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THE ROLE OF THREE WILLIAM HERSCHEL TELESCOPES IN COLONIAL INDIA

R.C. Kapoor*
Indian Institute of Astrophysics, Koramangala, Bengaluru -560034, India.
E-mail: rckapoor@outlook.com, rck@iiap.res.in

Abstract: In this paper we provide information on some of the telescopes to which one of the most prominent names in the history of astronomy is attached: Frederick William Herschel. He built telescopes of different apertures and focal lengths, the majority being 7-ft or 10-ft focus, and gifted or sold to those interested. We find that at least three 10-ft Herschel telescopes were brought to Calcutta, India, and were used for astronomical observations by British residents and the Christian missionaries in the city. One of these belonged to David Hare, a Scottish watchmaker and philanthrope and the other to James Calder, a prominent merchant of Calcutta. The third one had been gifted by Sir John Herschel to his brother-in-law, Dr. Duncan Stewart, Surgeon in the service of East India Company, in 1834 while Herschel was living at the Cape of Good Hope. In 1844, Dr Stewart presented the telescope to the General Assembly's Institution established by the Bengal Mission of the Free Church of Scotland. We also include in this paper the hitherto unpublished "Herschel Manuscript Catalogue of Stars" visible on the horizon of Calcutta that Sir John had drawn up to accompany the 10-ft telescope, reproduced with the kind permission of the Syndics of Cambridge University Library.

The three Indian-based Herschel telescopes are no longer extant. Since 1924 there has been a search for all surviving Herschel telescopes, whether complete, incomplete or missing, but those that were brought to India have yet to be included in these studies—which we hope will now be rectified through this paper.

Keywords: William Herschel; Herschel telescopes; Sir John Herschel; Duncan Stewart; Survey of India; James Dinwiddie; David Hare; Scottish Church College; William Mackay; James Calder; Walter Ewer; James Prinsep.

1 RENASCENT INDIA'S FORAY INTO MODERN ASTRONOMY

After its invention in Europe in 1608 and astronomical use from 1609 in the hands of Galileo Galilei (1564–1642), the story of the perspective glass or *occhiale* quickly reached Indian shores. Hearing of the invention, Father Antonio Rubino (Antonius Rubinus, 1578–1643), a Jesuit missionary in Goa, began efforts in 1612 to acquire one from Rome. It is understood that Fr Rubino introduced the telescope in India (Baldini, 2015; Udias, 2003), but no published account of its use has come to light yet.

The first published account of the use of a telescope in India relates to the observations of the bright comets 1618 III and 1618 II in November 1618 by a Jesuit, Father Venceslaus Pantaleon Kirwitzer (1588–1626), while in Goa (Kapoor, 2016). The next incidence of use of a telescope to observe an astronomical event from Indian soil dates to 1651 (Kochhar, 1989). This was for the transit of Mercury on 3 November from Surat by Jeremiah Shakerley (1626–1655). Coming all the way from England, he had just 80 minutes to view the transit since it was already past its greatest phase when the Sun rose (see Kapoor, 2025). Next, it was a French Jesuit, Fr Jean Richaud, a member of the group of fourteen French Jesuit astronomers that had gone to Ayutthaya in Siam (Thailand) in 1687 at the invitation of King Narai (1633–1688). After a coup in May 1688, most of them were expelled and they headed for India (see Orchiston et al., 2022). Fr Richaud arrived in Pondicherry on 1 February 1689 where he resumed astronomical activity with his 12-ft telescope. To his credit goes the independent telescopic discovery on 8 December 1689 of the sungrazing comet C/1689 X1 and on 19 December of the brightest star in Centaurus, α Centauri, as a double. This marked a significant incident in the history of modern astronomy in India (Kameswara Rao et al. 1984). The Jesuit also determined the latitude of Pondicherry as 11° 55′ and longitude as 5h 11m from Paris.

The eighteenth century witnessed increasing interest in Indian philosophy, lands, science and culture by European missionaries and scholars. With that, there also burgeoned modern astronomical activity in India. Observations were made from time to time, mainly for the determination of latitudes and longitudes of places by measuring the meridian altitudes of celestial objects and by timing eclipses of the satellites of Jupiter, culminating in the transits of Venus in 1761 and 1769, which were observed from many locations (Kapoor, 2013). A new era in astronomical activity commenced when the British, fresh from their victory in 1757 at the battle of Plassey (Palashi), initiated scientific surveys to get an accurate geographical knowledge of the land. By 1765, the East India Com-

* It is with great sadness that we report that Professor Ramesh Kapoor died suddenly on 21 August 2025 after a brief illness. This paper is one of a number that he submitted to *JAHH* shortly before his death. For information about Ramesh's life and research see Venkateswaran and Orchiston (2025).

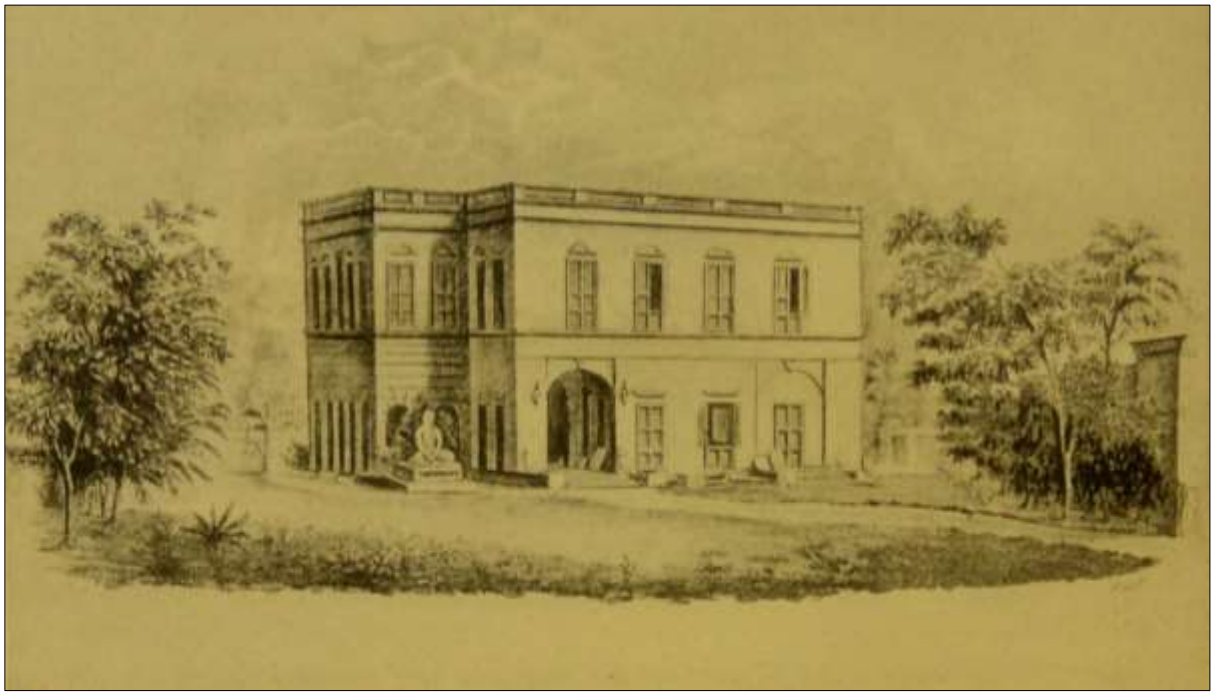


Figure 1: A lithograph of the Asiatic Society Building in 1828 (source: *The Indian Museum, 1814-1914*, Calcutta: The Trustees of The Indian Museum; image: Wikimedia Commons).

pany (EIC) had taken over almost all of Bengal. These operations were of great strategic value, and paved the way for rich dividends in the times to come. This can be gauged from the fact that the Survey of India itself was founded in 1767 in what may be termed the earliest modern scientific institution in the country.

Through the late eighteenth and early nineteenth centuries, the Indian Subcontinent saw major changes on the political and social front. The EIC brought a major part of India under its control. They divided it into four administrative regions in the form of the Presidencies of Bengal, Bombay, Madras and the North-West. The British dominance had also begun to greatly overwhelm India's political, cultural and economic life. The period saw the advent of the Indian Renaissance that put Medieval India on the path to modernity. English education struck roots, initial resistance from the British rulers notwithstanding.

Towards the end of the eighteenth century, the *Asiatick Society* was formed in Calcutta (Kolkata) on 15 January 1784 by Sir William Jones (1746–1794) and a few others "… for the purpose of inquiring into the History Civil and Natural, the Antiquities, Arts, Sciences, and Literature of Asia." (*Asiatick Researches …*, 1788(1): v) and promoting scientific discussions. Figure 1 shows the Society building as in 1828. The Society profoundly tried to change the preconceptions of the West about the Indian subcontinent. Its journals, in print since 1788, bear testimony to this.

Soon after, in 1786, the first modern astronomical observatory was founded in Madras by William Petrie (1747–1816), an officer with the EIC. Although it was a private one, it marked the beginning of modern observational astronomy in India.

In the nineteenth century more observatories were set up in different places. An observatory was established at Colaba, Bombay (Mumbai) by the EIC in 1823 for astronomical observations and time-keeping. The EIC next established an observatory at Calcutta in 1826 at the instance of Valentine Blacker (1778–1826), the Surveyor General of India (1823–1826; Phillimore, 1954 (III): 188). It was set up at the Surveyor General's office at Park Street, Chowringhee (Figure 2), and began with an alt-azimuth circle and a transit telescope, a zenith tube and a Kater's pendulum (*ibid.*). Subsequently it also acquired an astronomical telescope. The observations carried out there included lunar occultations and eclipses of the Jovian satellites. The main observational activities, however, involved time-recording and meteorological observations.

Astronomical observatories also were established by Indian rulers, in Lucknow in 1831 and in Travancore in 1837, and a private one in Poona (Pune) in 1842 by Captain W.S. Jacob (1813–1862); for further details see Kapoor and Orchiston (2023, 2025), Kochhar and Orchiston (2017) and Orchiston and Kapoor (2023, 2024).

This paper's focus is on certain telescopes to which one of the most prominent names in

Figure 2: The Office of the late Surveyor General, at Chowringhee, by Charles George Nicholls in 1805. Lt Robert Hyde Colebrooke (1762–1808) was the Surveyor General of Bengal during 1794–1808, followed by Major General John Garstin (image: Caroline Simpson Collection, Caroline Simpson Library, Museums of History New South Wales, https://vernon.mhnsw.au/objects/52436/watercolour).

the history of astronomy is attached, Sir Frederick William Herschel. He built a large number of reflectors. Their quality endeared a whole class of users in Europe and some even reached as far as India. In Kapoor and Orchiston (2025), we have reported about two Herschel telescopes. There was yet another that we learnt about just after this paper was finished so some overlap in what follows is inevitable. The period discussed here is the first half of the nineteenth century, and the locations are in and around Calcutta. Figure 3, adopted from Sciampacone (2010), depicts Calcutta ca. 1798–1858 and shows some of the locations mentioned in this paper. Note that we have chosen to use old spellings for the place names in order to preserve the historical flavour of the paper.

2 THE WILLIAM HERSCHEL TELESCOPES

The discovery by Frederick William Herschel (1738–1822; Figure 4) of a new planet on 13 March 1781 expanded the extent of the Solar System beyond anyone's perception (Herschel, 1781). It was initially misidentified by him as a comet that had the appearance of a star but "… very different from the rest …" (Herschel, 1781: 1). The observations were carried with a 7-ft reflector that Herschel had made (Bennett, 1976: 76). As the news spread, the object was observed by other astronomers in Europe and was soon accepted as a new planet. Herschel announced in 1782 its name as 'Georgium Sidus' in honour of King George III whereas the German astronomer Johann Bode (1747–1826) proposed the name Uranus. It was only by the middle of the nineteenth century that the name Uranus had come to be widely adopted.

William Herschel began building reflecting telescopes in 1773 (Bennett, 1976: 75; Ceragioli, 2018). As he observed the skies, he began to realize that a telescope's power of penetrating into space was related to the aperture of the objective though it is only much later that he spoke about the light-gathering power of a telescope at length in the pages of the *Philosophical Transactions* of the Royal Society (Herschel, 1800). Telescopes of different apertures and focal lengths (but mainly 7-ft and 10-ft) came from his workshop, and he continued to improve the speculum mirrors and the telescope mountings (Bennett, 1976: 75–76; Spaight, 2004: 48–49).

