AUSTRALIAN ECLIPSE EXPEDITIONS: JAMES SHORT AND THE ECLIPSES OF 1908, 1910 AND 1911

Nick Lomb
Centre for Astrophysics, University of Southern Queensland, Toowoomba, Queensland 4350, Australia.
Email: Nick.Lomb@usq.edu.au

Abstract: Solar eclipse expeditions give us rare glimpses of astronomers of the past away from the routine work of their observatories, as well as the equipment that they used. In the early 1900s there were three eclipses in the vicinity of Australia and each time Australian astronomers were involved together with colleagues from New Zealand. The three eclipses were the 1908 eclipse observed at Flint Island near Tahiti, the 1910 eclipse observed at Port Davey, Tasmania, and the 1911 eclipse observed at Vavau, near Tonga. The astronomical photographer at Sydney Observatory, James Short, was one of those who took part in expeditions to all three eclipses. For the Flint Island eclipse Short joined an expedition organised by British amateur astronomer and aviation pioneer, Francis McClean, as he did for the Tasmanian eclipse two years later, although this time there was also an official Australian expedition. At the Vavau eclipse there was an even larger choice of expeditions with two official British expeditions, an official Australian expedition and a private expedition organised by a former participant of McClean's Tasmanian expedition. Short joined the last of these. Though there were some clouds at Flint Island in 1908 and at Vavau in 1911, some useful results were obtained, while the Tasmanian expeditions were, unsurprisingly, completely defeated by the weather.

Keywords: early twentieth century eclipse expeditions, 1908 eclipse, 1910 eclipse, 1911 eclipse, coelostats, James Short, Francis McClean

1 INTRODUCTION

After the eclipse of 1871 that was observed from north Queensland, discussed in the first paper in this series (Lomb, 2016), there was a 37-year hiatus until the next eclipse in the vicinity of Australia. This was a long enough period for there to be a generational change in Australian astronomers, so that the personnel involved in observing the two Pacific eclipses of 1908 and 1911 plus the Tasmanian eclipse of 1910 were completely different to those in the earlier eclipse expedition. Figure 1 shows the tracks of the three eclipses.

As discussed in the first paper, examination of eclipse expeditions is of great interest as they provide rare glimpses of astronomers working away from the normal routine at their observatories. In the early 1900s, at least in Australia until the coming of astrophysics to the country with the establishment of the Commonwealth Solar Observatory in 1924 (Frame and Faulkner, 2003: 34), astronomical research was basically the continuation of that of the nineteenth century. At the state observatories the emphasis was on the measurement of photographic plates for the local zones of the International Astrographic Catalogue (Ellery, 1888: 38), while amateur astronomers observed occultations, double and variable stars plus the Sun (Orchiston, 2017: Chapter 4).

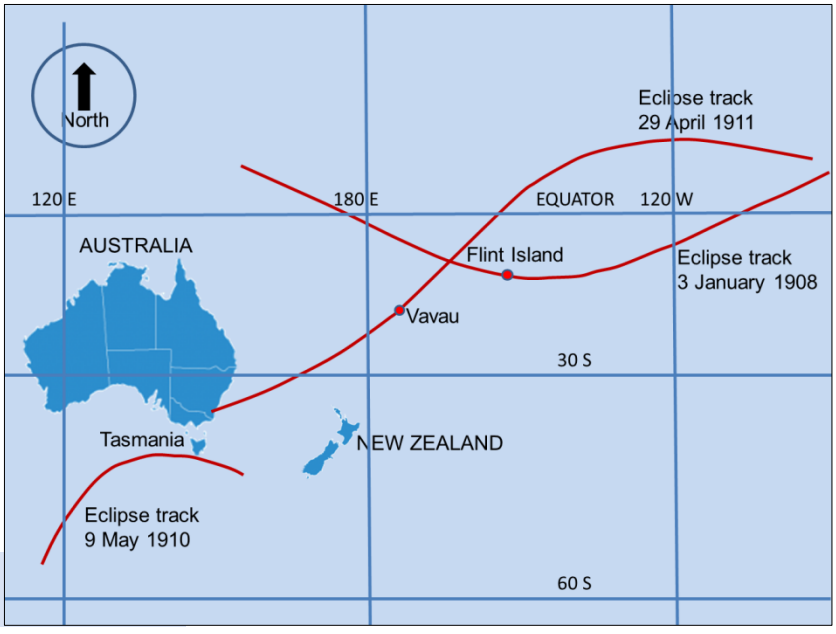

Figure 1: Eclipse tracks of the total solar eclipses of 1908, 1910 and 1911 (map: Nick Lomb).

