Madras and Kodaikanal Observatories: A Brief History

Rajesh Kochhar

Rajesh Kochhar is the Director of National Institute of Science, Technology and Development Studies, New Delhi. His research interests include science policy as well as history and sociology of science.

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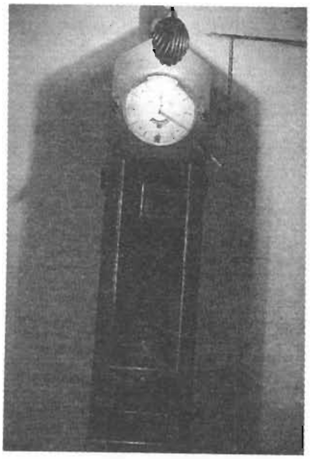
Introduction

Modern astronomy came to India in tow with the Europeans. The earliest recorded use of telescope in India was by an Englishman, Jeremiah Shakerley (1626-c.1655). He was one of the earliest followers of Kepler and viewed the transit of Mercury in the year 1651 from Surat, west India. He could, however, time neither the ingress nor the egress. His observation, therefore, was of no scientific use. More representative of things to come was the work of the Jesuit priest Father Jean Richaud (1633-1693) who in 1689 discovered from Pondicherry that the bright star Alpha Centauri is in fact a double. Truly speaking, modern astronomy could take root in India only in the latter half of the 18th century, when it was pressed into service as a geographic aid.

As the British East India Company's non-trading activities increased and it came to control more and more territory, many of its officers started making astronomical observations for the determination of latitudes and longitudes. Surveying instruments were thus in great demand. They could be purchased from England or from the captains and crew of the European ships. When an officer died or left the country, his surveying instruments would find ready buyers. In the early days, it was not the policy of the Company to supply surveying instruments to its officers. But a small stock of surveying instruments – sextants, quadrants, theodolites, clocks and telescopes was gradually built up by purchases from England or from within the country.

The transits of Venus in 1761 and 1769 saw a flurry of astronomical activity. At the request of the Royal Society of London, the Company sent out reflecting telescopes, clocks, and astronomical quadrants for the observation, in particular, of the 1769 transit from various places. The King of France deputed Guillaume Le Gentil (1725-1792) to observe from Pondicherry the transits of 1761 and 1769. He could observe neither, but spent the time determining the longitude of Pondicherry with respect to Greenwich and Paris. An early British observer was the Calcutta-based Colonel Thomas Dean Pearse (1741/2-1789) who, during the 1770's, made observations of longitude and latitude. He participated in the Mysore War of 1781-84 and utilised his time during the march from Madras by making observations. These early observers had to employ a lot of ingenuity. In 1787, the Company purchased the following instruments for survey work in Bengal to be carried out by one Reuben Burrow (1747-92), one time assistant to the Astronomer Royal Nevil Maskelyne:



Astronomical clock by John Shelton, presumably made for the 1769 transit of Venus. the clock is now at Kodaikanal and still in use.

Arnold's chronometer Sicca	Rs 1000
Astronomical quadrant	Rs 200
Dollond's achromatic telescope	Rs 360

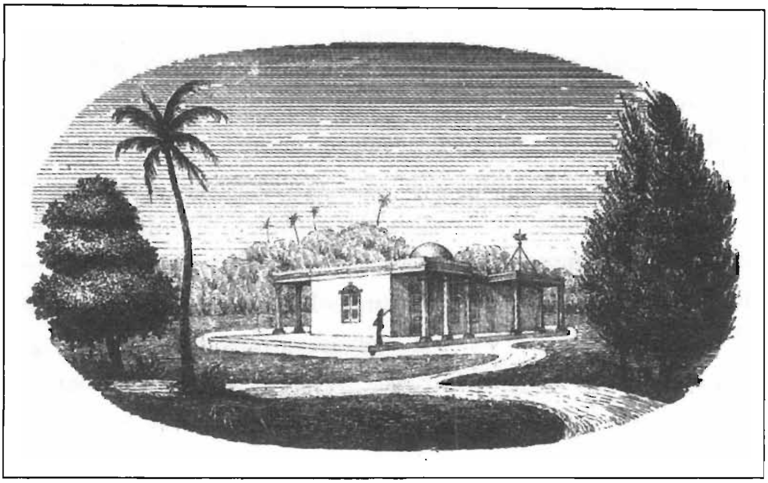
A sicca rupee was a new rupee, after two or three years of use, it was sold at a small discount.

