills and cut down their travel to a couple of hours only.

6.2 Nizamiah Observatory

In 1901, a private observatory was established in Hyderabad with the efforts of an aristocrat, Nawab Zafer Jung Shamsul Mulk Bahadur (d. 1907). He had bought a small telescope and later a larger one, a 15-inch Grubb refracting telescope from England (Figure 10), an 8-inch Cooke astrographic camera, clocks and even instruments for meteorology. The Observatory was built at the Nawab's estate at Phisalbanda in Hyderabad. After the Nawab's demise in 1907, as he had wished, the Observatory was taken over by the Government of Nizam in 1908, and Arthur B. Chatwood was appointed its Director (see Kapoor and Orchiston, 2023b).

Chatwood reported from Secunderabad on his efforts to watch Comet 1P/Halley around the time of its solar transit with an 8-in Cooke refractor. In a letter dated 19 May 1910 to the Astronomer Royal, Chatwood (1910: 614) reported:

> Very careful visual observation at this time failed to reveal the presence of the comet, and the immergence and emergence could not be detected. Observations were made with the 8-in Cooke 133-in focal length triplet and single achromatic eyepiece 1.25 in-. focal

length and others. I cabled you as follows:- Transit no trace comet seen.

6.3 Reports From Mussoorie, Simla and Hyderabad

General J.F. Tennant (1829–1915; Figure 11) had briefly headed Madras Observatory (when he was still a Major) from 13 October 1859 until when Norman Pogson took over its reins as Astronomer beginning in February 1861.

Tennant communicated to *The Observatory* an observation of Comet 1P/Halley made from "… somewhere in the Himalayas." (Tennant, 1910: 297). He presented the following account extracted from a lady's letter to him, but one without a date and location of the observation:

> I did have a night of it last night; I was bent on seeing the comet, as – had seen it and said it was so fine.
>
> I awoke several times, and finally at 2:35 I saw its tail stretching from the hill opposite right into the sky, nearly up to the Milky Way, which was right up across the centre of everything. It was then not quite as bright as the Milky Way, its width about the same, only sharply defined, like an arrow shooting up from the horizon. I pulled my bed right out of the tent [the writer was sleeping in a tent in the garden] so that I need not get out but could watch as I lay. Presently Venus rose, then about 4 the first streaks of dawn began to appear –at least they were not streaks at all, a diffusion of pale light up from the horizon. Up till now the tail had got brighter and brighter till it got as bright as the Milky Way; then everything became dimmer and at 4:30 the comet suddenly jumped up, almost as if it were with a great bound; it seemed moving so fast in 10 min. it was right away from the horizon. It was not as bright as Venus, though it looked bigger, and its tail had almost disappeared in the general light, and it got less and less bright.

One may read "sight" for "night" in the first line of the quote above. In a subsequent letter of 28 August 1910, Tennant (1910: 372) provided the missing information, saying:

> The observation was on May 16 at the East End of London. From the G.T.S. data, vol. xxxv., I find the places: Lat. .. 30º 27' 40" N, Long 78 6 30E, Height 7500 feet above sea.

He also clarified that these were not very accurate values, but were still useful.

For the place 'the East End of London', one may read "the East End of Landour", as clarified later by *The Observatory* (1910: 413). Landour is a cantonment town, very near Mussoorie and 35 km from Dehra Dun at the foothills. The twin towns, famous as the "Queen of the Hills", are in the Garhwal Himalayas, with respective elevations ~2000 m and 2300 m above mean sea level. The highest point *Lal Tibba* (red hill; 30.475° N, 78.164° E; ~2300 m) is in Landour and should be the location from where the observation was made. Watching the comet's form from here would have been like doing so from the heaven above. Recall that it was from

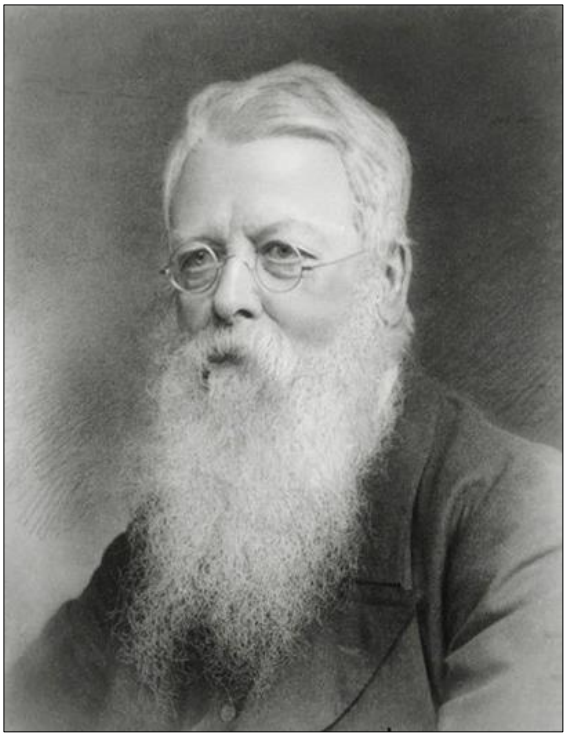


Figure 11: J.F. Tennant (courtesy: IIA Archives).

Mussoorie that Captain Tennant (1859) had observed Comet C/1858 L1 (Donati) in 1858. On historical counts, Mussoorie was selected as the terminus of the Great Trigonometrical Survey of India in 1832. However, the office of the Survey of India eventually was established at Dehra Dun. Mussoorie is home to Sir George Everest's House and Laboratory, also called the Park Estate. It was built in 1832; George Everest was the Surveyor General of India, from 1830 to 1843.

In a letter dated 20 May 1910 from Rangoon to *The Observatory*, J.C. Clancey (1910: 297) wrote of the clouding out of the transit event though the comet had been visible from there for many mornings until only a week earlier. He was also not sure of the Madras centre

but cited a telegram from the Meteorological Office in Simla stating that though the weather was cloudy, the definition of the transit was excellent, and good photographs were taken. However, the telegram added that "no certain indication of the comet has so far been found." No information is provided about the observers, the photographs or the equipment used.

Readers may note that when in 1875 the India Meteorological Department (IMD) was established at Calcutta, around the same time a branch meteorological office also was set up in Simla. In 1905, the Simla office became the headquarters of the IMD and was named

Figure 12: M.A. Rahman Khan (Khan, 1951; Internet Archives).

the Meteorological Centre of the IMD (see http://www.weathershimla.gov.in/; accessed 25 May 2011).

M.A. Rahman Khan (1881–1954; Figure 12), Principal of Osmania University College from 1924 to 1934 and a Research Associate of the Institute of Meteoritics at the University of New Mexico, was a keen pursuer of and an acknowledged expert on meteors. In 1932 he was invited by Charles P. Olivier, President of the American Meteor Society, to become a member of the Society, and he accepted. Much earlier, Khan had gone to England and graduated from the Royal College of Science with an Associateship in Physics (ARCS) and a BSc Honours. This was a period when major breakthroughs were taking place in physics, like when he says,

> Vague rumours of Bohr's theory of atomic structure were in circulation at the time in our College Physical Society meetings, but first-hand knowledge was lacking. (Khan, 1951: 118).

Once back to India, Khan joined Nizam College in Hyderabad in December 1913. Khan has several papers on meteors and their observations to his credit, but in his autobiography he writes about how the apparition of Comet 1P/Halley in 1910 made a lasting impact on his mind:

> The advent of Halley's Comet in 1910 gave me a further impetus to study Astronomy. I had translated into Urdu some chapters of Sir John Herschel's Outlines of Astronomy and, guided by the information published in Nature on Astronomical Topics, was a regular observer of Planets and Meteors. (Khan, 1951: 12).

In 1910, Comet 1P/Halley occupied its due space in Indian newspapers and magazines. Writing from Hyderabad on 20 April 1910 to *The Times of India*, Rahman Khan reported his observations of the Comet thus (Padgaonkar, 1985: 34):

> This morning between 4:30 and 5 I saw (with the naked eye), a large comet (with quite a distinct tail), roughly near the north-east of Venus. Its position would be, perhaps, better defined if I say that it was a little to the north of due east, with an altitude sufficiently high to let it appear well above the fumes of smoke and vapours bordering the horizon. This comet is probably Halley's. I use the word probably as a scientific safeguard. In an ordinary telescope the comet is seen to have a bright nucleus and long well-defined tail ('Comet Special' issue of 'Science Age', Nov–Dec 1985).