Though internationally many eclipses had been observed since 1871, there had been no breakthrough in knowledge about the solar corona. The explanation of the mysterious green spectral line seen in the corona, known as coronium, as due to highly ionised iron was only to come in the late 1930s (Swings, 1943). However, these three eclipses came just before a huge change in the purpose of eclipse observations that occurred due to Einstein's prediction of the deflection of starlight by the Sun in his General Theory of Relativity (Einstein, 1915). For the next eclipse of the Sun to be observed from Australia in 1922 (Sydney Observatory, 1923), the observing aims were largely concerned with the verification of Einstein's prediction. The Lick Observatory expedition at Wallal in Western Australia made the first successful verification, despite the well-publicised claims for Eddington's expeditions to the island of Príncipe off the coast of Africa and the town of Sobral in Brazil for the 1919 eclipse (Treschman, 2014).

Though the understanding of the Sun had not changed, there were improvements in observing methods. Some of these were to do with the use of mirrors to deflect light into telescopes and cameras to make setting up the instruments much easier. These mirrors were part of devices called siderostats and coelostats that were driven to follow the Sun (Mills, 1985). Another important improvement was the change from wet plate photography to the use of much more convenient dry plates in the 1880s. These plates were not only more sensitive than the previous plates, but they also enabled longer exposure times (Stokley Jnr, 1923).

In this paper there is a focus on the role of James Short, who was the astronomical photographer at Sydney Observatory for four decades. His role was largely connected with the Astrographic Catalogue but included much else such as cloud photography. The next section has his biography since his life has not been previously discussed in print. As will be seen, though Short was not an easy person to have as an employee, he must have had considerable technical skill for his presence was welcomed at all three eclipse expeditions.

2 JAMES SHORT: A BIOGRAPHICAL SKETCH

James Short was the astronomical photographer at the Red Hill branch of Sydney Observatory. Initially, he was appointed by the NSW Government Astronomer Henry Chamberlain Russell (1834–1907; Bhathal, 1991) as Attendant on the Photo-Telescope. At a conference in Paris in 1887 (now often referred to as the International Astrographic Congress) Russell had accepted the task of photographing a large zone of the southern sky on behalf of Sydney Observatory as part of the International Astrographic Catalogue project. There were initially 18 (and finally 23) observatories involved in the project, each working with a telescope of identical specifications. Other observatories in the English-speaking world ordered complete Astrographic telescopes from the well-respected firm of Grubb of Dublin. Russell instead designed his own telescope and mounting that he had built locally and only ordered the lens from Grubb. All the local parts of the telescope were in readiness when the lens arrived on 19 September 1890 (Wood, 1958: 16).

According to a reference Russell (1902) wrote for him, Short was selected from several competitors for his position. It was a task that needed "… high class training in delicate machinery and in Photography." The initial appointment of Attendant on the Photo-Telescope was changed to that of Astronomical Photographer in March 1904, though still with a salary of £200 (Department of Public Instruction, 1904). For comparison, in the 1907 Harvester case that began the idea of a minimum wage in Australia, the weekly wage for an unskilled labourer was set at £2 2 shillings a week or about £109 a year, while that of a tradesman was determined at about £182 (Fair Work Commission, 2019).

James Short was born in Dublin, Ireland, on 11 November 1865. His father William was a bookbinder (Eire, 1989). In his early 20s he attended the Manchester Technical School, a school that had been formed five years earlier from the Manchester Mechanics' Institution (The University of Manchester, 2005). In his first year there in 1888 he studied a range of practical subjects: building construction, inorganic chemistry, mathematics, freehand drawing, model drawing, geometry and perspective, with first class passes for the last two subjects (Wyatt, 1888). He completed his studies with first class passes in all the five required subjects and received the Queen's Prize in mechanical drawing (Russell, 1902). Interestingly, according to Short (1904), teachers in the Manchester School System taught in the evenings and were paid only by results: £4 for each student with a first class pass and £2 for each with a second class pass.