Soon after, in 1789 Burrow proposed to the Company that an astronomical observatory be built, but the Company turned it down. As a result, individual efforts in Calcutta did not have any cumulative effect. In contrast, Madras turned out to be more congenial for matters scientific, thanks to the practical requirements there.

Madras Observatory (1786-1899)

In the 1780's the East India Company was already a big landlord on the east coast of India. Its geographical and navigational needs now came to the fore:

(i) to survey the territories it already had;
(ii) to increase revenue earnings;
(iii) to ensure safety of sea passages; and
(iv) to learn about the geography of the country the British were increasingly getting involved with.



The Madras Observatory.

Astronomy was thus required for navigational and geographical purposes. As the sea traffic increased, the limitations of the Coromandel coast became abundantly clear. The Bay of Bengal is affected by monsoons for seven months in the year. Company ships that took barely six days between Calcutta and Madras in the winter months, December through April, could require 4-6 weeks at other times. In addition, the Coromandel coast proved to be rocky, full of shoals, without safe landing for the Indiamen, and shipwrecks were common. A survey of the coast was thus essential and eventually in 1785, a trained surveyor-astronomer, Michael Topping (1747-96), was sent out from England equipped with surveying instruments. Topping has been called 'the most talented and highly qualified all round surveyor that served the East India Company during the 18th century'.

Another Englishman who along with Topping was responsible for the establishment of a public observatory in Madras, was William Petrie who had joined the civil service on arrival in Madras on June 25, 1765 Starting at the lowest rung as a writer (or a clerk), he rose to become a senior merchant in 1776. He served in the Governor's Council many times during 1790-1800. Petrie officiated as the Governor for a short period from September 1807 until December of the same year. Petrie was an influential and enlightened civil servant. He was himself an astronomer, and in 1799 enthusiastically supported Major Lambton's proposal for a trigonometrical survey of peninsular India.

In November 1786 Topping set out by land on his survey of the coast north of Madras and returned next February. In 1786 itself Petrie set up an iron-and-timber observatory at his 11 acre residence at Egmore, Madras and furnished it with his own instruments. The next year, he hired a Danish youth John Goldingham as his assistant. Petrie's observatory fulfilled the long-felt need for a reference meridian in British India and immediately became India's Greenwich. In January 1788 when Topping was sent on the coastal survey south of Madras, he arranged for Petrie's observatory to be occupied in public service. Goldingham was now hired at a monthly salary of 15 pagodas[1] (as against Topping's 192) to make observations of Jupiter's satellites in Madras corresponding to Topping's field observations.

[1] 1 gold pagoda = 3 1/2 rupees = 8 shillings

When in 1789, Petrie left for England on a short visit, he placed the Observatory in Topping's charge, offering it as a gift to the Government. Being made of iron and timber it could be removed and rebuilt.

Topping, backed by Petrie himself, made a strong plea to the Company for nationalization of this observatory, pointing out 'it is doubtless from considerations of this nature that the Hon'ble Court (of Directors) have come to the resolution of thus affording their support to a science to which they are indebted for the sovereignty of a rich and extensive empire'. On May 19 1790 the Court of Directors decided to accept Petrie's offer and to establish an observatory for 'promoting the knowledge of Astronomy, Geography and Navigation in India'.

In 1791 a garden house was purchased at Nungambakkam, Madras, while the instruments were removed to the Fort because of the war against Tipu Sultan of Mysore. The old garden house was provided with another storey, to act as the library, Astronomer's residence, and offices. A separate 20 ft × 40 ft single room was constructed in 1792 as the Observatory.