In his autobiography Khan (1951) also recalls observing on different occasions not just meteors and meteor showers but also three other comets. They were C/1936 K1 (Peltier), "… a new comet in February 1941" (actually, C/1941 B2 (de Kock–Paraskevopoulos) and a comet in February 1943 that he identified as 'Whipple'—which must have been C/1942 X1 (Whipple–Fedtke–Tevzadze). While on his second visit to England, in 1927, he had the opportunity to join the Physical and Optical Soc-

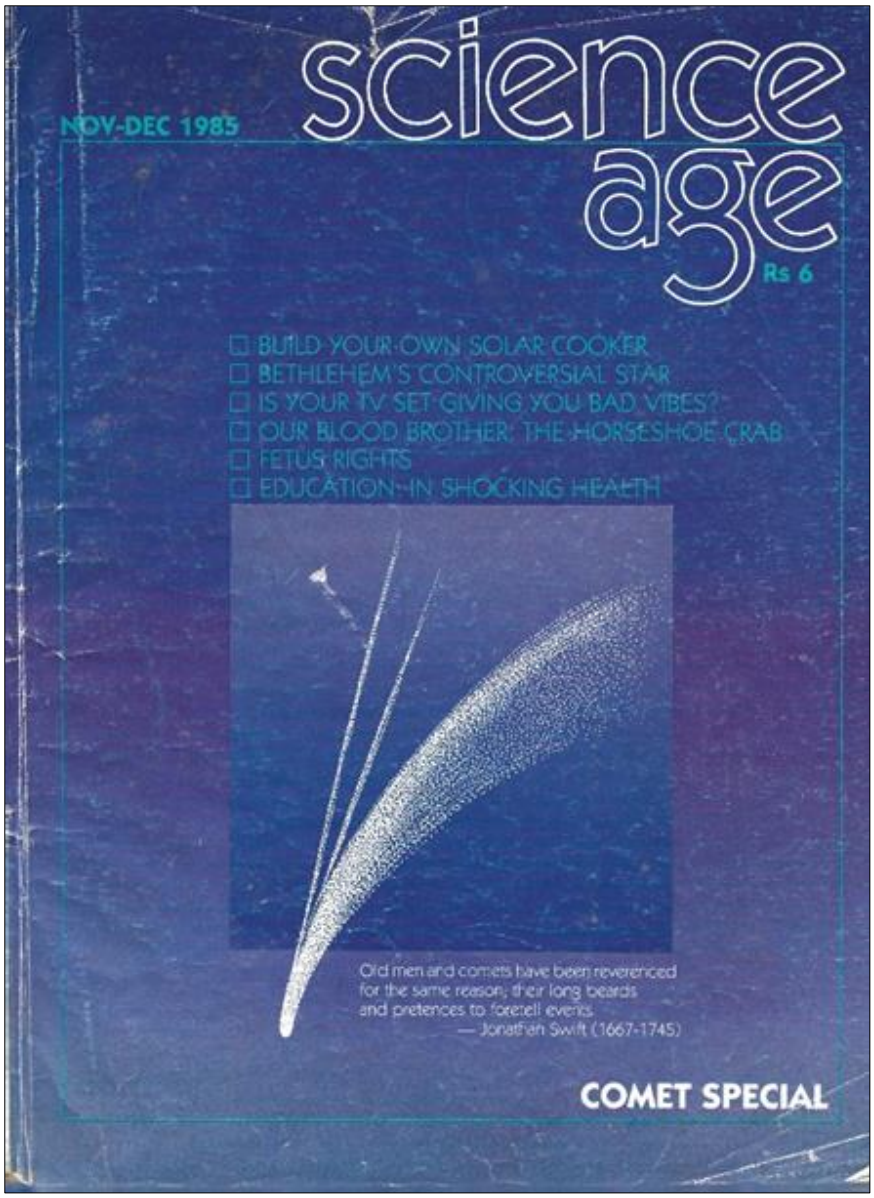


Figure 13: The cover of the 'Comet Special' Issue of *Science Age,* Bombay (R.C. Kapoor Collection).

ieties' party to watch the total solar eclipse of 29 June from the downs of Richmond in North Yorkshire (Khan, 1951: 258–259). The location was fairly close to the central line but duration of totality was to be only 23.8 sec. The excursion became a big disappointment when clouds rushed in at the crucial moment and everyone missed viewing totality.

6.4 Childhood Recollections

When the last apparition of the Halley's Comet was to happen in 1985–1986, *Science Age*, an Indian science magazine published from Bombay brought out their November–December 1985 issue as "Comet Special" (Figure 13). The issue carried excellent articles on comets by some well-known names in astrophysics and plasma physics in India.

In the same issue, one M.S. Kalyanasundaram, 84 (Figure 14), son of S. Sitarama Aiyar (referred to in his write-up as S. Sitaramayya), reminisced about seeing the Comet as a nine-year old. Mr Sitarama Aiyar is mentioned in an earlier Section; he had joined Madras Observatory in October 1896 as an Assistant to the Astronomer (Michie Smith, 1898: 4). Kalyanasundaram (1985: 32–33) was quite observant for his age, and what he recalled and reported was a gem:

> **I saw it first!**
>
> Being 84, I shall be seeing Comet Halley a second time, if I live a few months more. I'd like to say how I saw it first. My father, S Sitaramayya, was the senior-most assistant in the observa-

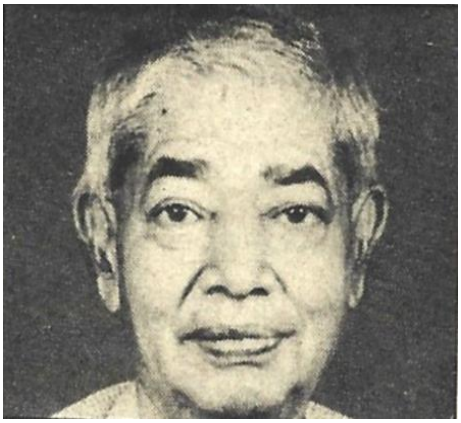


Figure 14: Mr M.S. Kalyanasundaram, 84, who had seen Comet 1P/Halley in 1910 at age 9 (after Kalyanasundaram, 1985).

tory at Kodaikanal (7000 feet above mean sea level), who collaborated with John Evershed ... We brothers were attending school at Madurai (then Madura), about 100 km from Kodaikanal. Father used to keep us posted with particulars about the impressive comet which, at one stage, occupied more than half the sky … During the summer vacation, we joined our parents at Kodaikanal. We used to go to the observatory and watch father at work. We were surprised that photographing the comet took so long … About 45 minutes of exposure was needed to get a picture of the comet. If circumstances were not favourable for such a long exposure – like the intervention of clouds – the work had to be continued the next night,

Figure 15: Radha Gobind Chandra (with his telescopes (Wikimedia Commons).

and perhaps the night after, to get the total exposure required. All that time, the comet kept moving, so that the telescope had to be kept trained on the comet. It was done with the aid of a clockwork arrangement linked with the telescope. The total clockwork was designed with the stellar motion in view (that is, 360 deg in 24 hours); it had to be modified to suit the new need. Occasionally, a slight manual adjustment was necessary.

6.5 Chandra's Account

Radha Gobinda Chandra (1878–1975: Figure 15) was an amateur astronomer. He lived in Bagchar in Jessore, now in Bangladesh. A keen observer, he had to his credit a large number of observations spread over several decades that were wide ranging: eclipses, meteors, Comet 1P/Halley, variable stars, Nova Aquilae 1918, Nova Herculis 1934 etc. Chandra regularly sent reports of his observations to the related astronomical bodies in England and the USA.

Biswas et al. (2011a: 512) speak about his interactions of early days with Kalinath Mukherjee, a lawyer by profession but a knowledgeable amateur astronomer. Mukherjee used to write on astronomy for Bangla papers. It was he who fired up Chandra's interest in astronomy. In those days, professional astronomers lacked telescope-time to observe variable stars and collect data. This area became the fruitful domain of amateur astronomers, and Chandra is acknowledged as having made valuable contributions. He continued his astronomical activity indefatigably, filling a big longitudinal void in observing, right until 1954 when he chose to retire.

Chandra had observed Comet 1P/Halley with binoculars from Jessore (Jashore; 23.178° N, 89.180° E), which is now in Bangladesh. He procured ephemerides and information on the comet from Jagadananda Roy, who was a science teacher at the Visva Bharati, a place developed by the Tagore family in the second half of the nineteenth century. Chandra first spotted the comet on the morning of 24 April, below Venus and south of γ Pegasi. Chandra presented his observations of two months in a Bangla journal *Hindu Patrika* and in a book *Dhumaketu* (Comet) that he wrote (but the book was only published in 1953—see Biswas et al., 2011a: 21).

