Journal and Proceedings of the Royal Society of New South Wales, vol. 145, nos. 445 & 446, pp. 111-127.
ISSN 0035-9173/12/020111-17

Symposium – Commemorating Governor Sir Thomas Brisbane, National Trust, Observatory Hill, 1 December 2011

Some scientific aspects of Parramatta Observatory

Ragbir Bhathal

School of Computing, Engineering and Mathematics, University of Western Sydney,
Kingswood Campus,
Penrith, NSW

E-mail: r.bhathal@uws.edu.au

Abstract

Governor Sir Thomas Brisbane, the sixth governor of New South Wales built Australia's first private observatory in 1822. He did this to carry out astronomical observations that would not only be of scientific value but also be beneficial to mankind. This paper discusses some scientific aspects of Parramatta Observatory and the problems that the observatory encountered in the observations of the night sky far from the metropolitan centres of astronomical influence in Europe. The paper also proposes that Parramatta Observatory should be placed on the UNESCO/IAU world heritage list of astronomical observatories.

Introduction

Before the 1800s very few observations of the Southern Hemisphere had been carried out by northern hemisphere astronomers and it was considered virgin astronomical territory. The astronomers were busy carrying out positional astronomy and assembling catalogues of stars, double stars, nebulae, clusters and galaxies seen in the night sky in the northern hemisphere. Thus, there was great interest among the astronomers to extend their observations to the rich Southern Hemisphere sky. Brisbane was well aware of the observations that had been carried out of the southern sky by a number of northern hemisphere astronomers. He knew of the Transit of Venus observations, Edmund Halley's 1677 observations at St Helena and Nicolas Louis de Lacaille's observations at the Cape of Good Hope in the 1750s. He was also aware of the fact that the Colonial Office would not provide him with the necessary funds to build another government observatory in Australia since the Cape Observatory had already been designated as a government observatory to study the southern sky. Furthermore, the Cape Observatory had the support of the Board of Longitude and the scientific establishment. The Cape was also of strategic importance to Britain's imperial program and the Observatory was closer to Europe than Australia (Evans 1988). He realised that the only way he was going to observe the southern sky and leave his name for posterity was to establish an observatory with his own funds. He pursued his ambition with vigour.

Well connected

Brisbane was well connected in the social, political and scientific circles in Britain and was already a Fellow of the Royal Society

before he came out to Australia. During the occupation of Paris in 1815 he prevented the destruction of the Academie des Sciences. In gratitude he was elected an honorary member of the Academie. Thus, he became well known to the members of France's scientific elite, such as Laplace, Fourier and Bouvard. In fact, Laplace was known in scientific circles both in Britain and Europe for his classic Mecanique Celeste (Celestial Mechanics) which expounded Newton's law of universal gravitation (North 1994). Brisbane had already built an observatory on his estate at Brisbane House in Scotland in 1808 and was well versed in astronomical matters and had kept the time for Britain's armed forces. It was the second permanent observatory in Scotland and it was fitted with the best available instruments made by well known instrument makers, such as Troughton. He had pursued a distinguished military career, having served in Flanders, the West Indies, the Peninsular War and the American War. He rose to the position of Brigadier General and served with the Duke of Wellington in the Napoleonic wars (Saunders 2004). Being a member of the upper social classes in Britain he had access to the powers of influence in government and the scientific establishment.

He had a passion for astronomy and he set about to obtain the governorship of New South Wales because it would provide him with a great opportunity he wrote, "for carrying on extensive Astronomical Observations that are not only highly interesting to science but may be beneficial to mankind" (Brisbane 1815). His higher purpose for doing something that was beneficial for mankind stemmed from his strong sense of Christian duty. He became a one man lobby group with the sole purpose of becoming the governor of New South Wales to build his observatory in Australia. He knew he had the means and the wealth to build a private observatory in Australia. He lobbied his influential contacts for the governorship. In 1815, shortly after the defeat of Napoleon, the victorious Duke of Wellington informed Brisbane that he had recommended him to the Secretary for War and the Colonies, Lord Bathurst, for his appointment as the sixth Governor of New South Wales. However, Lord Bathurst remarked that he "wanted a man to govern, not the heavens, but the Earth" (Bhathal and White 1991). To which Wellington responded by saying that Brisbane had been useful in keeping the time of the Army as well as carrying out his regular military duties punctually.

Imperial science

Brisbane's appointment was strongly supported by Sir Joseph Banks, the influential President of the Royal Society who argued that Brisbane had strong administrative skills and would advance the cause of imperial science in the colonies (Banks 1817). This was sufficient to persuade Lord Bathurst to appointment Brisbane to the Governorship of New South Wales. Banks was a strong supporter of science for utilitarian purposes in Britain's colonies and saw the improvement of British territories as a means for advancing the self-sufficiency of the motherland. Banks was very successful in institutionalising his drive for imperial expansion through the medium of scientific exploration (Gascoigne 1998). Later in 1823, Sir Humphrey Davy, President of the Royal Society echoed the same sentiment when he wrote to Bathurst to say that, "The measure of an Arc in New South Wales would not only be of importance to Astronomy in affording data for determining correctly the figure of the Earth, a matter of great interest to Navigation, but would likewise be useful in laying a foundation for a correct Survey of

our Colonies in the great and unexplored Country" (Davy 1823). Brisbane was familiar with the methods of determining the figure of the Earth by making observations of the length of an invariable pendulum and also with the much more accurate method of triangulation (Pannekoek 1961). In fact, he brought with him to Australia Borda's pendulum for determining the figure of the Earth. He was, thus, well placed to carry out Davy's instructions. While Brisbane had sought to establish an observatory for the purposes of pure science, the bureaucrats and colonial administrators saw the observatory as playing a vital role in the economic growth of the country. In later years meridian astronomy and surveying the country became important functions of the colonial observatories in Australia. In a way Brisbane's observatory set the pattern for the colonial observatories which were set up in Australia in the second half of the 19th century. Their programs were planned and dictated by the Astronomer Royal in England. The Astronomer Royal also had a hand in the selection and recommendation of the directors who were to head the colonial observatories.