In contrast to the Greenwich Observatory, which came into existence without any instruments, Madras had instruments but no observatory. 'The Company had from time to time sent many valuable Astronomical Instruments to Madras, most of which, for want of a proper deposit, and of proper person to render them Serviceable, had been Scattered abroad in different parts of the Country, or lain by neglected at the Presidency'. Topping collected these instruments at the Madras Observatory, whose starting point was Petrie's own instruments. Till 1830 the Observatory was wholly engaged in survey oriented astronomy. Its chief assets were a 20-in transit and a 12-in altazimuth 'neither of them bearing an object glass of so much as an inch and a half in aperture'.

The ever-expanding British colonial interests depended upon safe navigation, which in turn required familiarity with the southern skies. In 1826 state-of-the-art instruments were ordered. Whatever new instruments the Observatory acquired in the remainder of the 19th century came in the next four decades. After 1864 the Observatory did not get any new instruments. Its survival was, however, ensured when in 1861 September, a German mathematical instrument maker, F Doderet, was appointed at Madras to start workshops for the repair of levels, theodolites, etc. for the Public Works Department. Doderet looked after the instruments, improvised them, and made new ones out of those discarded. He kept the two equatorials — the Observatory's lifelines, in working condition, years after they were no longer new. For the 1868 eclipse, Doderet made handy telescopes out of the parts of the historical 1830 transit and mural circle, thus proving that history is a luxury poorly-equipped observatories can ill afford. The period 1830-64 can truly be called the golden age of the Madras Observatory.

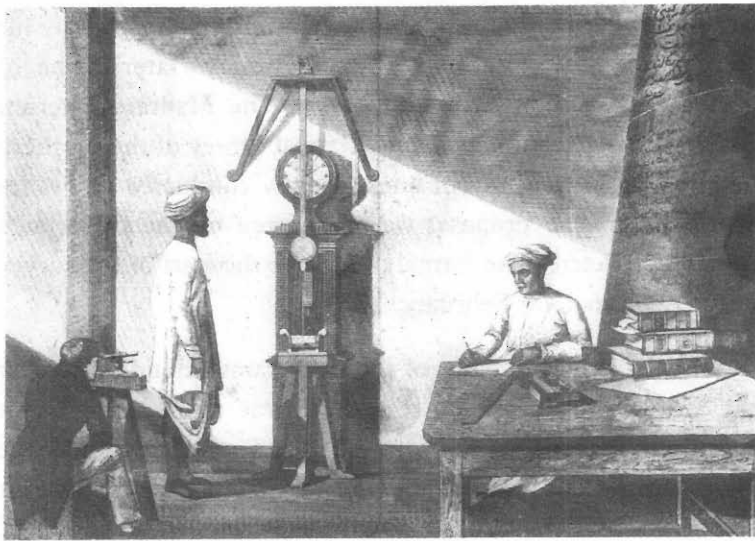
The Great Trigonometrical Survey of India (1800)

With the fall of Tipu Sultan of Mysore, in 1799, the East India Company acquired vast territories in South India. Its control now extended from the east coast to the west. Immediately, Brigade-Major William Lambton, vigorously supported by his commanding officer Sir Arthur Wellesley (later Duke of Wellington), submitted a proposal to the Madras Governor Lord Clive suggesting a trigonometrical survey of the southern penninsula on the lines of ones recently conducted in France and Britain. The proposal was supported by the Governor's Councillor Petrie. The formal orders for the start of the survey were issued in 1800 February.

In January 1818, the scope of the survey was extended to cover the whole of the subcontinent. It was named the Great Trignometrical Survey of India (GTS) and was placed under the direct control of the Governor General, with Lt George Everest (1790-1866) of Bengal Artillery as the chief assistant to Lambton, the first Superintendent of the Survey. Lambton died in 1823 and was succeeded by Everest who retired in 1843. The trignometrical survey was a monumental scientific endeavour, unparalleled in the world by virtue of its vastness and problem of logistics.