After first translating it from Bangla, Biswas et al. (2011b: 4–5) reproduce Chandra's account of the observation, which he wrote a week later, on 2 May:

> The comet's tail was scheduled to occult the Venus on May 2 1910, but Chandra didn't observe the occultation although the Venus was seen juxtaposed near the tail. He speculated that the transient part of the tail was lying on the Venus and hence the occultation was not visible. Afterwards, photograph of the comet 1P/Halley taken by John Evershed between 4.40h and 5.10h IST revealed that the transient part of the cometary tail was indeed lying on the Venus. This proves the high quality of intuition possessed by the self-taught astronomer Chandra. However, he observed the comet in its full bloom for the first time on May 10 at 3.20h IST. According to him[2], the tail was passing through the north of γ Aquarii, west of α Aquarii, north of β Aquarii and south of ε Pegasi. He observed some small stars through the tail to the north of γ and β Piscium. The head of the comet was lying in the second part of Pisces and the tail was extended to the last portion of Capricornus. He continued his observations on the comet which was not visible by naked eyes, maintaining exchange of experiences with Roy of Santiniketan (23º39′ N, 87º43′ E) and John Evershed (1864–1956), the Evershed effect discoverer, of Kodaikanal Observatory (10º14′ N, 77º28′ E)[2]."

It was the day when Venus and Comet 1P/Halley were to be in conjunction. Elsewhere, from Ontario, Hunter (1910: 204–205) reported the conjunction on 1 May and noting that their distances from Earth were about the same, the comet's head did not seem to be more than half the diameter of Venus. He also found the comet showing up with a tail 6º long on the morning of 2 May and that it grew substantially over the next few days.

The comet was then leading the Sun and the planet was a morning object. Computing the ephemeris, we get what Radha Gobinda Chandra actually meant when he said that he "didn't observe the occultation." At Jessore on 01 May at 23:00 UT, when the Sun was below horizon, at altitude/azimuth about –7°/70° N-E, the Comet head would be at 26°/92° and Venus at 24°/104° N-E. That is, the Comet was 2° above and 12° north of Venus that morning. With tail up, the Comet, on the morning of 2 May, bypassed Venus. Chandra's subsequent observations are also in consonance with the computed ephemeris of Halley's Comet.

2. Radhagobinda Chandra, 'Dhumaketu' (Puthipatra, Kolkata, 1985).

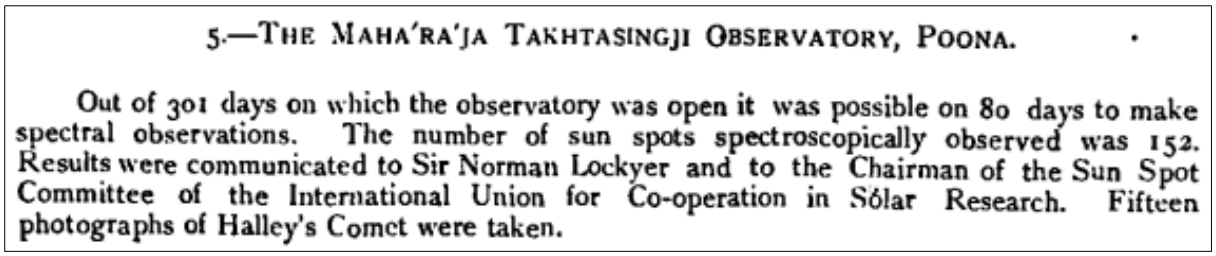
6.6 Maharaja Takhtasingji's Observatory

In 1888 an observatory was established in Poona (Pune) by Maharaja Raol Sir Takhtsinhji Jaswantsinhji GCSI KIH of Bhavnagar (1858–1896; r. 1870–1896). This was at the insistance of Kavasji Dadabhai Naegamvala (1857–1938; Ansari, 2019). Naegamvala was the Professor of Physics at Elphinstone College in Bombay where he had graduated with laurels in Physics and Chemistry in 1878. He joined the College as a Lecturer in Experimental Physics in 1882. Naegamvala specialized in spectroscopy. In 1888 he moved to The College of Science in Poona as India's first Professor of Astrophysics. The College, founded in 1854 and renamed the College of Engineering in 1911, is the third oldest engineering college in Asia (see www.coep.org.in).

The Maharaja Takhtasingji Observatory was built in Poona under Naegamvala's supervision with the grant from HH Maharaja Raol Shri Sir Takhtsinhji Jaswantsinhji. Naegamvala arranged for the Observatory to be equipped with most modern instruments, namely, a 16½-inch Grubb reflector, a 6-inch Cooke equatorial refractor, a 12-inch siderostat and solar grating spectroscope, a transit instrument, spectroscopes, and for photography, a standard clock and a chronograph. The Grubb reflector was a Newtonian. In 1897, the 16½ inch mirror was replaced by a 20-inch mirror.

Naegamvala's notable observations are discussed by Ansari (2019) and included a spectroscopic study of the Orion Nebula, the transit of Mercury of 9 May 1891, the spectrum of the great sunspot group of 1892, and photographing the nebula NGC 4594 (now known as the Sombrero Galaxy), etc. He also took spectra of Nova Persei soon after it was brought to his notice on 25 February 1901 by Captain Molesworth from Trincomali. The observations of the transit of Mercury were carried out with the 16½ inch reflector, with silvering removed from the paraboloid (!) and using a Pritchard's wedge interposed between the eye and the Huyghenian eyepiece. The ingress was over by the time the Sun rose (Naegamvala,1891). Naegamvala (1898: 120–121) is highly commended for his observations of the solar corona and for photographing the flash spectrum during the Indian total eclipse of 22 January 1898 while camping at Jeur in the Sholapur district of Maharashtra.

Historically, Naegamvala was the first Indian solar physicist, duly acknowledged by Sir Norman Lockyer. On his retirement in 1912, the Maharaja Takhtasingji Observatory had to be shut down. As probably the last account of the Observatory, here in Figure 16 is a brief extract-



5.—THE MAHA'RA'JA TAKHTASINGJI OBSERVATORY, POONA.

Out of 301 days on which the observatory was open it was possible on 80 days to make spectral observations. The number of sun spots spectroscopically observed was 152. Results were communicated to Sir Norman Lockyer and to the Chairman of the Sun Spot Committee of the International Union for Co-operation in Sôlar Research. Fifteen photographs of Halley's Comet were taken.

Figure 16: Extract from the Bombay Presidency Report (1912: 44).

ed from the Bombay Presidency Report (1912 (IV): 44) placing on record the astronomical activity for the year 1910–1911. It says that fifteen photographs were taken of Comet 1P/Halley. However, no information is provided about these photographs.

6.7 The Palm-leaf Manuscript Account

There is a record of the appearance of a comet on a palm-leaf manuscript located in the Kanippayyur Sankaran Namboodirippad Memorial Research Library in Thrissur, Kerala. The comet reference was brought to light by Vinay Iyer (2020). The MS is a single copy with no author's name. The contents, in mixed Malayalam and Sanskrit, are on diverse subjects but concentrate on mathematics and astronomy, and are dated. There are references to the Sun changing colour and to the flooding of River Bharathapuzha accompanied by the appearance of a comet and an earthquake, all happening between 1882 and 1910. One of the comet references, originally in Malayalam and translated by (Iyer, 2020: 4) reads as follows:

> In 85 [the year 1085 ME], in the month of Medam, a comet rose in the sky around 5 nāḍikās before sunrise, round in shape and tail upwards, [and was visible until] the month of Edavam, when it set [appeared] in the west and was then visible until [date?], round in shape and tail upwards, for around 7 nāḍikās into the night.

Herein, the year 85 is short for the Malayalam Year 1085; the Malayalam Era or the Kollam Era commenced from 824 CE (see Gislén, 2018: 134); the calendar is solar and begins in the month *Ciṅṅaṃ* (mid-August–mid-September). The month *Medam* begins in mid-April and the next one is *Edavam* beginning in mid-May; *Nāḍikā* is a unit of time, equivalent to *ghati* which is equal to 24 minutes. Consequently, the dates of the observation fall within the period 14 April–17 June 1910. Using JPL's Horizons, Iyer (2020) checked on the apparent positions of Comet 1P/Halley and the Sun and their respective rise times at Thirunavaya, the observer's probable location on the banks of the Bharathapuza (latitude 10.864° N), over the period 12 April–26 May 1910. From the given times of the observations with respect to the times of sunrise and the sunset, Iyer (2020: 11) concluded that the comet references in the manuscript related to Halley in 1910, the first one being in the morning between 21 and 23 April and the last one in the evening on 22 May 1910. The manuscript also refers to comet sightings in the Malayalam years 1058 and 1082 that according to Iyer (2020) are about the Great September Comet of 1882 (C/1882 R1) and Comet C/1907 L2 Daniel) respectively. Recorded on a palm-leaf manuscript, the astronomical and mathematical references evoke great interest and seem to be from an expert hand, probably a traditional astronomer.

