



History of an observatory on the Agasthiyar hill top

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Abstract

Remarkable feats of the past often leave behind historical pointers leaving us mesmerised. One such episode is that of the establishment of a magnetic and meteorological observatory on the peak of the Agasthiyar mountain 6200 feet above the sea level on the western Ghats in the year 1855 by John Allan Broun under the princely state of Travancore. It had facilities far ahead of its times representing the commitment to scientific universalism by its patrons. Broun established the observatory on the Agasthiyar mountain peak and undertook a meticulous study overcoming daunting geographical constraints. Broun was awarded the Keith Medal from the Royal Society of Edinburgh for the period 1859–1861. He received the Royal Medal from the Royal Society of London in 1878. He passed away in 1879. Remnants of the magnetic observatory which earned Broun scientific acclaim remain undiscovered, clouded within the Agasthiyar mountains.

Keywords Trivandrum observatory · Agasthiyar observatory · Magnetic declination

1 Introduction

“Trevandrum (Trivandrum) Observatory” was perhaps the mother of all modern scientific endeavours of the erstwhile Travancore Kingdom. King Swathi Thirunal Rama Varma laid the foundation in 1836 for an observatory that has a glorious scientific past which never got its due from the western scientific community. Unlike the observatories run by the East India Company at Bombay (Colaba) (established 1826) and Madras (established 1786), both of which were military establishments based within forts. The Trivandrum Observatory was part of a growing complex of the educational and cultural institutions within the princely state of Travancore. Located in the heart of the Trivandrum city, the observatory is located on the highest hilltop in the city at a height of 196 ft above sea level providing clear horizontal vision to the western Ghats towards the east and the Arabian sea in the south. When the observatory was being constructed in 1836, the only press in Trivandrum was owned by the Church Missionary Society, so the Sircar (Government of Travancore) also ordered a new printing press to be built under the observatory’s director. Decades later, this would become the

government press (the Sircar Press). What makes it beyond today’s imagination are the historical pointers that a second observatory functioned on the Agasthiyar mountain peak at a height of 6200 ft. above sea level during 1855–1859 and 1864–1865 (Fig. 2) (Wells, 1857). This article focuses on the history of this forgotten and lost observatory. The drawing in Fig. 2 represents an observatory consisting of two domes and seated within a mountain terrain which are taller than the observatory. There also appear dense patches of vegetation representing a geographical location different to that from the drawings in Fig. 1 which represents the Trivandrum observatory on the highest hillock with three distinct domes and systematically designed approach road.

Mr. John Caldecott, the then Commercial Agent of the Travancore Government at Allepey was the first director of the “Trivandrum Observatory” having served from 1836 to 1849. With Caldecott’s death in 1849, the then King Uthram Thirunal Martanda Varma offered the post of Director to John Allan Broun who at the time was serving as the director of Sir Thomas Mackdougall Brisbane’s magnetic observatory in Makerstoun, Scotland (Fig. 2). Broun was heading the magnetic meridian mapping studies at the Observatory which was the major subject of enquiry for the British Association for the Advancement of Science (BAAS). Since 1839, the BAAS had been developing a coordinated system of global magnetic observations. Strung across stations from North America to Eurasia, and down through Australasia towards Antarctica, thirty-three observatories formed a more or less synchronized

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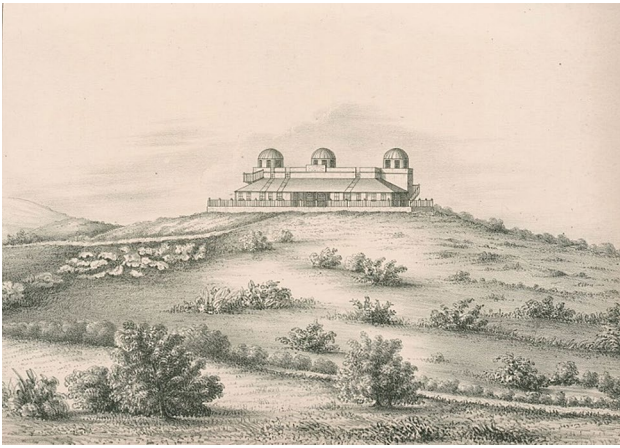


