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AUSTRALIAN ECLIPSES: THREE "MEN OF SCIENCE" AND THE SYDNEY ECLIPSE OF 1857

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Abstract: On 26 March 1857, a total eclipse of the Sun passed over Sydney, Australia. It was the first total eclipse to be seen from the town since European settlement in 1788. Three scientific men planned to observe the early morning eclipse: the Government Astronomer The Reverend William Scott from a lighthouse on the coastline, the geologist The Reverend W.B. Clark from high ground at North Sydney and the young astronomer John Tebbutt from his home at Windsor, a small town just outside Sydney. For observation they had small telescopes, watches and meteorological instruments; the spectroscopes and photographic cameras that characterized the next Australian eclipse 14 years later and subsequent eclipses were not yet available. When they found that clouds covered the Sun for most of the eclipse and throughout totality, all three diligently turned to examining the effects of the two minutes of sudden darkness on their surroundings. The public also knew about the eclipse and occupied all available high ground around Sydney on the morning of the event. Though they had been informed of the total eclipse, they were not warned about the dangers of looking directly at the Sun, as they would have been at more recent eclipses. However, most would have equipped themselves with smoked or coloured glasses to try to protect their eyes.

Keywords: 1871 total solar eclipse, annular eclipse 1851, Macquarie Lighthouse, Sydney Observatory, Windsor, Reverend William Scott, Reverend W.B. Clarke, John Tebbutt, corona, prominence.

1 INTRODUCTION

On the morning of 26 March 1857, The Reverend William Scott (1825–1917), the newly appointed Government Astronomer of the Colony of New South Wales (Orchiston, 1998), rose early and travelled out to the Macquarie Lighthouse[1] on South Head in Sydney (see Figure 1). He was there to observe the partially eclipsed Sun rise over the eastern horizon, and the forecast total eclipse soon afterwards. Scott was not alone as hundreds of people had made the same trek that morning from the more populated and central areas of Sydney and were at the lighthouse or nearby. They were there to observe but they themselves were under observation through a telescope located seven kilometres away in North Sydney.

As shown on Figure 2, the 1857 total eclipse began west of Sydney, just on the other side of the NSW-Victorian border. After it passed through Sydney, the path of totality went over the Pacific Ocean, across Mexico, and ended in the Gulf of Mexico. In Sydney, the Sun rose at 6:03 am AEST or 6:08 am in Sydney Mean Time (SMT), as was then used. Totality began at 6:51 am SMT and ended two minutes later at 6:53 am, with the Sun only 8.5° above the horizon during totality. Due to this low elevation, anyone wanting to try to see the total eclipse needed a location with an unobstructed view towards the east so the environs of the Macquarie Lighthouse overlooking the Pacific Ocean were ideal. There were other observing locations on high ground elsewhere in Sydney.

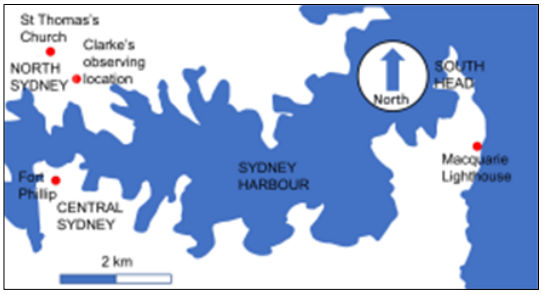

Figure 1: A sketch map of Sydney showing the locations mentioned in the text (map: Nick Lomb).

In Mexico, the path of totality passed north of the main city, Mexico City. However,

Figure 2: A map of south eastern Australia showing the path of totality for the March 1857 eclipse, as well as the locations mentioned in connection with the eclipse (map: Nick Lomb).

in the city of Durango, also known as Durango de Victoria, the eclipse was full. It took place in the evening with the Sun at 13° elevation during the two minutes of totality. The local paper *La Enseña Republicana* reported:

> … the stars in the sky were clearly and distinctly seen and the artificial lights shone as in the darkness of the night. (Cuevas-Cardona and Corral, 2019).

The people of Durango were terrified of the sudden darkness and those in the streets of the city and in its main square ran in all directions.

The March 1857 eclipse was the first total eclipse of the Sun over Sydney since the arrival of Europeans in 1788. There was, however, an annular eclipse of the Sun that had been visible just a few years earlier, on the late afternoon of 1 February 1851. On that occasion the northern limit of annularity passed through Sydney, so that while a full annulus around the Moon could be seen from the central and eastern parts of the city, from much of the western parts only a partial eclipse was visible. The eclipse was also observed from the other large Australian city, Melbourne, Victoria, as the path of annularity passed through it.