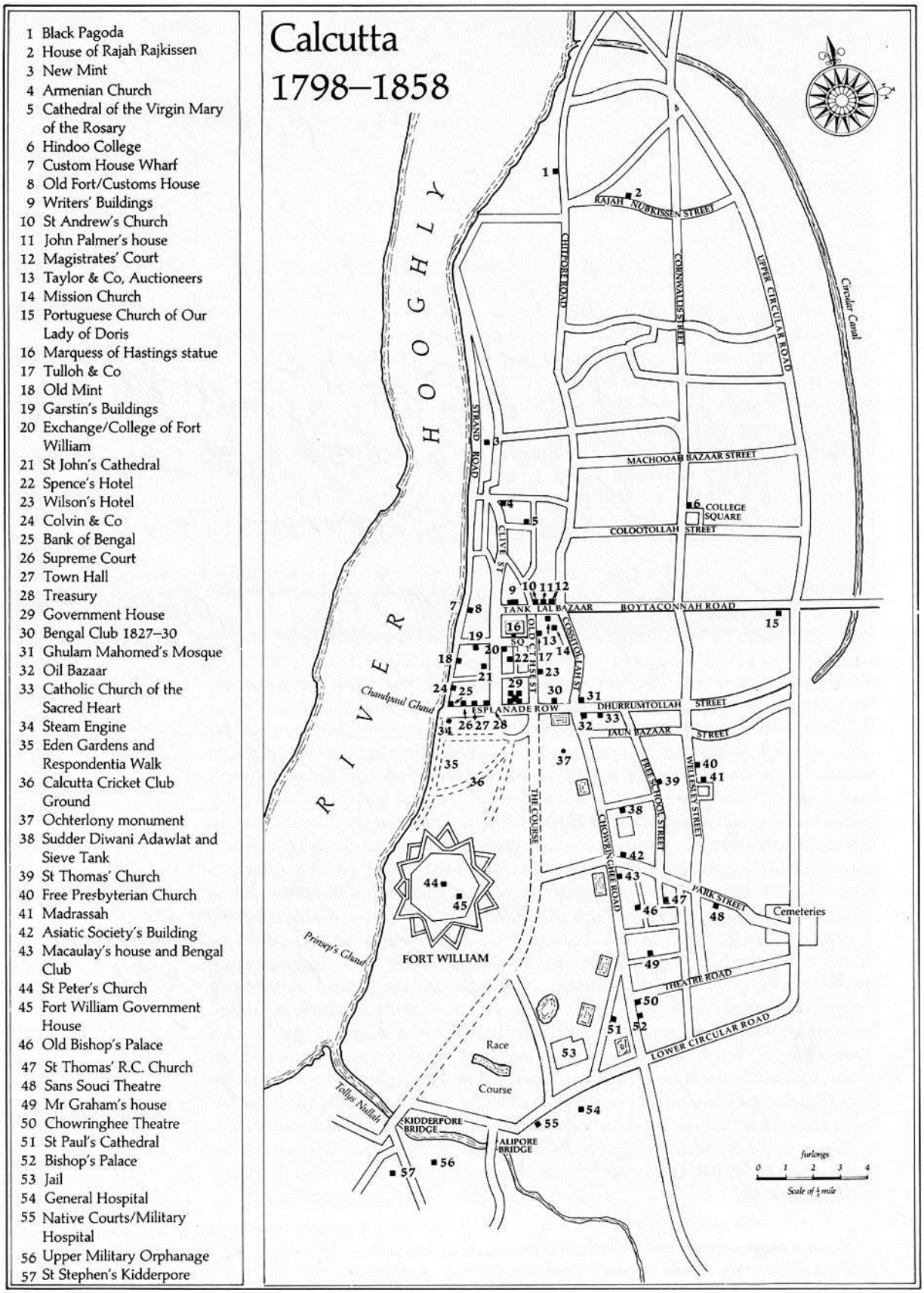


Figure 3: A map of Calcutta, 1798–1858 (© The British Library Board (YC.1990.b.6211); after Losty 1990: 72).

The telescopes were sold to those interested, and Herschel said, that he made telescopes only to indulge the very great love that he had for astronomical observing.

The 7-ft telescopes had ~6-inch mirrors, while his 10-ft telescopes had ~9-inch mirrors. Herschel was ably assisted by his sister Caroline Herschel (1750–1848; Figure 5). She would grind and polish the mirrors, and also indulge in the long drawn-out calculations relating to Herschel's observations.

With time, Herschel built several large long-focus telescopes. The 40-ft telescope (with a 48-inch mirror) built at Slough in 1786–1789, for which King George III had paid, was the largest in the world for decades (Figure 6). Summing up the strenuous work involved in building the telescope, Sime (1900: 113) put it thus:

> Four years of hard thinking and continuous labour, of battles with not very intelligent workmen, sometimes forty in number, and of disappointment with himself, if not also with grumbling from his sister Caroline, ended at last. A triumphant tone may be heard in the words which conclude his short history of the progress of the work. They are:—"Aug. the 28th, 1789.—Having brought the telescope to the parallel of Saturn, I discovered a sixth satellite of that planet, and also saw the spots upon Saturn better than I had ever seen them before, so that I may date the finishing of the 40-feet telescope from that time."

It was surpassed only in 1845 by Lord Rosse's 72-inch diameter reflector.

A Herschel telescope (Figure 7) is a reflector where the primary optics, the speculum mirror, is slightly inclined to the axis of the tube. The focus is at the interior edge of the tube where an eyepiece is placed. This obviates light losses off a secondary (Ceragioli, 2018).

The Herschel telescope in Figure 8 is a Newtonian, with a 6⅛-inch diameter speculum and 7-ft focal length, built about 1783–1785. The body is mahogany, measuring 1.8 × 1.75 × 0.45m, 40 kg (Science Museum Group, n.d.). Figure 9, the Item B-3 in Maurer (1971: 287), shows Herschel's 10-ft reflector. It had been purchased by Austrian Kaiser Franz I (1768–1835) and is presently at the Technisches Museum in Vienna.

Herschel's telescopes, built either by Sir William or under his guidance, were most sought after for their quality. The tube, octagonal in shape, and the stand were of mahogany, and the mirrors made of speculum, a 1:2 alloy of tin and copper. The latter needed to be re-polished and even re-figured when tarnished with time.

The 1820 edition of *Encyclopaedia Londinensis* (1820) featured a Herschel telescope in its treatise on Optics. Figure 10 is a reproduction

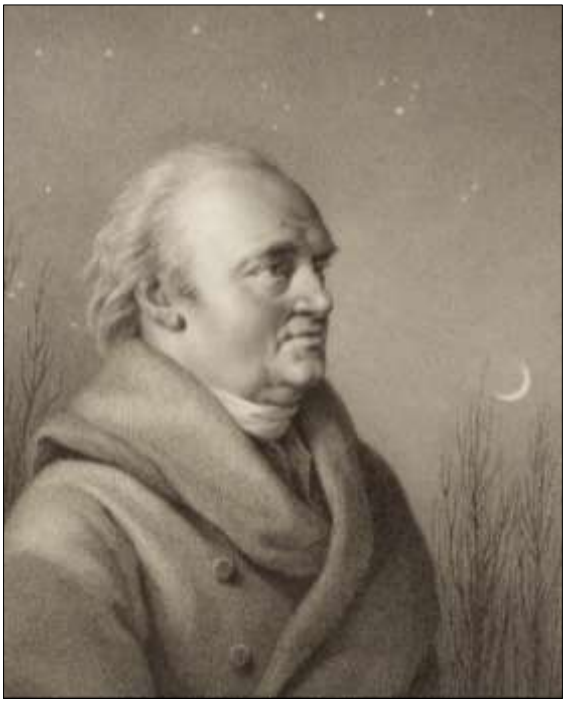


Figure 4: "Portrait of William Herschel by Frederick Rehberg, 1814. The background shows the area of the sky where Uranus was located when Herschel first observed it. Original print in the Adler's collections" (after Raposo, 2019).

Figure 5: A chromolithograph by A. Diethe dated about 1896 showing Sir William Herschel polishing a telescope element, and Caroline Herschel adding lubricant (image: Wellcome Collection (2018-04-03) https://wellcomecollection.org/works/hs76suwh).

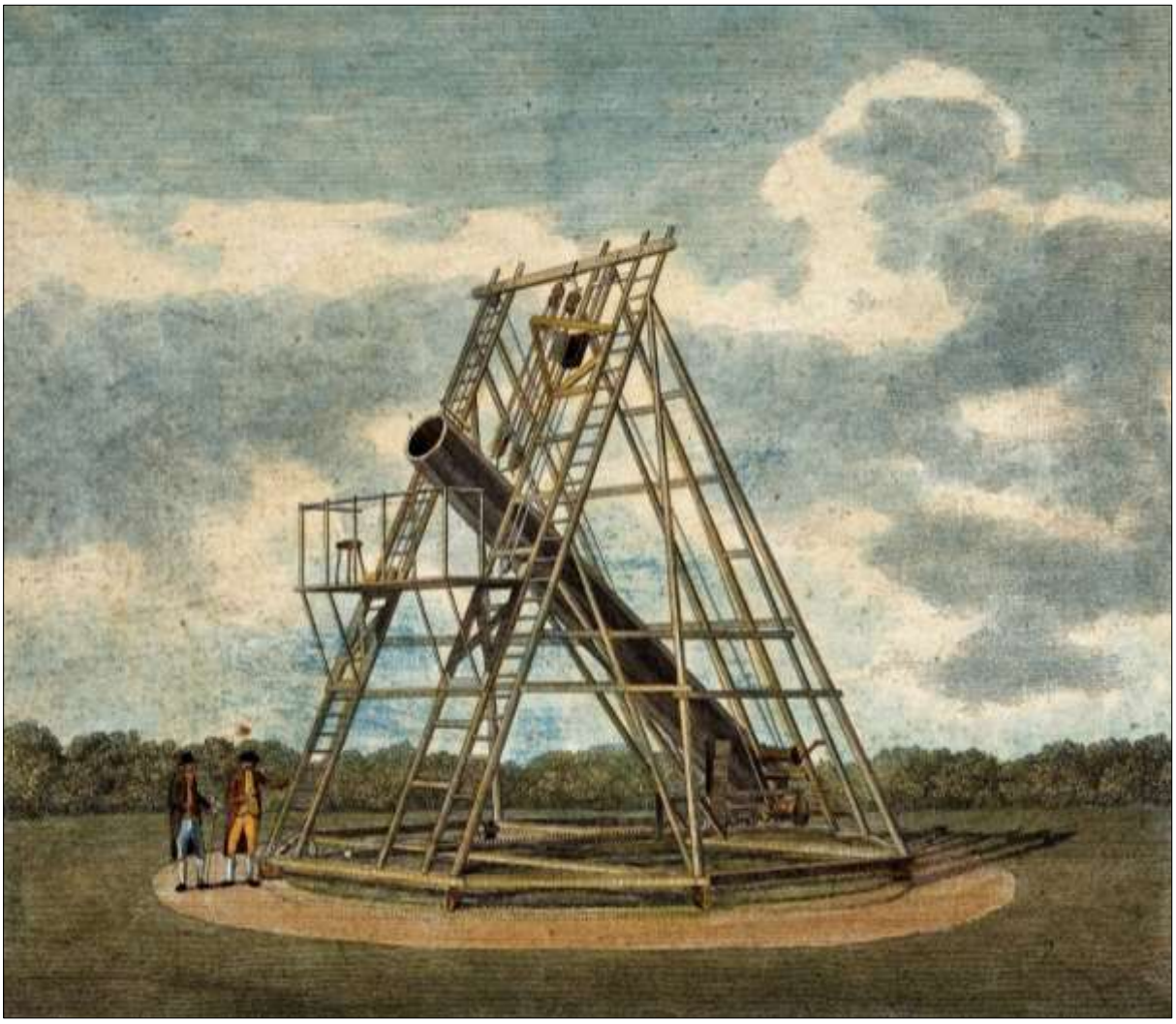


Figure 6: "Astronomy: a 40-ft telescope constructed by William Herschel, in use outdoors. Coloured etching, 18--. Wellcome Collection." (Reference: 46257i, https://wellcomecollection.org/works/srz5zy9y).

Figure 7: The Herschelian telescope (after Chambers, 1877: 609).

of the engraving by J. Pass that depicts telescopes and camera obscura, with the labels: 1. Multiplying Glass; 2,3. Improved Camera Obscura; 4 to 7. Refracting Telescope; 8,9. Reflecting Telescope; and 10. Newtonian Telescope, with specifications as given in the text. The last one is, without doubt, Herschel's 7-ft telescope, like the one in Figure 8. On pages 607–608, the *Encyclopaedia* comments on William Herschel's design of the telescope's stand:

> The high magnifying powers of Dr. Herschel's telescopes, made all the usual apparatus for their support extremely imperfect. But his judgement and his ingenuity, and fertility in resource, are as eminent as his philosophical ardour. He has contrived for his reflecting telescopes stands which have every property that can be desired. The tubes are all supported at the two ends. The motions, both vertical and horizontal,

are contrived with the utmost simplicity and firmness.

Herschel built telescopes not just for King George III, King of Spain Charles IV, Austrian Kaiser Franz I, Napoleon Bonaparte's younger brother Lucien, or, the wealthy and the influential. He also made them for observatories, and many prominent astronomers, including Nevil Maskelyne, Johann Bode, Baron von Zach, Giuseppe Piazzi, to name a few (Bennett, 1976; Maurer, 1971; 1998; Spaight, 2004).

3 THE HERSCHEL TELESCOPES IN INDIA

William Herschel built about 60 full-scale telescopes, most of which were 7-ft and 10-ft, plus several hundred mirrors (Mullaney 2007: 10). Since 1924, there has been a search for all known William Herschel telescopes. A few are still intact, but most are in parts or pieces and they are scattered throughout various institutions in England and other countries. Catalogues have also been prepared, together with related records and documentation, by Maurer (1971; 1998) and by Spaight (2004), who also include missing or destroyed Herschel telescopes.

Since 2008, we have been searching for published accounts of modern astronomical observations that were carried out in India. In the process, we came across references to two telescopes built by or under the guidance of Sir William Herschel which are missing from the aforementioned catalogues (Kapoor and Orchiston 2025). In our continued search, a third Herschel telescope emerged. Thus, as of now, we know that at least three Herschel telescopes arrived in India, all of them 10-ft focus. The first reference to one is made in a letter by Dr. Dinwiddie in 1805. It belonged to David Hare (1775–1842), a Scottish watch-maker in Calcutta. Another Herschel telescope belonging to James Calder (1784–1833) was used by James Prinsep in 1832 to observe eclipses of the Jovian satellites. Yet another Herschel telescope was acquired by Reverend Dr. William Sinclair Mackay (1807–1865), circa 1844, through Dr. Duncan Stewart, the brother-in-law of Sir John Herschel. In the following sections we provide information about these telescopes and their owners.

4 DAVID HARE'S HERSCHEL TELESCOPE

Recall the paper read by Sir William Herschel before the Royal Society on 6 May 1802, titled "Observations on the two lately discovered celestial bodies." This was about the recently discovered objects Ceres and Pallas. The observations were extensive, carried out with the 7-foot, 10-foot and 20-foot telescopes at very

Figure 8: The 7-ft reflecting telescope by William Herschel, 1783–1785, in the collection of the Science Museum in London (https://collection.sciencemuseumgroup.org.uk/objects/co56255/reflecting-telescope-by-william-herschel-1783-1785-telescope-newtonian-telescope-reflecting CC BY-NC-SA 4.0).