6.8 Ketkar's Report

Venkatesh Bapuji Ketkar (1854–1930) was a well-known *Siddhāntic* astronomer and mathematician who is acknowledged for his work on the Indian *Pañcānga*. Ketkar has several books to his credit, such as *Nakshatra Vigyana*, *Ketki Grahaganita Parishishta* and *Bhūmandalīya Sūryagrahaṇa*, etc. The first of these is a very interesting work in Marathi, published in 1916, that introduces to the layman the subject of modern astronomy. In 1911, Ketkar made calculations to predict the existence of two Trans–Neptunian planets and even gave the basic elements. The predicted values corresponding to the Epoch 1 January 1911 were published in the *Bulletin de la Société Astronomique de France* (SAF, 1911: 277). In the case of the first planet, the values of period of revolution (242.28 yrs), heliocentric distance (38.95) and mean longitude (109°) match approximately those for Pluto. As we know, Pluto, was discovered by Clyde Tombaugh on 18 February 1930. Sharma (1981) has given details of Ketkar's mathematical model that he developed to arrive at the required orbital elements. Notably, William Pickering in 1909, and Percival Lowell in 1902 and in 1915, had independently suggested or made predictions about the existence of Planet X from the perturbations caused by an invisible body in the orbits of Uranus and Neptune.

Ketkar had observed Halley's Comet on

19 May 1910 from Dharwar in Karnataka. An English translation of his communication to the *Bulletin de la Société Astronomique de France* (SAF, 1911: 279) reads so:

> Halley's Comet, Comets – Mr. V.B. KETAKAR, in Dharwar (India), observed Halley's Comet on 19 May 1910. He saw only a very faint streak of light near Pegasus, but the head of the comet was invisible, although having been searched for at sunrise. On 20 May, the comet was seen again, with its tail pointing away from the Sun (software translation).

There is no detail of the observations made, or of any measurements or the equipment used. Just to have an idea of the situation, on 19 May at Dharwar (15.459° N, 75.008° E), say at 00 UT, the Horizons System gives the Sun's *Alt*, *Az* as –7.6°, 67.3° N–E, the Comet's –5.5°, 68.0° N–E; the Moon was set, being at –36°, 287° N–E. Ketkar's noticing a faint streak of light near Pegasus suggests that the tail was nearly vertical; to compare, the star γ Pegasi would nearly be at *Alt*, *Az* ~42°, 82° N–E.

7 COMET 1P/HALLEY AND INDIAN SCIENCE AND SOCIETY

7.1 The Comet and the Astronomical Society of India

The coming of the Halley's Comet led to the formation of an Astronomical Society of India (ASI) in Calcutta along the lines of the British Astronomical Association.[1] It had members from the field of science, and also laymen and Christian missionaries (Figure 17). Writing about the ASI, *The Observatory* (1911; 95) commented that the Society is starting under the guidance of some astronomers of high repute in their mother-country, and gave it their best wishes. The first meeting was held at the Imperial Secretariat on 26 July 1910, and H.G. Tomkins, FRAS, was elected its President. Michie Smith consented to be one of the Vice-Presidents together with Gilbert Walker for 1910–1911, followed by John Evershed from 1911 until at least 1920 (*JASI*, 1910–1911: 1–3).

The Society brought out a *Journal of the Astronomical Society of India* (*JASI*) aimed at a wide readership. Many eminent scientists and astronomers contributed to it. In the *JASI*'s first issue of 1910, one reads that

> … the idea to form an Astronomical Society of India arose from the interest which had recently been taken in the appearance of Halley's Comet.

The issue carried a paper "Observation of Halley's Comet in Java, May 18th, 1910" by a Mrs Percy Brown. She reminisced watching the Comet on 18th May at 3 a.m. as

> … a mysterious gleam in the dark sky over the black tree tops ... the vast tail of the Comet stretching from the horizon right till the zenith … almost like a miraculous searchlight sent across the heavens.

Her write-up was accompanied by two photographs of the comet taken at Kodaikanal Observatory on 22 April and 3 May 1910 respectively. In fact, Volume 1 of that *JASI* also carried a photograph of Halley's Comet taken on 28 May 1910 by R. Taylor.

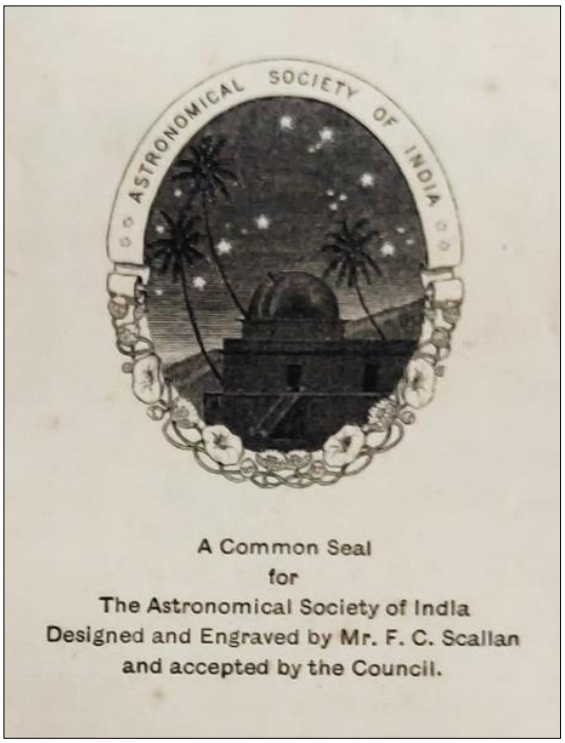


Figure 17: The Common Seal of the Astronomical Society of India (*JASI*, 1911: I: January issue).

Sir C.V. Raman (1888–1970), then working in Calcutta, was elected to the Society's Council on 26 March 1912, and he later became its Secretary. He was an active member, very interested in astronomy and was made Director of its Variable Star Section. He wrote papers for the *JASI* on astronomical optics and diffraction, zodiacal light, observations of Saturn with a small telescope, etc., that amply demonstrated his love of astronomy. Papers and notes on a variety of astronomical topics were published in the *Journal*. These included comets, with papers providing orbital elements for 25D/1916 D1 (Neujmin 2) and C/1916 G1 (Wolf), while others reported cometary observations by members. From Kodaikanal Obser-

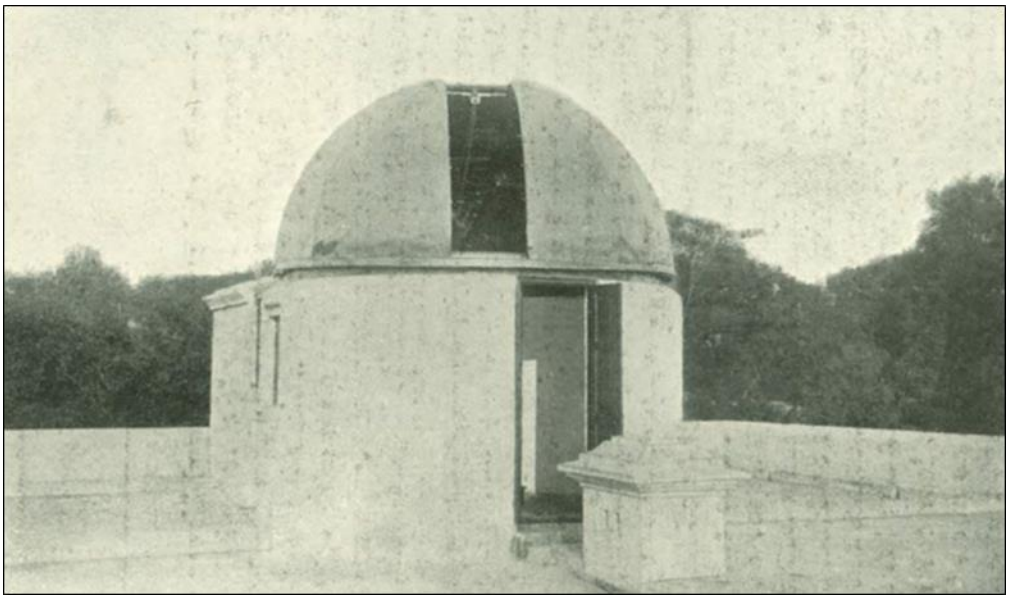


Figure 18: Reverend Mitchell's observatory at Bankura in Bengal (after Mitchell, 1913–1916).

vatory, Royds and Sitaramayya (1912) wrote on the determination of ancient dates from astronomical data.

Meghnad Saha (1893–1956) also had published papers in the *JASI*, e.g., on Nova Aquila III and on electron-chemistry and its application to problems of radiation and astrophysics. Saha had also written in Bangla an essay on Comet 1P/Halley for the magazine of his *alma mater* Dacca College (Kochhar and Narlikar, 1995: 23), where he passed his intermediate science examination in 1911.

7.2 Reverend John Mitchell, his Observatory at Bankura, and Comet 1P/Halley

Another astronomer who published on Comet 1P/Halley in the *JASI* was the Reverend John Mitchell (1867–1941).