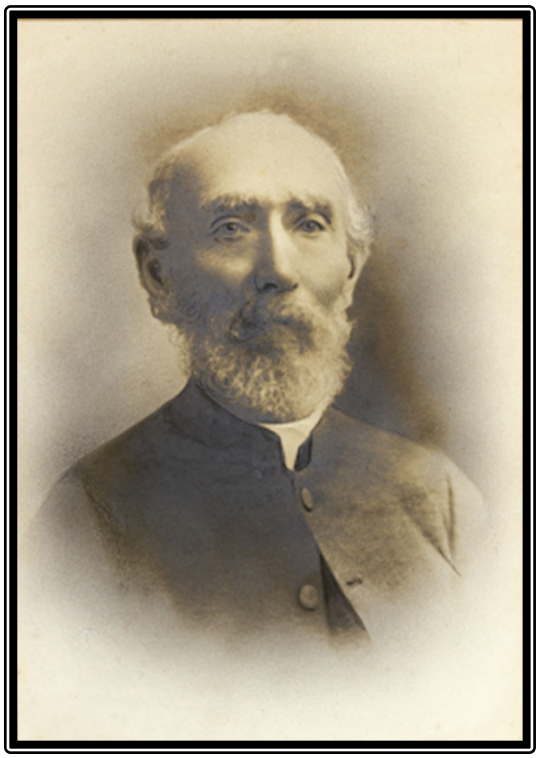

Figure 3: The Reverend William Scott (1825–1917) in later life (collection: Museum of Applied Arts and Sciences, Sydney, P3331)

The 1857 Sydney total eclipse is of considerable interest due to a couple of factors, one scientific and the other sociological. The scientific one is that the 1857 eclipse provides a contrast and a reference point for the great increases in observational technology—exemplified by photography and spectroscopy—as well as knowledge about the Sun in the 14-year interval to the next Australian eclipse (Lomb, 2016). William Scott was also an observer for that 1871 eclipse, visible from Cape York, far north Queensland. The sociological reason is the comparison between the public reaction in Sydney in 1857 and that at the next occasion on which totality passed over a major Australian city, the one that took place in Melbourne in 1976 (Lomb, 2021). It also provides a comparison for the forthcoming Sydney eclipse of 22 July 2028.

In this paper we start by looking at observations of the 1857 eclipse by the three main scientific observers in Sydney and its vicinity, one of whom was William Scott as previously mentioned. The others were William Branwhite Clarke (1798–1878) and a young John Tebbutt (1834–1916), both of whom were, or were to become, highly respected figures in the Australian science community of the time. After considering the observations of the scientists, we examine the reaction of the public to the eclipse.

2 SCOTT'S OBSERVATIONS

William Scott (Figure 3) arrived in Sydney on 31 October 1856 as the newly appointed Government Astronomer for New South Wales. When selected for the post he was a lecturer in mathematics in Cambridge, UK. Being without astronomical experience, he spent two months at the Greenwich Observatory learning about the subject, before boarding a ship for Australia with his family (Orchiston, 1998). His first task was to confirm the site selected for building the new observatory, later to be known as Sydney Observatory, and then to liaise with the Colonial Architect as it was being built.

On Monday 16 March 1857 the *Sydney Morning Herald* newspaper carried a letter from Scott giving details of "The Coming Eclipse" (Scott, 1857a). It was not the first such published letter, as one from John Tebbutt had pre-empted Scott's a few days earlier (see Section 4). Scott gave the results of his calculations of the eclipse, adding that they differed little from the calculations that had appeared earlier. He noted that the planet Mercury could be visible during the eclipse, about 13° above the eclipsed Sun. He also told readers to watch for "… flame-like projections which appear on the moon's edge

during the total eclipse …" Of course, these are what we now call solar prominences.