Fig. 1 Trivandrum Observatory—drawing from the article “Account of the Trevandrum Observatory” published in *The Madras Journal of literature and science*, Vol VI in 1837

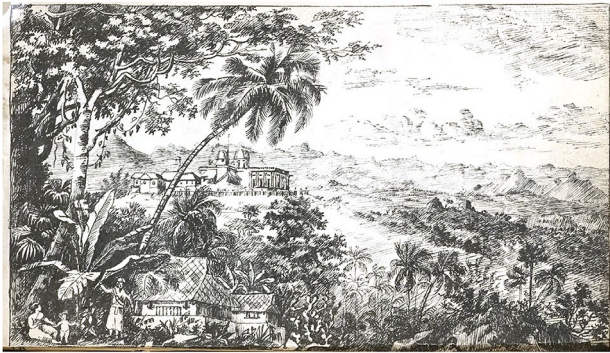


Fig. 2 Drawing from the “*Report on the Observatories of His Highness the Rajah of Travancore at Trevandrum and on the Agastier Peaks of the Western Ghats*, Trivandrum: Sircar Press, 1857”

global network of magnetic observatories. Having received the invitation from the Raja of Travancore, John Allan Broun wrote from Europe, in July 1851 to Lt. General Cullen, on the subject of setting up a magnetic observatory in Trivandrum even before his arrival. He had previous experience on terrestrial magnetism between Makerstown Observatory and the Cheviot Hills in Scotland. He had communicated his ideas on the subject to a number of scientists in Europe, and all agreed with him in considering the objects he had in view of the highest importance to science.

2 Establishment of the Agasthiyar observatory

Broun accepted the higher salary offered by the Raja of Travancore and resigned his position as Brisbane’s observatory director. Broun along with his wife and four children arrived in Trivandrum. In the preface to Broun’s book *Magnetic declination made at the Trivandrum and*

Agastia Observatories he writes that “His Highness Marthanda Varma the Raja of Travancore having named me for the direction of his observatory, I left Europe on the eleventh of November 1851, and arrived at Trivandrum on the eleventh of January 1852, when I took charge of the observatory” (Broun, 1874). The research on terrestrial magnetism of that time was primarily to understand how the strength of magnetic field varied from the equator to higher latitudes and elevations. It required simultaneous measurements of magnetic field strengths from two different locations. On the 23 March 1852, he brought the subject of building an observatory for magnetic studies before the Sirkar in an official form, and on the 30 April 1852, he received the official sanction for the erection of the observatory on the Western Ghats. The Western Ghats is a range of mountains which extend from the valley of the Tapti to the Gap of Palghat about 800 miles and then after an interruption to Cape Comorin. The Agasthiyar peak was considered by the ancient people of Travancore as the place made holy by the stay of the great sage, Agasthiyar, a savant physician, philologist, and theologian (Fig. 3).

Broun records that his first trek to the Agasthiyar peak was on 11 May 1852 along with Lieut. Colonel S. A. Grant to identify the best locality for an observatory. They mounted on ponies and their camp material was carried overhead by coolies from the local market. After travelling 16 miles eastwards from Trivandrum winding through rice fields, over hills and through forests all human cultivation ceased at the village of Areenaud. The path then was a continuous ascent and descent through forests over brooks which were picturesque glades resembling English parks. The track taken by them lead to the north of Agasthiyar which turned at a corner of a steep spur. At the end of two days of journey they reached the base of Attyaar Mally where timid hill men provided them huts to stay. These hill men were called Kanikar’s who lived in small clusters of 20–30 families and were smaller in size relative to the natives on the plain. The clothing they used was barely a yard long. They offered a fowl to Gods whose name they barely knew at the time of sowing and gathering. The chief was also the priest who knew the terrain very well. They lived in huts made of huge trunks which were loaded with ponderous stones in unstable equilibrium that rolled down when the wild boar entered his ridge and warned them. Broun accounts that he ascended the Agasthiyar Malay guided by these hill men. The first 1000 ft. was treacherous like a bad stair case formed out of roots and rocks. The Agasthiyar mountain forms a ridge 4600 ft. above the sea level on which General Cullen had already established a meteorological station with aneroid barometer, thermometers, pluviometers and Lind’s wind gauge. On reaching this station they had to wait for two more days as they recorded 12 inches of rain in two days and had