Scientific Contributions of the Madras Observatory

For over a century the Madras Observatory was the only astronomical observatory in India engaged in systematic work on stars. Goldingham, Taylor, Jacob and Pogson were the successive Government Astronomers who dominated activity at Madras. In 1843, after 13 years of painstaking work with the newly acquired transit instrument and mural quadrant, Taylor produced the celebrated catalogue of about 11,000 southern stars. It was hailed by the Astronomer Royal Sir George Biddell Airy as 'the greatest catalogue of modern times'. Jacob was interested in binary stars and he studied their positions, orbits and measured their proper motions. The Observatory received a new meridian circle during his tenure and with it, a series of observations of the satellites of Jupiter and Saturn commenced. Norman Pogson came in 1861 and was the Government astronomer until his death in 1891. He entered into newer areas of observation. While the transit instrument and the meridian circle were both utilised



Goldingham swinging a Kater's pendulum hung in front of a Haswell clock in the observatory in 1821. The second assistant, Thiruvenkatachary, is reading the clock, while the first assistant, Srinivasachary, sitting near the 18 ft granite pier, is noting down the reading (Phil. Trans. 1822).

to produce a catalogue of 3000 stars that included standards, large proper motion stars and variables, it is with the new 8-inch Cooke equatorial that he made his discoveries of asteroids and new variables. The asteroids Asia, Sappho, Sylvia, Gamilla and Vera and the variables – Y Virginis, U Scorpii, T Sagittari, Z Virginis, X Capricorni and R Reticuli – were all first discovered visually at Madras either with the transit instrument or by the equatorial instruments. The discovery of the light variation of R Reticuli by C Raghunathachary in 1867 is perhaps the first astronomical discovery made by an Indian in modern times.

During this period, the Madras Observatory participated in observations of total solar eclipses that were visible in India. Historically, the most important of these was the eclipse of August 18, 1868 which was observed by both British and French teams together with the team from Madras. They used spectrometers and obtained the spectrum of prominences. The observations led to the discovery of a bright yellow line in these spectra, that was a little more refrangible than the well known D lines of sodium and this line was given the spectroscopic designation of D3. This was the first evidence of the existence of the second lightest element in nature, namely helium, which acquired this name precisely because it was first seen in the Sun.

Advent of Physical Astronomy (1874)

Although spectroscopic and photographic techniques had been used in the Indian observations of the solar eclipses of 1868, 1871 and 1872, it was the transit of Venus in December 1874 and a belief in a connection between the Sun and the famines that led to the beginning in India of solar physics or physical astronomy as it was then called.

At the initiative of the Astronomer Royal, Sir George Airy, observations of the transit of Venus were planned at Roorkee and Lahore, under the supervision of Colonel James Francis Tennant. The following instruments were sent out from England.

i. Photoheliograph by Dallmeyer
ii. A 6-in aperture, 82-in focus equatorial by T Cooke & Sons,
iii. A small transit instrument,
iv. A standard and two journeyman clocks,
v. A chronograph,
all by T Cooke & Sons.

Tennant's suggestion of setting up a solar observatory in Simla with these instruments was turned down and he was asked to send the instruments back to England. However, where Tennant failed, Joseph Norman Lockyer succeeded by using his good offices with Lord Salisbury, the Secretary of State for India, who had visited Lockyer's laboratories at South Kensington a number of times and shown great interest in his work. Lockyer in 1877 suggested that the photoheliograph already in India should be used for daily photography of the Sun; and 'the remaining instruments should certainly come home at once. If not contrary to Indian regulations, I would beg to be allowed the use of them... .'

Salisbury accepted the suggestions, writing to the Governor General of India on 1877 September 28 '... and viewing the fact that a study of the condition of the Sun's disc in relation to terrestrial phenomena has become an important part of physical investigation, I have thought it desirable to assent to ... obtain photographs of the Sun's disc by aid of the instrument in India ... '. 'The stand of the photoheliograph will be retained in India, and a fresh tube will be sent there to replace that used by Colonel Tennant (which had been found defective) ... The other instruments may also be sent to England, and will be placed in the custody of the Science and Art Department which has offered to take charge of them'. The telescope tube was replaced by the Astronomer Royal and thus, directly on orders from the Secretary of State for India, solar photography started at Dehra Dun in 1878. In 1880 a bigger photoheliograph – of 6-in aperture, 9-ft focus objective giving 12-in diameter pictures – was sent out by the Solar Physics Committee. Also arrangements were made to modify the older one to give 8-in pictures, instead of 4-in ones. Direct photography continued in Dehra Dun till 1925 with some years of overlap with Kodaikanal.