A private observatory

Brisbane arrived in Sydney in November 1821 to not only govern New South Wales and change the way it was governed but also to build a private observatory. He built the observatory at the back of Government House in Parramatta about 25 kilometres from the centre of Sydney. The wooden building was of simple design and functional. The rather simple architectural style of the observatory building was more in keeping with Jacques Dominique Cassini's views on observatory architecture than Australian colonial views on nineteenth century public architecture. Cassini, the director of Paris Observatory, who came from a long family line of famous scientists, believed an observatory should not be an architectural monument. He wrote, "an observatory could not be a work of architecture because all ornament would be foreign or superfluous to it and should not be allowed unless it would in no way interfere with the use of the building or unless a public monument was intended for which no expense should be spared" (Bhathal 1993). The building was 7.4 metres square and had two domes (3.5 metres in diameter) facing north and south respectively. Figure 1 shows the plan of the building and the location of the instruments. It is based on a drawing by Reverend W. B. Clarke. Figure 2 shows the combined plan of the observatory in 1822 and the completed excavation work which was carried out by Anne Bickford for the Parramatta Park Trust (Parramatta Park Trust 2011). According to Christopher Levins, the director of the Park there are plans to restore the building with appropriate interpretation to show it as a working observatory.

The Transit telescope and the mural circle were located at the south western and north eastern ends of the south room. The mean-time clock was placed just north of the transit instrument while the sidereal clock was placed near the mural circle. Transit observations were made by means of an eye and ear method. This demanded that the observer listened to the clock while he watched a star's image cross the wires in the eyepiece. The observations were recorded in the columns on Brisbane's printed forms for transmission at a later date to the metropolitan centre. The measurements of the right ascensions using the transit instrument and a pendulum clock were made and recorded separately from those of the zenith distance of the stars with the mural circle. The records, according to Dunlop, were to serve not only as "a valuable treasure for the present generation to possess,

but an invaluable inheritance for them to transmit to posterity" (Dunlop 1828). The astronomers at Parramatta Observatory served as the collectors of information about the celestial bodies just like the 19th century collectors of specimens in the biological sciences (Moyal 1976).

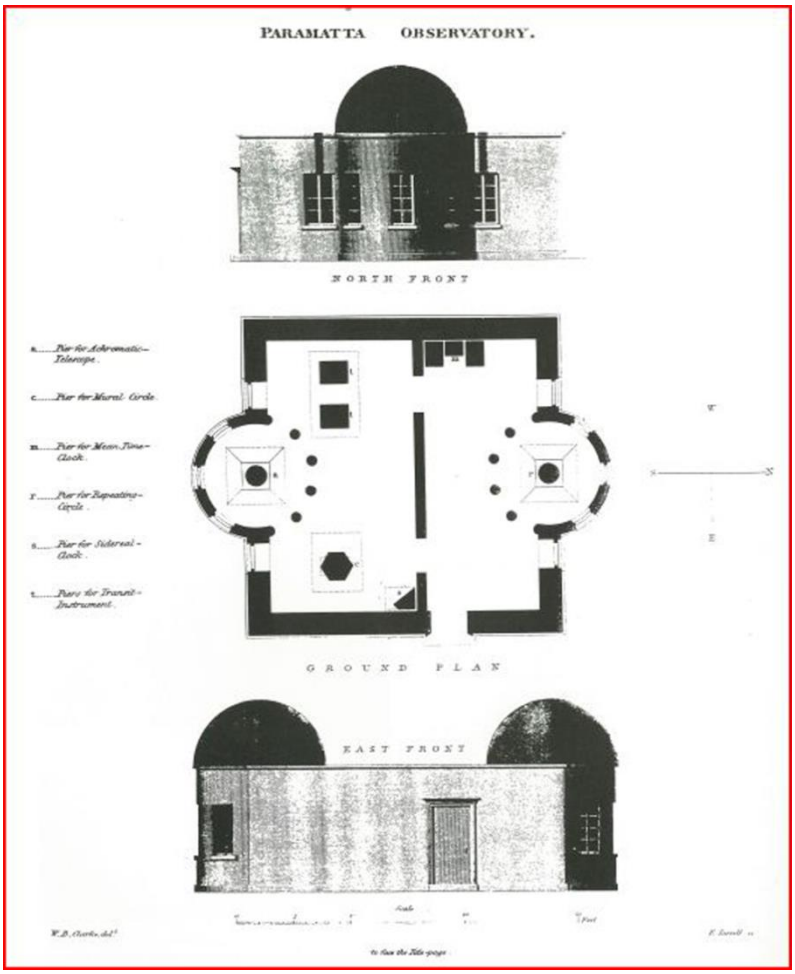

Figure 1. Plan of Parramatta Observatory drawn by Reverend W. B. Clarke. The locations of the Achromatic Telescope (a), Mural Circle (c), Mean-Time Clock (m), Repeating Circle (r), Sidereal Clock (s) and Transit Instrument (t) are shown in the figure.