As already mentioned, before sunrise on the morning of the eclipse Scott made his way from his home in Macquarie St in central Sydney to the Macquarie Lighthouse (Figure 4). He described his experiences in a further letter to the *Sydney Morning Herald*, written on the day of the eclipse and published the next day (Scott, 1857b). He had with him a portable telescope with an objective lens of 2.75 inches (7.0 cm) and an equatorial mount that had been lent to him by Sir William Denison, who was then styled Governor-General (Scott, 1857c). As well, he had some thermometers, the readings of which a Captain Ward of the Royal Engineers was to record. Disappointingly, the Sun was covered by clouds from sunrise to the end of the eclipse. The only clear patch was for a period of about 14 minutes soon after sunrise, during which the partially eclipsed Sun could be discerned and Scott could see "… some remarkably deep indentations in the moon's edge …" (Scott, 1857b). He tried to measure their extent with a micrometer but failed to do so due to the vibration of the telescope. Scott was pleased that the time of greatest darkness agreed with his previous calculations of the time of totality. It was not completely dark though as throughout the eclipse he could see a "… bright line of light on the distant horizon …" This light, which came from places outside the Moon's shadow, was reflected by the clouds covering the sky and made the darkness less deep than it would have been with a clear sky. According to his thermometers there was little temperature change during the eclipse, with the black bulb thermometer—used for measuring solar radiation—changing by no more than 0.6°F (0.3°C).

Though the eclipse was clouded out in Sydney, the sky was clear at the other Australian town on the path of totality, the gold-mining town of Bathurst that lies about 160 km to the west of Sydney. *The Bathurst Free Press and Mining Journal*, a local newspaper, reported on the eclipse (The Solar Eclipse, 1857a):

> Nothing could be more beautiful than the appearance of the eclipse when the moon arrived at the centre of the sun's disc, surrounded as it were by a brilliant ring of fire.

The column containing the description of the eclipse, including the quoted sentence, was reprinted a few days later in the *Sydney Morning Herald* (The Bathurst Free Press of Saturday, 1857). This prompted Scott to write a further letter to editor of the *Sydney Morning Herald* to comment on this column (Scott, 1857d). He began by explaining that the main aim of astronomers studying eclipses was "… to throw more light on the nature or existence of the solar or lunar atmosphere." It was in this context that he was particularly taken with the "ring of fire" observation at maximum eclipse. He calculated that as the apparent diameter of the Moon exceeded that of the Sun at the time of the eclipse, any solar atmosphere had to have reached a height of at least 17,000 miles (27,000 km) to have been visible.[2] A more plausible explanation, he said, was that the cause was the bending of light through the Moon's atmosphere. However, he noted that a detailed explanation of the appearance of the ring of light was needed before any argument could be accepted.

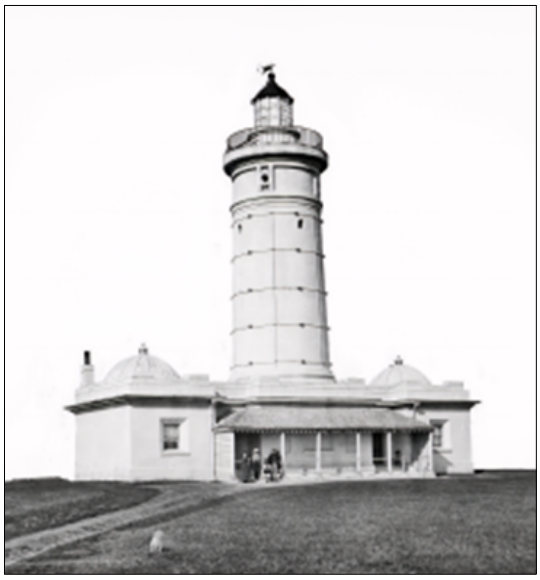

Figure 4: The original Macquarie Lighthouse, South Head in Sydney in about 1870. Note the metal hoops holding the tower together (photo: American and Australasian Photographic Company, courtesy Mitchell Library, State Library of New South Wales ON 4 Box 56 No 233).

3 CLARKE'S OBSERVATIONS

The Reverend W.B. Clarke (Figure 5), often known as the father of Australian geology (Clancy, 2021: 109; Grainger, 1982), had become interested in the subject while a student at Cambridge, UK. He had published several papers on geology, before emigrating to Australia with his family. After arrival in Sydney in 1839, he was appointed as the Headmaster of the King's School at Parramatta and also given responsibility for a couple of nearby parishes (Mozley, 1969). In 1846 he moved to St Thomas' Church on Church Street, North Sydney, as its first pastor. Despite his church duties, he travelled around New South

Wales surveying its geology and its mineral resources. He was the first to point out the likelihood of gold being found in the Colony. Clarke also had an interest in meteorology, compiling weather records at his home in Parramatta and, later in North Sydney, for many years. As well, he was deeply involved in the scientific life of the Colony, including being a founding member of the Royal Society of New South Wales and its Vice-President for almost a decade.