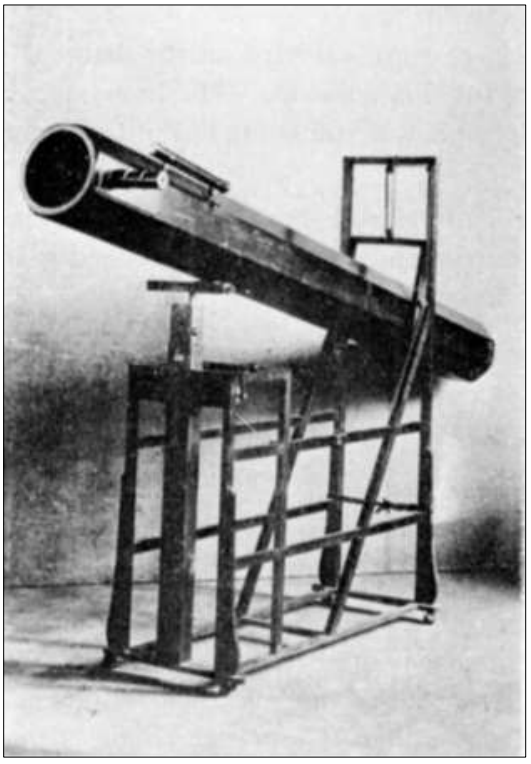


Figure 9: Herschel's 10-ft reflector; purchased by the Austrian Kaiser Franz I, ca. 1800, it is now preserved in the Technisches Museum in Vienna (after Maurer 1971: 287–289; item B-3).

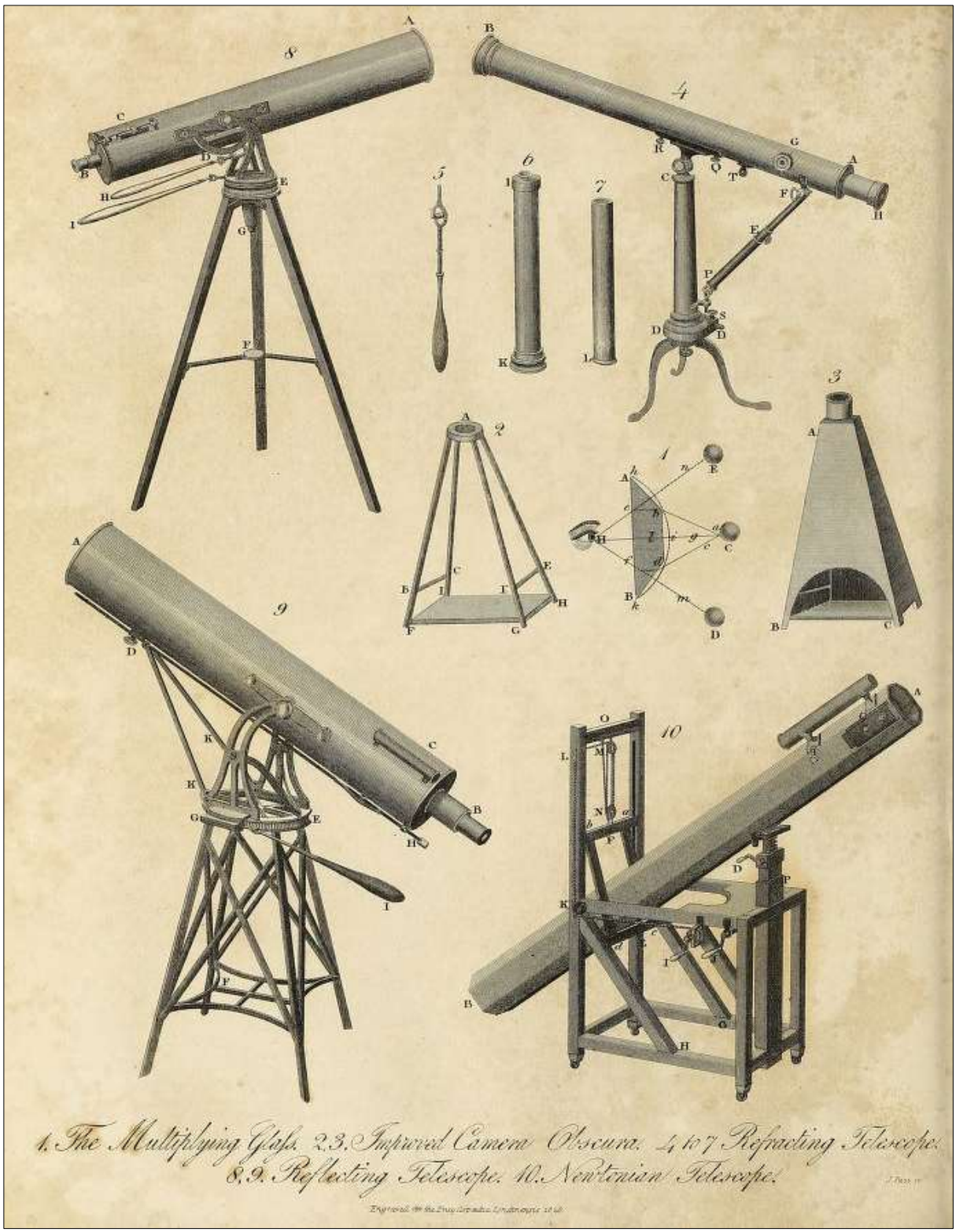


Figure 10: Plate VII, Optics, in the *Encyclopaedia Londinensis*, Volume XVII (1820) facing page 599; the telescope depicted at bottom right was made by Herschel (image: Biodiversity Heritage Library).

high magnifications. Herschel (1802: 218–219) summarized what he deduced about the size of these new objects:

> With these data, I have calculated the distances of the stars from the earth at the time of observation ... and, by them we find, that the diameter of Ceres, at the mean distance of the earth from the sun, would subtend an angle of 0″,35127; and that, consequently, its real diameter is 161,6 miles. It also follows, that Pallas would be seen, at the

> the same distance from the sun, under an angle of 0″,3199; and that its real diameter, if the largest measure be taken, is 147 miles; but, if we take the most distinct observation, which gives the smallest measure, the angle under which it would be seen from the sun, will be only 0″,2399; and its diameter, no more than 110⅓ miles …

He then laid down seven criteria to be able to arrive at the possible nature of the new stars:

> From the account which we have now before us, a very important question will arise, which is, What are these new stars, are they planets, or are they comets? … Since, therefore, neither the appellation of planets, nor that of comets, can with any propriety of language be given to these two stars, we ought to distinguish them by a new name, denoting a species of celestial bodies hitherto unknown to us … so the quality in which these objects differ considerably from the two former species, is that they resemble small stars so much as hardly to be distinguished from them even by very good telescopes. From this, their asteroidal appearance, if I may use that expression, therefore, I shall take my name, and call them Asteroids … These bodies will hold a middle rank, between the two species that were known before; so that planets, asteroids, and comets, will in future comprehend all the primary celestial bodies that either remain with, or only occasionally visit, our Solar System. (Herschel, 1802: 223–229).

The small sizes of the bodies surprised all. It took some time to accept the tiny masses as a new class of objects in the Solar System that was neither planet nor a comet, and the new term ‘asteroid’ was given by William Herschel to describe them.

Dr. James Dinwiddie (1746–1815; Figure 11), a Scottish natural philosopher, astronomer, inventor and mathematician who was then in Calcutta had read this paper. He had come to Calcutta in 1794, and he stayed until 1806. He soon established himself as a public lecturer on natural philosophy and chemistry, galvanism, and particularly in the areas which related to and could be beneficial to the affairs of the EIC. He became Professor of Experimental and Natural Philosophy, Mathematics and Chemistry in 1801 at the College of Fort William, which had been formed a year earlier by the Governor General Lord Wellesley (1798–1805) with a view to imparting higher education to future administrators outside of Britain.

In a letter dated 13 May 1805 to the *Calcutta Gazette* (published on 23 May), Dinwiddie (1868: 478–481) talked about his own observations of Ceres and Pallas and the appearance of Ceres in a Dollond Achromatic, at powers of 300× and 400×, as a disc or nucleus

> … just discernible, but too small to be measured. The body appears surrounded with a coma or atmosphere, extending, like that of a comet, to a perceptible distance from the solid.

He described how because of the large eccentricity and orbital inclination of Pallas, the two orbits intersect each other, “… a very extraordinary phenomenon in astronomy.”

Figure 11: A plaster bust of Scottish astronomer Dr. James Dinwiddie (after Proudfoot, 1868, and Wikimedia Commons).

He admired the quality and the precision reached by the 10- and 20-foot telescopes built by Dr. Herschel who from a series of meticulous observations with the same was able to conclude that the angular sizes of these objects at the mean Sun–Earth distance would be a third part of a second and about half that, respectively. In his letter Dinwiddie (1868: 479) also said:

> From a careful examination of the phenomena, Dr. Herschell is disposed to consider Ceres and Pallas as belonging to a distinct class of bodies, intermediate between those of planets and comets. And from the great resemblance they bear to small fixed stars, from which indeed they can be distingished only by the best telescopes, he gives this class the name asteroids. Although this, like

> most other names, carried no explanation, it may, however, for the sake of distinction, be with propriety adopted.

Cunningham (2017: Chapter 10) has discussed Herschel's papers of 1802 and also Dr. Dinwiddie's impressions thereof at length and points to his lukewarm response to the term asteroid. Further in his letter, Dinwiddie acknowledged that "The discovery of these asteroids has given a new interest to astronomy." Noting that several observatories were established in Europe where astronomers were collaborating by dividing the sky up in order to conduct surveys, he regretted about Calcutta did not have an observatory that could participate in so important a project. Notably, in the *Addendum* to his letter, Dinwiddie (1868: 480–481) shares important information:

Figure 12: David Hare (after Mittra 1877: facing p. 1).

> There is at present in this Settlement one of Herschell's ten feet reflectors, by which a satisfactory view might be had of the two asteroids; but the instrument had, unfortunately, lost its two highest astronomical powers before it came into the hands of its present owner, Mr. Hare, Watch-maker. When these shall be replaced, a more delightful view of the heavens will be obtained than has ever been enjoyed in this country. Mr. Hare has also received from London an excellent transit instrument, which I hope soon to put up for him. When this is done, the solution of one very important problem, the true Calcutta time, will be accurately obtained.

The "Mr Hare" referred to above is David Hare (1775–1842; Figure 12), a Scottish watch-maker. Hare came to Bengal, arriving at Diamond Harbour on 4 May 1801 (Samaddar, 1976: 33), started in business, and as he prospered he turned to philanthropy. David Hare is highly regarded for being a pioneer in founding a number of educational institutions in Calcutta and introducing Indians to modern education. He has been called "… the father of English education in Bengal." (Ray, 1902: 101). He had a house, now named Nicco House, at 1 Hare Street (named after him) that was amply used for his philanthropic activities (Firminger, 1906: 152). Unable to devote due time to his business, he formally made it over in 1820 to one Mr Ernest Grey (Gray), also a watch-maker. At a later stage, after the death of a brother of his, Hare went to live with Grey (Mittra, 1877: Chapters I and VI) at 4 Hare Street. Interestingly, Grey himself had an observatory and also an astronomical clock in the nearby Garstin's Buildings in Hare Street, and he participated in astronomical observations.

In 1817, Hare established the Calcutta School Book Society for printing and publishing books in English and Bengali and in 1818, a school to impart indigenous and English education that came to be named Hare School. The Society was sponsored by many public-spirited people from different backgrounds and was patronised by Lord Warren Hastings (1732–1818), the Governor General of the Presidency of Fort William (Figure 13). In 1840, David Hare was appointed Sheriff of Calcutta. That was an apolitical position of authority and would be bestowed upon an eminent citizen of the city for a year.

Just around then, in 1817, Hindoo College of Calcutta was established by a few influential and prosperous Hindus with a view to provide modern, Western education in English medium to the aspiring native youth, with support of the East India Company Government. Raja Rammohun Roy (1772–1833; Figure 14), the great reformer and India's Renaissance Man, and David Hare were the prime movers in its establishment.

Raja Rammohun Roy had moved to Calcutta in 1814 (Collet, 1914: xxxvii). In 1815 he founded the *Atmiya Sabha* (Friendly Society), with a view to promoting discussions on theological subjects. David Hare found a good friend in him whom he joined one evening in 1815 in a meeting at his place with few of Roy's friends present and raised the need to establish an English school (Collet, 1914: xl, 35; Kochhar, 2011: 859). The College made a humble beginning but it began to chart a path of progress (Mittra, 1877: Appendix B). The College was renamed Presidency College in 1855 and eventually evolved in 2010 into the Presidency University. "As a promoter of education Hare nourished the primary force which created Indian

8Figure 13: "A Perspective View of FORT WILLIAM in the Kingdom of BENGAL", by the Dutch artist Jan van Ryne (1712–1760) in 1754. The Fort was named after King William III. It has a fascinating history and is now the headquarters of the Eastern Command of the Indian Army (http://www.columbia.edu/itc/mealac/pritchett/00routesdata/1600_1699/calcutta/fortwilliam/fortwilliam.html; image: Wikimedia Commons).

nationalism." (Banerjee, 1976: 14). For his part, Raja Rammohun Roy had, during 1821–1824, penned many articles on scientific topics for his journal and also wrote text books in Bengali on such diverse subjects as geometry, geography, grammar and astronomy. He was keen that mathematics and natural sciences be part of the education. Raja Rammohun Roy did not live to see that happen but it was definitely "… he who initiated the movement for the introduction of scientific education in India." (Tagore, 1966: 30).

Apart from Dinwiddie's reference to it, there is no other information about Hare's Herschel telescope. There is no clue as to what happened to it or the transit telescope after Hare died in 1844. Perhaps they both went to Mr Grey, and he took them to Aberdeen when he returned to Scotland in 1848 (Smith, 1921: 177).

5 DR. DUNCAN STEWART'S HERSCHEL TELESCOPE

Yet another Herschel telescope belonged to Dr. Duncan Stewart, but was associated with the Free Church Institution in Calcutta and the Reverend Dr. William Sinclair Mackay (1807–1865). Mackay had a great inclination for astronomy. and was associated with the Bengal Mission of the Free Church of Scotland that had been established in 1830. Relatively little is known about him, other than he came to Calcutta in the autumn of 1831 to join Dr. Duff. Apparently,

Figure 14: A painting of India's 'Renaissance Man' Raja Rammohun Roy by Rembrandt Peale in London in 1833 (American Decorative Arts, Peabody Essex Museum; Wikimedia Commons).

They were fellow students at the University of St. Andrews in Scotland (Hunter, 1873: 61).