This exemplified the master servant relationship in the colonial science of the 19th century in the newly emerging colonial territories. The metropolitan centre controlled the type of information that had to be collected, how it was to be collected and how it was to be analysed. The book keeping and accounting had to be done meticulously since the reputation and the status of the observatory depended on it (Schaffer 2010). The colonial observatories had an audience of experts in astronomy in the metropolitan centres of scholarship. They dished out the honours, the accolades and the criticism. They were the judges of excellence.

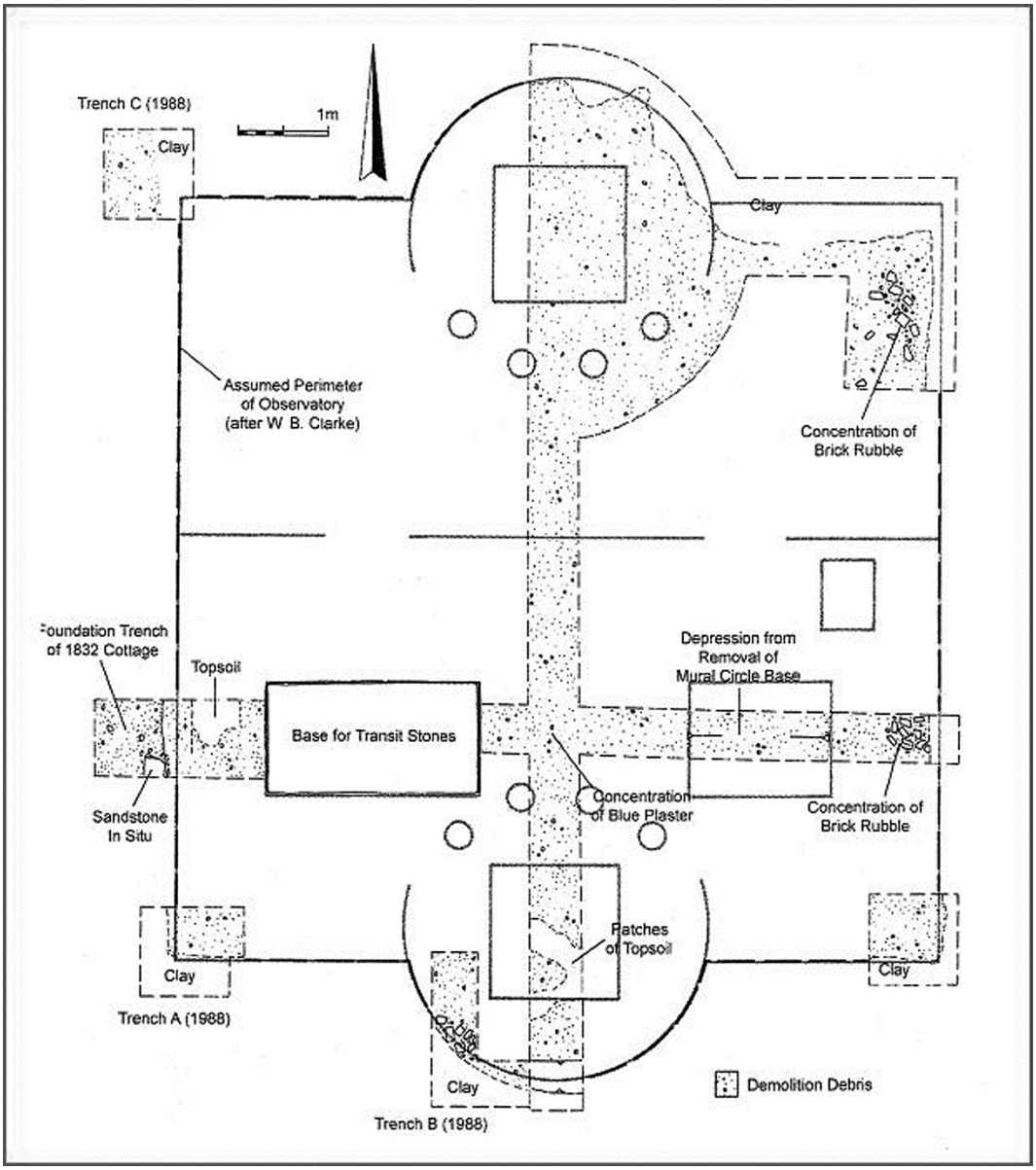

Figure 2. Combined plan of the Observatory in 1822 and the completed excavation work from the Excavation Report prepared by Archaeology and Heritage P/L for the Parramatta Park Trust.

Figure 3. The 5 foot 6 inch Transit Instrument by Troughton was used to determine the position of stars for the Catalogue of 7385 Stars. The stone piers which held this instrument are to be found in Parramatta Park. The instrument is on display at Sydney Observatory.

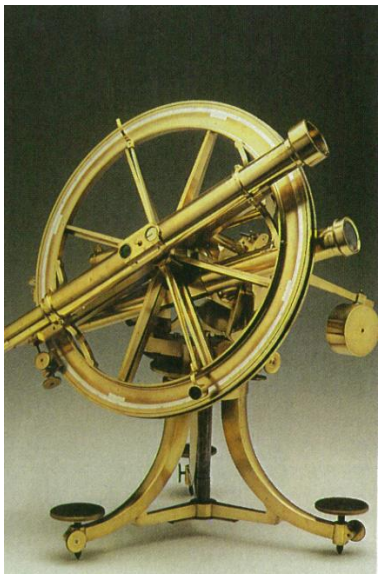

Figure 4. The 16 inch Repeating Circle by Reichenbach was located under the north dome of the Parramatta Observatory. It was used for measuring the angle between the stars for the purpose of determining their positions. This instrument is on display at Sydney Observatory.