Clarke had prior eclipse experience as he had carefully watched the eclipse of 1851 at the settlement of Parramatta, about 24 km west of Sydney and now a suburb of it. He observed together with the retired British Navy hydrographer Captain Phillip Parker King (1791–1856), who was the pre-eminent

Figure 5: The Reverend William Branwhite Clarke (1798–1878) from a collodion glass plate negative (photo: Freeman Brothers Studio, collection: Museum of Applied Arts and Sciences, Sydney, H8504-1).

astronomer in the Colony during the years before the arrival of Scott and the rise of John Tebbutt (Orchiston, 1988). They were at Newlands (Clarke, 1857), an estate purchased by The Reverend Samuel Marsden (1764–1838) and which, after his death, was transferred to his daughter (Broughton House, n.d.). A substantial two-storey house was completed on the property in 1839. That house, later named as Broughton House, still stands on Thomas Street, Parramatta, though with additions, and is now a nursing home.

Clarke's main role during the 1851 eclipse was to conduct meteorological measurements but King let him look occasionally through a telescope that was "… armed with a red screen …" (Clarke, 1851). As well, King provided him with a telescope exclusively for his use during the eclipse, one "… armed with a green screen …" The two of them also had a third telescope that was kept pointed at the flagstaff at Fort Phillip to let them estimate the changes in brightness during the eclipse. The day was clear and cloudless, providing excellent conditions for eclipse viewing. Observing the Sun at the maximum of the eclipse, Clarke did not see a complete circle of light around the Moon, as "… there was always present the dark portion of the moon, whose edge was never within the disc of the sun." In this observation he disagreed with a few (unnamed) observers at Sydney and at St Leonards, which was renamed North Sydney in 1890 (Hoskins, 2015).[3] These observers viewed the Sun by projection and claimed to have seen a complete annulus around the Moon. In this dispute, both parties were right and demonstrated their observing prowess, since, as previously indicated, the northern limit of annularity passed between Sydney and Parramatta.

William Scott did not see the 1851 annular eclipse as it occurred five years before his arrival in Sydney. Neither did 17-year old John Tebbutt see it, or at least observe it seriously, as in his *Astronomical Memoirs* he writes that his first astronomical observation was of a comet in 1853 (Tebbutt, 1908: 5). However, it was observed by others, including some distant from Sydney. Clarke, at the end of the newspaper article recording his observations of the 1851 eclipse, quotes from a letter to Captain King from Charles La Trobe (1801–1875), who had just been promoted to the position of Lieutenant-Governor of Victoria (Eastwood, 1967). La Trobe wrote, "The sight was worth riding a hundred miles to see, and yet it is strange how few seem to have cared about it." (Clarke, 1851).

At the 1857 total eclipse, Clarke had planned to accompany William Scott to Macquarie Lighthouse, but could not do so (Clarke, 1857). Possibly, the logistics of travelling at night from his North Sydney home to South Head were too difficult. Instead, he set up his observing site on high ground just to the south of the church where he was pastor, an area that is today occupied by high-rise office buildings.[4] In 1857 the view was still open and through his telescope Clarke could watch Scott and his activities at the lighthouse. He had with him a telescope, which was an f/10 instrument with an aperture of 3 inches (75 mm), and a good variety of meteorological instruments: mercury and aneroid baromet-

ers, a hygrometer and three thermometers of different kinds, including one for measuring solar radiation. Clarke was assisted by his son, Mordaunt William Shipley Clarke (1833–1918), who was equipped with a theodolite that had a green filter to protect his eyes from damage by direct sunlight.

Clarke published his observations of the eclipse in one of the main astronomical journals of the day, the *Monthly Notices of the Royal Astronomical Society* (Clarke, 1857). He starts his description with sunrise. There was a band of clear sky near the horizon so that he could briefly glimpse the rising Sun, already about one-third of which was covered by the Moon. Clarke mentions that a neighbour, the painter Conrad Martens (1801–1878), while projecting the Sun through his telescope saw "… a blue edge outside the indentations of the moon's disk, and a bright red light along the inner edge of the sun's lower limb." He speculates that the effect was due to differential refraction, enhanced by the low altitude of the Sun. An alternative explanation would be chromatic aberration in the objective lens of the telescope.