Calcutta was a major port in South Asia and a nucleus of European commerce. It grew fast as an urban centre in the nineteenth century and being the colonial capital, it earned the rank of the second most important city in the British Empire. Its architecture effused the spreading colonial power and charmed the high and mighty of Bengal to come and settle in the city. Reverend Dr. Alexander Duff (1806–1878; Figure 15) arrived in Calcutta in May 1830 as the first overseas missionary of the Church of Scotland in India. Shortly, Dr. Duff and Raja Rammohun Roy joined forces and, with the support of Lord William Bentinck (1774–1839),

Figure 15: A mezzotint image of the Reverend Dr. Alexander Duff by James Faed in 1851 (https://www.nationalgalleries.org/art-and-artists/28374; Wikimedia Commons).

who was then the Governor of Fort William and Governor-General of India during 1834–1835, they founded the General Assembly's Institution on 13 July 1830. It began on Chitpore Road with just five boys (Smith, 1879(I): 120–121). Chitpore Road, now Rabindra Sarani, is the oldest road in Calcutta. Their effort bore fruit right from the first examinations conducted.

Meanwhile, Dr. Duff's eloquent pleadings for substantial financial support from the National Church in Scotland were successful. As a result, a plot of land was purchased on Cornwallis Square, and in 1837 buildings were erected for the General Assembly's Institution, including a residence for Dr. Duff (Day, 1879: 72).

Raja Rammohun Roy and Dr. Duff played a pivotal role in the introduction of modern Western education in India through the medium of English. Their efforts had a long-lasting effect.

Then in August 1843 came mail with the devastating news of the 'great Disruption' between the Established Church and the Free Church of Scotland. The Disruption affected the congregations and the Scottish mission ministers in Calcutta. Dr. Duff and his fellow missionaries, William Mackay, David Ewart, John Macdonald and Thomas Smith, all chose to leave the Established Church of Scotland and form a Free Church of Scotland in Calcutta (Day, 1879: 167).

They then took steps to start another educational institution, and the Free Church Institution was opened in March 1844. Support for it came from different sources, with donations even from individuals living overseas. Hunter (1873: 84) recounts that the Free Church Institution opened

> On Monday, the 4th March 1844 … with teachers, monitors, and 791 pupils present on a roll of upwards of 1000, only it was now in Nimtollah Street, and not, as previously, in Cornwallis Square. Nor was the library entirely destitute of books. Friends, European and native, had made donations collectively amounting to about 1100 volumes, whilst a Herschell's ten-foot telescope, also presented to the mission by Mr Stewart, son of Dr Stewart, formerly of Moulin, Dingwall, and the Canongate, Edinburgh, became the nucleus of a fresh set of apparatus.

We shall meet Dr. Stewart shortly but first about the gift of the 10-ft Herschel; it is independently written about by Day (1879: 179) and by Smith (1879(II): 43). The latter states how

> Dr. Mackay, who had built his usual observatory on the roof, was gladdened by the donation of a Herschel ten-foot telescope from the son of Dr. Stewart, of Moulin memory.

Meanwhile, the Free Church Institution and the General Assembly's Institution both continued to offer a Western-style education in parallel. Day (1879: 124–125), for example, describes the wide range of the subjects that he was taught earlier when at the latter institution:

> Duff took his pupils through a course of physical science, in addition to a high literary course. Mechanics, hydrostatics, pneumatics, optics, astronomy, the principles of the steam-engine — the textbooks generally being of the Science

Figure 16: The General Assembly's Institution in Calcutta, ca. 1890 (image: National Library of Scotland; permanent link: https://doi.org/10.25549/impa-c123-78882).

> Series of Lardner — were taught in the college classes. A course of lectures on chemistry was also delivered, accompanied with experiments; the youthful and fascinating science of geology was studied on account of its bearing on theology; while we were so familiar with the use of the sextant, with Norie's "Navigation", and with the "Nautical Almanac" …

Eventually, the General Assembly's Institution (Figure 16) and the Free Church Institution merged in 1908, and formed the present Scottish Church College (Anonymous, n.d.).

Meanwhile, in 1849 Dr. Duff founded The Free Mission Institute at Chinsurah (Chuchura), beginning with only a handful of boys (Chinsurah Duff High School, n.d.). Dr. Mackay served as the Principal. The school was named in 1928 the Chinsurah Duff High School in honour of the great educationist and promoter of modern science.

The Reverend Dr. Alexander Stewart (1764–1821) was the father-in-law of William Herschel's son Sir John Frederick William Herschel (1792–1871; Figure 17), the mathematician and astronomer. Reverend Stewart and was a Scottish Gaelic scholar and mathematician, and after serving as a Minister in Moulin, transferred to Dingwall in 1805 and to the Canongate parish in Edinburgh in 1820 (Stewart, 1880: 178).

Dr Duncan Stewart (1805–1875; Figure 18), the second son of Reverend Dr. Alexander Stewart, was a surgeon who worked for the EIC in Calcutta during 1825–1855 (Crawford, 1914: 169). He was highly commended for his extensive reports on smallpox in Calcutta when it appeared during the epidemics of 1833, 1837 and 1844, and on the state of vaccinations in Bengal (Stewart, 1844).

Figure 19 shows Dr Stewart's residence 'Chouringee' in 1850. In 1829 or 1830 Dr. Stewart had gone to Cape Town on leave where he met his brother-in-law Sir John Herschel. Sir John had arrived on 16 January 1834 with family and a 20-inch reflecting telescope. The Herschels stayed on, and left the Cape for England on 11 March 1838 (Ruskin, 2004) after four astronomically fruitful years. Herschel's *Results of Astronomical Observations at the Cape of Good Hope* … appeared some years later as a book (Herschel, 1847), and earned him great praise from the astronomers. Dr. Stewart left for

Figure 17: An 1835 mezzotint by W. Ward of Sir John Frederick William Herschel, after H.W. Pickersgill (Reference: 4167i, image Wellcome Library, London).

India in March or April 1834 (Evans et al., 2014: 54) and arrived in Calcutta in May 1834 (Bengal & Agra Directory …, 1835: 75).

Figure 18: An 1845 watercolour by Charles Grant (1788–1866) of "Dr Duncan Stewart, Calcutta" (http://collections.rmg.co.uk/collections/objects/146025; Wikimedia Commons).

5.1 Sir John Herschel's *Catalogue of Stars*

That Dr. Duncan Stewart was the keeper of the said telescope is evident in the introduction to the "Herschel Manuscript Catalogue of Stars" (Reference Code: GBR/0012/MS Add.10234, ca. 1860) held in the Cambridge University Library (Herschel, [1834]):

> A fair copy of a Catalogue of Stars Visible on the Horizon of Calcutta, drawn up by J. W. F. Herschel to accompany the ten feet reflecting telescope sent to his relations including medical doctor, Duncan Stewart, eldest brother of Lady Margaret Herschel, employed by the East India Company, 1825–1855.
>
> Manuscript in ink on London Superfine paper (blind embossed stamp on top left corner of inner front wrapper). Consists of one gathering of 6 leaves (12 folios) including inner wrappers, sewn. Contains: 2 pages of text; 14-page catalogue (consisting of 10 columns ruled in red ink); and 6 blank pages. Red paper/card cover pasted on boards with raised, black leather label with title 'Herschel Manuscript Catalogue of Stars' embossed in gold-coloured lettering.

Under the head *Immediate Source of Acquisition* is stated "Purchased from Blackwell Rare Books, Oxford, 26 July 2010".

Sir John Herschel's Catalogue was scanned by Cambridge University Library on request and the whole manuscript, minus the six blank pages, is presented in the Appendix at the end of this present paper, reproduced by the kind permission of the Syndics of Cambridge University Library. The title page reads: "Sir John Herschell's Manuscript Catalogue of Stars visible in the horizon of Calcutta." There are two pages of text. The first one begins with the above wording, adding, "arranged in order of Right Ascension" and credits *Sir J.F.W. Herschell*, who had drawn it up

> … to accompany the ten feet reflecting telescope sent out to India by that distinguished astronomer for the private use of his relations in this country. It will of course answer equally well for other telescopes, and will in some measure serve as a test of their goodness and space-penetrating power.

There are 113 celestial objects tabulated. Be it the nebulae, double stars, globular clusters, planetary nebulae, clusters of irregular figures or the nebulous stars, they are all there to keep the viewer enamoured of the vault of heaven. The objects are chosen keeping in mind the

Figure 19: A 24 March 1850 lithograph by Edward F. Lingham showing 'Dr Duncan Stewart's residence Chouringee' (Royal Museums, Greenwich, ID: PAH6032; image: Wikimedia Commons).

telescope's "power of penetrating into space" (to borrow from Herschel's (1800) title) and reflect the thought that went into the Catalogue's preparation. The descriptions are brief but to the point. It refers to the "… great nebula about θ Orionis … [as the] most extraordinary object perhaps in the heavens …", etc. The second page of the text explains the Column-heads, ten in all, giving the respective RA (hms) and Declination (N/S), the constellation, a brief description of the object and Remarks. The co-ordinates are not epoch-specific and therefore offer for a comparison with the corresponding Epoch J2000.0 values, etc. Interestingly, all the objects are assigned signs representative of their nature. Column 5 names

> … the authority [Sir William Herschel, Dunlop, Messier] whence the objects are extracted … [whereas] the names and numbers in the last two columns refer to Bode's maps of the constellations.

For some objects, the brightness is given in (apparent) magnitudes. The Catalogue also mentions constellation names that are no longer in use: Antinous, Argo Navis, Machina Electrica, Norma et Regula, Officina Typographica and Scutum Sobieski.

5.2 Dr Mackay's Astronomical Activities

In 1844 Dr. Duncan Stewart presented the telescope to the Free Church Institution, but we do not know if it was used for any observations during the intervening ten years, following its arrival in Calcutta. An ideal target, for example, would have been Comet 1P/Halley, which was eagerly awaited in 1835. The comet was first recovered on 5 August by Dumouchel, joined a few minutes later by de Vico (Kronk, 2003: 109). By the end of September, the comet could be observed with the naked eye. It had its share of causing panic as a portent of doom. The comet passed closest to the Earth on 12 October, at 0.1865 *au*, when it also began to trail the Sun (perihelion: 16 November). In Cape Town, Sir John Herschel had begun a search for it in late January, but eventually saw the comet for the first time on 28 October.

In India, the Comet was observed by T.G. Taylor at Madras Observatory from 31 August 1835 up to 5 February 1836 and then on 3 April 1836 with a Dollond equatorially-mounted 5-ft achromat. An initial report by him, signed 28 September, appeared in the September 1835 issue of the *Journal of the Asiatic Society of Bengal* (1835; Taylor, 1835: 521). Presenting its positions over 31 August–26 September, he commented that the comet was 10 days later than its predicted time of return. Further, the comet was invisible to the unaided eye but would be visible from 21 October. At the end of Taylor's report, James Prinsep, the Editor of the *Journal*, added his own comment: "The comet has been visible here since the 12th Oct., after

sunset, and is now very bright." This is around the time when Dr Mackay was in charge of the General Assembly's Institution at Chitpore Road. Note that astronomy enthusiasts in Calcutta were unaware, with Prinsep's one-liner perhaps the only published report from Calcutta about the comet. His other report is also brief, and unpublished. It is in his letter of 20 January 1836 to Sir John Herschel where, while closing, he says: "With the Comet we have been very idle." (Prinsep, 1836: 4). Interestingly, *The Bengal Almanac* for 1835: xxxix had already published an alert:

> From the 3d August 1835 to the 11th February 1836, Halley's Comet is expected to make its appearance and will be visible in the morning …[1]

About Dr Mackay, Lal Behari Day (1879: 225) said that he was "… one of the most accomplished missionaries that ever came to India." Dr. Mackay was well read in Greek and Latin literature. A theologian, he contributed regularly to the *Calcutta Christian Observer* and the quarterly *Calcutta Review*. Of interest here are the impressions that Day (1879: 227–228) had of Dr. Mackay:

> Mackay was, however, not merely a literary man; he was a good mathematician, and perhaps the first astronomer of his day in India, apart from those in Madras. Next to theology, which he studied deeply in all its branches, there was no subject to which he paid greater attention than astronomy. Wherever he lived, whether in Calcutta or at Chinsurah, he had a private observatory of his own, furnished with the necessary apparatus, from the "lone high tower" of which he watched the "stars in their courses". As he was enthusiastic in the study of astronomy, he endeavoured to impart a portion of his enthusiasm to his pupils. I attended his lectures on astronomy for three years, during which our text-books were Maskylne, Herschel, Vince. He was not content with teaching us theoretical astronomy; he showed us its application, and some of his pupils became quite expert in the manipulation of Norie's Navigation and the Nautical Almanac. He also unfolded the principles of the steam-engine to his pupils, many of whom had become familiar with the theory of locomotive engines long before the introduction of railways into the country.

From 1843 to 1849 Mackay's observatory was atop the main building of the Free Church Institution in Nimtollah (Nimtala) Street in Calcutta, but details of his equipment—other than the Herschel telescope, which was owned by the Institution not by him—are lacking.

We do know that Dr. Mackay observed the Great March Comet of 1843 (1843 I; C/1843 D1) from Calcutta. This comet appeared at a time in astronomical history when the nature of cometary tails was still debated: was it an appendage or an emanation? In his letter of 10 June 1843 to Sir John Herschel, Mackay (1843: 8) had this to say:

> The comet was first seen at Calcutta on the 5th of March, and continued visible until April 3. Distances from bright stars were observed, from which approximate right ascensions and declinations have been deduced.

Mackay (ibid.) had observed the comet with respect to the star η Argus (now η Carinae) in the constellation of Argo Navis (now Carina) whose brightness he noticed had risen from between the first and second magnitude to the first magnitude, reaching as bright as Canopus and "… in colour and size very much like Arcturus … Alpha Crucis looked quite dim beside it." Mackay's observation is apparently the first recorded mention of the variability of a star from India, while the discovery by the Indian astronomer, C. Ragoonatha Charry (1828–1880) of a new variable star, R Reticuli (043263, a Mira variable), would take place 24 years later in 1867 (Kameswara Rao et al, 2009). Charry was an assistant to Madras Observatory Director, Norman Pogson.