Brisbane had not only purchased the instruments at his own expense but had also paid for the services of Charles Rumker, a well known astronomer from Germany and James Dunlop from Scotland who was technically skilled for maintaining the instruments in the observatory. Thus, three men from different levels of 19th century society with its social stratification and norms of behaviour and acknowledgement came together to establish an observatory in Parramatta. While Rumker was the equal of Brisbane in intellectual terms he seems not to have given Brisbane the due respect that he deserved as a member of Britain's ruling classes and the aristocracy. Rumker was not familiar with Britian's class system and the social stratification of British society. Furthermore, Brisbane had not articulated the terms and conditions for the publication of the results of the observations emanating from the Observatory. In fact, he had not come to any agreement with either Rumker or Dunlop regarding the publications from the Observatory. This mix of personalities and the environment they worked in was explosive and eventually led to problems in the proper running of the observatory and the difficult personal relations that developed between them. A further compounding factor was the fact that they were intellectually isolated from the main centres of astronomical endeavour in Britain and Europe.

The instruments included four astronomical clocks, a mural circle, a repeating circle, a transmit instrument, an equatorial telescope, a sextant, Bourdon's pendulum, barometers and thermometers (King, Gordon and Rogers 1847, Russell 1888 and Lomb 2004). The instruments were made by well established instrument makers, such as Troughton, Hardy, Banks and Reichenbach. Brisbane had brought some of these instruments, for

example the mural circle from his own observatory in Scotland. The principal instruments were placed on masonry piers in the Observatory (See Figure 1). Illustrations of the Transit Instrument and the Repeating Circle are shown in Figure 3 and Figure 4. By May 1822 the observatory was ready for use. They began systematic observations of the night sky. Since Brisbane was busy with the duties of government, he was unable to devote much time in assisting with the observations. The task fell mainly on Rumker and Dunlop.

Comets and Newton's theory of gravitation

The detection of comet Encke on 2 June 1822 catapulted the Observatory into international fame. The official government observatory at the Cape missed discovering the comet. The comet had been seen previously in November 1818 by Jean Louis Pons of Marseilles and had been named Encke in honour of Johan Franz Encke who had calculated its orbit. According to Agnes Clerke (1893), "Encke at once took the calculations of the elements in hand, and brought out the unexpected result that it revolved round the Sun in a period of three and a quarter years … he fixed May 24, 1822, as its next return to perihelion. Although on that occasion, owing to the position of the earth, invisible in the northern hemisphere, Sir Thomas Brisbane's Observatory at Parramatta was fortunately ready equipped for its capture, which Rumker effected quite close to the spot indicated by Encke's ephemeris". She further noted, "The importance of this event can be better understood when it is remembered that it is the second instance of the recognised return of a comet". The first had been Halley's Comet and it confirmed that comets, like planets, obeyed Newton's laws of gravitation. The discovery provided another confirmation of Newton's theory of gravitation as applied to the motion of comets. Herschel himself as the President of the Royal Astronomical Society, noted that the discovery by Rumker verified the certainty of our theories. Furthermore, Encke's comet introduced the existence of a new class of objects called comets of short period. Although it had been seen in 1786, 1795 and 1806 it had not been recognised as having a periodical appearance (Pannekoek 1961). After its discovery it has been seen at every return. It also had some rather peculiar properties that needed further investigations which taxed the minds of eminent metropolitan astronomers. For example, it was found that the comet lost some of its mass on every return and that it had a variable acceleration which could not be accounted for. These problems were satisfactorily solved in the first half of the twentieth century. One other important result of the discovery was the use of perturbations to find out the mass of Mercury. According to Pannekoek (1961), "To compute the perturbations, there was no way but to follow the comet continuously along its orbit by means of a careful computation of special perturbations. As a reward, this procured an accurate derivation of the mass of Mercury, because in 1835 the comet passed it at close quarters".

The Royal Astronomical Society awarded Rumker a hundred pounds in recognition of his work while Brisbane gave him a grant of one thousand acres of land near Picton, about 100 km from Sydney. He named it Stargard after his birthplace (Bergman 1960). After a dispute with Brisbane in June 1823 he moved to Stargard and returned to the Observatory in May 1926 after Brisbane had departed for Scotland. The inexperienced Dunlop was left to make the observations for the Catalogue. Figure 5 shows the parcel of land that was

given to him in Picton. Although it was Dunlop who had spotted the comet at the telescope, the honours went to Rumker who had calculated the position and guided Dunlop in its search. Rumker and Dunlop were to discover other comets. Rumker discovered a comet in 1824 and holds pride of place as being the first discoverer of a comet in the Australian sky. Dunlop went on to discover a comet in 1833. They began a tradition of comet hunters in Australia which culminated in John Tebbutt, Australia's most significant 19th century astronomer, discovering the two great comets of the 19th century, viz: the great comets of 1861 and 1881 comets (Bhathal 1993). The tradition of comet hunting still continues to the present day and is mainly carried out by amateur astronomers.

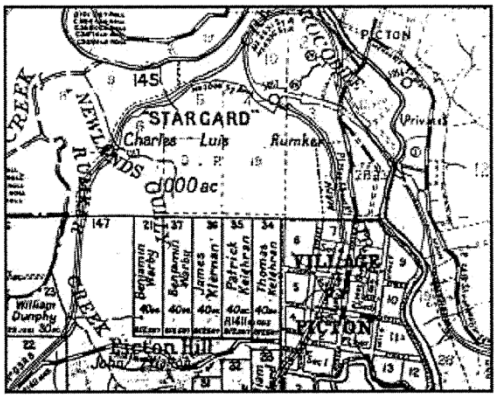

Figure 5. Plan showing the 1000 acres that were given to Rumker by Governor Brisbane. This was a reward for discovering Encke's comet. Picton Historical Society.