Reverend Mitchell was educated at Huddersfield Technical School and Christ's College, Cambridge, before entering the Wesleyan Ministry. He came to India in 1899 where for several years he was involved in missionary and educational work. In June 1903 he founded the Bankura Christian College and was the Principal until 1910 (see Kapoor and Orchiston 2023b). Reverend Mitchell had a great interest in astronomy, and he took a keen interest in the Astronomical Society of India even though Bankura was more than 200 kilometres from Calcutta. He was elected an FRAS in 1891, and returned to England in 1917 (Mitchell, 1942: 68).

Reverend Mitchell made several contributions to the *JASI*. For example, the February 1913 issue of the *Journal* included a detailed account of how he built an observatory at Bankura. In Figure 18 it is just possible to gain a glimpse of the 5-inch refracting telescope inside the 10-feet dome. In the May–June 1914 issue of the *JASI* he described his observations of Jupiter.

In an enlightening lecture to the Society that appeared as a long article on comets and meteors in the *JASI*, Reverend Mitchell (1913–16) shared his observations of Halley's Comet:

> I well remember, on the 28th February 1910, first catching sight of Halley's Comet. It was circular in shape and nebulous in appearance and there was no nucleus. It could only then be seen through the telescope. Up to March 7 it remained like this, and then it disappeared in the Sun's glare, and it was not until the 20th April that I again caught sight of it in the early morning. In the meantime it had changed in appearance. There was now a well-defined nucleus sharp and bright like a star. This was surrounded by a circular patch and produced into a tail and a bright star was shining through the tail. Speaking about stars inside the comet, on the 27th May, about 7-30 P.M., I noticed a star in the head of the comet only a short distance from the nucleus. For over 2 hours I watched that star. Gradually the nucleus drew nearer until about 9-20 (Standard Time) the star was so close that the two resembled a double star, closer than the components of Polaris and about as close as the components of the well-known double-star Castor, i.e., 5" apart. When

> at its nearest point to the nucleus I noticed a very slight diminution in the brightness of the star, but only at this point. Elsewhere the star shone out through the comet's tail and head undimmed in brightness.

There is also a description of the transit of 19 May:

> Another important feature in connection with this comet was this. On the 19th May 1910 the comet passed between the Earth and the Sun. There was a transit. Now had the comet's nucleus been appreciable in magnitude, it would have been seen as a small point on the background of the Sun's disc. I remember watching most carefully. I also took a photograph of the Sun, but not the slightest speck was discernible and in no part of the world was the slightest trace of the comet seen by any observer.

The Reverend was appreciative of India's advantage over Europe in having clear winter skies and that the work here might supplement observations made in other countries.

The Bankura Christian College (BCC) is under the Diocese of Durgapur, Church of North India. The Department of Physics, the oldest among the Science Departments at the College, commenced in 1921 under the University of Calcutta when the College was known as Bankura Wesleyan College. The College Observatory was reopened by the Physics Department on 13 September 2012, and rightly named the Reverend Mitchell Observatory.

The College is in the possession of an old transit telescope, which is shown in Figure 19. picture courtesy Dr Bikash Chakraborty, BCC. Reverend Mitchell had made provision for a transit instrument when his observatory was being constructed, but there is no information available about the 5-inch Cooke refractor that he had installed and used for his observations.

7.3 The *Tattvabodhini Patrika,* and Cometary Astronomy

It is ironic that in an era of scientific renaissance, the *JASI*'s apparition matched that of a comet, for after publishing only a few volumes it passed into oblivion. The final issues appeared in 1921 (just four years after Reverend Mitchell had returned to England).

However, there was another Indian scientific journal, the *Tattvabodhini Patrika* (1843–1950), that was devoted to the Newtonian sciences and unlike the *JASI* stood the test of time. In 1915 Kshitindranath Tagore published an article titled "Hyalir Dhumaketu" (Halley's Comet; Vol 19, No. 863, p. 55), where he explained how Newton established the theory that comets were periodic, under the influence of the Sun's gravity, and followed well set-out orbits. Halley had shown that the same comet was seen in 1531, 1607 and 1682, and in conformity with his calculations it appeared again in 1758. However, how comets shone was not known (Bhattacharya et al., 1989).

Figure 19: The transit instrument at Bankura Christian College (photograph courtesy: Dr Bikash Chakraborty).

The *Tattvabodhini Patrika* was started by Debendranath Tagore (1817–1905), the father of Rabindranath Tagore. A cousin of Rabindranath Tagore was the afore-mentioned Kshitindranath Tagore (1869–1937),who was a well-known essayist and thinker, official Historian of

Adi Brahmo Samaj and editor of the *Tattvabodhini Patrika*.

The poet laureate Rabindranath Tagore (1861–1941) had been introduced to science and astronomy in the early days by his father. His first science writing was on planets, "Grahagan Jiber Abashbhumi" ("Planets are home to life forms"), when he was just 13; it was published in the *Tattvabodhini Patrika* in 1874. Rabindranath Tagore would also have been aware of the transit of Venus that was visible from India in that same year. Decades later, Tagore shared his knowledge and perception of the Universe with his readers through his very popular book *Bishwa Parichaya* (*Our Universe*), written originally in Bangla, in the belief that "… literature can help to pave the way for science, and for this, science need feel no compunction …" (Tagore, 1937). The book was dedicated to the eminent physicist Satyendranath Bose.

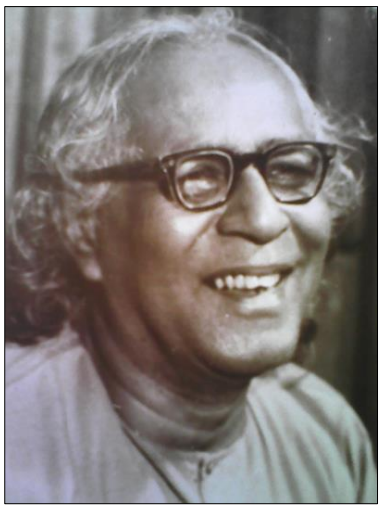


Figure 20: Nolinikanto Sarkar, (after Banerjee, 2014).

I have not been able to find any reference to Rabindranath Tagore having watched Comet 1P/Halley in 1910, even though he was very interested in astronomy and had a telescope of his own since his younger days. In Biswas et al. (2011b: 4), we do find an indirect hint in a reference made to Jagadananda Roy (1869–1933), a highly acclaimed science and mathematics teacher at Santiniketan (Goswami, 1969: 56–58). Roy had written a book *Graha Nakshatra* (*Planets and Stars*) in Bangla and also penned an article on Comet 1P/Halley in Bangla for the *Falgun* 1316 (Bengali year; February–March 1910) issue of *Probasi*. As Biswas et al. (2011b: 4) have recounted, Rabindranath Tagore had given Roy a 4-inch telescope so that he could observe the Comet. Although there is nothing more on this, it is impossible to believe that Tagore had not also taken a look at the comet. Yet in Tagore's letters from the years 1910–1912 that have been published, there is no such hint. The year 1910 was also when Tagore composed his famous poem "Where the Mind Is Without Fear and the Head is Held High." On 14 August 1910, he published *Gitanjali* (in Bangla) for which he was awarded the Nobel Prize for Literature in 1913. In his work, *The King of the Dark Chamber* (1914), we do find him intro-ducing a fiery comet. The original play *Raja* was in Bangla, written in 1910. In Tagore (1916: 116), it is

> The blaze of the fire fell on your features – you looked like the awful night when a comet swings fearfully into our ken – oh, then I closed my eyes – I could not look on you any more …

Another comet reference appears in Chapter XIV in his novel *Shesher Kabita* (1929; lit. *Last Poem*), but there is nothing specific.

7.4 Nolinikanto Sarkar's Recollection of Comet 1P/Halley in 1910

Nolinikanto Sarkar (1889–1984; Figure 20) was an acclaimed journalist, singer and literary critic, and a devoted follower of Sri Aurobindo (Sri Aurobindo Ghose; 1872–1950), the great philosopher, yogi and nationalist. Together with Barindra Kumar Ghose, younger brother of Sri Aurobindo and few others, in 1920 he had started the famous Bangla film weekly *Bijoli* (see Banerjee, 2014). In his autobiography, *Asa Jaoar Majhkhane* in Bangla, published in 1980, Sarkar (2004: 595–600) presents a very informed description of his observations of Comet 1P/Halley in 1910:

> THE Alipore Bomb Case came to an end. I was still waiting for the call to serve the Motherland. But now there did not seem to be much hope. Meanwhile, I had completed my studies and taken up a job as a schoolmaster in Jadupur Board School. After working there for some seven months I resigned due to a difference of opinion with the school secretary.
>
> A significant event of this time was the appearance of Halley's Comet in 1910. On or around May 5, I saw the comet for the first time, although it had already been spotted by the Kodaikanal observatory on April 26. It was about 4 o'clock in the morning when, in the eastern sky close to the planet Venus I saw this amazing spectacle. It was very bright and long like the tail of a white horse. There was a bright glow at one end. The next night I saw that it

> had grown bigger and was farther up from the horizon. After that, night after night, it grew in size till, within a month its huge and awe-inspiring body covered half the sky. There was a general belief that a comet was an ill omen. Perhaps this belief was not altogether baseless. On May 6, 1910, King Edward VII died and on September 13 of the same year we lost our beloved poet, Rajani Kanto Sen. On the other hand, the astronomers who had calcu-lated that the tail of the comet would brush against the earth causing much destruction had to eat their words. (Tr. Aniruddha Sircar).