Short must have migrated to Australia soon after graduation, since he was working at Sydney Observatory from 1890. That year Russell sent him to Red Hill, a small hill on a triangular piece of land bounded by Pennant Hills and Beecroft roads about 19 km north-west of Sydney Observatory, to test its suitability for astronomical photography (see Figure 2). It was soon found that Red Hill was often clear when it was cloudy at the location of Sydney Observa-

tory (Beecroft Cheltenham History Group, 1995). In addition, it was found that an exposure of three and a half hours gave a better result at Red Hill than an hour longer exposure at Sydney Observatory (Stellar Photography, 1904). Russell decided to set up a branch observatory there but through lack of funds the Astrographic telescope could not be moved there until 1899. James Short was placed in charge of the telescope, which was set up in a circular building of galvanised iron with a concrete base. A six-room timber cottage was built for Short and his wife, next door to the telescope building.

Short did not take well to the bureaucracy in the Public Service environment and there are numerous letters in the archive, some from his own collection, when he was chastised by the Government Astronomer of the day for stepping out of line. In 1904 Henry Lenehan (1843–1908) complained about the letter to the *Sydney Morning Herald* (Short, 1904) regarding the Manchester School Board being signed as from Red Hill, the name of the observatory where Short lived and worked. He pointed out that public servants were not allowed to comment on matters of "Administration" (Lenehan, 1904). Another admonishment from Lenehan (1907) concerned arranging a school visit from Beecroft Public School without going through official channels.

A letter to the *Daily Telegraph* in 1909, in which Short commented on reports of the first sightings of the approaching Halley's Comet and cast doubt on an observation from Adelaide, also led to trouble. William Raymond (1871–1937), who was Officer-in-Charge after the death of Lenehan, wrote that "You must see yourself that there will be endless trouble if matters are allowed to drift on in the way they are apparently going." He mentioned that George Dodwell, the Government Astronomer at Adelaide Observatory, was very hurt over the criticism (Raymond, 1909).

Matters came to a head under the next Government Astronomer, William Cooke (1863–1947; Hutchison, 1981). From 1916 there was a Public Service Board inquiry into Sydney Observatory. Short took the opportunity to criticise all the four government astronomers that he had served under. In response the Government Astronomer at the time, William Cooke (1918), wrote to the Under Secretary for Education, Peter Board, in January 1918, saying of Short:

> He is unreliable, absolutely destitute of enthusiasm, and disloyal … [Furthermore,] It is quite obvious that whatever maybe his qualifications as a photographer, and these I admit, he is an impossible person to carry on the work, and I must press for his immediate transfer to some another department.

Figure 2: James Short at the Pennant Hills Observatory in 1890 (collection: Museum of Applied Arts and Sciences, Sydney, 2005/124/1-1: Gift of Mrs Carole Short, 2005).

The hundreds of photographic plates taken and successfully measured for the Sydney Zone of the Astrographic Catalogue testify to Short's competence as an astronomical photographer. Another indication is his election as a Fellow of the Royal Astronomical Society on 10 December 1909 (Saunder, 1909). As well, Short presented a number of papers to the NSW Branch of the British Astronomical Association, including on the *Aurora Australis* (Short, 1909), on *Mars and the recent occultation* (Short, 1918) and *Four geometrical solutions* that gave alternative ways of solving standard spherical trigonometrical problems involving latitude and declination (Short, 1920).

Short's seemingly difficult temperament does not seem to have been a problem during the eclipse expeditions in which he took part. These were the three expeditions from 1908 to 1911 to be described in the following sections, plus Sydney Observatory's own expedition with Cooke to Goondiwindi, Queensland in 1922. In January 1923 James Worthington (1884–1980), with whom he joined forces for the 1911 expedition, wrote to him inviting him to join an eclipse expedition in California to view a total eclipse in September of that year, "We should be honoured and delighted if you can join the party …" (Worthington, 1923). The letter, addressed to "My Dear Mr Short", is friendly and cordial, suggesting good bonding between the two eclipse observers, despite the large class difference between them.