1. Catalogues and scientific experiments

The main reason for establishing Parramatta Observatory was to prepare a catalogue of bright stars of the southern sky. Apart from the necessity of obtaining accurate positions for astronomical purposes, there was also the need to obtain these positions for navigational and surveying purposes for Britain's ambitious imperial program of dominating the colonies and using them as producers of wealth for the motherland.

In a short period of time some 40,000 observations of over 7,000 stars were made for presentation in a catalogue. Brisbane used his contacts in the Royal Society and the Royal Astronomical Society to get approval for the publication of the catalogue of stars at government expense. The services of William Richardson, an assistant at Greenwich Observatory, were used to supervise and complete the reduction from the observations collected by the astronomers from Parramatta Observatory. The catalogue was finally published in 1835 as the Catalogue of 7385 Stars Chiefly in the Southern Hemisphere (sometimes referred to as the Brisbane Catalogue or the Parramatta Catalogue). In the preface, Richardson (1835) noted that, "Although the places of the stars in the Catalogue cannot be supposed as correct as those determined in great national observatories, yet it is hoped that it will be of considerable service in astronomy, by exhibiting the positions of upwards of 7,000 stars, properly arranged, being the result of a very extensive survey of the southern portion of the heavens, the greater part of which is invisible in Europe, and has not been so minutely examined since the time of Lacaille, and the Histoire Celeste Francaise of Lalande, works of acknowledged utility".

Brisbane and Dunlop were each awarded the Gold Medal of the Royal Astronomical Society in 1828 without the positions being cross-checked for accuracy by other astronomers. In fact, Richardson's comment that, "the places of the stars in the Catalogue cannot be supposed as correct as those determined in great national observatories" was ignored. Rumker was to receive his

medal in 1854. In awarding the medal to Brisbane, the President of the Society, John Herschel (1829) heaped high praise on Brisbane. Later observers found that the Catalogue was spoiled in part due to the fact that the instruments at Parramatta Observatory had been defective. Since he wanted to record as many stars as possible in a short period of time, Dunlop had used the Mural circle for measuring the Right Ascensions of the stars although this instrument was not meant for use for this purpose. This invariably led to errors in the positions of the stars for the Catalogue. Herschel, himself became the harshest critic of the Catalogue. He found that there were wide differences in the positions of the stars in the Catalogue and the observations he made between 1834 and 1838 while he was at the Cape of Good Hope (Evans 1988). He wrote rather scathingly that the Catalogue was only "worthy of the Age of Ulug or Tycho Brahe" (Bhathal and White 1991). This was a period three hundred years earlier when the astronomical instruments to measure the positions of stars were rather crude and left much to be desired in terms of accuracy. The statement by Herschel is in sharp contrast to the lavish praise he had previously bestowed on Brisbane's work. By 1860 the Catalogue had lost much of its value.

Apart from the major work on the Catalogue, Rumker and Dunlop also carried out observations of star clusters and double stars (Dunlop 1829) which are still referred to by their Parramatta numbers. Dunlop (1828) also discovered several nebulae and star clusters and published a catalogue of 621 nebulae and star clusters in the Philosophical Transactions. However, a substantial number of these nebulae could not be found by later day astronomers and it appears

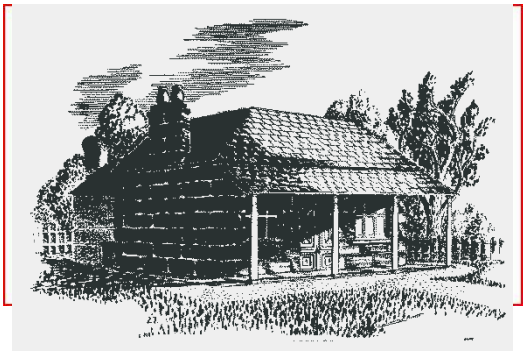

Figure 6. Dunlop's house in Parramatta from which he made his astronomical observations. The house was located between Marsden Street corner and St John's gates on the north side of Hunter Street. Collinridge Rivett (1988). Mitchell Library.

that Dunlop made several errors in his observations. He recorded the positions of the objects with his homemade telescope which had a speculum mirror of 23 cm aperture. Speculum is made of an alloy of copper and tin. It tarnishes quite readily and the reflectivity of the mirror drops. The smallness of his telescope and the tarnishing of the mirror compounded the difficulties he had in making his observations. Furthermore, his keenness in wanting to make as many observations as he could as quickly as possible at the expense of accuracy led to the mistakes in his catalogue. He carried out his observations from his home. A sketch of his home by Collinridge Rivett is shown in Figure 6 (Rivett 1988). Figure 7 shows the discrepancies in the positions of the celestial objects in Dunlop's catalogue.