**John Allan Broun Esq., F. R. S.,
Government Astronomer—1852-1869**

Fig. 3 Portrait of Mr. John Allan Broun available presently in the observatory

to remain confined within the huts. The coolies they had brought along them pleaded to return to the base as the low temperature was something they had never experienced in their lifetime. On 15th May 1852, the ascent to Agasthiyar was started at 9 a.m. in the morning. They descended 1000 ft. and then trekked up the Agasthiyar along an Elephant track to reach a spur called “Podiya Mallay (Puthughai Malai)” which was believed to be the residence of the Agasthiyar sage. They crossed water streams and stoned terrain cutting through the dense shrubs and forest. The bare footed attendants helped them climb the rocky and wet terrains, a climb of 1400 ft. which enabled them to reach the peak of Agasthiyar by noon. The top was bare rounded granite rock with less than 20 yards’ level ground. There was a patch of forest in the south east descending to 70 yards which Broun identified to be the best location for the observatory. A quarter of an hour was spent at the top and Broun decided to find an easier route to the top through the north-east jungle. They descended and reached Attyaar base in three hours losing blood from leech bites. On 17th May they reached back Trivandrum (See Fig. 4).

On 26th May, Broun conveyed the report of the trek to the Diwan of the Travancore government and declared his intension of setting up the Observatory on the Agasthiyar peak. Broun was plagued with a number of difficulties on this proposal. The chief objection to this locality lay in its



Fig. 4 Drawing of the “Agustia Peak by I.B. Plate 2, Broun (1857).”

position, without roads, a day’s journey from the nearest cultivated grounds, surrounded by forests inhabited by elephants and tigers. The construction of an observatory on this nearly inaccessible rocky peak presented considerable difficulties. It was doubted also whether native observers, accustomed only to the climate of the plains, could live, or could be induced to try to do so, on a mountain top which for months of each year remains buried in cloud. Legend of the place made the local believe that anyone who would go up to work on the Agasthiyar would die. Broun realized that the native observers with a strip of cotton wound over the loins would never be able to survive in such isolation and cold. The lifeline to the place would need to be carried on the heads of coolies only at times permissible by the climate. Menaced with many other difficulties, Broun wrote to the British Resident for permission to start building the Observatory at the Agasthiyar peak. He communicated that the Sircar had already permitted him to build an observatory on the Western Ghats but was not allowing him to commence the building works on the Agasthiyar peak. In September 1853, Lt. Gen. Cullen granted Broun permission to start building the observatory at the peak at his own expense and responsibility.

On 14th February 1854, Broun along with Lt. Col. Grant again proceeded to the Agasthiyar peak with the intention to draw a plan for building an Observatory. They stayed at “Attyaar Malay” for two days and with the help of the Kanikar’s cut bamboos and erected two huts on the “Podiya Malay”. A winding path on the northern side was identified which could be used easily by coolies with head loads to assent the peak. Broun decided to set up an observatory made of wood at 2500 ft. below the peak so that carpenters could be convinced to work. He planned to take it down and later on erect it at the summit of the Agasthiyar using head loaded coolies. Not finding any other easier trekking routes Broun returned to Trivandrum by 1st March. On 2nd March, Broun communicated to the British resident his plan for building the Observatory. The carpenter who had built the Trivandrum Observatory was sent under the charge of the first native observer G. Coorien to get as many wood cutters and coolies required for the building and start working.



The proposed building was to have a small computing room, instrument room, four small sleeping closets for the observers, a tower of two stories with outer platform intended for observations of wind and state of sky and two rooms for Broun.