Short retired from the public service on 20 January 1931, soon after his 65th birthday. As the retirement was during the Depression there were no funds for appointing a successor so that the Red Hill branch observatory was closed and the Astrographic telescope transferred back to Sydney Observatory (Wood, 1958: 24). The year after his retirement Short had an accident at Central Station, when he fell between a train and the platform but with quick thinking managed to save himself. When the incident reached the newspapers, he was referred to as "James Short, 56, of the Pennant Hills Observatory" (Close call: Between Train & Platform, 1932) so that he seemed to have shaved ten years from his age, and was suggesting that at his new Pennant Hills address he was continuing some observational work.[1] He certainly continued his meteorological observations for on his death the Central Meteorological Bureau wrote to his widow, his second wife, offering their condolences and stating,

> The interest and enthusiasm of Mr Short over a long period of years has enabled this Bureau to compile a long and valuable meteorological record for Pennant Hills. (Warren, 1943).

The letter also mentioned the recovery of the equipment that had been on loan to him.

James Short died on 21 Jun 1943 at the age of 77. He left behind his widow and two surviving sons, one from each of his two marriages.

3 THE FLINT ISLAND ECLIPSE OF 3 JANUARY 1908

The eclipse track passed through an isolated part of the Pacific, making landfall on only two remote islands: Hull Island, about 1100 km north of Samoa and Flint Island, about 720 km northwest of Tahiti. As the eclipse duration was longer at the latter island and the Sun was to be closer to the zenith, astronomers chose that island for their observing. An expedition from Lick Observatory went to the island, financed by William Cocker and led by William Wallace Campbell (1862–1938) (Campbell, 1908). They were joined on the island by a private expedition organised by Francis Kennedy McClean (1876–1955).

Francis McClean was best known as a pioneer aviator, a field for which he was knighted in 1926. He also had an interest in astronomy that was acquired from his father, who was a Fellow of the Royal Society. As well, he had a friendship with the famous astronomer Norman Lockyer, who is often credited with being the discoverer of helium on the Sun though in reality the discovery involved a number of other scientists, including the Madras Observatory Director Norman Pogson, the French astronomer Jules Janssen (Nath, 2013), and Norman Lockyer's son, William James Stewart Lockyer (Stratton, 1956). McClean began the expedition to observe the 1908 eclipse on his own as he could not get anyone else in the British astronomical community interested. He left London on 3 October 1907 and in Marseilles boarded the ship *Himalaya* that already had on board his 15 cases of equipment (McClean, 1908).

On arriving at Sydney McClean met members of the NSW Branch of the British Astronomical Association as well as the Government Astronomer Henry Lenehan. Through them he visited Red Hill Observatory where he met James Short, who worked there (Section 2), and the retired surveyor Joseph Brooks (1847–1918), both of whom agreed to join the expedition party. Brooks had started his career at age 16 with the South Australian Department of Survey and Crown Lands as a draughtsman and later moved to the New South Wales Lands Department as a surveyor. There he worked his way up to the new position of Field Astronomer and later became Superintendent of the Trigonometrical Survey Branch (Orchiston, 2017: Bio Box 8.5). Another to join was the afore-mentioned William Raymond, who was then First Assistant

at Sydney Observatory. Raymond also had a background with the Trigonometrical Survey before moving to Sydney Observatory. There his main task was observing the position of stars with the transit circle, though he also made magnetic observations and operated a seismograph (Wood, 1958: 19).