Sarkar's observation is in order, as the computed altitudes and azimuths of the Comet and Venus on the morning of 5 May for the specified time indicate. On 4 May, 22:30 UT (which is 4 a.m. of 5 May), the computed position of the Comet head and the planet are, respectively, *alt* 20°/ *az*. 88° N-E and 17°/ 99° N-E. About the Alipore Bomb Case, see Note 2.

7.5 Reflections of Dr Sir Muhammad Iqbal, Poet and Philosopher

The book *Stray Reflections* is a private notebook of the legendary Urdu poet and philosopher Dr Sir Muhammad Iqbal (1877–1938; Figure 21), remembered in India for his patriotic song, "*Sāre Jahāṉ se Acchā Hindositān Hamārā* (lit., Hindustan better than the whole world; formally known as "*Tarānah-e-Hindi*"; 1904). Iqbal received a doctorate in 1907 from the Ludwig–Maximillian University, Munich for a thesis titled "The Development of Metaphysics in Persia." In 1908 he qualified as a lawyer in London. The book is a collection of diverse reflections of the poet (Iqbal, 1961 / 2006), produced during 1910 while he was living in Lahore. He saw Halley's Comet and made some thoughtful comments:

> 15th May, 1910: Yesterday morning at about 4, I saw that glorious visitor of our hemisphere known as Halley's comet. Once in seventy-five years this superb swimmer of infinite space appears on our skies. It is only with the eyes of my grandsons that I shall see it again. The state of my mind was quite unique. I felt as if something indescribably vast had been closed up within the narrow limits of my clay: Yet the thought that I could not see this wanderer again brought home to me the painful fact of my littleness. For the moment all ambition was killed in me.

In an address at the International Conference on "Muhammad Iqbal and the Asian Renaissance" at Shah Alam in 1997, Anwar Ibrahim (b. 1947), the then Acting Prime Minister of Malaysia and presently the Prime Minister, quoted these very thoughts, also adding a comment or two of his own (Ibrahim, 1997):

> Some 80 years ago, at four in the morning, Iqbal saw "that glorious visitor of our hemisphere known as Halley's comet," which he described as "this superb swimmer of infinite space". Mediating upon the grandeur of creation and the shortness of human life, he said: "It is with the eye of my grandsons that I shall see it again". It has been six decades since Iqbal left us, but his vision remains. After all, it was he who said: " Individual and nations die; but their children, i.e. ideas, never die."

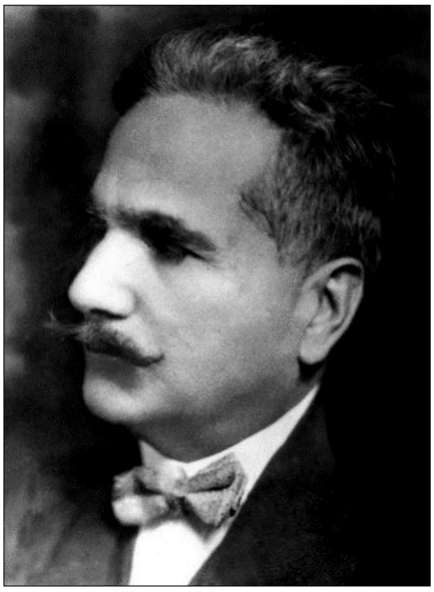


Figure 21: Dr Sir Muhammad Iqbal, (http://www.allamaiqbal.com/new/picture_gallery_iqbal.html; Wikimedia Commons).

7.6 Reflections of Salim Ali, Ornithologist

In his autobiography *The Fall of a Sparrow* that was first published in 1985, Salim Ali (1896–1987), the most notable ornithologist and naturalist of India, recalling his schooldays expressed what he thought at 89 now of when he watched Comet 1P/Halley in 1910 (Salim Ali, 1985: 14–15):

> One of my vivid memories of this period is driving out one morning with Hamidbhai in his tonga for a partridge shoot at a place called Tando Hyder, a few miles out of Hyderabad, in the starry dark of an early dawn with Halley's

> Comet looming brilliantly overhead, and wondering if any of us would be alive when it made its next scheduled appearance in 1986. At eighty-nine 1986 still seems a long way ahead, but considering the toughness and durability of the Abdulali breed (grandfather 114, uncle 103, an aunt 100, a sister 97), I begin to suspect that this may not prove as improbable an event as it then seemed.

Salim Ali has to his credit a number of books and numerous academic articles. He wrote mainly for the *Journal of the Bombay Natural History Society*. In 1975 he was conferred with the J. Paul Getty Wildlife Conservation Prize of the World Wildlife Fund for his

Figure 22: Literary authority Sukumar Ray (https://www.historytoday.com/sites/default/files/ray_main.jpg; Wikimedia Commons).

"… lifelong dedication to the preservation of bird life in the Indian subcontinent." He lived when Comet 1P/Halley returned in late 1985 and early 1986 but whether he had a look this time over, when one really needed a small telescope for a good view, is not known.

7.7 Dispelling Cometary Fear and Superstition in 1910

Sukumar Ray (1887–1924; Figure 22), father of the renowned filmmaker Satyajit Ray, had graduated in physics and chemistry and specialized in printing technology. He became more notable as a literary figure. Zinia Mitra in an essay writes of him as 'master of science and nonsense' (Mitra, 2005). He had a telescope with which he would observe celestial objects. He wrote in the family's famous Bangla magazine *Sandesh* that debuted in 1913, a large number of essays aimed at young readers on topics on science, technology and astronomy. In one of his essays, *Proloyer Bhoy* (fear of annihilation) on the serendipitous celestial occurrences, that appeared in *Sandesh* in 1917 (Ray and Basu, 1975: 226–228), he touched upon comets, meteors, meteor showers and total solar eclipse as also on the excitement generated by the recent visit of Halley's Comet. Herein, he sought to dispel any misgivings in his readers' minds thus:

> If comets were ordinary objects like the Moon or the Sun, instead of suddenly appearing in the sky, their diffused broom-like appearance would not have caused any alarm. But since they suddenly appear unannounced, they are paid so much of importance by humans. People of almost all the nations regard comets as bad omens or calamity … A few years ago when Halley's Comet appeared, some had calculated that the broom-like tail of the comet will crash on the Earth. There was a lot of debate in the newspapers on what would happen to the earth due to the impact of the tail. But nothing happened to the Earth – on the contrary, the tail was ripped into two. Hence the idea that the Earth will be destroyed by a collision with the comet is not realistic since the tail is so incredibly light that the tail itself will be in danger rather than the Earth. However, the experts say that it is difficult to predict accurately what will happen if even the Earth passes through the head of the comet. Perhaps there will be a spectacular meteor shower.

That was some remarkable conjecture. The nearby Odisha did not miss out on the renaissance. A number of science books in Odiya and science articles in Odiya magazines had begun to appear right since the middle of the nineteenth century (Srujanika, 2010). In the present context, we may mention Jalandhar Deb (1872–1952), a versatile litterateur, who wrote in 1909 an article *Helira Dhumaketu* for the periodical *Sambalpur Hiteshini* in Odiya. Therein, the writer

> Announces the forthcoming naked-eye visibility of Halley's comet. Encourages people to see the comet and decries the fear of comets and eclipses. Discusses the common characteristics

of comets, periodicity, appearances and the current movements of Halley's comet (Srujanika, 2010: 26).

Gurazada Venkata Apparao (1862–1915), the great Telugu poet and noted for his celebrated social play *Kanyasulkam* was an influential social reformer. He too penned an essay *Canna kalapu cinna buddhulu* through which he had sought to dispel fears and superstitions from the minds of people at the time Halley's Comet appeared in the sky in 1910.

In 1910 Wilmot Corfield, who was then Vice President of the Philatelic Society of India while living in Calcutta, published a poem titled 'To Halley's Comet' in *The Journal* "Dak dicta" (5 June 1910). A few lines are cited below:

Flame far flung as a sworded dream
In brandished tresses of golden gleam ...
You came, but whence, at the heel of Time?
You go, but where, on a quest sublime ...
You came, but whence, from the birth of days?
You pass, but whither a wingless haze
Fair brandished Comet with aureate mane
O, where shall we meet when we meet again.