Kodaikanal Observatory (1899)

Although the need for a modern observatory, as a successor to the one in Madras, for research in the newly opened field of physical astronomy had been felt for many decades, it was only in 1891 that the question of a new observatory was taken up in earnest. The severe famine in the Madras Presidency in 1876-77 was taken to underline the need for a study of the Sun so that monsoon patterns could be better understood. Thanks to the efforts of John Eliot, Meteorological Reporter to the Govern-

The Main Hall, Kodaikanal Observatory with the twin domes. The dome on the right houses the 8-in telescope used by Pogson.

ment of India (later renamed Director General of Observatories), it was finally decided in 1893 to establish a solar physics observatory in Kodaikanal in the Palani Hills of South India with the Madras Astronomer Charles Michie Smith as the Director. It was further decided that all astronomical activity be transferred from Madras to Kodaikanal and that the new observatory be placed under the control of the Central Government. Kodaikanal Observatory came into existence on April 1, 1899. To start with it had the following instruments that had in the meantime been collected in Madras from a variety of sources.

i. Photoheliograph called Dallmeyer No 4; this was one of the five identical photoheliographs made by John Henry Dallmeyer (1830-1833) for the British expeditions to observe the transit of Venus. With a 4-in aperture, 5-ft focus object glass, it was modified after the transit (in 1844) to give an 8-in diameter solar image. Similar to the ones in use at Greenwich and Dehra Dun, it was received in Madras in 1895 April on loan from Greenwich.

ii. Spectrograph received in 1897, consisting of a polar siderostat with an 11-in aperture plane mirror; a 6-in aperture, 40-ft focus lens; and a concave grating. The siderostat and the lens were made by Sir Howard Grubb, and the rest of the instrument by Adam Hilger.

iii. 6-in aperture telescope by T Cooke & Sons. Made for the 1874 transit of Venus observations at Roorkee, it was loaned to Lockyer, along with a three-prism solar spectroscope by Adam Hilger. Sent in 1885 to Poona, it was transferred to Madras in 1893.

iv. Transit telescope and chronograph. This 5-in aperture 5-ft focus equatorial was made by T Cooke & Sons for the Great Trignometrical Survey of India, which sent it to Madras along with the accompanying galvanic drum chronograph made by Eichen & Hardy of Paris.

v. 6-in equatorial by Lerebours & Secretan. An old Madras telescope of 1850 vintage it was remodelled by Sir Howard

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John Evershed (1864-1956)

Grubb in 1898 who mounted on it a 5-in focus photographic lens, and provided the telescope with a new driving clock.

The polar siderostat and the 40-ft focus lens, and Dallmeyer No. 4 were taken to Shahdol (now in Madhya Pradesh) and adapted for photography during the total solar eclipse of 1898.

In 1902 September a calcium-K spectroheliograph was ordered from Horace Darwin's Cambridge Scientific Instrument Company. Its construction was supervised by H F Newall and it arrived in August 1904, at a cost of $1300. This 12-in aperture, 2-ft focus solar telescope was used in conjunction with a Foucault siderostat incorporating an 18-in aperture plane silver-on-glass mirror made by T Cooke & Sons. In 1903 a dividing engine was received from the same company.

John Evershed's arrival in 1907 heralded the Observatory's golden age. He made a prismatic camera using the prisms he had brought with him, and got the spectroheliograph into working order. Evershed also built a number of spectrographs, and continued his work on radial motion in sunspots. In 1911 Evershed finally made an auxiliary spectroheliograph and bolted it to the framework of the existing instrument so that now the Sun could be photographed not only in the calcium-K light but also in the light of Balmer alpha of hydrogen. The daily photography of the Sun has continued uninterrupted to the present time. Kodaikanal has thus a unique collection of the record of solar activity spanning more than a century. Only two other institutions, the Observatory at Meudon in Paris and the Mount Wilson Observatory in the United States have a comparable collection.

