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Two Significant Landmarks In The Colonial Space Science

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Abstract

The beauty and the regularity of the heavenly bodies have fascinated the mankind from time immemorial. Perceptions of space and celestial bodies in ancient India derive from mainly two sources, which often overlap, namely mythological/religious explanations of the origins of the universe and the contributions of ancient scholars to astronomy. The Vedic astronomy and other related literature and works of astronomy and astrology are known for its vastness and richness. However, the modern astronomy came in to the existence after the arrival of Europeans. Even though Europeans were responsible for the introduction of modern space science, we cannot set aside our indigenous efforts in understanding space. This article makes an attempt to highlight the role of Europeans in the introduction of modern astronomy and India's indigenous efforts, particularly the role of Tippu Sultan in rocket technology.

Keywords: Colonial Space Science, Tippu Sultan, Vedic astronomy

1. Introduction

The earliest modern astronomers in India were the European traders and the Jesuit priests. With the post-Aurangzeb collapse of the Mughal Empire, the European vaishya outfits developed kshatriya ambitions and got down to the task of acquainting themselves with their future empire. In the early years, the young officers of the British East India Company, feeling and acting like pioneers in an exotic land, took astronomical observations for their own amusement. Surveying instruments were in great demand. They were purchased in England or from the captains and crew of the European ships. When an officer died or left the country, his instruments were readily bought by others or even by the Company itself, which in the course of time came to build a good stock of surveying instruments. The 1757 battle of Plassey transformed the British East India Company into a political power. Consequently, revenue and geographical survey of its lands began in right earnest.

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. However he illustrated 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 secretary of the Royal Society of London wrote on 22 January 1768 to the East India Company on "an affair of some importance to the Advancement of Science and the honor of this Country. . . . The honor of this Nation seems particularly concerned in not yielding the palm to their Neighbours, and the Royal Society intends to exert all its strength and influence in order to have the observation made with the great accuracy. . . .".

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 (1741-1789) 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:

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

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.

The East India Company having resolved to establish an observatory at Madras for promoting the knowledge of Astronomy, Geography and Navigation in India, Sir Charles Oakeley, then President of the Council had the building for the observatory completed by 1792. It was the first modern public observatory outside Europe; and to use today's term, the first modern research institute in India. The Madras series of observations had commenced in 1787 through the efforts of a member of the Madras Government, William Petrie – who had in his possession two, three- inch achromatic telescopes, two astronomical clocks with compound pendulums and an excellent transit instrument.

Although the Company had grandiosely declared that the purpose of the Madras Observatory was to 'promote the knowledge of Astronomy, Geography and Navigation in India', there were at the moment more important things than science; for example, increasing the Company's revenue by improving irrigation facilities. Topping was given this additional task.

Major William Lambton started his survey in 1802 from Madras Observatory using second-hand instruments bought in Calcutta. In the early years, both the Survey and the observatory were engaged in similar work. The observatory provided the reference of meridian for the survey work, and Capt. John Warren's 1807 values for its longitude continued to be used in the maps till its revision in 1905. Both the observatory and the Survey were short of instruments and borrowed from each other. The observatory provided time signals for the ships, and repaired privates as well as public scientific instruments. After the Lambton's, in 1823 George Everest arranged for the transfer of an Instrument from Madras.

With characteristic thoroughness, Everest wrote to the Astronomer and to the Surveyor-General, and then personally requested the resident at Madras to contact the Madras Governor. The instrument was an old second-hand 18 inch diameter circular instrument which combined the advantage of the Theodolite and Zenith Sector*. Twin of the instrument Lambton had been using, it was not suitable for primary triangulation, but was the best available. The Great Trigonometrical Survey of India (GTS) came into its own when Everest became the Surveyor-General, in addition to being Superintendent of the GTS in 1830. The Trigonometrical Survey took priority over all other surveys, and was equipped with the best of manpower and instruments. A workshop was set up (at Calcutta) for repair and reconstruction of instruments. Later a testing facility was established in England for designing new instruments and getting them made. From its very inception, military officers had manned the Trigonometrical Survey. They were however not permitted to be wasted on pure astronomy, although magnetic observations were considered legitimate military business. Where pure astronomy stood vis-à-vis applied astronomy is tellingly brought out by the following little known incident. In 1834, on orders from the government, astronomical instruments from the Survey of India were issued to enable the former Bombay astronomer, William Stephen Jacob to observe the opposition of Mars. This happened when Everest was out on fieldwork. On his return Everest made a strong protest against the loan, saying, the discoveries, which the late astronomer of Bombay is likely to make in science, would hardly repay the inconvenience occasioned by retarding the operations of the Great Trigonometrical Survey.