Just as at Scott experienced at the lighthouse, the sky was covered by clouds for Clarke at North Sydney. There were not only clouds,

> … but, over Sydney, the long trail of dark brownish black smoke of tall factory chimneys, domestic fires just lighted, and of steamers in motion, hung like a pall, or slowly drifted to seaward.

To Clarke the scene as the sky darkened during totality was one of foreboding:

> Without wishing to be poetical, I cannot help saying, that in the unusual darkness and gloominess, when the Sun was shut out completely, the appearance of Sydney and her people was one which gave the idea of something terrible about to come upon them. (Clarke, 1857).

Unable to look at the eclipsed Sun, Clarke turned his telescope to objects on the ground. One telescopic target was the flagstaff at Fort Phillip that carried flags signalling ship arrivals and related information. Before maximum darkness, the signals could be clearly seen, while during totality they could not be deciphered. The name of a steamer in the harbour became unreadable during totality. The best test of the darkness was the view towards the lighthouse and the surrounding ridge. Before totality crowds of people on foot, on horseback and in carriages could be distinctly seen, especially around Scott's telescope, which he had placed to the north of the lighthouse. When darkness fell as the Sun was fully eclipsed, "… the distinctness ceased, and the people, &c., looked like diminutive figures cut out of black paper fixed to a grey screen …"

During the hectic two minutes of totality Clarke did not neglect his meteorological instruments. He found the barometric pressure to be rising during the eclipse, up to and beyond totality. He explains that this was not due to the eclipse but "… the law of low tides at 3 o'clock and high tides at 9 o'clock." He was referring to solar tides that are caused by waves created by the Sun's heating of the upper atmosphere (Aplin et al., 2016). After correction for this effect, the barometric pressure turned out to be at a minimum at the time of totality, while the relative humidity was at its greatest at the same time. A modern interpretation of Clarke's barometric readings would be that they may be associated with short period pressure fluctuations induced as the moving shadow of the Moon cools successive patches of the atmosphere. The measured increase in relative humidity is what is expected as the temperature drops during an eclipse. Clarke also took note of what was happening around him: an acacia, of a species that folds its leaves at night and opens them in the morning, closed them again during the eclipse, birds and crickets became quiet and tame birds and poultry became alarmed and went to roost.

4 TEBBUTT'S OBSERVATIONS

John Tebbutt (Figure 6), who was to become Australia's foremost amateur astronomer and to be regarded on a par with professionals, was born in 1834 at Windsor, a town on the Hawkesbury River, 46 km north-west of central Sydney (Orchiston, 2017: 5-13). Becoming interested in astronomy at a young age, his first observations were of a comet that appeared in 1853. The following year he watched a large group of spots on the Sun and began his practice of reporting his observations in the newspapers.

Tebbutt followed this practice with regard to the total eclipse of 1857. On 12 March 1857 the *Sydney Morning Herald* carried a letter from Tebbutt alerting readers to the coming total eclipse (Tebbutt, 1857a). He gave full details of the event, such as sunrise time and the start and end of totality. As well, he described the path of the eclipse track from its beginning to its end in the Gulf of Mexico. With some prescience, he finishes the letter by stating that if clouds were to prevent the people of Sydney from viewing of

the eclipse, "… a considerable decrease of the light of the morning will apprise them of its occurrence." Five days later, Tebbutt followed up his letter with another (Tebbutt, 1857b), in which he states, without false modesty, that "I find by a calculation, conducted with great exactness, that the eclipse will be almost central at Windsor."

Indeed, the calculations were impressively close to the mark: he calculated that the centre line would pass about two miles (3.2 km) south of Windsor; in comparison, measuring the map on the NASA website (Espenak, 2016) indicates a value of 1.5 miles