After Sydney the next stop was Auckland where two more people joined: the photographer Henry Winkelmann (1860–1931) and Reverend Frederick William Walker (1859–1941), the vicar of Ellerslie. Born in England, Winkelmann joined his elder brother in New Zealand in 1878. After trying several fields of employment, he purchased a camera in 1892. Eventually, his photography became sufficiently profitable that he could set up a photographic studio and leave his other work. Probably his greatest success came in 1915, when he won the grand prix at the Panama-Pacific International Exposition in San Francisco (Edwards, 1996). Reverend Walker, also English born, arrived in New Zealand in 1891 and served at Ellerslie between 1900 and 1914 (John, pers. comm., 2019). He seemed to have an interest in astronomy as at Ellerslie he was known to have a telescope in his garden. As well, he was a Fellow of the Royal Astronomical Society, at least for a while. He was listed as such in 1911 (Royal Astronomical Society, 1911), a time when he was in England on 'exchanged pulpits', but was no longer listed in 1918 (Royal Astronomical Society, 1918).

From Auckland the augmented party left on the charted ship *Taviuni* on 12 December and, after a brief stop in Tahiti, arrived off Flint Island 11 days later. The island was surrounded by a coral reef with only one narrow passage that had been blasted through it. Landing of people and equipment was with the ship's boat and the island's surf boat through that channel. The island was leased by Levers Plantation Limited that maintained a manager on the island and about 25 Tahitians, men and women, were employed to work copra, the product of the coconut trees that had been planted over about 80% of the island (Campbell, 1908). Figure 3 shows a group photograph of some members of the eclipse party.

After landing the party erected the tents and began setting up the equipment, including a siderostat with a 21-inch (53-cm) plane mirror built by the well-known English instrument making firm of T. Cooke & Sons. This is a device with a single mirror designed to reflect sunlight into a horizontal beam so that it could be utilised by horizontal telescopes and cameras (Mills, 1985). This arrangement had the advantage that only the siderostat mirror had to be driven by clock-

Figure 3: Group photo of some members of the eclipse party. James Short is on the front left, the photographer Henry Winkelmann is on the top right, next to him, almost certainly, is his fellow New Zealander, Reverend Walker (photo: Henry Winkelmann, collection: Museum of Applied Arts and Sciences, Sydney, 2005/124/1-28: Gift of Mrs Carole Short, 2005).

work to follow the Sun, while the rest of the equipment could be kept stationary. Figure 4 shows Joseph Brooks adjusting the clock drive of the siderostat. The main instrument to utilise the siderostat was the De La Rue coronagraph[2] or solar telescope lent by Sir Norman Lockyer that had a lens of 4⅝-inch (11.7-cm) aperture and 8-foot (2.4 metre) focal length. This instrument had previously been used for eclipse observations at Novaya Zemlya (an archipelago in the Arctic Ocean), India and twice in Spain. The tube of the coronagraph along with that of the spectroscope were damaged in transit and were repaired on arrival on the island. The spectroscope, brought from England by McClean, was one of 4½-foot (1.4-metre) focal length. With the help of secondary mirrors to receive light from the siderostat, it was placed at right angles to the coronagraph.

Another instrument was the Dallmeyer photoheliograph that Short had brought from Sydney Observatory. That instrument, which had originally been used to observe the transit of Venus back in 1874 (Lomb, 2011: 120–121), still exists in the collection of the Museum of Applied Arts and Sciences in Sydney as object H10211 and it was (in 2019) on display at Sydney Observatory. Short also had a telephoto camera with a lens of 1¼-inch (3.2-cm) aperture and a focal length a little longer than the Dallmeyer.[3] Winkelmann's telephoto camera was based on a ½-plate camera made by the London lens manufacturer Ross & Co. with Ross-made Zeiss lenses that had an equivalent focus of 5¼ feet (1.6 metres). Raymond (1908), who had spent the first few days on the island on board the ship due to an illness that he called cholera, had a 4-inch (10-cm) aperture Grubb telescope, with which to sketch the Sun.