For over a century, the Madras Observatory continued to be the only astronomical observatory in India engaged in systematic measurement of star position and brightness. Goldingham, Taylor, Jacob and Pogson were the government astronomers who dominated the activity at Madras. With a new five feet transit, Taylor completed in 1884 his catalogue of positions of over 11,000 stars. Double star catalogues, measures of their separation and the determination of their orbits were Jacob's principal interest. The observatory received a new meridian circle during his tenure and with it, besides observations for the determination of star position and evaluation of proper motions, a series of observations of the satellites of Jupiter and Saturn were commenced. From 1861 until his death in 1891, N. R. Pogson as government astronomer, in keeping with progress in the science, entered into newer areas of observations.

While the transit instrument and the meridian circle were both usefully utilized for a star catalogue of 3000 stars that included standard stars, large proper motion stars, variable stars and the like, it is with the new 8 inch Cooke equatorial that he made discoveries of asteroids and variable stars. The asteroids Asia, Sappho, Sylvia Camilla, Vera and the variable star 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 in 1867 of the light variation of R. Reticuli by C. Raghunathachari is perhaps the first astronomical discovery by an Indian in recent history. Pogson also undertook the preparation of a catalogue and atlas of variable stars, complete with magnitude estimates made by him both of the comparison and the variable. These were edited by Turner after Pogson's death.

An Indian Observatories Committee in England advised the Secretary of State on matters pertaining to the administration of the Madras Observatory. In many respects, with no adequate staff to help him, Pogson had taken on more programmes of work than he could bring to a successful termination. There were questions raised in London in 1867 whether the Madras Observatory need be continued at all, since the British had started some other observatories in their possessions in the Southern Hemisphere. It was even recommended that the Madras Observatory should concentrate more on publication of the observations already made; than make new ones. The work of Pogson was commended on, and questions on the closure of the Madras Observatory relegated to the time when Pogson would retire.

Meanwhile in May 1882, Pogson had proposed the need for a twenty inch telescope, which could be located at a hill station in South India, engaged in photography and spectrography of the sun and the stars. The proposal received active support both in India and Britain and necessary authority given for the search of a suitable location in the southern highlands of India. Michie Smith undertook the survey of Palani and Nilgiri Hills in 1883 and 1885, his observations covering both the requirements of transparency and steadiness of image during both day and night.

At the Indian Observatories Committee meeting of July 20, 1893 with Lord Kelvin in the Chair, the decision was taken to establish a Solar Physics Observatory at Kodaikanal with Michie Smith as its Superintendent, the decision on the permanent site of the Astronomical Observatory being deferred to a later date. The observatory was to be under the control of the Government of India instead of under the Government of Madras, as it had been for a century earlier.

The relative importance of the two streams of astronomy, applied and pure, is best brought out by economics. In the meantime an observatory was set up at Kodaikanal in 1899 for solar studies.

Not surprisingly, it was also justified on utilitarian grounds. It was said that the observatory would help understand the occurrence of famines. The argument was Madras Presidency had been hit by a severe famine in the 1876 – 78s. However, the scientific programme for the Kodaikannal observatory prepared by the Royal Society in 1901 makes no mention of solar-terrestrial connection. Kodaikanal was in the forefront of solar research under John Evershed he was at the observatory from 1907 to 1922. Evershed had offers from the United States, but he decided to come to India, no doubt to work in solitary splendour. Equipping observatory with state-of-the-art instruments, some of which he himself made, he discovered the Evershed effect (1909).

For the thirty eight years between 1922 and 1960, the directors were Royds, Narayan and Das. The activity in solar physics was maintained at the pace it has been and work progressed in the traditions of the early years. Highlight of this era are the discovery of the oxygen lines in emission in the chromosphere without the aid of an eclipse, the centre-limb variations of the hydrogen lines and their use to study the solar atmosphere and the detailed study of the properties of the dark markings seen in H-alpha.

Even though the Madras Observatory was the first one started by the British and the Solar Observatory at Kodaikanal is the famous one which is still functioning there were many observatories started during the 19th century to advance the astronomical alertness. The list of observatories as follows:

1. Madras Observatory (1792–1900)
2. The Royal Observatory at Lucknow (1835–1849)
3. Raja of Travancore Observatory at Trivandrum (1842–1865)
4. Capt. W.S. Jacob’s Observatory at Poona (1842–1862)
5. St. Xavier College Observatory at Calcutta (1875– ca. 1918)
6. Maharaja Takhtasinghji Observatory at Poona (1882–1912)
7. Hennessy Observatory at Dehra Dun (1884–1898)
8. Solar Observatory at Kodaikanal (1901–to date)
9. Nizamiah Observatory at Hyderabad (1901–1954).

Thus, the establishment of British rule in India brought the contemporary Western science into India. The Western type of refractor telescope and observatories were founded in India for promoting astronomical science. Scientific telescopes created a new outlook which laid the foundation of modern astronomical studies on a scientific basis.

2. History of Rocketry

The word rocket originated from Italian rocchetto meaning 'small spindle (for spinning)' or the German word rocken, meaning 'distaff' (a rod or staff) used for holding the bunch of fibres from which thread is drawn in hand-spinning. In modern terms, rocket means a propulsive device using a mixture of propellants (fuel and oxidiser) which, upon ignition, provide a reaction force to propel a space vehicle, missile, rocket-assisted aircraft etc. Rockets for warfare or amusement were made by packing slow-burning gunpowder into a tube of cardboard, wood, or metal. Ignition of the powder charge produced hot gases which were expelled through a nozzle and thus propelled the rocket in the opposite direction.