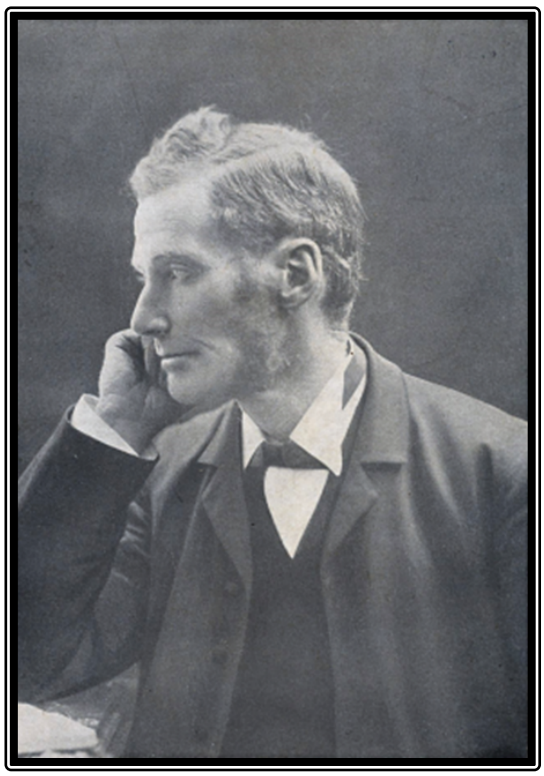

Figure 6: John Tebbutt (1834–1916) from the frontispiece of his *Astronomical Memoirs* (collection: Museum of Applied Arts and Sciences, Sydney, P3549-166).

(2.4 km). The closeness to the centre line meant that totality was 15 seconds longer at Windsor and its vicinity than in central Sydney, which was 30 kilometres from the central line.

On the day of the eclipse the sky was covered by cloud at Windsor, just as it was for William Scott at South Head and William Clark at North Sydney. Tebbutt managed to glimpse the partially eclipsed Sun at sunrise, but afterwards it was fully obscured for the duration of the eclipse. Not being able to observe the eclipse directly, Tebbutt instead carefully noted its effects around him. Afterwards, he sent a long letter reporting on his observations to the *Sydney Morning Herald* (Tebbutt, 1857c). He was pleased to find that the shadow of the Moon, the umbra, arrived exactly at the time his calculations had indicated. A minute earlier, while they were standing on the porch of their home looking west, he warned his incredulous father that a conspicuous object in the distance, the chimney of a steam mill, was about to fade from view (Tebbutt, 1908: 12). Not only did the chimney disappear in the darkness but, from their location on the eastern edge of the town, so did Windsor itself. He said that the darkness was not like that of the usual night time darkness "… for the atmosphere appeared to be laden with clouds of black dust." The Tebbutt farm animals seemed strongly affected, with some of the fowls retiring to their roosts, the horses pricking their ears and the dogs looking to their masters for comfort. In addition to relating the effects of the eclipse, Tebbut mentions that many of the people in Windsor rose early to try to see the eclipse (Tebbutt, 1857c). Some people in the town had considered the eclipse as a hoax, "… but the subsequent darkness verified the predictions of the despised star gazer, and convinced the most sceptical." In other words, Tebbutt felt that his reputation amongst the townspeople of Windsor would have been ruined if the eclipse had not taken place.

5 THE PUBLIC AND THE ECLIPSE

There was considerable public interest in the eclipse. A columnist at the *Sydney Morning Herald*, who called himself a "One-eyed Man", related his experiences of the eclipse. The One-eyed Man left his house in central Sydney at 4 am and spent two hours alternately walking, plucking flowers and running to cover the 10-km distance to the vicinity of the lighthouse in time for sunrise. He gave an evocative description of the scene:

> Besides the hundreds occupying positions on elevated grounds in and about Sydney, or who were otherwise perched on house-tops, for a view of this interesting event, there were perhaps above 200 persons, male and female, of a very respectable stamp, assembled at the Lighthouse grounds; and the array of carts and waggonnettes, cabriolets and cabs, carriages and 'buses (*magnibuses* and *minibuses*)—about two score in all—together with what would have constituted a very useful and valuable trail of horses for a Horncastle fair … (One-eyed Man, 1857).[5]

How did the observers plan to view the eclipse? There were no warnings of the risks of eye damage in looking directly at the Sun or of using filters and no suggestions of using pinhole projection as at more recent eclipses,

such as at the Melbourne eclipse of 1976 (Lomb, 2021). The answer given in the *Sydney Morning Herald* editorial the day before the eclipse (Editorial, 1857a) is that people "… will provide themselves with pieces of smoked or coloured glass." The newspaper's editorial on the day after relates that some (unnamed) people warned prior to the eclipse that the timings provided by the astronomers, presumably Scott and Tebbutt, were incorrect (Editorial, 1857b). In the event, the eclipse happened at the predicted times. The editorial comments that "… it is amusing to find how strong opinions divided people on even this subject." Other people showed little interest. We are told about a couple of "horse-breakers", who turned their horse towards the town, "… one exclaiming, ironically, "O this is a beautiful sight!" The same editorial also indicates the then accepted scientific opinion of the corona and prominences that would have been seen had the sky been clear:

> There was … no display of that red and outflaming light on the margin of the moon noticed when that orb, intercepting the sun, becomes itself the receptacle of his beams—just as the tops of the mountains often glare with his last rays. (Editorial, 1857b)

In the days before the eclipse, opticians and scientific retailers took the opportunity to try to sell their telescopes. The well-established firm of Flavelle Brothers advertised that they "… beg to inform scientific gentlemen and others that they have in stock a very fine and powerful astronomical telescope." (The Eclipse–Flavelle Brothers and Co., 1857). Solomon de Lissa, another optician, advertised "… a very splendid large size astronomical telescope of very superior power." (The Solar Eclipse, 1857b). This was a brass telescope of three feet (914 mm) length with a stand and two eyepieces. Another person, who took advantage of the interest created by the eclipse, was a lecturer, W.S. Creeny. He gave nightly lectures on astronomy and, of course, mentioned the eclipse. At one lecture, given on 24 March, he covered a large variety of topics including centrifugal force, the tides and the motion of the Moon (Second Lecture on Astronomy, 1857). Regarding the eclipse, he suggested that the best way of observing it was with "… a piece of green card perforated with a pin-hole." Creeny was the Headmaster of the Lyceum Boarding School (Lyceum Boarding School, 1857), and he also gave lectures on the evenings before and after the eclipse (Astronomy Christ Church School, 1857; New South Wales Alliance … 1857).

Not every member of the public viewed the eclipse scientifically, as some were moved to express their feelings and experiences through poetry. Among these was someone calling themselves "Acastus", the first verse of whose poem is as follows:

> What ailest thee, O regal Sun?
> Thy beams are fading fast away,
> Which late in 'customed splendour shone
> So strong, to usher in the day;
> And night, which far adown the west thou hadst hurl'd
> Again abruptly creeps upon the world (Acastus, 1857).

6 DISCUSSION

William Scott, who set out to observe the 1857 eclipse from South Head, was also involved in trying to observe the following Australian eclipse in 1871 (Lomb, 2016). There was a huge contrast between the attempt to observe the 1857 eclipse and the one 14 years later. For the earlier eclipse, discussed here, the scientific men observed as scattered individuals with their only equipment being small telescopes and their limited intentions were to time totality and maybe sketch the Sun and possibly measure indentations on the Moon's edge with a micrometer. With such sparse instrumentation and plans, there was little disappointment with the lack of a clear sky as they could make equally valid observations by observing the effects of the sudden darkness around them. At the next total eclipse, astronomers and other scientists from several Australian colonies came together in a major and complex expedition needing government support. They had larger and more professional telescopes and, most importantly, they had newly developed equipment with them. Instead of simply sketching what they saw through their telescopes, they had photographic cameras to image the eclipsed Sun, together with spectroscopes to analyse the constituents of the corona and polariscopes to search its light for scattering by dust.

Scientific knowledge of the Sun had greatly advanced in those 14 years. In 1857 Scott could say that the corona was most likely due to the Sun's rays passing through the Moon's atmosphere; a theory also mentioned as established fact in a *Sydney Morning Herald* editorial of the time. By 1871 it had been established through the comparison of photographs and drawings made at the Spanish eclipse of 1860 that the corona was around the Sun and not the Moon (Todd, 1894: 37, 53). As well, astronomers using spectroscopy had detected hydrogen in a promin-

ence and observed the mysterious 'coronium'[6] in the corona.

The eclipse of 1857 could be seen from Sydney; the next total eclipse of the Sun to pass over a major Australian city occurred over a century later, in 1976, and darkened the city of Melbourne (Lomb, 2021). Again, there is a large contrast. In 1857 the public were encouraged to view the eclipse and were given no warning about the dangers of looking directly at the Sun. There was a brief mention in the *Sydney Morning Herald* of the then accepted methods of viewing through smoked or coloured glass and a passing reference in the report of a lecture to the pinhole method, though without explaining the need for projecting the image. Maybe the cloud cover was fortunate and saved the eyesight of many Sydneysiders. In 1976 the public were actively discouraged from viewing the eclipse and told to stay indoors (Schneider, n.d.). There were not only warnings in the papers but on large banners at street corners.[7] In 2028, once again, there will be a total eclipse viewable from Sydney, now a much larger and more populous city than in 1857.[8] It is to be hoped that not only will the weather be better than 171 years earlier but that, with modern and safe eclipse glasses, the public will again be encouraged to watch one of Nature's greatest spectacles.