Donati's Comet (C/1858 L1) appeared and reached its full glory during the most tumultuous of times in India. The Great Uprising of 1857 against the British had failed, the Mughal Empire had fallen, and most male members of the Royal Mughal family had been slaughtered. To many, the apparition was a signal of divine wrath. The poet-laureate Mirza Ghalib (1797–1869) saw in the apparition a fiend out to unleash terror with its fiery tail (Kapoor, 2018). The evening of 5 October in 1858 was one like never before. John Hind had pointed out that the comet was to transit over Arcturus ($-0^m.05$), the fourth brightest star in the night sky. Dr. Mackay was then living as a missionary at Chinsurah, and he used a sextant and an old ship's chronometer to observe Donati's Comet on 6, 18 and 30 October 1858. From these observations he computed the orbital elements, and he communicated these to the Astronomer Royal for Scotland, Charles Piazzi Smyth (Mackay, 1862: 161). Mackay's elements compared well with the European determinations that he said were received about one month later. He emphasized that his observations were well spaced in

time and so corresponded to a longer arc of the orbit for the purpose of calculation.

The Great Comet of 1861 (1861 II; C/1861 J1) exceeded Donati's Comet in brightness and was visible to the unaided eye for three months. It had been discovered by the Australian amateur John Tebbutt (Orchiston, 2017; 2024). In a communication dated 19 July 1861 to the Royal Astronomical Society through Professor Smyth, Dr. Mackay presented his own observations of the comet. He said that

> The observations are remarkable instances of what may be done with a sextant and an old ship's chronometer. (Mackay, 1862: 160).

Dr. Mackay presented some details of his observations in *Friend of India*, dated 25 July 1861. It was a paper brought out by the Serampore Mission Press, from Serampore, near Calcutta. It was in this communication about the Great Comet of 1861 that Mackay (1862) also included his calculated orbital elements of Donati's Comet of 1858.

Surprisingly, there are no reported observations of the two Great Comets made with the10-ft Herschel telescope at the Free Church Institution back in Calcutta. Chinsurah was ~35 km north of Calcutta if one followed the Hooghly River upstream. Chinsurah was where Dr. Mackay had his private observatory at that time.

6 JAMES CALDER'S HERSCHEL TELESCOPE

Around the same period, there was yet another 10-ft Herschel telescope in Calcutta. This telescope was in the possession of one James Calder. For this telescope we need to supply a little background information.

The transits of Mercury of 4 November 1822 and of 5 May 1832 were widely observed in Europe. In India too, observations were made from several locations, by individuals and also officials of the EIC (Kapoor, 2025). James Prinsep made observations of the transit of 5 May 1832 from Calcutta with help from Lieutenant Andrew Waugh and a Mr Rennie from the Engineers. He had the opportunity to use Lieutenant Pemberton's equatorially-mounted 4-inch achromat and a power of 60, with a wire micrometer. A darkened glass was varied to facilitate safe view. As we saw, Mr Grey had his observatory in Garstin's Buildings nearby and also had an astronomical clock. With this clock Prinsep matched his chronometer before and after the event (Kapoor, 2025; Prinsep ,1832: 408–411).

Among the Mercury chasers was Walter Ewer (1784–1863), the son of a Governor of the settlement at Bencoolen. He had joined the Bengal Civil Service in 1803 and had a distinguished career (Buckland, 1906: 141). Ewer had a deep interests in music and astronomy. During his visit to Delhi in 1822, he used a telescope with a high magnifying power to read for the first time the inscriptions on the Qutub Minar that was then in too bad a state to allow any access (Ewer, 1822: 480–489). Ewer was elected a Fellow of Royal Geographical Society in 1839 and a Fellow of Royal Society in 1840 (Walter Ewer 1784–1863, n.d.).

Ewer had observed the transit of Mercury of 4 November 1822 from Kurnal (Karnal) with a 5-ft focal length telescope by Dollond with 100× and dark glasses in the eyepiece (Hodgson 1825; 1827: 110). A decade later, he observed the next one on 5 May 1832 from Chuprah (Chapra; 25° 43′ N, 5h 39m E). This time, he used a Troughton 3½-ft achromat with an aperture of 2¾ inches and 60× eyepiece, and he noted the internal ingress of the planet at 2h 42m 18*s* mean time (Prinsep, 1832: 411).

Elsewhere in the same issue of the *Journal of the Asiatic Society of Bengal*, Ewer (1832: 504–506) reported observations of the eclipses of Jupiter's satellites made at Chuprah; he quoted its geographical position as 25° 47′ 26″ N, 5h 39m 7s E. The observations related to Satellite I and Satellite II, made on 2 and 3 October 1832. The instrument was a Troughton 5-ft achromat, power about 200, aperture 3.8 inches. This telescope, Ewer said, had been 25 years in the country and was in excellent order.

There were observations of the eclipses carried out on 19 and 26 October in Calcutta and while listing the several observers who independently observed the eclipses, Ewer referred to a Herschel telescope:

> 19th October, 1832. — On this day by the Ephemeris the whole of Jupiter's satellites were to be eclipsed, and of the phenomena no less than four out of six, viz. two immersions and two emersions, should have been visible at Calcutta. The weather having been unusually fine and clear for some days past, it was thought to be a good opportunity for trying the power of the superb reflecting telescope, lately presented to Mr. James Calder, by Sir John Herschell: —one of the last made under his father's directions. The following gentlemen undertook to make simultaneous observations with their own telescopes, by way of ascertaining the extent of uncertainty in the use of different instruments under precisely similar circumstances: Captain D. Ross, Marine Sur-

Table 1: Jovian satellite eclipses observed from Calcutta in October 1832.

Observer and Location	Telescope Type & Focal Length	Aperture	Power (×)	Notes	Obs. Mean Time (h m s)	Longitude (h m s)
19 October—Emersion of Jupiter's first satellite						
Prinsep	ten-foot reflector	9	160	hazy	8 27 58	5 53 28
Pemberton	four-foot achrom	3.7	119	do.	8 27 59	5 53 29
Gray	42 in. achromat	2.7	80	do.	8 28 12	5 53 42
Logan	42 in. ditto	2.7	80	do.	8 28 05	5 53 35
Ross	42 in. ditto	2.7	80	Dull glass	8 28 27	5 54 07
26 October—Emersion of Jupiter's first satellite						
At Surveyor General's						
Wilcox	42 in achromat	2.7	80		10 23 15	5 53 05
Waugh	42 in achromat	2.7	80		10 23 41	5 53 31
Logan	42 in achromat	2.7	80		10 24 09	5 53 59
At Mr. Calder's						
Pemberton	four-foot achrom	3.7	119		10 24 09	5 53 59
Prinsep	ten-foot reflector	9	160		10 24 09	5 53 59
At Mr. Gray's						
Gray	42 in. ditto	2.7	80		10 24 01	5 53 51

> veyor General, at his residence in Chowringhee, and his assistant Lieut. Lloyd, with a second telescope at the same place; Captain Wilcox, Mr. Logan, and Lieutenant Waugh, at the Surveyor General's office, in Park Street; Mr. H. Barrow, H.C. Mathematical instrument maker, in Loudon Street, Chowringhee; and Mr. Gray, at his observatory in Garstin's Buildings; while Lieut. Pemberton with his own telescope, Mr. Gordon with his, and myself at the large reflector, should make the observation at Mr. Calder's residence in Esplanade-row.

Ewer (1832) further stated that

> To save trouble all the observations have been reduced to the same meridian, namely, that of the Ochterlony monument, by applying –2 sec. to those of the Surveyor Genl. Capt. Ross, and Mr. Barrow, and +1 sec. to those of Mr. Gray: during the remainder of the month other observations were made in a similar manner: —they have been reduced to the same meridian …

The observations were presented by Ewer (1832: 505) in tabular form and are reproduced in Table 1 to give an idea of the kind of the equipment used. Similar observations also were made during 3–27 November, including by Prinsep with the 10-ft Herschel reflector.

Among the gentlemen above, Captain Daniel Ross (1780–1849) was an hydrographer with the EIC, and at the time the Marine Surveyor General at Calcutta. A Fellow of the Royal Society, he was made President of the Bombay Geographical Society in 1839 (Phillimore, 1954 (III): 499). Captain Robert Boileau Pemberton (1798–1840) entered the British Indian Army in 1817. He was assigned to the 44th Native Infantry in 1824. A geographer, he was involved in the survey and exploration of the North-East frontier until 1832. He defined the boundary between Manipur and Burma and authored the *Report on the Eastern Frontier of British India* (1835), an excellent reference work (Hodson, 1946: 496–497). Richard Wilcox (1802–1848) from the Bengal Infantry, was First Assistant under Sir George Everest (1790–1866) and from 1830 to 1843 the Surveyor General of India. A distinguished Oriental scholar, Wilcox served as the Royal Astronomer at Lucknow Observatory from January 1835 until his death in October 1848. Major General Sir Andrew Scott Waugh (1810–1877), who in 1843 succeeded George Everest, had only joined the Great Trigonometrical Survey in July 1832 (Thackeray, 1900: 158–162). George Logan (1809–1854) came to India in 1830, and in March 1831 he was appointed in charge of the Surveyor General's Observatory (Phillimore, 1958(IV): 454–455).

James Prinsep (1799–1840; Figure 20) was a British scholar, antiquarian and colonial administrator in India. He came to India in 1819 when he was appointed to the Calcutta Mint of the EIC. During 1820–1830, when he was at Benāras (Varanasi) as Assay Master at the Mint, Prinsep also carried out meteorological and astronomical observations. He rose to become Assay Master in 1832, and stayed on in India until 1838. He had worked to reform the Indian weights and measures system and introduced uniform coinage. He was the founder, and Editor of the *Journal of the Asiatic Society of Bengal* during 1832–1838. It was in this period that he deciphered the Brahmi script and the Kharosthi script in the Asokan edicts thus opening the window to early Indian history. From

the study of coins and the inscriptions, Prinsep was able to deduce many Royal genealogies. A collection of his watercolours was lithographed in England and published in 1831 from Calcutta in a book *Benaras Illustrated, in a Series of Drawings* (Prinsep, 1831). This earned him great fame. He was a Fellow of the Royal Society. There is a 'Prinsep Ghat' on the banks of the Hooghly River that was built in 1843 in his honour.

Major General John Garstin (1756–1820) joined the Bengal Engineers in 1778 as an Ensign, and built monumental structures in India. Among these was Patna's *Golghar*, the granary for the British army in 1786, and Calcutta's Town Hall, built in 1813 in the Roman–Doric style (Goode, 1916: 339). It served as a place for social gatherings for the British in Calcutta, and is now a history museum.

In 1792, Garstin undertook construction of buildings in the northern part of St John's Church after the demolition of the Old Court House of the EIC there (Figure 21). The buildings were named after him, and as Phillimore (1950(II): 402) noted, "His name is preserved in

Figure 20: A portrait of James Prinsep (1799–1840), by his sister Emily Prinsep, before 1840 (private collection, after Allbrook (2008): 101; Wikimedia Commons).

Figure 21: Old Court House and Writers' Buildings; by Thomas Daniell (1749–1840) in 1786; the Writers' Buildings now serves as the offices of the State Government of West Bengal (https://franpritchett.com/00routesdata/1600_1699/calcutta/viewsearly/viewsearly.html

Calcutta by Garstin's Place, a cul-de-sac opening out of Hare Street." Garstin was a member of the Asiatick Society and had also served as Surveyor General of Bengal from 1808 to 1813.

James Calder (1784–1833), at whose residence in Esplanade Row the observations were carried out by Lieutenant Pemberton and James Prinsep, was a prominent Calcutta merchant. When exactly he set foot in Calcutta is not yet clear. He was a partner in the well-known English firm Mackintosh & Company. When the Calcutta School Book Society was being formed in 1817, many publicly spirited persons of Calcutta came forward in support. Calder was one of them, so much so that he was appointed Treasurer to the Society in 1817 (Ahmed, 1961: 49–50). Calder was the Sheriff of Calcutta in 1822 and again in 1829 (*The Bengal Club* …, 1970: 64), and he "... seems to have been an extremely charitable man, at whose hands prisoners, churches, hospitals and needy individuals of all kinds seem to have benefited." (Moore, 1926: 35). His name as a member of the Asiatick Society figures for the first time in the Volume XIII (1820) of the *Asiatic Researches*. Since 1822, he was part of the Committee of Papers whose task was to select from the papers communicated to the Society. His paper on the geology of India (Calder, 1829) is valued as the earliest essay on the subject. He made many gifts to the Asiatic Society and these included meteorites and minerals. The silicate mineral Calderite is named after him. Esplanade Row, where Calder lived, was a popular residential area of the British in Calcutta at that time. Figure 22 presents a view of Esplanade Row from Chowringhee Road, and is drawn from "Views of Calcutta and its Environs" by the Scottish artist and traveller James Baillie Fraser (1826). Fraser had arrived in Calcutta in October 1813 and he stayed on in India until 1820. During this period he produced sketches of life in the city and elsewhere.

The year 1833 proved the most tumultuous in James Calder's life. We read about Mackintosh & Company going bankrupt in 1833, and it appears that Calder also suffered this fate. Apparently, in October 1833 he left Calcutta aboard the *Mercury*, bound for King George's Sound, on the south coast of Western Australia (Families in British India Society …, 1834: 28), but the ship was wrecked and Calder perished. A long obituary for him appeared in the *Madras Courier* on 13 July 1833.

However, as we were wrapping up this study, we chanced upon a set of exchanges between Sir John Herschel and James Prinsep. These are in the Royal Society Archives, under "Science in the making". One of the letters by Prinsep dated Calcutta 13 December 1834 says this:

> Sir, I fear the enclosed offers but a very insignificant addition to the very numerous and distinguished honours which are already attached to yours named –

Figure 22: A view of Esplanade Row from Chowringhee Road in the 1810s (after Fraser, 1826: Plate 3; SOAS Digital Collections, University of London; https://digital.soas.ac.uk/LOAB000125/00001/citation).

> but it is offered as a courteous return for the attentions you have so often conferred on the asiatic Society. The fate of the relative through whom they were generally conferred, Mr Calder, still remains in a melancholy uncertainty, but there is a faint chance of his being yet in existence. The telescope he left in my charge I have made over to your brother-in-law Dr. Duncan Stewart. It will remain in perfect order even in our damp climate provided proper care be taken of it. We had hoped that Ewer might have been tempted to visit Calcutta after coming so far, and that Ewer would then show us some of the wonders lately discovered in the distant realms of space … (Prinsep, 1834: 1–2).

