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The Beginnings of Modern Astronomy Research in British India: Pogson and Evershed

Biman B Nath*

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Abstract

Modern astronomy was introduced in British India through colonial necessities and with modest instruments. However, within a few decades, due to the efforts of astronomers such as Norman Pogson and John Evershed, the standard of astronomical research in India attracted world-wide attention. We briefly sketch the evolution of this phase through a few examples of research topics pursued here and the change of the manner in which they were pursued.

Key words: Astronomy, Evershed, Evershed Effect, General theory of relativity, Helium, Kodaikanal observatory, Madras observatory, Pogson, Total solar eclipse.

1. Introduction

Modern astronomy in British India began with the same impetus as in other fields of science, namely to do with what the colonial powers considered useful for their purpose. If one compares *Jantar Mantar* that was built a few decades before the battle of Plassey, with the Madras observatory, which was built a few decades after the event, one can understand how the flavor of astronomy, in particular, changed with the British taking over as the new rulers.

Jantar Mantar did not have any new instruments like telescopes although it was not that Raja Jai Singh II was not acquainted with telescopes. He built Jantar Mantar for the purpose of accurate calendar and his massive structures were sufficient for that purpose. On the contrary, when the East India Company was trying to get a foothold in South India, after winning the Battle of Plassey, they realized the importance of mapping the Coromandel coast, which was not quite amenable for building a harbour. This led Michael Topping, a surveyor who was entrusted with the job, to look for a reference meridian, for which he chose the private observatory of William Petrie at Egmore. Topping wrote to the Company officials that astronomy was both 'parent and nurse of navigation' (Sen, 2016). It was with these colonial necessities that modern astronomy arrived in India.

However, soon after the Great Trigonometrical survey took off under the supervision of George Everest (after Colonel Lambert), in the 1830s, the importance of the Madras observatory diminished as far as geographical survey was concerned. However, there was still a need for a survey of southern stars for navigational purpose. By 1844, a catalogue of 11000 southern stars was produced by Glanville Taylor, called the *Madras Catalogue*. By this time, an observatory had been set up in South Africa, even this need was taken away from the Madras observatory (Sen, 2016). Although the then Royal Astronomer George Airy hailed the Madras Catalogue as 'the greatest catalogue of modern times', he wrote to the Secretary of State for India to close down the observatory. Somehow this was averted, mostly

* Raman Research Institute, Sadashiva Nagar, Bangalore 560080, Email: nath.biman@gmail.com

because of the pride of local British officers, and Norman Pogson was appointed the Government Astronomer at Madras.

2. Norman Robert Pogson

For various reasons, this appointment further signaled a downslide of the relevance of Madras observatory in world science.

One of the reasons was that the old style of astronomical research, mostly to do with positions and motions of stars, was coming to an end and Airy was definitely an old-style astronomer, whereas scientists like Pogson saw a new era in spectroscopy. Airy once even defended not having championed stellar spectroscopy at Greenwich observatory, by saying that the new science of spectroscopy did not fit into his understanding of Greenwich's purpose. Secondly, Airy had turned down Pogson's application for a position at the Radcliffe observatory, where he had worked as an assistant, and where he had come up with a system of measuring the brightness of stars that we still use today—the magnitude system. Historians have suspected that this was because Pogson did not have an Oxford or Cambridge degree. In his reluctant recommendation letter for Pogson for the Madras job, Airy wrote: 'Mr Pogson was educated, I believe, at a German University', which was factually wrong

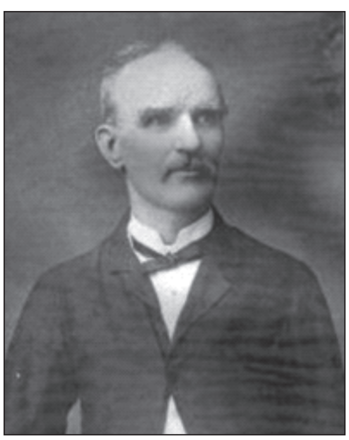

Fig. 1. N R Pogson (Courtesy: Indian Institute of Astrophysics Archives)

(Reddy, 2007). He was also not wealthy enough to build a private observatory for himself, as many others did at that time, and which we will see later that Evershed also did. Pogson came from a family of hosiery manufacturer, and had apprenticed with an instrument maker in Manchester, before taking up a job in an observatory.

Thirdly, Pogson's plan of conducting a survey of southern stars from Madras was slashed by Airy soon after Pogson landed here. Airy thought Sydney was a better place. Pogson wrote to Airy in bitterness:

> The remarks there fill me with surprise and regret, to think that of my many acquaintances, whom I have been accustomed to think were friends, and who knew well what my avowed objects and policy were in coming out to India… I could imagine willfully ignored (Pogson, Letter to Airy, 1862).

From this point on their relation became sour. Airy practically stopped reading Pogson's reports and never communicated them to be published in journals. As if this wasn't enough, Pogson complained about the salary, the assistants ('most are dolts...machines without the certainty of machinery') and living condition *('…*first observations in India taken in the compound, in happy, fearless ignorance of snakes, centipedes, scorpions, and all the filthy dangerous vermin abounding in my new home') (Pogson, 1868). But he continued to do his asteroid observations, the first ever done from Asia. He did not have much help, except Raghunath Chary, and his own children. He got his son trained in Kew Observatory and requested Airy to employ him, stating, almost pleading, that this was 'not as nepotism or extra income, but in the interest of getting things done', because the salary would be 'equal, I suppose, to that enjoyed by a Governor's coachman or cook, a fifth of that a native or East India deputy Collector' (Ansari, 1978).