Broun accounts that it was impossible to collect workmen to stay and work even on increased pay. Some workmen ran away leaving behind their tools unable to bear the rains and elephant trumpets. The head carpenter returned to Trivandrum after a few months of commencement of work on account of falling sick and shortly died. His death was seen as a judgement of the gods by the native workmen for having entered the Agasthiyar peak. Another carpenter was given charge and sent shortly. In September 1854, news was passed to Broun that the work of the building was nearly completed. On 19th September Broun along with his brother-in-law P. Vallouy left Trivandrum to examine the state of work and possibly find an alternate route. From the base of Attayar this time they entered through the south east and still the path was no easier. On reaching the site, Broun found that the new carpenter had himself rearranged the plan and a lot more work was still remaining. Only three carpenters were remaining and the sawyers and wood cutters had left. Broun ordered the carpenters to separate the rooms intended for his use from the main building and set it up on the Podiya Malay. His original idea of having the entire Observatory reassembled on the peak of the Agasthiyar was not possible at this stage. Broun and Mr. Vallouy remained at Podiya Mallay for four days and redrew plans on how by 1855 an observatory could be functional at the peak of the Agasthiyar. After returning to Trivandrum Broun sought the help of Sircar officers to deploy carpenters, woodcutters and sawyers for the construction. Some of those who turned up were those who were given land on condition that their active service would be required on urgent occasion and could not turn down the present call, or were professional coolies who were taken on by strong hands. All these decamped from work on the first opportunity.

On 8th February 1855, Broun along with his family moved from Trivandrum to the Agasthiyar. Broun wanted to personally oversee the works so that it could be completed timely and the observation works could be started. When they reached Attayar base they were informed that the bungalow at the Podiya Malay was not completed. Broun visited Podiya Malay to find that the roof of the building had not yet been fixed. Hence he had to stay at Attayar base in huts where snakes came next to the beds laid for his children. On 13th February Broun assented Podiya Mallay with his family. The wooden structure was yet to be completed. Most of the carpenters and coolies disappeared. After 16 days of ravaging the rain a roofing for two small closets were completed. On 3rd March, the Tahsildar of Nedoovengaad visited Broun who brought enough coolies to thatch the roof of

the bungalow occupied by Broun and family. On 7th March, Broun descended to the work site to find only 2–3 coolies with no work progress on the observatory building. Broun himself set out at laboring on disintegration of the building so that it could be taken top. The planks for the roof was still not swan. Broun corresponded with the Sircar officers and made an arrangement whereby chief officers of each parish in the district of Nedoovengaad would furnish 30–50 coolies and their supplies in turn till the work was completed. Though this was never accomplished, a definite dwindled number of coolies were available hence forth for the work. Gen. Cullen sent a band of 30 pioneers who arrived on 28th March and were to be used to carry the heavy load up the peak. The people disliked the work and offered to build roads instead. Broun divided them into two and sent one party to improve the trek road upward and other party to build a foundation for the observatory. Other than the stair case of Attayar a better route was still elusive. Broun, Vallouy and some Kanikars fortunately found an elephant track with a slight inclination initially then almost level terminating on the bare summit of the spur, the north most point through which originally they had entered the valley of Attayar. This was the best route for the coolies. Broun offered a reward to the first coolie who would carry a load to the top and increase the reward for the number of loads he would carry on the first day. With the reward for a load becoming equal to what a coolie would earn a day in the low land, the number of coolies increased. Some did up to 5 loads a day. Some did just 2–3 and ran away happily. The Sirkar employees used by Broun to get coolies were themselves also greedy. Some of them would round up a batch of coolies and bring them up frightening them with stories and demand ransom to free them of the works assigned at Agasthiyar.

In April Broun made a discovery regarding the presence of flesphatic clay on the south east corner of the top of Agasthiyar. Had they been discovered earlier, he points out that they could be baked in sunlight and could have formed better walls than planks and saved a lot of labor. A quantity of shell lime was delivered from the seashore before the roofing was completed. Using it pillars of granite for three magnetometers, their telescopes and the clock were built. The pillars were built of granite stones obtained in digging for the foundations; and the lime for cement was brought from the seashore on coolie's heads. Each pillar was founded on the granite, and the flooring and floor beams were kept at a sufficient distance from them, so that the pillars were thus far independent of the building. The corner posts, with a section of eight inches square, were inserted deeply into the ground between the decaying blocks of granite resting under the soil. A fire place was also built. Large cylinders made of burnt clay were used as chimneys. On 11th May, Broun started making arrangements for