The principle of feeding stationary and horizontal telescopes with light from a siderostat was not followed by the neighbouring Lick Observatory expedition. Instead they erected a 40-ft (12-metre) vertical tower with a lens of the appropriate focal length on top. Campbell and Albrecht (1908) extolled the advantages of that arrangement for coronal photography as being: the lens and the tube were above the heat radiated by the ground; good ventilation provided for the tower; and simpler optics without unnecessary mirrors could be used. Known as the 'Schaeberle Camera' after its designer John M. Schaeberle, it was used by Lick Observatory on 13 solar eclipse expeditions starting from 1893 (Pearson and Orchiston, 2008). The Lick observing plans for the Flint Island eclipse included not just photography of the corona but measuring heat radiated from it together with a variety

Figure 4: Joseph Brooks adjusting the clock drive for the siderostat with the Lick Observatory tower faintly visible in the background (photo: Henry Winkelmann, courtesy: National Library of Australia, Joseph Brooks personal album, PIC/17294/100).

of other observations.

As at many other eclipses, on the day of the eclipse passing clouds provided great excitement and put the view of the eclipse at risk. Heavy rain fell just before totality, forcing the observers of the Anglo-Australian party to cover the siderostat. Fortunately, the rain ceased just as Bailey's Beads came into view and the siderostat could be uncovered and observations commenced. During the first minute of the four-minute totality clouds persisted, after which there was only some light cloud in front of the Sun.

During the eclipse six plates were exposed with the De La Rue coronagraph by a team consisting of McClean, Brooks and Walker. Four of these were successful. For his report on the eclipse McClean asked the expert eclipse illustrator William Henry Wesley (1840–1922), the Assistant Secretary of the Royal Astronomical Society, to evaluate the four useful plates and to make a composite drawing from them. This was a rather late application of an established practice for nineteenth century eclipse photographs (Pang, 2002: 97–105). Wesley found the special features of the corona in 1908 to be

> The marked inclination of its axis of symmetry to that of the sun's rotation … [and] The great height to which the north polar rays extend, especially the fine narrow ray in the centre of the rift.

plus some more detailed features.

McClean's other instrument was the spectroscope. Though it was used during the eclipse both the plates exposed with it failed, so no results were obtained. Short, helped by the purser from the *Taviuni*, managed to expose seven plates on his two instruments. Due to the initial cloud this was less than the planned ten exposures. Of these seven, the two with the shortest exposures were under exposed and one plate was slightly fogged but the remaining four were successful as shown in Figure 5. Winkelmann exposed eight plates through his telephoto camera with three blank due to cloud and the rest showing "… varying depths of corona".

While sketching the eclipsed Sun through the Grubb refractor William Raymond saw several streamers extend out from the Sun with "… a huge prominence of a reddish colour …" appearing just before totality ended. He said that the sky remained relatively bright during totality so that it would have been possible to read a newspaper. Ruby-coloured lights were prepared in advance but were not needed (McClean, 1908).

On his return to Sydney after the eclipse Raymond found himself in charge of Sydney Observatory as Henry Lenehan, the Government Astronomer was ill and died soon afterwards. He did, however, manage to prepare an article for the *Sydney Morning Herald* before he was overwhelmed by his new duties (Raymond, 1908). After summarising the scientific details of the expedition, he gives some information on the wildlife. There were three kinds of crab on the island with the largest and most concerning being the coconut crab that had such powerful claws and teeth that they could easily break someone's arm. There were also turtles that came in large numbers to lay their eggs on the beach. The natives would turn them on their backs at night and then bring them into the camp during daylight. One night 12 of the animals were unfortunate enough to be caught in this way.

Reverend Walker reached home in Auckland before Raymond and based his first sermon after returning on his eclipse experiences (The Solar Eclipse …, 1908). He said

> Just as the moon covered the disc of the sun, giving it a dark green appearance, Mercury and Venus shone out most brilliantly – one on either side of the sun. Altogether the sight was very wonderful and staggering to the mind and heart – something so exceedingly beautiful, so like the work of Him "who does wonders both in heaven and earth".

4 THE TASMANIAN ECLIPSE OF 9 MAY 1910

The circumstances of this eclipse were not promising. Totality was only visible from Antarctica and, as shown in Figure 6, from the southern part of Tasmania, the part lying below a line roughly from Corinna on the western side to Campbell Town on the east. As the eclipse was to take place not long before sunset, the Sun would be only a few degrees above the horizon during the event. The worst consideration of all was that in late autumn there was a strong likelihood of poor weather.