Then in a later letter dated 1 May 1835 Prinsep informs Sir John that

> Your brother-in-law Dr Stewart has possesion of your fine reflecting telescope, which remains in as good order as ever, and will do so with ordinary care for a very long period. He is quite well, but being like myself a busy man in his vocation we seldom meet. (Prinsep, 1835: 4).

That explains to some extent the idleness about observing Comet Halley from Calcutta but it also creates confusion. It means that Dr Stewart came to possess two 10-ft Herschel telescopes, both in 1834. Of these, he gave one to the General Assembly's Institution, in 1844. What happened to the other? Also, how did Sir John's "Herschel Manuscript Catalogue of Stars" re-surface back home in England? Dr Stewart stayed in India working for the EIC until 1855, and we suggest that he took the Catalogue with him when he returned to England.

7 CONCLUDING REMARKS

As the eighteenth century wore on, modern astronomical activity in India began to gather pace. Importantly, the observers made records, aimed also at dissemination. It is no wonder that they always aspired to stay abreast of developments in Europe. They sourced the necessary wherewithal from Europe—be it books and journals, almanacs and maps, or state-of-the-art equipment like achromats, astronomical clocks, alt-azimuth instruments, transit instruments, and quadrants, etc., built by Dollond, Ramsden, Troughton, Simms and others (Kapoor and Orchiston 2023; 2025).

The three William Herschel telescopes that made a passage to India reflected this passion and the quest for the finest in instrumentation. The telescopes arrived in Calcutta at different times. The astronomy enthusiasts in Calcutta were a small community but would normally be aware of equipment and activities elsewhere in the city, thanks to the Asiatic Society of which many were members, and possibly in Town Hall gatherings. For instance, in 1832, when James Calder's telescope was used and the observations were published in the *Journal of the Asiatic Society of Bengal*, Dr. Mackay surely would have been aware of the prized possessions of David Hare and James Calder since their respective abodes in Hare Street and Esplanade Row were close by, only a few miles south of Upper Chitpore Road where the General Assembly's Institution was located.

Ironically, only fleeting accounts of the use of the three Hershel telescopes could be found in published records. Furthermore, currently there is no trace of any of these telescopes or parts there-of in Calcutta. Nor have we been able to connect any of the telescopes to those in existing Herschel telescope catalogues.

About the telescope at Dr Mackay's observatory, we initiated correspondence with the Scottish Church College in late March 2020. The College showed keen interest but we could not make progress at that time because the COVID-19 pandemic was forcing everyone to remain housebound. Recently, I revived the contact and visited the College on 18 February 2025. They made an extensive search for old records but the earliest they could dredge up were from 1901. The office of the Principal has a large portrait in colour of Dr. Alexander Duff but there is no image of Dr. William Mackay at the College.

Recall that Dr. Alexander Duff founded the General Assembly's Institution in a rented building in Calcutta, but in due course he received enough funds to acquire land and construct new buildings. Then came the great Disruption in 1843, and in March of the following year Dr. Duff and colleagues founded the Free Church Institution in a huge rented building in Nimtollah Street (now Nimtala Ghat Street), Calcutta, where Dr. Mackay had an observatory on the roof (Hunter, 1873: 84). Subsequently, the Institution bought land nearby and in March 1857 moved into a sumptuous new building. This had 28 rooms and three halls with accommodation for 1200 students. Two of the halls had galleries where 450 to 700 students could be accommodated. Later the building was sold and in 1920 and became the Jorabagan Police Station (West Bengal Heritage Commission, 2025). Figure 23 shows what this this once-magnificent building looked like in February 2025.

Figure 23: The state of the old Free Church Institution building at 74 Nimtala Ghat Street, Kolkata, on 18 February 2025 (photograph: R.C. Kapoor).

What is puzzling is that in the first half of the nineteenth century, there were astronomy practitioners and Royal enthusiasts in Lucknow, Bombay and further South but to our knowledge no Herschel telescope made their way there.

8 NOTES

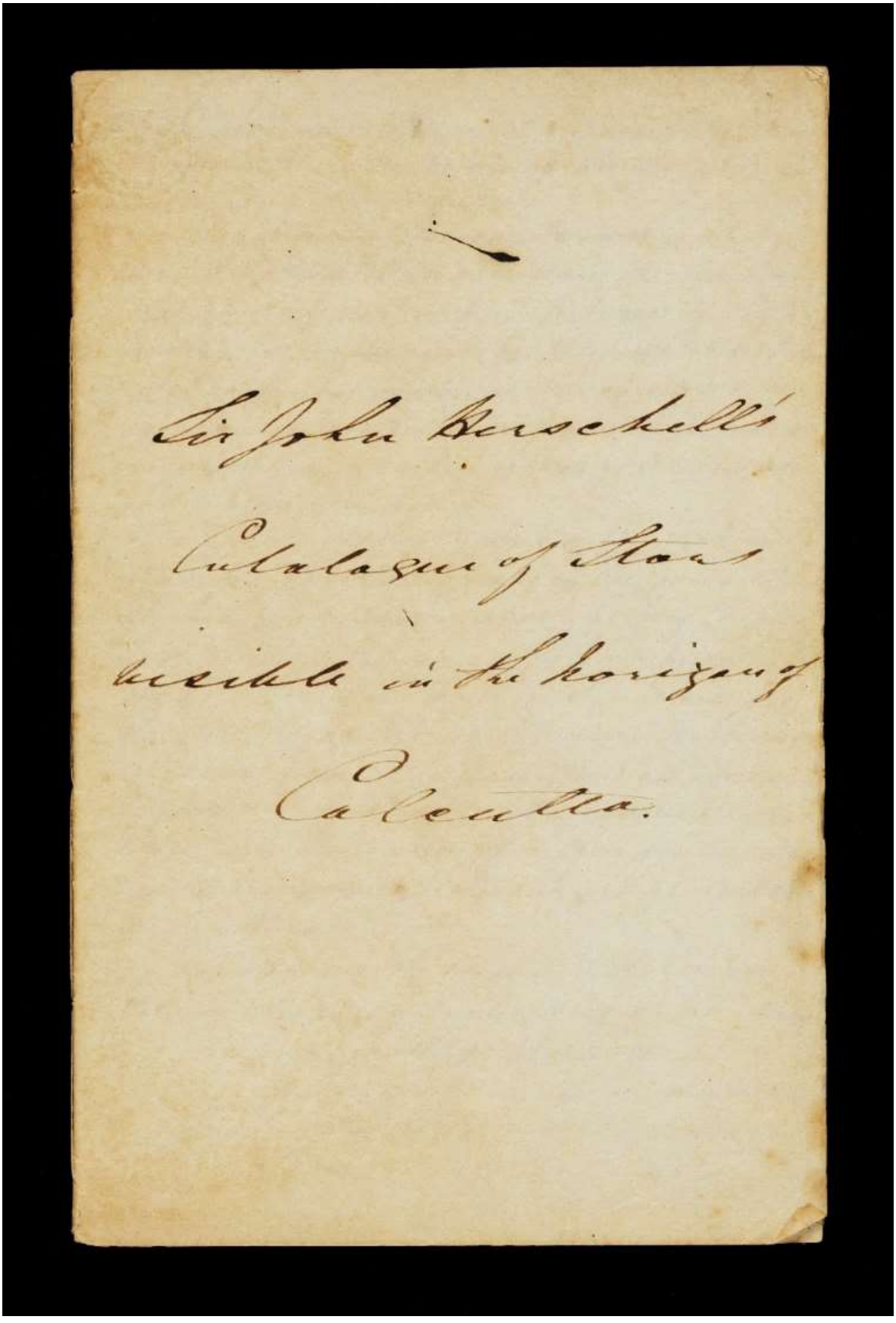
1. We stumbled upon Thomas Spofford's *Farmer's Almanac* for 1835, published in Boston saying

> 'This year will also be remarkable for the return of the great comet of 1769, commonly designated as "Halley's Comet," from its having been successfully predicted by that celebrated astronomer (https://dl.tufts.edu/pdfviewer/v979vg07k/5425kn979). While newspapers were doing their bit, some like *The Hobart Town Courier* in Tasmania, dated 29 May 1835, enthused the readers rather too soon: "The Halley comet is now visible in America, in Ursa major, consequently invisible in this country. It will continue to approach the earth till March next (1836) when it will begin to recede."

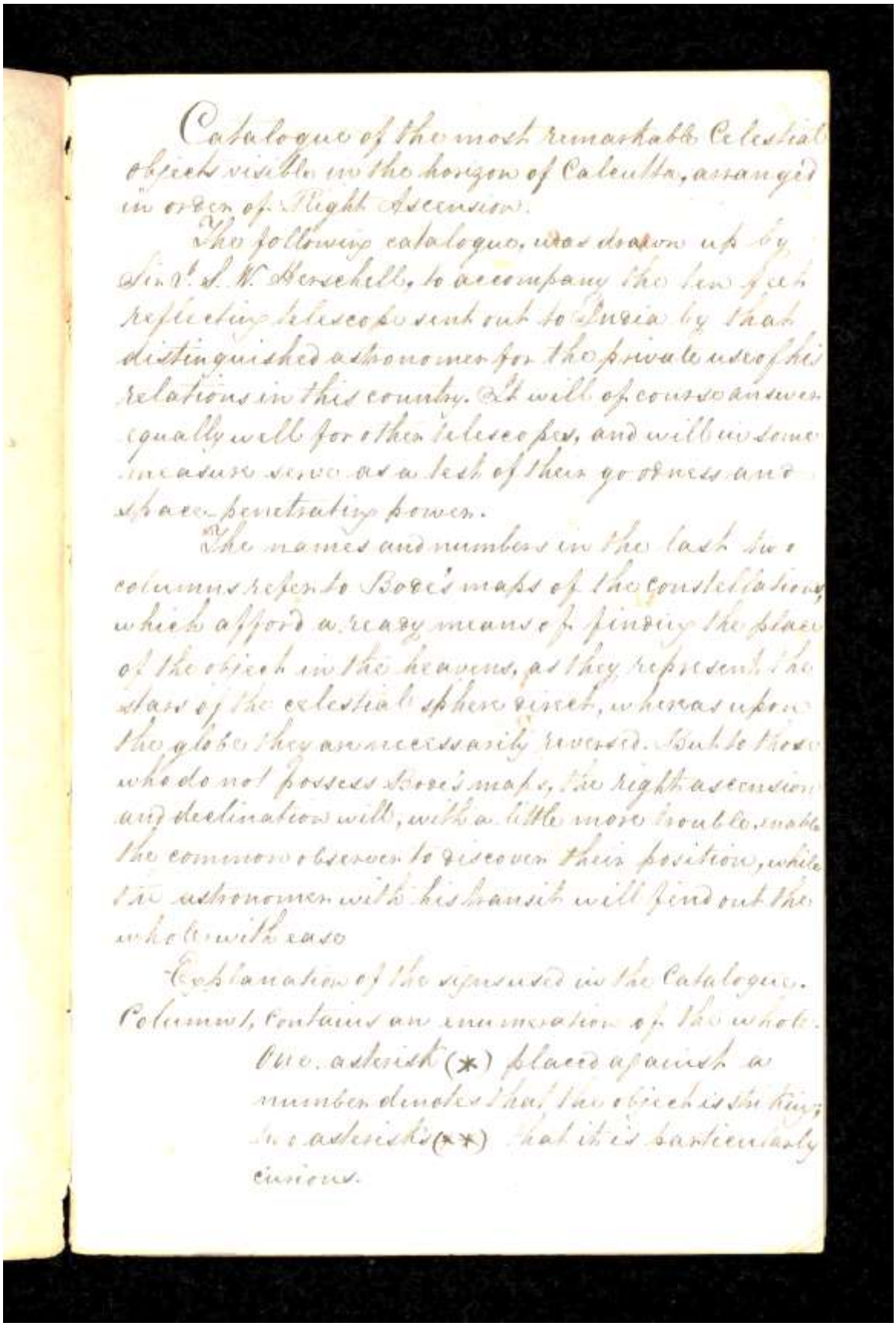
The source was not named.

9 APPENDIX: THE HERSCHEL MANUSCRIPT CATALOGUE OF STARS

In this Section we reproduce scans of the "Herschel Manuscript Catalogue of Stars", held by the Cambridge University Library (Reference Code: GBR/0012/MS Add.10234 (https://archivesearch.lib.cam.ac.uk/repositories/2/resources/13574/citation). There is a Title Page and pages 1–16 of the manuscript. The latter has an additional six pages but these are blank and are not included here. The Title page reads "Sir John Herschell's Manuscript Catalogue of Stars visible in the horizon of Calcutta". The "Herschel Manuscript Catalogue of Stars" is © The Estate of Sir John Frederick William Herschel/Cambridge University Library and the scans are reproduced by the kind permission of the Syndics of Cambridge University Library.



Herschel Manuscript Catalogue of Stars: Title page (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).



Catalogue of the most remarkable Celestial objects visible in the horizon of Calcutta, arranged in order of Right Ascension.

The following catalogue was drawn up by Sir W.m H. Herschell, to accompany the two 7 feet reflecting telescopes sent out to India by that distinguished astronomer for the private use of his relations in this country. It will of course answer equally well for other telescopes, and will in some measure serve as a test of their goodness and space-penetrating power.

The names and numbers in the last two columns refer to Bode's maps of the constellations, which afford a ready means of finding the places of the objects in the heavens, as they represent the stars of the celestial sphere viewed, whereas upon the globe they are necessarily reversed. But to those who do not possess Bode's maps, the right ascension and declination will, with a little more trouble, enable the common observer to discover their position, while the astronomer with his transit will find out the whole with ease.