The great poet, nationalist and social reformer Mahakavi C. Subramaniya Bharathiyar (Subramaniya Bharathi; 1882–1921; Figure 23) had a good knowledge of astronomy. He wrote a poem in Tamil, '*Satharana vaurshaththu dhumakethu*' where he welcomed Comet 1P/Halley's arrival in 1910 and allayed people's fears. It was published in his Tamil magazine *Karmayogi* (March 1910, page 86). The poem is noteworthy for its content and scientific temper. In its title, the phrase *Satharana varushaththu* stands for the name given to the year 1910–1911. Read with the word '*dhumakethu*' it means 'the comet of the *Satharana* year'; *Satharana* is the 44th year in the 60-year cycle of the Tamil calendar. The poem goes as follows:

Welcome, you sparkling comet, welcome!
Like a palm tree towering above a
a crop of jowar, like a glittering tail of a
little fish, a tail that keeps growing and shining,
questioning the prominence of the silvery disc
in the East, come You comet, welcome.

Come to think of it, they say that you are
from several million yochanae*
and that your long tail, shaped by the
inconceivably soft air in space, will keep going,
glowing, growing.

May you not caress this Earth and thereby
cause distress and misery to the indigent inhabitants.
Scholars conceive and construct thousands
of novel events that may be the
effect of your presence. It is a few centuries
since our people, spread over Bhaarath, have
forgotten astronomical science; we
became aware of your nature, and of your
propensities, only from the foreigners, strangers.
None among us has a clear understanding about you.

Figure 23: Mahakavi C. Subramaniya Bharathiyar (Wikimedia Commons).

Come, sparkling comet, let me ask you a few
questions. Some say that you will cause harm to
the villainous and the malevolent and thereby push
this ancient Earth into an ocean of misery, before
you go. Is this false or true?

Some others claim that, created as you are by
that primordial 'Shakthi' (Power), your visit
is only to purify and sanctify this Earth.
Is this true or false?

Though you have a habit of approaching this
Earth once every seventy-five years, your visit this
time will cause countless novel happenings,
so say some others. Is this true or false?

Yet others say that achievements galore and
enlightenment towards spiritual bliss will blossom
due to your visit. Is this false or true?'

* 'Yochanae -yojane' is a unit of distance – variously given as 6 to 15 km. (Translation by K.R. Nagarajan; see Viswanathan, 2005 for the original verse).

In early twentieth century, there appeared several Assamese magazines that frequently published articles and news on science. Kaliram Medhi (1878–1954) who served in the British civil administration, was a well-known literateur who also wrote essays on a variety of subjects in Assamese. Having been a student of physics, he had written essays on science as well, like "*Mul Padartha* (fundamental matter)", "*Prithivi* (the world)", "*Suryya* (the Sun)", "*Helir Nejal Tara* (Halley's Comet)", "*Aayan baa Baidyutik Paramanu* (ion)". Of these, *Helir nejal Tara* was the essay on Halley's Comet, published in 1910 in "*Assam Bandhav*", Vol. 1, No. 8 & 9 (Dutta and Ray, 2011: 16).

7.8 Dr Modi's Investigation of Earlier Apparitions of Comet 1P/Halley

Even before Comet 1P/Halley had reached naked eye visibility in 1910, it had stirred up the cognoscenti in India. Here, reference should be made to Jivanji Jamshedji Modi (1854–1933) for his comprehensive account of the records and sightings of comets made over the ages by Muslim scholars and others that he presented on 9 February 1910 before the Bombay Branch of the Royal Asiatic Society (Modi, 1917).

Dr Modi was a renowned scholar of Sanskrit, Persian and the Avesta, with a large number of books and research papers to his credit on Zarthustrian and Iranian studies, anthropology, meteorology and natural history etc. His presentation on comets is scholarly, modern and worth a read by those interested in history of the Islamic contributions to the physical sciences. It deals with:

(1) The version of some Mahomedan historians about comets such as al-Masudi and his mention of sighting of Comet 1P/Halley in CE 912, Abū'l Faḍl, the author of *Akbarnāmā*, Ahmad-bin-Mahmud, the author of *Nigāristān*, Nizamuddin, the author of the *Tabākat-i-Akbari*, Badauni, the author of *Muntakhāb-ul-Tawarikh*, Jehangir, the author of *Wākiāt-i-Jehangiri* and Mutamad Khan, the author of *Ikbālnāmā-i-Jehangiri*;
(2) The identification of the cornets seen or described by them;
(3) The views of Mahomedan writers on comets;
(4) The influences attributed by the people to the appearance of comets; and
(5) The views of the Pishinigan or the ancient Persians and their Nirangs (a ritual or incantation) referred to by Abū'l Faḍl. All these writers present information on their perception of comets. However, among these, Abū'l Faḍl and Jehangir receive a detailed discussion by Modi for their observations in the light of contemporary view of the comets; there is more on this in Kapoor (2016).

7.9 The Comet and the Indian Institute of Science in 1910

Those were the days when Indian Institute of Science had just made its humble beginning at Bangalore, in May 1909. Although Comet 1P/Halley was prominent in the sky during the second quarter of 1910, it is telling that the report of the Director of the Institute for the year 1910 did not make any reference to this famous comet.

8 THE SEQUEL: COMET 1P/HALLEY IN 1985–1986

Comet 1P/Halley returned for its thirtieth recorded apparition in 1986 (1P/1982 U1; perihelion 9 February) when it aroused widespread public interest. It was recovered by David Jewitt and G. Edward Danielson on 16 October 1982 with the 5.1-m Hale reflector at Mount Palomar. The comet passed closest to the Earth at 0.6193 au on 27 November 1985, and on 11 April 1986 was at 0.4172 au while on its return. The European Space Agency (Giotto), the Japanese (Suisei and Sakigake) and the Russians (Vega 1 and Vega 2) sent spacecraft on flyby missions to the comet. On 14 March 1986, Giotto passed less than 596 km from the nucleus and sent back unforgettable images of the nucleus—see Hughes (1987) for details.

This time around, Halley's Comet failed to excite people at the crucial moments of the show. During its most active phase, it was not favourably positioned in its orbit with respect to the Earth and the apparition became a whimper. Yet, the comet was keenly followed at several astronomical observatories in India. Indian astronomers aimed to study the interaction of the ionic tail with the solar wind, carry

out photometric and spectral studies, photography of the coma, radio observations, the comet's chemistry etc. The Indian observatories and institutions joined NASA's International Halley Watch (IHW) programme. There are details on the subject in Sivaraman (1985) and Chandrasekhar (1988) and the many publications that followed.

In the public domain, an advertisement placed by the Nehru Planetarium (Bombay) on the inside of the back cover of Comet Special issue of *Science Age* (Nov–Dec 1985) summed up how the young in India responded to the apparition. The advertisement quoted a spontaneous remark that a child made after seeing the Planetarium's show 'Comets to Stars': "I love to see stars in the ~~sky~~ day.." (Figure 24).

Meanwhile, the comet captured enough space in the Indian print media. Isaac Asimov wrote a cover story for the 9–16 March 1986 issue of the *Illustrated Weekly of India*. Figure 25 is a telescope manufacturer's advertisement in the popular science magazine "Science Today", October 1984 issue, inviting the readers to get equipped in time, for, "Halley's Comet is approaching."

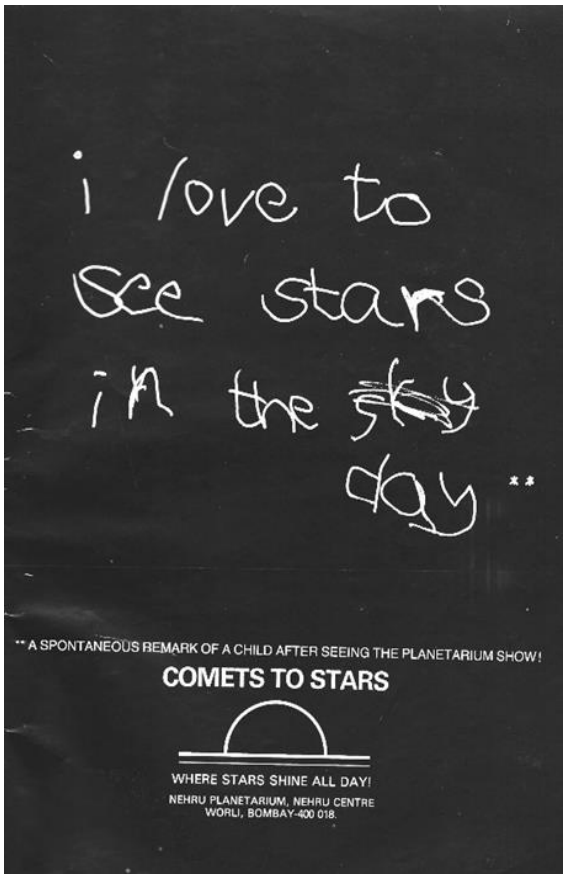


Figure 24: Nehru Planetarium' advertisement on the inside of the back cover of "Comet Special" November–December 1985 issue of *Science Age* (R.C. Kapoor Collection).