instruments and their adjustments. On 15th May his family left for Trivandrum and with that he stopped his daily climb up the peak and started staying on the peak itself. His family on the return journey observed the native hunters shooting down a royal tiger which was not uncommon then. By the 31st of May, the instruments were ready for making observations. From March, the Agasthiyar peak had received very little rain and that had enabled the work to progress well. The shortage of rains forced them to trek 1600 ft. down to collect drinking water. Broun observed that the low country on both sides of the Ghats had been deluged but rains rarely touched the Agasthiyar peak. The dry season also permitted brining up dry straw from Attyaar to thatch the roof on the Agasthiyar. Broun accounts that from the platform of the observatory, the whole of south Indian peninsula could be seen from Cape Comorin southwards to near Cochin on the Travancore coast and to near Adam's Bridge in the gulf of Mannar. On favorable occasions the Adam's peak in Ceylon could be seen above the horizon. A picturesque description of the east and west, murmuring of waterfalls, faint cry of monkeys, colors of the landscape and seasonal changes was documented by Broun.

Broun describes the observatory built on the Agasthiyar peak as a building standing on the south east corner of the peak in a small jungle. The plan of the building was rectangular, 55 by 18 feet. The western part had two floors, from the upper floor a staircase leads outside the roof to the small platform on the ridge of the tower. The tower was covered with thatched straw carried from the Attyaar. The part of the building which could not be thatched was covered using double bamboo mats having a thick coat of dammer and pinnaka oil in between. The building is documented to have a compartment "I" where there were placed three magnetometers, the declinometer, its telescope pillar, the bifilar, a telescope pillar, a balance and its telescope. Another compartment "A" served as the computing room where the telescope pillars were kept and in between slides were arranged so that mirrors could be seen using the telescope. Two separate huts were built for cooking the roofs of which were thatched and the wall were made of felspathic clay.

The instruments at the observatory were a clock with mercurial pendulum made by Mr. Johnson, London, a barometer, thermometers and an anemometer kept on the tower roof. These instruments are documented to be made by Mr. Adie and were exactly the same as used at Trivandrum observatory. For observations Adie's declinometer, Adie's bifilar, and Adie's balance magnetometer, the barometer and attached thermometer, dry and wet bulb, ground and other thermometers were also used. Direction and force of wind, species of clouds and amount of cloud surface, evaporation of salt water, temperature of water, rainfall, etc., were also observed—all the observations were to be made simultaneously with those at Trivandrum. Broun

returned to Trivandrum on 31st May 1855. The assistants of the observatory establishment were divided into three sets of four. Each set would occupy the mountain observatory for three months. Of the two sets at Trivandrum, one set would carry out the observations and one set that return from the mountain station would remain free. An increase of one fourth of their pays for cooks, coolies and provisions allowed them to be much better than when only the Trivandrum observatory was functioning. The observations began on 1st July 1855 on the Agasthiyar observatory. The balance magnet set by Broun malfunctioned and Broun returned on 19th September to rectify it. Having failed because of the dampness that had entered into the instrument, he returned to Trivandrum on 25th September. The magnetic observations begun on 1st July 1855 and continued hourly till July 1858, after which it was made during the day hours only, till the end of March 1859. Broun along with his two head assistants J. Kochukunju and E. Kochiravi and observers collected hourly data using the instruments (Ratcliff, 2016). The time was communicated from Trivandrum to the Agasthiyar Observatory by means of mirror flashes when the sun shined, at previously agreed instants in the morning, as Broun had practiced before between Makerstown Observatory and the Cheviot Hills in Scotland. During the cloudy weather of the monsoon of 1856, the clock at Agasthiyar observatory stopped working. To be prepared for such an accident again, Broun sent a clock made by Mr. Bryson of Edinburgh, to the mountain. He also had the clock at the mountain cleaned identifying that the stoppage occurred chiefly due to the smoke from the fire. As he found that the mirror flashes could not be given at all seasons, he proposed to fix a portable transit, of Englefield's construction to a post near the observatory, so that the observers would be able to determine their time directly. Two coolies were employed to carry the weekly reports from Agasthiyar to Trivandrum. On 19th November 1856, one of the attendants found the coolie carrying the letter kneeling with his hands on the ground dead. There were no marks on his body and the Sircar officers who examined his body declared his death to be out of cold.