7 NOTES

1. In 1857 Macquarie Lighthouse was the only lighthouse in the vicinity of South Head. Another lighthouse, Hornby Lighthouse, was built closer to South Head in the following year in response to the wreck of the sailing ship *Dunbar* five months after the eclipse. The ship was wrecked on the rocks below South Head Signal Station, just 460 metres to the north of the Macquarie Lighthouse.
2. A modern calculation based on the Jet Propulsion Laboratory's Horizons database indicates that at the time of the eclipse the Moon had an angular diameter 67 arc seconds greater than the Sun and hence covered the first 24,000 km above the Sun's visible surface. The Sun's corona would not have been hidden as it extends hundreds of thousands of kilometres above the surface.
3. As its population grew North Sydney was split into smaller suburbs, one of which revived the name St Leonards.
4. Clarke gives confusing information regarding his observing location. He states that it was "… exactly W. 4°S of the lighthouse on the South Head." That is not possible, since that would place him in central Sydney and not St Leonards, as he indicated in the title of his paper. The site must have been north of the lighthouse (see Figure 1). The 4° also appears to be incorrect for he reported that the Sun rose 16° north of the lighthouse. Since on 26 March, just after the Southern Hemisphere autumn equinox, the Sun would have risen 2° north of east, the site must have been at a bearing of 14° north of west from the lighthouse. That bearing, the given distance of 4½ miles (7.2 km) and the given elevation of 277 feet (84 m) all ties in with a location near Mount Street, in between the Pacific Highway and the Warringah Freeway.
5. Horncastle is a town in Lincolnshire, UK. A large horse fair was held there every August until 1948.
6. The then unidentified spectral line that led to the suggestion of an undiscovered substance named coronium, is today identified as iron, highly ionised in the million degrees Celsius temperature of the Sun's corona.
7. Despite all the warnings and the cloudy sky, after the eclipse 150 people in Melbourne visited the Victorian Eye and Ear Hospital fearing eye damage (Six have possible injury, 1976).
8. The 1 March 1856 census gives the population of the City of Sydney and Suburbs as 69,173 (NSW Registrar General, 1857), while on 30 June 2020 the Estimated Residential Population of Sydney was 5,367,206 (Australian Bureau of Statistics, 2021).

8 ACKNOWLEDGMENTS

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Dr Nick Lomb obtained a PhD from Sydney University for a thesis titled, *A Detailed Study of Alpha Virginis and three other broad-lined Beta Canis Majoris stars*. During his thesis work Nick developed the theory of least squares frequency analysis, which has now become a standard method of numerical analysis, called the *Lomb–Scargle Periodogram*. His relevant publication in the journal *Astrophysics and Space Science* has received over 5000 citations according to Google Scholar.

On joining the staff of Sydney Observatory, he initially concentrated on the determination of precise positions of minor planets. Subsequently, he had a close involvement in the preparation and publication of the *Sydney Southern Star Catalogue*. After Sydney Observatory came under the auspices of the Museum of Applied Arts & Sciences (MAAS), Nick was appointed Curator of Astronomy for the Museum. As curator he planned exhibitions such as *Return of the Comet*, *Hands on Astronomy*, *By the Light of the Southern Sars*, *Mars: The Closest Encounter*, *Transit of Venus: The Scientific*

Event that Led Captain Cook to Australia, *Observing the Weather* and *From Earth to the Universe*. He was also involved in public outreach by providing astronomical information for the public and making regular appearances in the media. He organized an adult education class at Sydney Observatory for close to 25 years.

Having left the Observatory, Nick continues to prepare the annual *Australasian Sky Guide* that is published by Powerhouse Publishing, as he has done since 1991. Now an Adjunct Professor of Astronomy at the University of Southern Queensland, he researches the history of Australian astronomy. He has authored two books on the transit of Venus and in recent years has published research papers on the history of the *Astronomical Society of Australia* and on eclipses of the Sun and eclipse expeditions. He has been to three total eclipses and has been fortunate with the weather at all of them: South Australia in December 2002, Siberia in August 2008 and Palm Cove, Queensland, in November 2012.