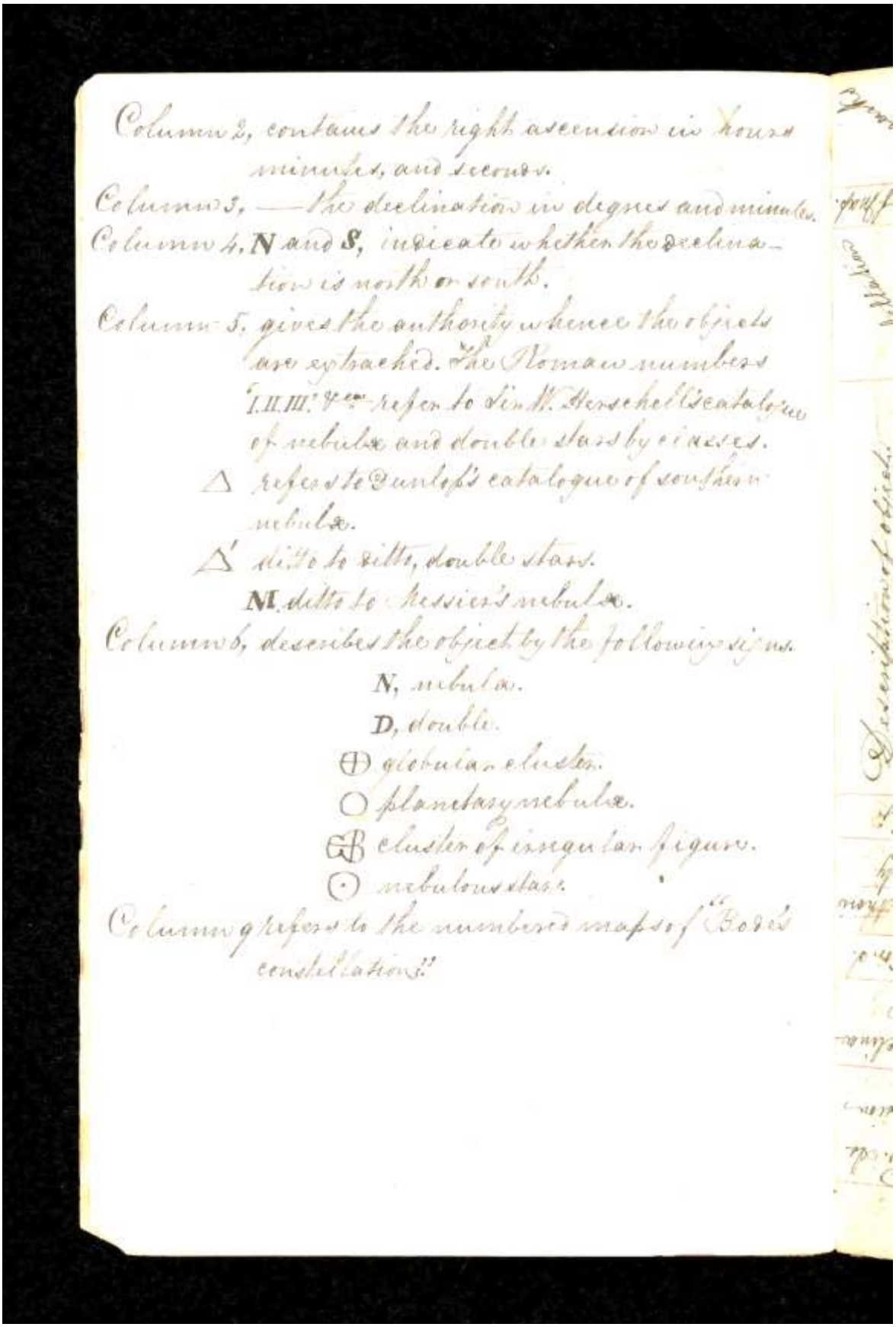
Explanation of the signs used in the Catalogue.

Column 1, contains an enumeration of the whole.

One asterisk (*) placed against a number denotes that the object is tolerably fine.

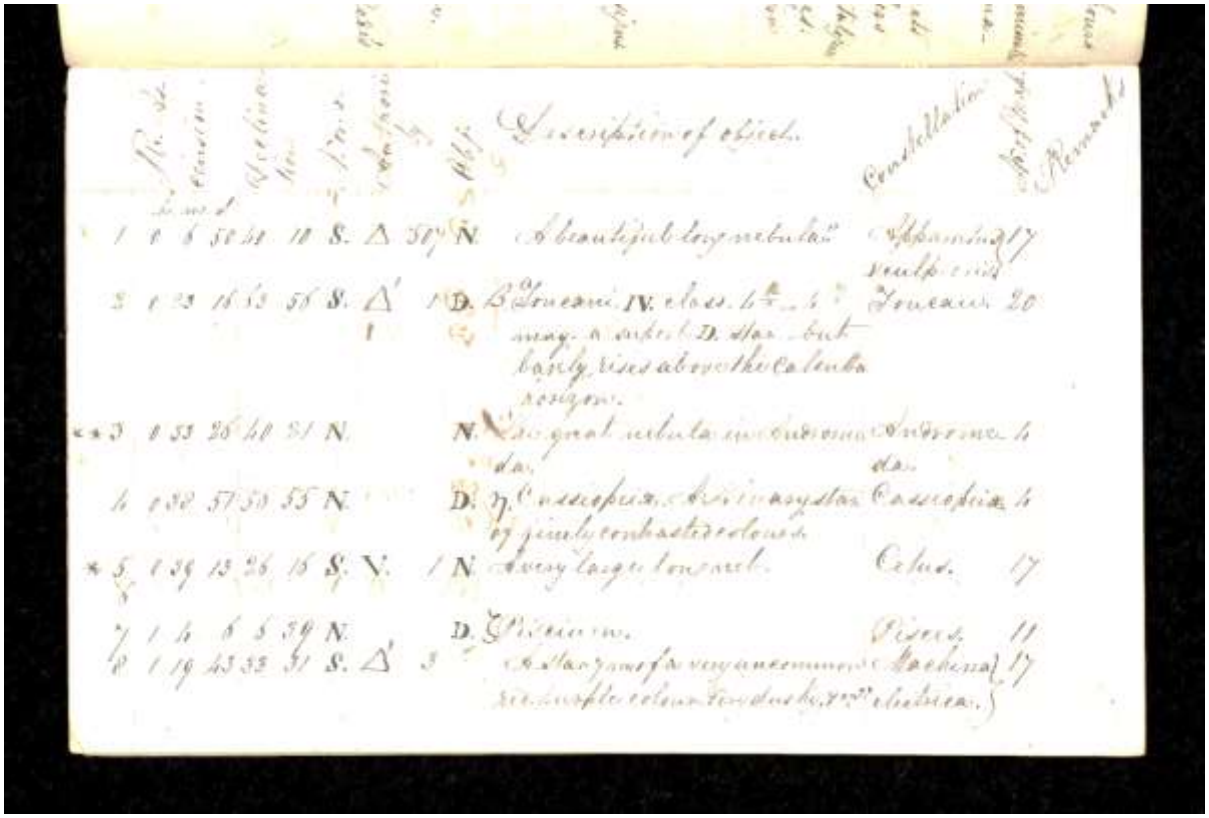
Two asterisks (**) that it is particularly curious.

Herschel Manuscript Catalogue of Stars: Page 1 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).



Column 2, contains the right ascension in hours minutes, and seconds.
Column 3, — the declination in degrees and minutes.
Column 4, **N** and **S**, indicate whether the declination is north or south.
Column 5, gives the authority whence the objects are extracted. The Roman numbers I. II. III. &c. refer to Sir W. Herschel's catalogue of nebulæ and double stars by classes.
△ refers to Dunlop's catalogue of southern nebulæ.
△′ ditto to Bilt, double stars.
M. ditto to Messier's nebulæ.
Column 6, describes the object by the following signs.
N, nebulæ.
D, double.
⊕ globular cluster.
○ planetary nebulæ.
GB cluster of irregular figure.
⊙ nebulous stars.
Column 7 refers to the numbered maps of "Bode's constellations."

Herschel Manuscript Catalogue of Stars: Page 2 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).



Herschel Manuscript Catalogue of Stars: Page 3 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).

Herschel Manuscript Catalogue of Stars: Page 4 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).

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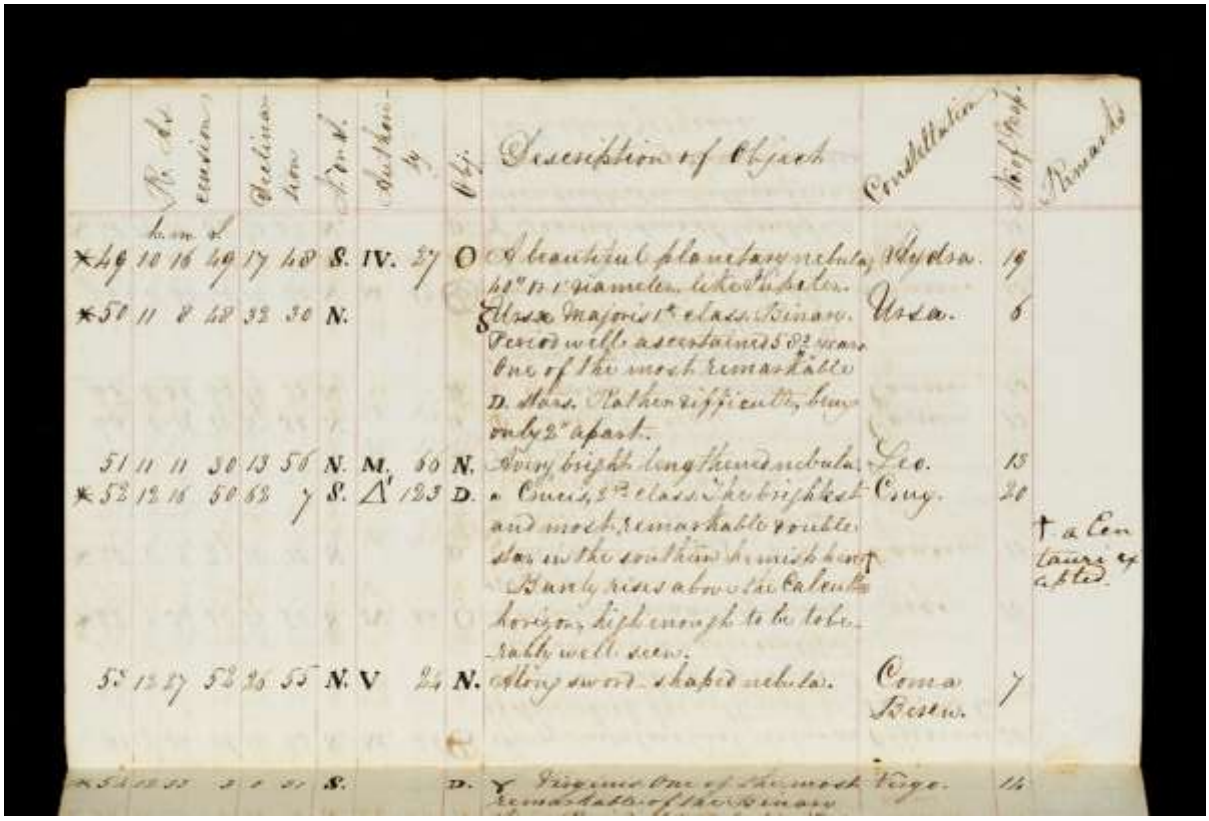
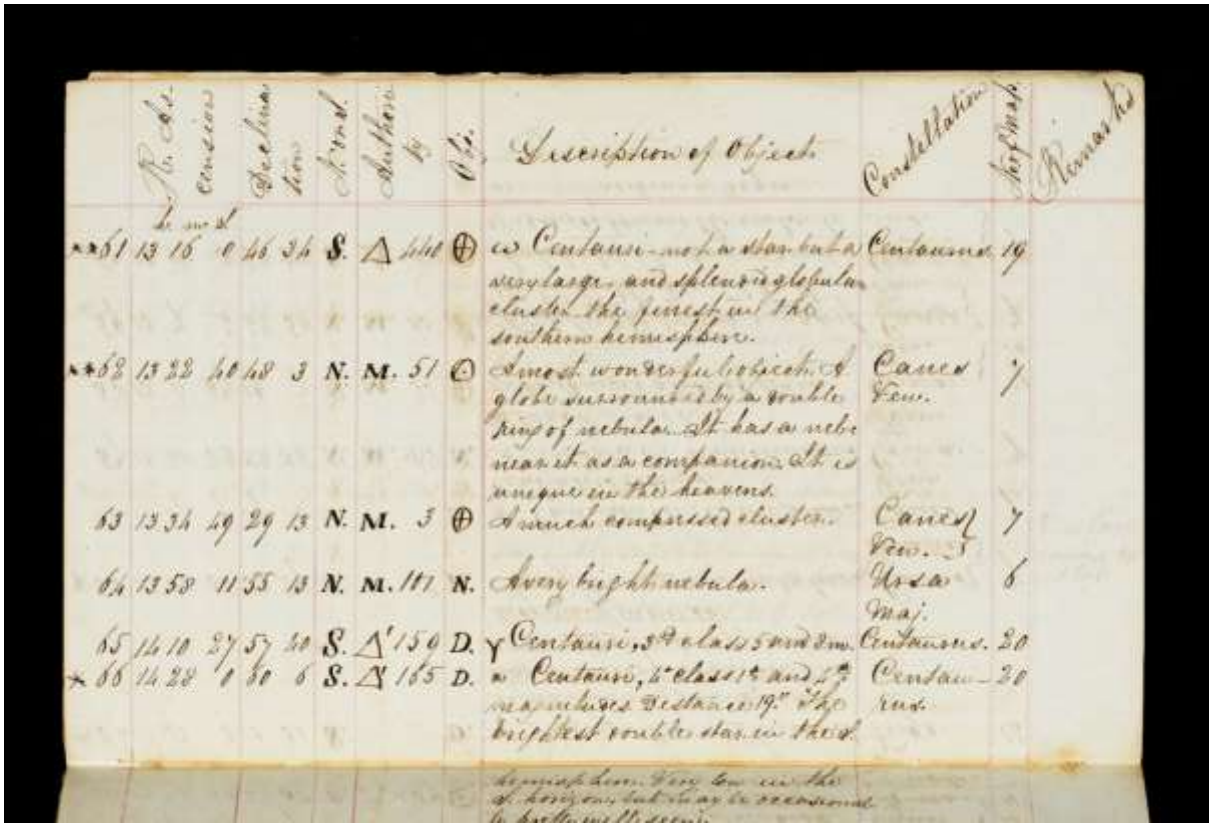
Herschel Manuscript Catalogue of Stars: Page 7(MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).