Broun accounts that the Government of Travancore repaid him an amount of £ 170 the expenditure till June 1855 on account of the building of the Agasthiyar Observatory. He was also sanctioned a monthly allowance of £ 7 towards "batta" to the assistants and the minor expenses at the Agasthiyar Observatory.

Systematic magnetic and meteorological observations were taken from the Agasthiyar Observatory for four years from 1855—March 1859 (Broun, 1874). Broun became ill and moved to Europe in 1859. The illness lead to a permanent deafness to one of his ears. Broun returned to India after treatment in 1862. During his absence from 1859–1862,



the observatory went dormant. On 16th April 1862, Broun again addressed the Diwan, restating the objective of the Agasthiyar Observatory, its original construction under many difficulties, at his own expense in the first instance, the necessity of another year's observations on account of errors due to circumstances connected with the position of the observatory, circumstances whose effects could not be at first foreseen; and the Sirkar's sanction already granted for another year's observations. At the same time Broun requested the Sirkar to sanction £ 30 for the small instruments made in Lamont's atelier at Munich, according to his own method, which Broun had requested Lamont to favour him within 1861; with these instruments, Broun hoped to avoid some of the errors caused by the previous instruments. He also requested the Sirkar to sanction a monthly allowance of seventy rupees for twelve months, on account of additional pay to observers during the year's observations at Agasthiyar and also of three hundred and fifty rupees for certain apparatus which had arrived at Ceylon. The official sanction of the sums required for another year's observations was communicated to Broun by the Diwan on 5th September 1863. In the Souvenir of the Centenary of His Highness the Maharaja's Observatory, it is mentioned that the Observatory at the Agasthiyar peak had to be repaired in 1863 before the final observations were made and few more instruments were added. Broun personally took up overseeing the works of cutting and sawing of timber and the necessary carpentry work at Podiya mallay, the nearest point to Agasthiyar peak where sufficiently good timber could be obtained. To have the Agasthiyar Observatory thatched, it was necessary to get the Diwan to give orders to the Tahsildar of Nedumangad (the district west of Agasthiyar); the latter should then give orders to the Adikarries of Aryanadu and Uzhamalakkal (the nearest proverticars), whose duty it was to procure the requisite number of coolies to proceed to the mountain, cut grass several thousand feet below the summit, carry it up, and then thatch the observatory.

Broun considered that the first thing to be done was to complete the observatory for the reception of the instruments by the erection of stone pillars in proper positions. This was done with as much care as possible, separating the bases from the surrounding soil by small trenches so that the action of the wind on the corner pillars of the building might be as little felt as possible. After much trouble in many ways, he succeeded in completing the building and adjusting the instruments, ascending daily 1200 feet from the small wooden bungalow in which he lived (5000 feet above the sea) reaching the top at about eight a.m. and descending at sun set, the adjustments were completed on the 18th of May at 4 p.m. The observations began on the 20th of May 1864 by three observers, and were continued by other sets of three observers, who relieved each other at intervals of three months till 28 February 1865, when

the series of observations ceased citing reasons like adverse climate, errors in instruments, transportation to and fro from the Agasthiyar peak, difficulty in meeting the expenses of the facility and inadequate staff. The instruments were removed in March 1865, and Adie's bifilar and balance was again adjusted on the pillars they had previously occupied in the Trivandrum Observatory (Kurian, 2009).

3 Scientific measurements conducted at Agasthiyar observatory

The King of Travancore was quite familiar with ancient Indian astronomy, and was keen to compare it with modern Western astronomy. Caldecott who was the first Director of the "Trivandrum Observatory" was also made the court Astronomer. Available evidence suggests that the agenda which Caldecott set for himself was keeping in mind his own European aspirations. Though Caldecott was appointed to study astronomy, he also began taking meteorological measurements from July 1837 taking into note the recommendation by the British Association for the Advancement of Science for an hourly meteorological observation. After the death of Caldecott, when Broun took charge of the Trivandrum observatory, he exhibited special interest in magnetism and meteorology. Broun was interested in geomagnetic studies. He examined the laws of terrestrial magnetism and the variation of meteorological elements as influenced by height in the atmosphere. This, he thought, was possible only by simultaneous observations at two stations differing in height. For the comparison and co-ordination of the laws depending on differences of height, of latitude and of longitude, he felt the need for simultaneous measurements from two geographically distinct observatories. Research on terrestrial magnetism of that time was primarily to understand how the strength of magnetic field varied from the equator to higher latitudes and elevations. This required simultaneous measurements of magnetic field strengths from two different locations. Thus his vision for an observatory on the Agasthiyar peak was justified.