As a result of these considerations, the Joint Permanent Eclipse Committee (JPEC) of the Royal Society and of the Royal Astronomical Society in the UK decided not to send an expedition of their own nor did the prolific eclipse observers from Lick Observatory. There was instead an official Australian expedition plus Francis McClean organised an expedition, as he had at Flint Island two years earlier. The JPEC wrote to the Victorian Agent General in London offering to assist any expedition from Australia with advice and the loan of equipment (Tavernier, 1909). That loan was accepted, and assistance was also provided to McClean's party.

The Australian expedition was organised by a Committee set up by the Australasian Association for the Advancement of Science at its Bris-

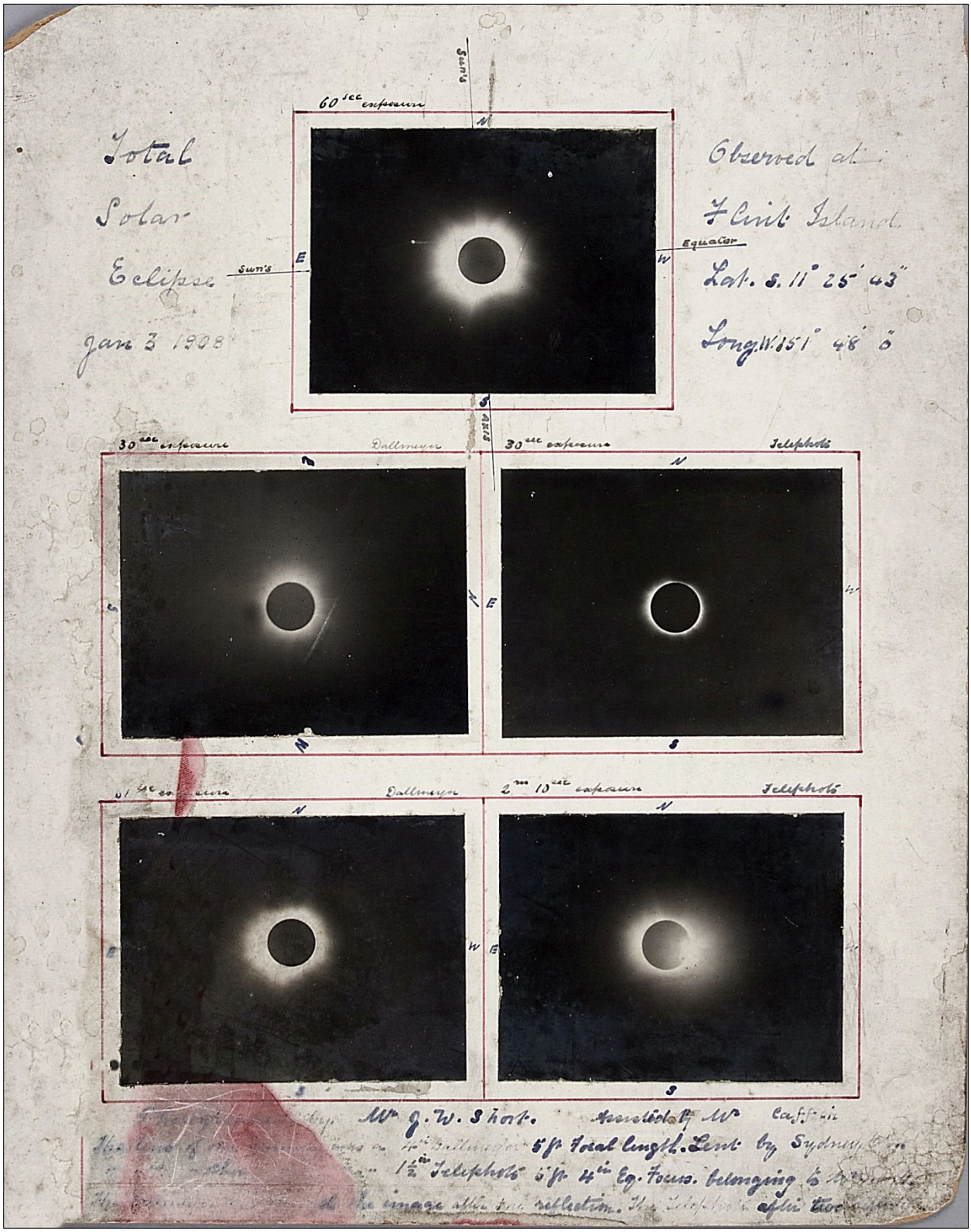

Figure 5: James Short's photographs of totality with his two instruments and with different exposure times (Collection: Museum of Applied Arts and Sciences, Sydney, P3549-178).