8.1 The Comet and the IIA in 1985–1986

Comet 1P/Halley was keenly followed at Kavalur and Kodaikanal Observatory of the Indian Institute of Astrophysics (IIA); and also at UP State Observatory (Nainital); the Physical Re-

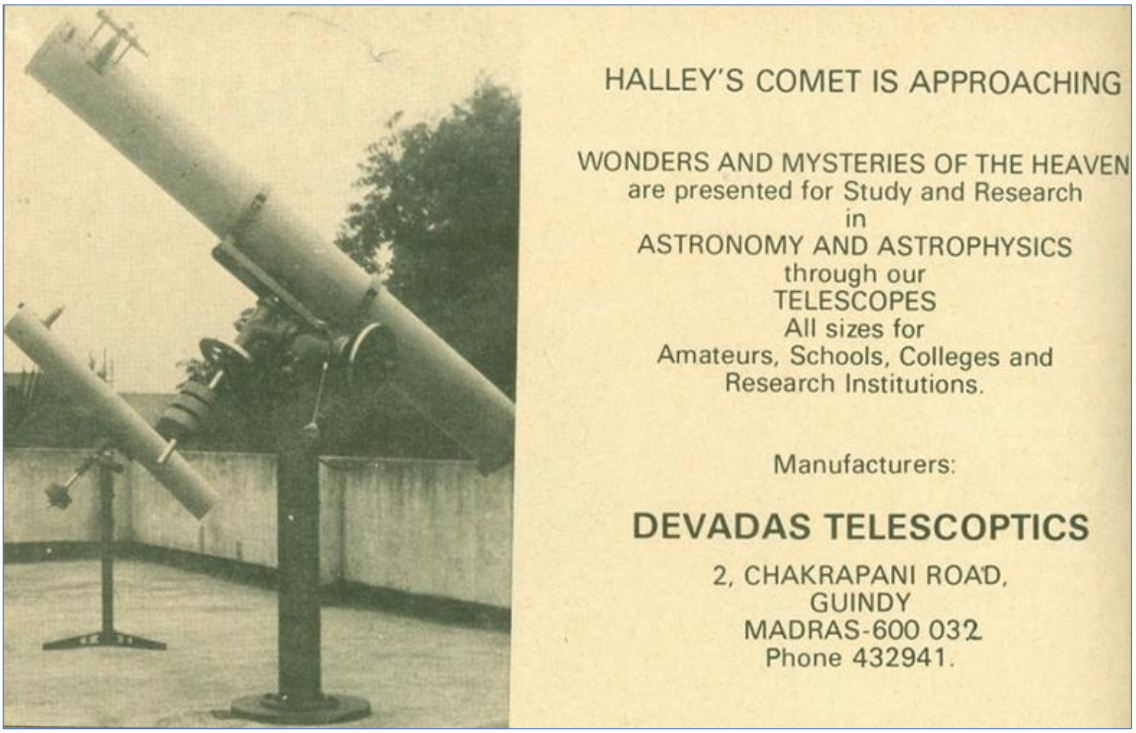


Figure 25: "Halley's Comet is approaching" – a telescope manufacturer's wake-up call on page 8 in the October 1984 issue of the popular science magazine *Science Today* (courtesy: IIA Archives).

Figure 26: Halley's Comet in 1986, taken at the Vainu Bappu Observatory, Kavalur (IIA Archives)

search Laboratory (Ahmedabad); and at Japal–Rangapur Observatory of Osmania University. It was photographed at Kavalur Observatory with the 1.02-m Zeiss Telescope for the first time on 29 August 1985. One such image from Kavalur is shown in Figure 26, which brings out the tail in fine detail.

On 6 January 1986, at the invitation of Professor M.G.K. Menon, the Chairman of the Governing Council of the IIA, the then Prime Minister Shri Rajiv Gandhi (1944–1991; Figure 27) visited Kavalur Observatory to view Comet 1P/Halley. Kavalur is in the midst of thick forests of the Jawadi hills and for obvious reasons an appropriate safety net was created. A helipad was made close to the locally built and newly installed 2.34-m telescope building. It was through the 1.02-m Zeiss reflector that he had glimpses of not just the Comet, but the Orion Nebula, the Crab Nebula, Jupiter and other prominent celestial objects that were then visible. Over dinner at the Campus, he discussed with Professor J.C. Bhattacharyya, Director of the IIA, and the astronomers the nature of comets, the Solar System, cosmology, astronomy education at Indian universities, and the history of the IIA and its astronomy programmes. Shri Rajeev Gandhi named the Observatory and the 2.34-m telescope after M.K. Vainu Bappu (1927–1982), the Founding Director of the Indian Institute of Astrophysics. The telescope was Vainu Bappu's brainchild but—sadly--he did not live to see in in place.

Figure 27: Shri Rajiv Gandhi, Prime Minister, India, naming the 2.34-m telescope as the Vainu Bappu Telescope on 6 January 1986 (courtesy: IIA Archives).

9 CONCLUDING REMARKS

This ends our account of India's association with Comet 1P/Halley in 1910, but it is important to stress that this paper merely presents a selective story and is by no means exhaustive. There must be other records—as yet undiscovered—awaiting recognition in Indian archives, upon which further papers will be based.

And where is Comet 1P/Halley now? Well, on 9 December 2023 it will reach its aphelion (at 35.1434618 au from the Sun), and start its journey to the inner Solar System. It is scheduled to pass perihelion (0.5928134 au) on 29 July 2061 (JPL, 2023).

10 NOTES

1. At this juncture, we may add that decades later, an Astronomical Society of India (ASI) was formed in 1973, based at the Department of Astronomy in Osmania University in Hyderabad. Its members drawn from institutions and universities, comprised astronomers, scientists, engineers, students working or interested in astronomy and interested laymen. By this time, modern astronomical research in India had struck firm roots, as did the ASI and its journal, the *Bulletin of the Astronomical Society of India*, in the years that followed.
2. 'The Alipore Bomb Case', the other name of the 'Emperor vs. Aurobindo Ghose and others', was the most sensational trial of a number of Indian nationalists for 'Waging war against the Government' held during 1908–1909, in the wake of the most unpopular administrative decision, the Partition of Bengal, that led to a great discontent against the British Raj (see Bose, 1922).

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This paper celebrates a very dear friend, Wayne Orchiston, a young man at 80.

Section 3 borrows its title from Honoré de Balzac's "Droll Stories" ("Contes Drolatiques" published in 1832, 1833, and 1837 in sets of 10 stories each).

I have benefitted from discussions with Professor Jagdev Singh on Kodaikanal Observatory matters. My colleague Dr Prashant Das fished out, from his personal library, the relevant astronomy articles from the collected works of Sukumar Ray and provided a translation of his original article in Bangla, *Proloyer Bhoy*. I am also grateful to Mr Anurag Banerjee, Founder and Director of the Overman Foundation for permission to use Nolini Kanta Sarkar's photograph from their blog.

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Professor Ramesh Kapoor completed a PhD at Agra University in 1980, but had begun his career as an observational astronomer in 1971 at the Uttar Pradesh State Observatory (now Aryabhatta Research Institute of Observational Sciences, ARIES) at Nainital. His main interest at that time was flare stars. From March 1974 until September 2010 he was with the Indian Institute of Astrophysics (IIA) in Bengaluru, where he worked on various topics in relativistic astrophysics: observational aspects of black holes, white holes, quasars, pulsars, etc. He has published in peer-reviewed journals and presented papers at national and international conferences.

He participated as an observer and organizer in IIA solar eclipse expeditions in 1980, 1983, 1995, 1999, 2009 and 2010; apart from Indonesia in 1983, all of these were in India. He also travelled to Columbia (South Carolina) to observe the eclipse of 2017 and to La Higuera (Chile) for the eclipse of 2019.

Ramesh's current interest is the history of astronomy in India. "Comet Tales from India", an ongoing project since 2009, seeks to record comets from the Indian region reported in publications, manuscripts and on inscriptions from antiquity until the nineteenth century where available data, however minimal, permit identification of the comet. The resulting research has been presented in journals and at conferences. His new project, "Eclipse Tales from India", seeks to trace total and annular solar eclipses mentioned in Indian written works or in inscriptions from antiquity until the nineteenth century.

All along, Ramesh has been active in promoting astronomy, with many popular articles published in national dailies and science magazines. He frequently interacts with the print and the electronic media on diverse scientific topics that are of interest to the general public. He has also published on Indian systems of medicine.

Ramesh has been a member of the International Astronomical Union since 1985; a Life Member of the Astronomical Society of India since 1973; an Associate of the National Institute of Advanced Studies (NIAS, IISc) since 2002; and a COSPAR Commission E Associate since 2005. His ORCID iD is https://orcid.org/0000-0002-4858-0476.