During the 1840's not more than a dozen observatories in the world were making regular magnetic observations. Paris had been recording magnetic observations from as early as 1667. In India, at the Madras astronomical observatory hourly magnetic observations were recorded from 1822 onwards. These were continued till 1861 when it was decided to record only two observations per day at suitable hours. The work was further reduced in 1875, when the bifilar magnetometer which was the only instrument in use got damaged. The magnetic observations were finally discontinued at Madras in 1881.

The Agasthiyar Observatory could do sustained work in the fields of magnetism and meteorology under John Allan



Broun, on the lines suggested by the British Association for the Advancement of Science. The errors in observations at the “Trivandrum Observatory” were generally checked by the observations at Agasthiyar observatory, and vice versa (Broun, 1874). Trivandrum’s proximity to the magnetic equator enabled simultaneous measurements of magnetic declination, during short periods at different stations in Travancore, as nearly as possible on the magnetic equator, At about 5000 feet below the Agasthiyar peak, on the Agasthiyar peak itself, and at Trivandrum observatory. On one occasion observations were made hourly during a month at five different stations, varying gradually in height from the Trivandrum Observatory (200 ft.) to 6200 ft. above the sea level, in which fifteen observers were employed. The number of observations made daily (except Sunday) at Trivandrum and Agasthiyar amounts to upwards of 1000; from these nearly 700 corrected results were obtained.

In the first volume of work published by Broun, every aspect of the sun and moon that could affect the magnetic needle was detailed (Stewart, 1875). Broun observed that the vibrations of the magnetic needle exhibited secular variations with a time interval of 10.5 years during which the acceleration or retardation of the secular variations had equal values. The observations lead to a twofold inequality, where one would correspond to a single oscillation in a year with a minimum in March or April and a maximum in September or October while the other would correspond to a semi-annual oscillation with maxima in March and September. From his observations made from the Agasthiyar peak, he concluded that the Sun and the Moon wield certain stimulus on the declination of the magnetic needle, and there is a lunar diurnal variation for this influence. Near the equator, the influence was in December opposite to what it was in June. He also showed that the lunar action was reversed at sunrise, and much greater during daytime than at night, whether the moon was above or below the horizon. Broun also deduced that day to day changes in the horizontal force of the earth's magnetism was simultaneous all over the world and some of these changes he attributed to the moon while the others had periodical changes once in 26 days, due the influence of sun (Broun, 1872). He also inferred that the greater magnetic disturbances were due to actions proceeding from certain meridians of the Sun. The diurnal variation of atmospheric pressure and its dependence on altitude was documented by Broun. Broun also discovered that the disturbance on the surface of the sun was connected to the state of earth’s magnetism and proved that they had a periodicity of ~26 days (Broun, 1872). The same periodicity was reported from the Prague Observatory by its then director Dr. Hornstein (Stewart, 1875). The period of sun’s rotation about its axis as deduced from the movement of the sun spots in different zones on its surface, is today scientifically ascribed to the

mean period of 27 days for the fluctuations in values of the magnetic elements.

Broun could give in complete form the laws which regulated the solar-diurnal variation of magnetic declination near the equator. It consisted of one maxima and one minima of easterly declination in each month of the year and one or more secondary maxima and minima. He noted that principal maximums occurred in the months of April to September at about 7:00 a.m. and the corresponding minimums occur at 12:20 p.m. in the same months. Further, he noted that the opposite occurs in the months of November to February. Based on these observations, he predicted that that large magnetic disturbances proceed from particular solar meridians. He also showed that there exists a lunar-diurnal effect on terrestrial magnetism which varied with the position of the sun and was proportional to the cube of the distance from the moon (Kurian, 2009).