William Congreve and William Hale had opened the new era in the history of modern rocket technology. However, their places in the history of rocketry cannot be fully appreciated without an understanding of rocket development over the previous six centuries. As Congreve himself pointed out, he never invented the rocket; he was merely its "improver". Indeed, his interest in pursuing rocketry was sparked directly by his knowledge of its earlier use in India.

3. The First Rockets

Evidence indicates that the Chinese utilised rockets in warfare in the year 1232 AD. One such weapon called fe-ho-tsiang, or flying fire arrows. It is believed to have consisted of an arrow attached to a rocket propelled by gun power. Chinese strongly relied on the ancient yin-yang philosophy to explain the burning of gunpowder. According to yin-yang philosophy, all forces in the universe resulted from the balance of yin (female or passive) and yang (male or active) elements. The union of saltpetre (yin) and sulphur (yang) thus produced fire. Subsequently the technology spread from China to Europe where it was sporadically used. However, the second half of the eighteenth century witnessed Indians using war rockets. The documents are not clear whether Indians indigenously developed the gunpowder or they borrowed the technology from outside the country, especially China. The reason for this is that the history of the development of firearms is poorly documented. The mythological source that speaks about gunpowder and rocket technology in India seems to do not possess any historical values.

One of the European works Sketches Chiefly Relating to the History, Religion, Learning and Manners, of The Hindoos (1790) by Quintin Crawford describes Indian Rockets as:

> *It is certain, that even in these parts of Hindostan that were never frequented either by Mohammedans or Europeans, we have met with rockets, a weapon which the natives almost universally employ in war*

The available western sources indicate that Indians, particularly Tippu Sultan and his contemporaries, used the war rockets against their enemies. In the second half of the eighteenth century Hider Ali and his son Tippu Sultan ruled Mysore state. Both were maintaining war rockets, the former had 2000 war rockets later had 5000. Another source is available at Wallops Flight Facility at Wallops Island in the east coast of Virginia in USA. That was a painting depicting Tippu Sultan's Rocket Technology. This was rightly pointed out by Dr. Abdul Kalam when he was in USA during the 1960s.

> *Here, I saw a painting prominently displayed in the reception lobby. It depicted a battle scene with a few rockets flying in the background....It turned out to be Tippu sultan's army fighting the British. The painting depicted a fact forgotten in Tippu's own country but commemorated here on the other side of the Planet*

William Kirkpatrick translated and annotated the Select Letters of Tippoo Sultan (1811), which reveals the organizational structure of an Indian rocket unit in 1793. At that time there were 48,000 fighting men in Tippu's army. These troops were divided into twenty-seven kushoons (brigades). Attached to each kushoon was one jowk, or one company of rocket-men. Each jowk of rocket-men comprised 39 soldiers, making a total of 1026 rocketeers. Tippu's army had at least 1944 rockets; bullock carts and camels also transported rockets.

Another Englishman stationed in India during this period, Captain Charles Gold, gives a different number of rocket-men, or rocketeers, in Tippu's army. According to Gold's Oriental Drawings (1806), Tippu had sixteen kushoons, each with 200 rocketeers; this came a total of 3200 rocketeers. It is interesting to note that if there had been twenty-seven kushoons (Kirkpatrick's figure) with 200 rocketeers, the figure agrees with the 5000. Rocketeers usually ascribed to Tippu's army. Part of the confusion may be due to changes in Tippu's army pay regulations over the years. Gold wrote that the rocket-men were omitted in the records because they were part of the irregular infantry and were paid different wages from ordinary soldiers.

There is no disputing the fact that Tippu's forces used rockets more extensively than previous Indian rulers. According to a list of the ammunition captured by the British at Srirangapattanam on 20 May 1798, there were 9000 filled rockets of different sizes and 700 empty rockets

4. Conclusion

Indian war rockets may have been simple, but they impressed eighteenth-century British soldiers so much that the East India Company made inquires to find anyone who knew how to make them. Evidently the Company entertained the idea of making copies and retaliating against the Indians, but no expert could be found. A handful of these implements had already been sent back to England as war trophies. Around 1801, William Congreve, a colonel in the British army, heard about these weapons and clearly examining from that time until his death in 1826 he devoted himself to the design, testing and production of a variety of rockets for military purposes. So it is obvious that the British borrow the technology from Indians.

There were several reasons for the popularity of war rockets in India. The abundance of saltpetre (a mainstay in the East India Company trade) and bamboo was also factors in the popularity of the rocket in the East. Bamboo, found in India and China, made possible easily adapted rocket guide sticks that were light, strong, and straight; in Europe, pine or other wood sticks had to be specially shaped and balanced, which is a time-consuming job.

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It was used to measure the angle between the zenith and a star as it crossed the meridian
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