His problems with his peers in England came to ahead during the important total solar eclipse in 1868. This was the famous eclipse during which the signature of helium was discovered in the Sun. While the Royal Astronomical Society funded an expedition under the supervision of James Francis Tennant, who was a surveyor, and equipped the team with telescopes and spectroscopes, Pogson was left high and dry. He noticed that the coastal town of Machalipatnam was in the totality belt and which needed a weather station because it had been badly hit by a cyclone four years before. He mounted an eclipse expedition in the guise of setting up a meteorological station, picked some engineers from the Telegraph and Railway departments, managed to get a spectroscope from William Huggins and went there.

Although most historians wrongly wrote that Pierre Janssen saw the helium line first from Guntur, Janssen categorically thought it was a familiar sodium line (Nath, 2013). Only Pogson thought the line was 'at or near D*'*. As Norman Lockyer later recounted the story of helium in an article in *Nature* in 1896 (Lockyer, 1896), this was what prompted him to look at this line carefully when he observed the sun on 20th October that year. Subrahmanyan Chandrasekhar wrote in an article in 1947 that, '... referring to [the] yellow line, Pogson said it was 'at or near D'. Almost the whole of the story of helium depends on this distinction' (Chandrasekhar, 1947). Pogson also noticed for the first time the polarized nature of coronal light (Nath, 2013).

But unlike others, Pogson's report was not published. His peers in England had decided that Pogson was no good. That year his wife was dying of cholera. Yet he somehow managed to get the report published privately with government money from Madras. He died in 1891. His work on variable star remained unpublished.

Before his death, British astronomers considered setting up a more modern observatory, mostly to take up solar physics. The works of Norman Lockyer and others had hinted at a possible connection between sunspots and weather, including the success and failure of monsoons, and the British government was supported the work in the belief that it might help correctly predict monsoons. Colonial necessities again, however, as we have seen earlier, the work of astronomers would often go beyond the colonial mandate and contribute to science in general.

3. John Evershed

Kodaikanal was chosen as the location for the new observatory, which started its work in April 1899, with Mitchie Smith as its first director. The character of astronomy in India, however, changed with the arrival of John Evershed in 1907. Evershed was an excellent amateur astronomer. Although he was trained in chemical engineering, he had a private observatory in Kenley, Surrey. He had designed his own spectroscope, knew George Hale, a well-known American astronomer at that time, and was doing regular observations with his own spectroheliograph—with which one can take the photograph of the Sun at a particular frequency of light. Especially his results during a solar eclipse in 1898 in India impressed everyone. He was appointed the chief assistant at Kodaikanal, and soon after his arrival, he became the director (For details, please see *John Evershed and Solar Physics at the Kodaikanal Observatory,* Indian Institute of Astrophysics).

Evershed focused on the shifts in wavelengths of light emitted by different elements from the Sun. One idea was that the pressure in the solar atmosphere was large and caused the shifts. Walter Adams at Yerkes observatory in the USA had compared the wavelengths of lines from different parts of the Sun, eg, between the limb and the center. This removed the uncertainty due to pressure. Jacob Halm at the Cape of Good Hope observatory noticed in 1907 that lines from the limb were redshifted relative to the center, which made sense if gas is rising.

Evershed made an important discovery in this connection. While others were studying sunspots near the central meridian of the sun, Evershed observed spots at various positions, and found that the closer a spot was to the limb, the more pronounced was the displacement of spectral lines in the outer regions of the spot. This suggested an outward flow of material radially from the center of the spot, parallel to the surface of the Sun. This 'Evershed effect' established his reputation as a careful observer.

Fig. 2. John Evershed at the Kodaikanal Observatory (Courtesy: Indian Institute of Astrophysics Archives)

The magnitude of the shift of wavelength was a contentious issue at that time, especially because Einstein's gravitational theory predicted a redshift, irrespective of the location of the line. Without going into the details of this complex history, what stands out is the importance that was given to Kodaikanal results by scientists all over, in addition to that from Mt. Wilson. Evershed had estimated by 1912 that the pressure in the solar atmosphere was about a tenth of an atmosphere, which would discount the pressure hypothesis for redshift. This estimate was later corroborated by the theoretical work of Meghnad Saha.

However, Evershed was not sure that his results matched Einstein's prediction. Firstly, the band of lines of cyanogen that was being used was not narrow, and the scatter in the data of shifts did not allow a straightforward interpretation. In March/April of 1918—exactly a century ago—Evershed started a new set of measurements with a more sophisticated method, by superposing negative film on film. Although Mt. Wilson people chose the fourth order spectra, Evershed found that third order spectrum had more contrast and was better for his purpose. He published this result in Kodaikanal observatory Bulletin in 1920, saying:

> The result…is remarkably close to the shift corresponding to 0.634 km/sec, predicted by Einstein and taken by themselves these results must be considered distinctly favourable to the relativity effect (Crelinsten, 2006).

Although it is a very difficult measurement, because of the convective movements in the solar atmosphere, and which has been tackled only recently with new techniques using iodine lines (the same technique for detecting exoplanets) (Takeda, 2012), yet, this was a remarkable result obtained from this part of the world.

4. Summary

This transition from the early days of cataloguing southern stars for navigational purpose to the stage of doing forefront astrophysical research is indeed remarkable. Although modern astronomy, like other fields of science, came to India because of colonial needs, scientists had transcended the colonial mandate, and went on to make discoveries that went beyond the needs of the colonial rulers. In the process of their own research, they trained Indian assistants and inspired students in universities, among whom astrophysicists like Meghnad Saha would emerge one day.

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