Broun was awarded the Keith Medal from the Royal Society of Edinburgh for the period 1859–1861 for two of his papers communicated to the Royal Society. In the first paper, he showed a more accurate method to take measurements using a bifilar magnetometer than the method which was hitherto adopted. In the second paper, he established an annual law for the horizontal force of the earth’s magnetism and discovered that the earth’s magnetism had the same day to day variation all over the world. The lunar-diurnal variation of the magnetic declination was the most original and interesting contribution of Broun’s observations made from the twin observatories. He observed that the lunar action was reversed at sunrise and that it was much greater during the day than during the night, whether the moon was above or below the horizon. Broun had already discovered the similarity in the changes of the earth's horizontal force all around the world from day to day. Certain of these changes, he found to be due to the moon, while others had a period of twenty-six days. This periodicity, he attributed to solar action, and in discussing the subject, he found that the greater magnetic disturbances were apparently due to actions proceeding from particular meridians of the sun. He thus proposed the existence of certain relation between atmospheric motions and the directions of the lines of equal barometric pressure all over the globe. For his various researches, he obtained in 1878, just one year before his death, “The Royal Medal” from the Royal Society of London.

4 Conclusion

In the “Report on the Observatories of His Highness the Rajah of Travancore at Trevandrum and on the Agasthiyar Peaks of the Western Ghats”, Broun assigns the location of the Agasthiyar Observatory to be 8° 38' North latitude



and 5 h 9 m 15 s East longitude (8.633333 N, 5.154167 E). But these coordinates are incorrect as they correspond to a location in Nigeria (Ile-Ire, Kwara, Nigeria). Why it was never attempted to be corrected remains a matter of ambiguity. The latitude and longitude of the Trivandrum Observatory are mentioned as 8° 30' 32" North latitude and 76° 59' 45" East longitude (8.508889 N, 76.995833E) in the report, which are fair enough to the location where it stands today at (8.508577414074825 N, 76.95834547603062 E). It was recorded that the then Governor of Madras Sir William Denison ordered the magnetic Observatory to be closed in 1881, when the Madras Observatory stopped their magnetic studies. The “Trivandrum Observatory” which was envisioned to be an astronomical observatory for the princely state of Travancore, evolved into meteorological and magnetic observatory during the tenure of Broun. Broun on returning to England spent rest of his life compiling the data collected from the twin Observatories. He continued to receive a pension, payment for a computer and other incidental expenses for publishing the data taken from the twin Observatories. Broun produced publications of other kinds and communicated important results from his analysis of the Trivandrum and Agasthiyar data in several articles but none of these satisfied Broun’s contract with the Travancore Sircar. The resident and *dewan* pressurised Broun to come up with an initial volume of scientific publication by 1875 as a way that would justify the investment made on the twin Observatories by the Sircar or all together stop the financial assistance being provided to him. Nearly a decade after Broun returned from Trivandrum in 1874, the first volume was published in London (Broun, 1874). A large volume of data remained unpublished when Broun passed away in 1879.

The Trivandrum and Agasthiyar Observatories were envisioned as a means of growth of scientific capital by the princely state. By contributing materially and financially to the magnetic observatory on the Agasthiyar peak Travancore empire contributed to the global science society. Institutions like the BAAS benefited substantially from the investments made by the princely state of Travancore on the Agasthiyar Observatory. Through the Kings- Swathi Thirunal and Ayiylam Thirunal, the princely state maintained its patronage of terrestrial physics for over thirty years and they had clear expectations from the twin observatories. In wishing to further ‘the cause of science’ and to ‘give to the scientific world’, the observatory’s supporters had expressed

a commitment to scientific universalism. What happened to the building at the Agasthiyar observing station on the mountain peak after 1865 and the native observers who got trained under Broun is not documented. A research expedition conducted in 2019 on the Agasthiyar peak did not find any conclusive evidence on the location of the lost observatory. The remains of such a heritage remain clouded within the Agasthiyar peak on the Western Ghats.

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Data availability Data will be available upon reasonable request to the corresponding author.

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