The analysis is based on the data from a paper by Cozens, Walsh and Orchiston (2010) and information supplied to the author by Tim Parks. Dunlop's positions of the nebulae were heavily criticised by Herschel who had

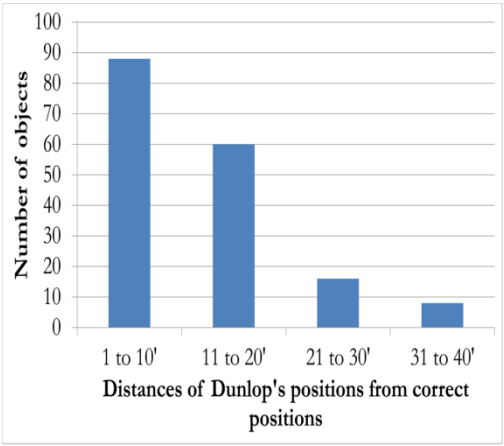

Figure 7. Number of objects versus Dunlop's positions from the correct positions. These observations refer to the objects Dunlop recorded in his catalogue of 621 nebulae and clusters.

gone to the Cape from 1834 to 1838 for making observations of celestial objects. He was only able to find 34% of Dunlop's celestial objects. After Herschel's criticism Dunlop's Catalogue lost much of its credibility. While Dunlop's catalogue may be complete as recently suggested by Cozens, Walsh and Orchiston (2010) it still leaves much to be desired as it contains a large number of objects that he was unable to resolve with the primitive equipment he used. This was not entirely his fault as the technology that was available to him at Parramatta was not the most up-to-date. He had built a home made telescope to make his observations. They suggest that the catalogue will be of use to amateur astronomers. However, it needs to be pointed that with today's computer technology amateur astronomers can access the best and most accurate catalogues online for their needs. In 1838 Herschel returned to England from the Cape with a wealth of data and produced his catalogue of nebulae. According to Clerke (1893), "The resulting great catalogue of 5079 nebulae (including all then known), published in the Philosophical Transactions for 1864, is, and will probably remain, the leading source of information on the subject".

The astronomers at Parramatta Observatory also undertook observations of solstices, moon culminating stars, conjunctions and oppositions of planets and occultations of stars (Brisbane and Rumker 1824, Brisbane 1826). The latitude and longitude of Parramatta was also measured (Brisbane 1823a). Apart from these astronomical measurements, Brisbane also instituted a program of regular meteorological observations, the first to be made systematically in the continent apart from those made by Dawes in the 1870s (Bhathal and White 1991, Brisbane 1824a, Brisbane 1825). He set up a network of meteorological stations which were manned by convicts at Sydney Heads, Newcastle, Bathurst, Port Macquarie, Macquarie Harbour and the Derwent River. This program of meteorological measurements became part of the work load of the colonial observatories in the second half of the 19th century before it became the responsibility of the Commonwealth Government at the turn of the 20th century. The meteorological measurements were important in an agricultural country like Australia. Brisbane was also involved in the first geophysical measurements in Australia and made measurements of the Earth's temperature (Brisbane 1824b). One of Brisbane's other major plans was to determine the figure of the Earth by making measurements with an invariable pendulum. He had brought with him a pendulum which he and Rumker had 'swung' before leaving London. The pendulum was then swung in the new observatory to establish the difference in gravity between Parramatta and London. Brisbane transmitted the results of his experiments to Captain Henry Kater for publication in the Philosophical Transactions

of the Royal Society of London (Brisbane 1823b). The results, according to Kater who had compared the measurements conducted in London and Parramatta, were not conclusive. The plan to measure the arc of meridian as requested by Humphry Davy was not accomplished by the Parramatta astronomers.

Royal Society of New South Wales

Brisbane was also active in the promotion of science in the colony. He was elected the first President of the Philosophical Society in Australia which had been formed on 27 June 1821 for the "purpose of collecting information with respect to the natural state, capabilities, productions and resources of Australasia and the adjacent regions and for the purpose of publishing from time to time such information as may be likely to benefit the world at large" (Liversidge 1910). The Society was later reconstituted as the Royal Society of New South Wales. In the 20th century it gave rise to some of the major scientific and engineering societies in Australia.

2. Brisbane recalled

By 1824 Brisbane was having difficulty with the administration of the colony. He had few competent administrators to assist him in the work of the government. His colonial secretary refused to carry out his instructions and supressed letters or answered them without reference to Brisbane. He was unable to resolve the conflicts between the emancipists and the exclusives. Some of them made vicious misrepresentations about his administration to the authorities in London (Liston 2009). There was also criticism in the press regarding Brisbane's astronomical activities and the impact they were having on his carrying out the duties of government. He was accused, among other things, of neglecting his duties as Governor of the colony to make astronomical observations and shoot parrots (Heydon 1966). Despite his attempts to refute these false accusations, Lord Bathurst recalled him to London. The damage had been done. He relinquished the administration of the colony in December 1825 never again to see his Observatory.

The observatory and the equipment were acquired by the government. The Observatory became a government observatory and part of Bank's scheme of imperial science although later events showed that it did not get the same support as the observatory at the Cape which had closer connections with the Admiralty. Furthermore the criticisms of the catalogues it had produced tarnished its image in the metropolitan centres of Europe.

Rumker and Dunlop

Rumker was appointed the first Government Astronomer in 1827 and at the request of the Royal Society he was asked to measure an arc of meridian for New South Wales. In January 1829, Rumker left Sydney for London to purchase new instruments for the Observatory and also to get the Royal Society to publish his Astronomical Observations made at the Observatory at Parramatta in New South Wales. These were published as a supplementary volume to the Philosophical Transactions at government expense. It upset Brisbane because Rumker did not acknowledge Brisbane in the paper despite the fact that Brisbane had paid his salary at the Observatory and taken him to Australia at his own expense. This was not only a grave oversight by Rumker but it was also partly Brisbane's fault for not having worked out an agreement with Dunlop and Rumker as to the terms under which publications were to emanate from his Observatory. For this