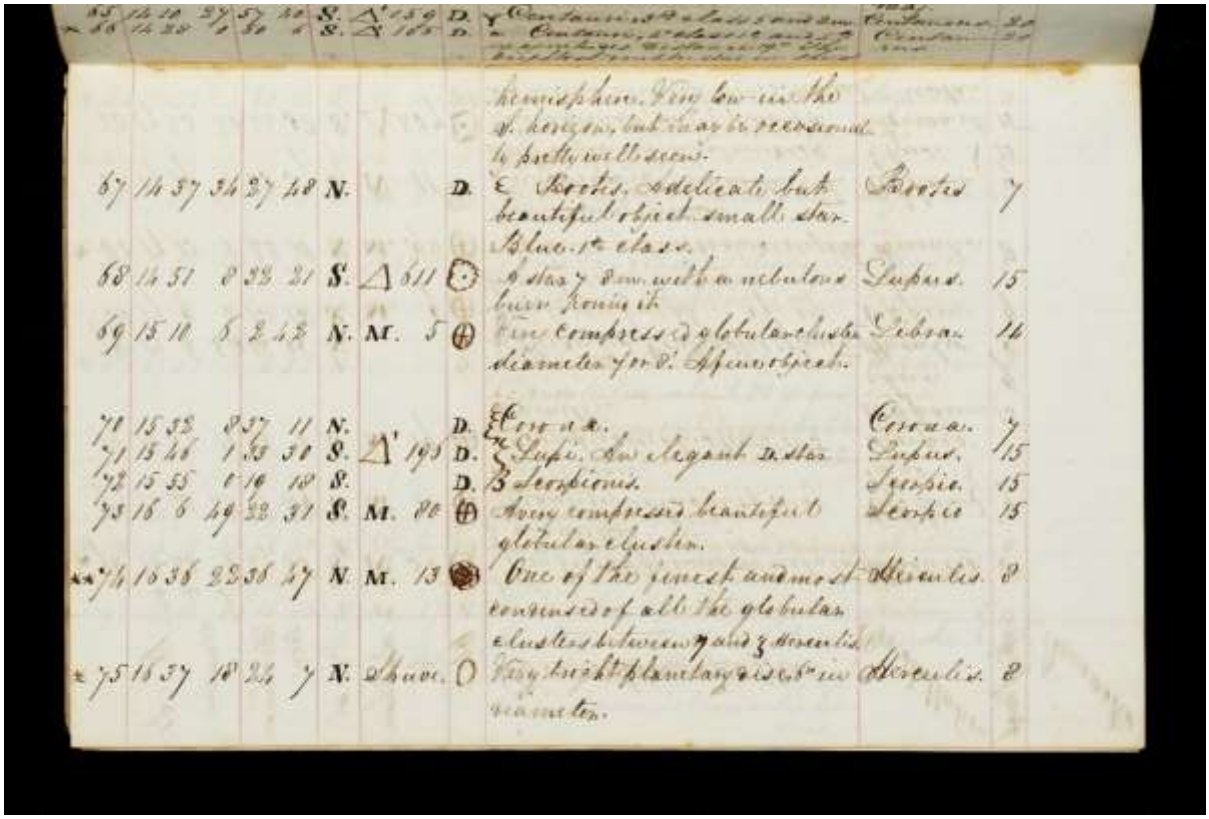


Herschel Manuscript Catalogue of Stars: Page 8 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).

Herschel Manuscript Catalogue of Stars: Page 9 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).



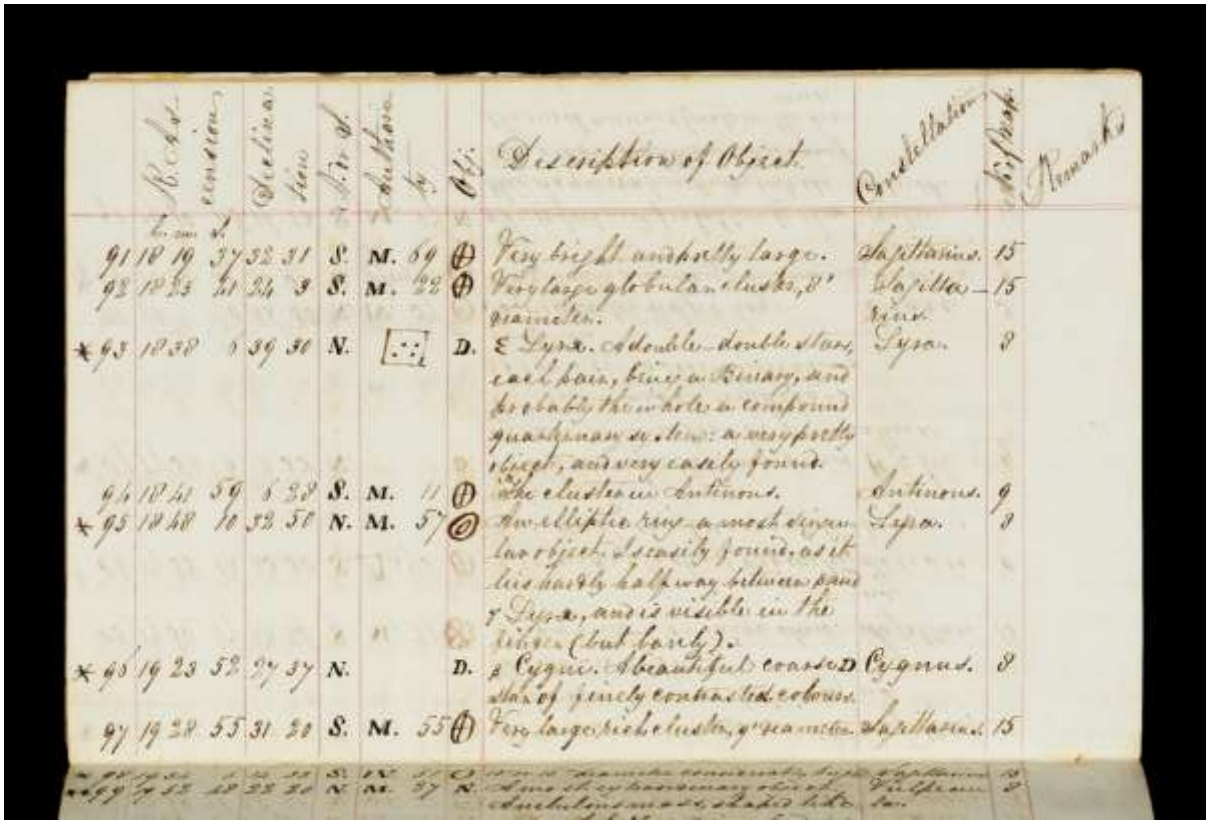
Herschel Manuscript Catalogue of Stars: Page 10 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).



Herschel Manuscript Catalogue of Stars: Page 11 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).

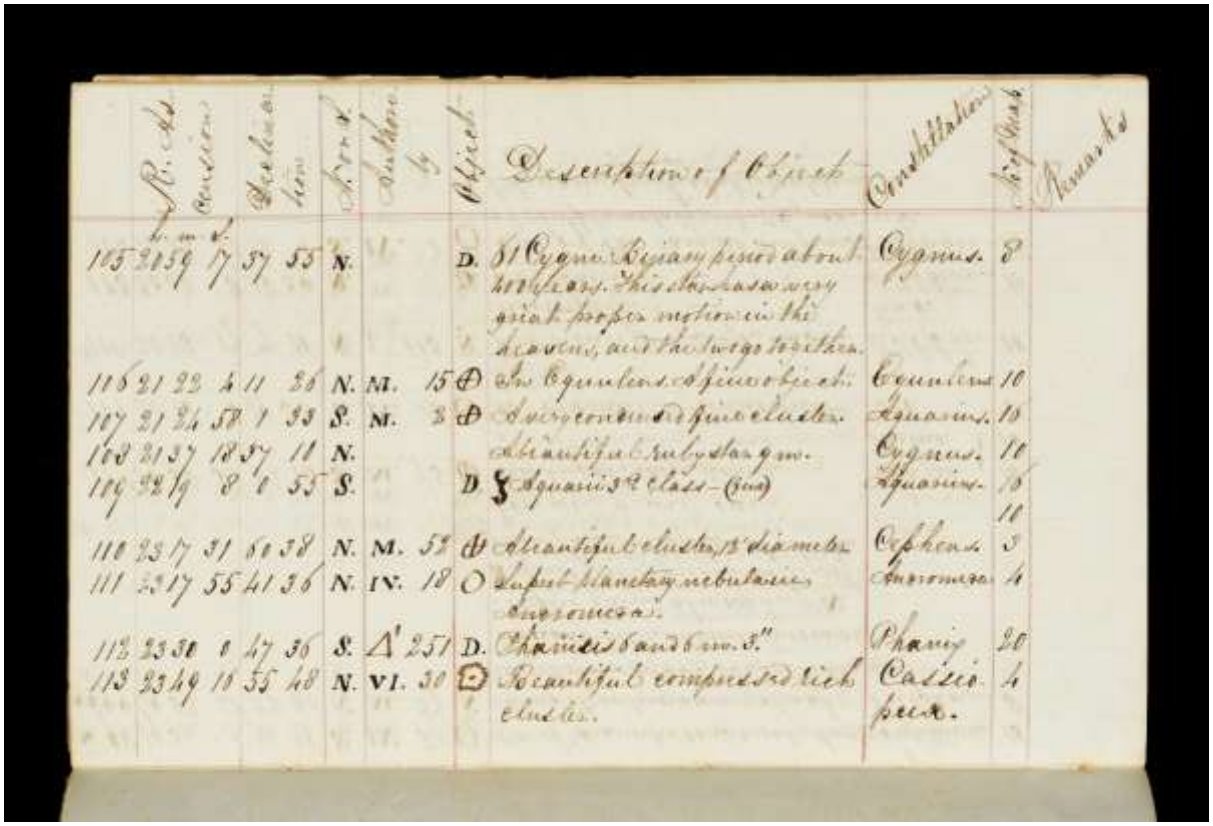
Herschel Manuscript Catalogue of Stars: Page 12 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).

Herschel Manuscript Catalogue of Stars: Page 13 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).



Herschel Manuscript Catalogue of Stars: Page 14 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).

Herschel Manuscript Catalogue of Stars: Page 15 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).



Herschel Manuscript Catalogue of Stars: Page 16 (MS Add.10234; Reproduced by kind permission of the Syndics of Cambridge University Library).

10 EDITORIAL COMMENTS

Normally when I edit and format *JAHH* papers I discuss possible changes or additions with authors, and this often leads to the minor revision of a paper. However, because of Ramesh's sudden demise we were not able to engage in this last-minute 'tweaking' of his paper. There are two areas where I would like to suggest additions to his original text.

One is in the last paragraph in Section 4, where I have suggested that Hare's Herschel telescope probably passed to Ernest Grey following Hare's death and that Grey then took the telescope to Aberdeen in 1848 when he returned to Scotland. This all makes good sense given the Hare–Grey friendship, and I would encourage Aberdeen astronomical historians to investigate this possibility.

The other area I wish to comment on—which, like the Grey/Aberdeen option, I am sure Ramesh would have found helpful—is the date of Sir John Hershel's manuscript (which occupies the Appendix in this paper). Nowhere is the date of this MS given, but I believe we can safely assign it to 1834. The point is that Dr. Stewart visited Cape Town in early 1834, where he met his relative Sir John Herschel, who himself only arrived in Cape Town on 16 January 1834. Stewart returned to Calcutta in May or April 1834, but he did not take the Herschel telescope with him at the time, and Sir John specifically mentions sending the telescope and Catalogue to Calcutta. From data in Calcutta we know that the telescope arrived there sometime in 1834. We also know that when assembling the Catalogue Sir John did not spend time conducting his own observations for this but simply drew on information published by his father, and by John Dunlop (Paramatta Observatory in Australia) and Charles Messier. All this would seem to indicate that Sir John assembled the Catalogue in 1834, not long after Dr. Stewart had returned to India.

Professor Wayne Orchiston (Co-Editor, *JAHH*).

11 ACKNOWLEDGEMENTS

The document "Herschel Manuscript Catalogue of Stars" by Sir J.F.W. Herschel is copyright © The Estate of Sir John Frederick William Herschel/Cambridge University Library. The scans of seventeen pages thereof have been reproduced here by the kind permission of the Syndics of Cambridge University Library. I thank Cambridge University Library also for the Licence Fee waiver. I was able to reach the Estate of Sir John Frederick William Herschel, thanks to the *Herschel Museum of Astronomy* at Bath (https://herschelmuseum.org.uk) and Ms Olivia Stannard, Picture Library Manager, Cultural Heritage Imaging Lab, Cambridge University Library. My sincere thanks are due to the Caroline Simpson Collection, Caroline Simpson Library, Museums of History New South Wales for permission to use the image entitled "The Office of the late Surveyor General, Chowringhee by Charles George Nicholls".

I am thankful to Dr. Arpita Mukerji, Principal, Scottish Church College (SCC), Kolkata and Dr. Alison Lindsay, Head of Historical and Legal Search Rooms, National Records of Scotland, General Register House, Edinburgh, for useful correspondence in 2020 about the Reverend Dr William S. Mackay. I thank Dr. Madhumanjari Mandal, currently Principal of SCC, who initiated a thorough search for old records at the College. I am grateful to Mr. Nikhilesh Pal, telescope-maker and amateur astronomer who became my guide through the great city of Kolkata.

The research presented here has made use of NASA's Astrophysics Data System and the 'On-Line Solar System Data Service' of the Jet Propulsion Laboratory. Many papers and images, works of history, as also those on the history of astronomy were gratefully accessed from the websites of The Royal Society, Internet Archive, Bibliothèque Nationale de France, Wellcome Collection, Hathi Trust Digital Library, PAHAR, Google Books, National Library of Australia, Wikimedia Commons, the Biodiversity Heritage Library at the Smithsonian Libraries and Archives in Washington, D.C. and a number of other institutions.

It is my pleasure to thank the Director of the Indian Institute of Astrophysics (IIA) for facilities. Mr. P. Prabahar and Mr. B.S. Mohan at the IIA Library have been my constant help in accessing various references. Lastly, I am happy to thank my son, Mr. Manu Kapoor, for crucial help at the computer.

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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.

As report on the title page of this paper, Professor Kapoor passed away unexpectedly on 21 August 2025, after having already submitted this paper to *JAHH*.