Perhaps the most important result of these early years was the discovery by Evershed in 1909 of the radial motion in sunspots. During the following few years numerous studies of this phenomenon, now known as the Evershed Effect, were made in Kodaikanal and at a temporary field station in Kashmir. In 1922 Evershed also discovered, under conditions of good seeing, innumerable small displacements of lines equivalent to velocity shifts of the order of a few tenths of a kilometre per second. These studies pioneered the work on wave phenomena in the solar photosphere and the chromosphere. In 1912 instruments were received from Poona on the closure of Takhtasinghji's Observatory. Kodaikanal then acquired its largest telescope, the 20-in Bhavnagar Telescope fabricated by Messrs Grubb. It was finally installed only in 1951.

The first half of the 20th century saw astronomy in India represented by two observatories: The Imperial Government's Kodaikanal Observatory, and Osmania University's Nizamiah Observatory.

Thanks to Anil Kumar Das (1902-1961, Director 1946-1960) and the International Geophysical Year that started in 1957, Kodaikanal acquired three instruments in 1958: (i) a Lyot hydrogen-alpha heliograph ($2234) with a 15 cm aperture objective, from Paris (ii) a Lyot coronograph ($8126) with a 20 cm aperture, 3 m focus objective from M/s REOSC, Paris. The coronograph has never really been used. (iii) a tunnel telescope of 38 cm aperture and 36 m focus (Rs 5,25,000), from Sir Howard Grubb Parsons. The tunnel telescope has been the main solar physics telescope in the country, ever since. This was the last consignment of instruments to reach Kodaikanal Observatory.

In April 1960 with the appointment of Manali Kallat Vainu Bappu (1927-1982) as Director, the emphasis shifted towards modernisation of the stellar astronomical facilities. With the establishment in 1968 of an observatory in Kavalur, the main observational activity shifted to this new observatory. However, the solar observations have continued in Kodaikanal in a more modernised set-up.

Concluding Remarks

The first half of the 20th century saw astronomy in India represented by two observatories: The Imperial Government's Kodaikanal Observatory, and Osmania University's Nizamiah Observatory. The real reason for the establishment of Kodaikanal Observatory was the need of the British astronomers to collect good quality data on the Sun, which as Lockyer pointed out was not so obliging to Britain itself. The solar connection with the monsoons (which even today determine India's prosperity) was used as a convenient reason to strengthen the case for a solar observatory in India. During the British period, Kodaikanal's main stay was the state-of-the-art instruments made by Evershed himself.

It was after India's independence in 1947 that Kodaikanal Observatory received the new Government's support in the name of astronomy for pleasure and prestige. Thus the International Geophysical Year was used to buy new equipment for solar studies.

When Bappu became the Director, he discovered that by the standards of the 1960's the facilities in Kodaikanal were totally inadequate as far as stellar astronomy was concerned. He started the search for a good site in peninsular India where a stellar observatory could be built. A decade-long effort led him finally to the spot in Javadi Hills of Tamilnadu close to the village of Kavalur where the Vainu Bappu Observatory stands today. As a result of Bappu's efforts a totally indigenous 2.3 metre telescope was fabricated and then installed in Kavalur. Bappu never lived to see it. This telescope was dedicated to the nation in January 1986 by the then Prime Minister, the late Shri Rajiv Gandhi and in honour of Bappu's memory both the telescope and the observatory were named after him on this occasion.

Address for Correspondence
Rajesh Kochhar
Director
National Institute of Science, Technology & Development Studies
Pusa Gate, K S Krishnan Marg
New Delhi 110 012, India.
Email: rkk@nistads.res.in
rkochhar2000@yahoo.com

No matter how compelling or elegant it is, a theory of physics must be subjected to experimental verification or it differs little from medieval theology.

Sheldon L Glashow
Interactions
Warner Books, New York, 1988, p.77