oversight Rumker was to pay dearly. While in London he became embroiled in a rather unfortunate acrimonious dispute with the powerful and quarrelsome Sir Thomas South, a friend of Brisbane and the President of the Royal Astronomical Society about the price of the instruments he had come to purchase. South was well known in intellectual circles in London for his quarrelsome nature (Hoskin 1989). Furthermore, there was a dispute about the return to Brisbane of the original logs of the observations made at Parramatta Observatory. There seems to have been a misunderstanding between Rumker and Brisbane as to what constituted the original logs and the notebooks that Rumker had used to record his observations. South used his influence to have Rumker dismissed in 1830 from British government service (Bergman 1960). Later, in 1831 Rumker wrote in a pamphlet in which he said, "That no fault was found in me in respect to the discharge of my scientific duties has also been admitted by the Committee and the President of the Royal Society wrote to me: 'I can only therefore lament that any combination of circumstances have deprived Astronomers of your scientific labours in the Southern Hemisphere. And that this combination of circumstances have been explained to me by the Secretary and other members of the Royal Society as consisting in the rows between the Royal and the Royal Astronomical Society (but in reality only between their leading members)' and that I had been sacrificed to oppose the President of the Royal Society, because I had been patronized and supported by him. Is it then not a lamentable confession of the leaders of science in England that for the sake of opposition and party spirit a man must be displaced from a station of infinite importance to Astronomy when his arduous exertions have been acknowledged useful by the scientific world?" (Bergman 1960). Rumker returned to Hamburg, where he became the director of the School of Navigation and later of the Observatory. He led a very productive scientific life and was elected a Fellow of the Royal Society. The 1871 Catalogue of Scientific Papers compiled by the Society, lists 233 papers which he published in various scientific journals. In intellectual terms he had surpassed Brisbane.

Dunlop was appointed the Superintendent of Parramatta Observatory and took over the running of the observatory in 1831. Unfortunately, he did not have the theoretical and intellectual expertise to run the Observatory. He had always been a follower rather than a leader and had prospered under the guidance of Brisbane and Rumker. He did not have the standing of either Brisbane and Rumker in the political or scientific circles in London and Sydney to obtain the resources to run the Observatory effectively. The instruments and the building were allowed to deteriorate. This was compounded by Dunlop's ill health and from about 1837 he found it a chore to look after the Observatory and carry out observations of the night sky. He was seriously ill and could not manage the day to day operations of the Observatory. Because it was situated inland in Parramatta, ships' captains had to make a long and often unwelcome journey to Parramatta Observatory to check their chronometers for the correct time before sailing out of Sydney. In 1841, an event occurred which had dire consequences for the survival of the Observatory. The well known British explorer, Captain James Ross travelled to Parramatta to check the correct time on his chronometer but Dunlop, who was ill and in bed, called on his dog to attend to the English gentleman (Bhathal and White 1991). Ross was extremely offended by this behaviour and complained to the Admiralty about the sad state ofaffairs at the

Observatory. This set in chain a series of events which led the long arm of imperial science to begin a scrutiny of the Observatory's output. Hardly any papers were being published by the Observatory and questions were being asked in London by George Airy, the Astronomer Royal and the Colonial Office which was footing the bill for running the Observatory in the colony of New South Wales
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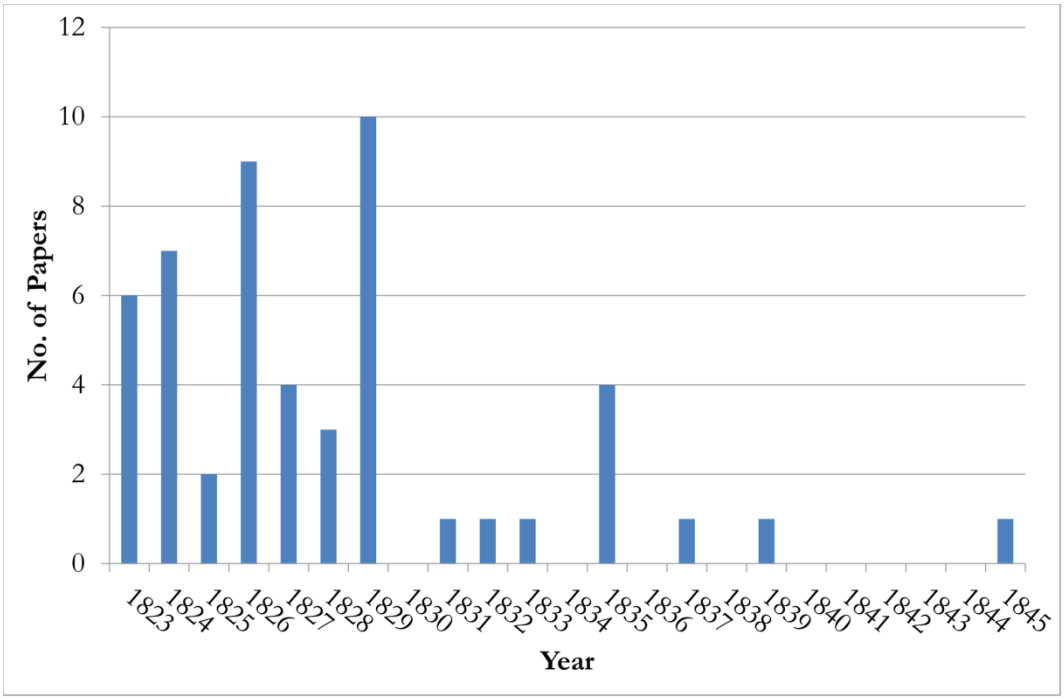

Figure 8. Number of papers published by Parramatta Observatory 1823-1845.

The productive years of the Observatory in terms of publications were from 1823 to 1829. From about 1830 the Observatory began its slow decline. This is illustrated in Figure 8. The data for constructing this graph is taken from the following journals in which the Parramatta astronomers published their observations: British Association Report, Edinburgh Journal of Science, Edinburgh Philosophical Journal, Edinburgh Philosophical Magazine and Journal of Science, Geographical Memoirs on New South Wales, Memoirs of the Astronomical Society of London, Memoirs of the Royal Astronomical Society, Monthly Notices of the Astronomical Society of London, Monthly Notices of the Royal Astronomical Society, Philosophical Transactions of the Royal Society of Edinburgh, Philosophical Transactions of the Royal Society of London and the Transactions of the Royal Society of Edinburgh. The information on the journals was supplied by Tim Parks.

In 1847 a Committee of Enquiry headed by the naval hydrographer, Captain Phillip Parker King was set up to investigate the lack of progress of the Observatory (King, Jordan

and Rogers 1847). The report prepared by this Committee led to its eventual closure in 1848. All that remains today are the stone piers of the transit telescope in Parramatta Park. At the insistence of John Tebbutt, an obelisk was erected to mark the remains of Brisbane's observatory. Apart from the astronomical observations, the Parramatta astronomers were also involved in other scientific experiments and measurements.

Back in Scotland, Brisbane went on to build another observatory at Makerstoun. He became the President of the Edinburgh Astronomical Institution and was involved in making the Royal Observatory in Edinburgh more efficient. In 1832, he was elected President of the Royal Society of Edinburgh (Heydon 1966).

Conclusion

Brisbane established Australia's first private observatory which produced Australia's first catalogue of over 7000 stars of the Southern Hemisphere. However, at a later date it was found to be defective and lost much of its credibility. The Observatory was also responsible for discovering Encke's comet. This was an important discovery, because it was only the second time that the predicted return of a comet had been observed but it also threw up problems for further investigations which were resolved in the first half of the twentieth century. The first had been Halley's comet whose appearance had been predicted by Halley based on Newton's theory of gravitation. The observation of Encke's comet made it a permanent member of the solar system and confirmed that comets, like planets obeyed Newton's law of gravitation. This discovery provided another confirmation of Newton's theory of gravitation as applied to comets. It introduced a new class of celestial objects called comets of short period. One other important result of the discovery was the use of perturbations to find the mass of Mercury. Despite the failure of the Observatory to produce an accurate catalogue of southern stars, its fame must rest on the discovery of Encke's comet and for providing another instance for the confirmation of Newton's theory of gravitation based on observations carried out at Parramatta Observatory through scientific instruments. The discoveries of the comets by the Parramatta astronomers were responsible for establishing the tradition of comet hunting in Australia in the second half of the 19th century and beyond.

Although the catalogues of double stars and nebulae had errors in them, they contain objects that are still referred to by the names of the Parramatta astronomers. The scientific programs that were undertaken at Parramatta Observatory laid the foundations for the scientific programs (astronomy, meteorology, geophysics and surveying) that were to be pursued by the colonial observatories which were built in Australia in the second half of the 19th century.

Old Government House and the Domain in Parramatta Park form part of the Australian Convict Sites World Heritage property and are listed on the UNESCO World Heritage List. However, the Observatory which represents Australia's intellectual endeavours and heritage have been completely ignored by Australian heritage authorities and UNESCO. It seems that the convict past is more important than Australia's intellectual history. The Observatory deserves to be placed on the UNESCO/IAU world heritage list of observatories alongside Cape Observatory which was founded at about the same time. Brisbane's achievements can be best summarised in the words of Herschel (1829): "It will be a source of honest pride to him

while he lives, to reflect that the first brilliant trait of Australian history marks the era of his government, and that his name will be identified with the future glories of that colony, in ages yet to come as the founder of her science. It is a distinction truly worthy of a British governor".

Acknowledgements

The author wishes to thank the Mitchell Library for use of its resources and assistance in carrying out this study. He thanks the Powerhouse Museum for use of its images of the instruments from Parramatta Observatory. He also thanks Tim Parks for supplying information on the papers and the catalogues published by the astronomers at Parramatta Observatory and for his useful comments on the paper. He also thanks the late Peter Tyler and members of the Sutherland Astronomical Society for valuable comments on the paper when he gave a talk on Parramatta Observatory at their monthly meeting. The author also thanks the anonymous referee for valuable comments. Shirley Saunders paper in the Historical Records of Australian Science on the history of Parramatta Observatory gives an interesting insight into the social and political aspects of the observatory. Carol Liston's paper in Clune and Turner's book on the Governors of New South Wales gives a valuable insight into the social and political climate of NSW during Brisbane's time in Sydney. A shorter version of this paper was presented at the Brisbane Commemoration Seminar organised by the Royal Society of New South Wales, the National Trust of Australia (NSW Branch) and Parramatta Park Trust on 1 December 2011 at the National Trust of Australia (NSW Branch) office on Observatory Hill, Sydney.

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Ragbir Bhathal

(Manuscript received 23 July, 2012, Accepted 11 December, 2012)

Dr Ragbir Bhathal was the Chairman of the Organising Committee of the Brisbane Commemoration Seminar held at the National Trust of Australia (NSW Branch) at Observatory Hill, Sydney on 1 December 2011. He is an astrophysicist and teaches and carries out research at the University of Western

Sydney. He is also a Visiting Fellow at the Research School of Astronomy and Astrophysics at the Australian National University. He is a member of the IAU's Astronomy and World Heritage Working Group.