bane meeting in 1909, under the chairmanship of Pietro Baracchi (1851–1926), the Government Astronomer of Victoria (Australasian Association for the Advancement of Science, 1911). Italian born Baracchi became Acting Government Astronomer in 1895 but was only confirmed in that position five years later (Perdrix, 1979). Together with the previous Government Astronomer Robert Ellery, Baracchi had made some of the first spectroscopic observations of southern stars, while just before his retirement he was involved in the site survey that led to the establishment of the Commonwealth Solar Observatory at Mount Stromlo, near Canberra (Or-

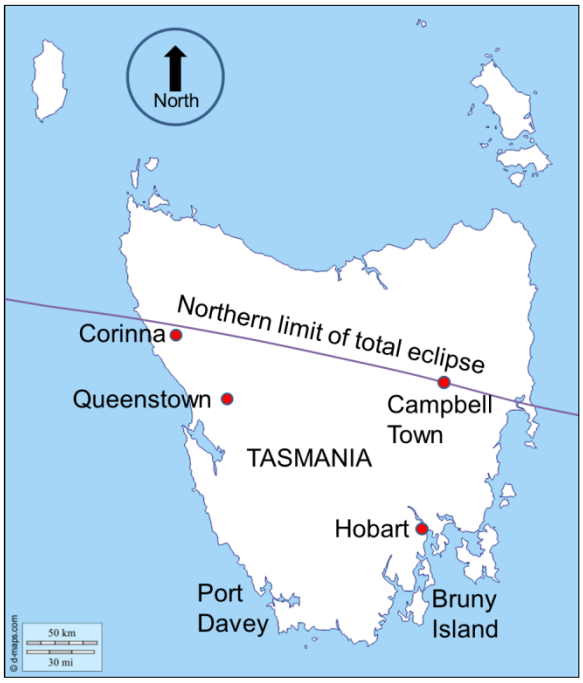

Figure 6: Map of Tasmania indicating the northern limit of the 9 May 1910 eclipse and the places mentioned in the text (base map: https://d-maps.com/carte.php?num_car=64384&lang=en; map modifications: Nick Lomb).

chiston, 2017: Bio Box 11.2). Others on the Committee included William Cooke, who was Government Astronomer for Western Australia, and a position was reserved for the Government Astronomer of NSW whenever that position was filled—in 1912 Cooke accepted that position (Wood, 1958: 19–22). Cooke only accepted the NSW position because he was promised a world tour to inspect other observatories, a dark sky site for Sydney Observatory and the latest astronomical equipment; none of which eventuated (Tasker, 2019).

The Solar Eclipse Committee, as well as organising its own expedition, arranged for concession rail and ship travel for "… bonafide visitors to Tasmania for Eclipse purposes." According to the draft of a booklet published by Melbourne Observatory, authenticity of a traveller was to be verified with a coupon signed by the local representative of the Eclipse Committee (Baracchi, 1910). The booklet, which was republished by newspapers, also gave full information on the circumstances of the eclipse and on the most useful observations to undertake, whether with a camera, visually through a small telescope or with the naked eye. Surprisingly, to the present author, who has often prepared such information prior to solar eclipses, there was little emphasis on the dangers of looking directly at the Sun or on the precautions to take.

The observing location for the Australian eclipse expedition was selected to be Bruny Island (see Figure 6) on the east coast of Tasmania. Baracchi with two assistants left Melbourne on 13 April 1910 with 80 heavy packages as luggage. These included the instruments sent out from Britain by the JPEC, one of which, the Greenwich coronagraph, is shown in Figure 7. All the instruments were for making

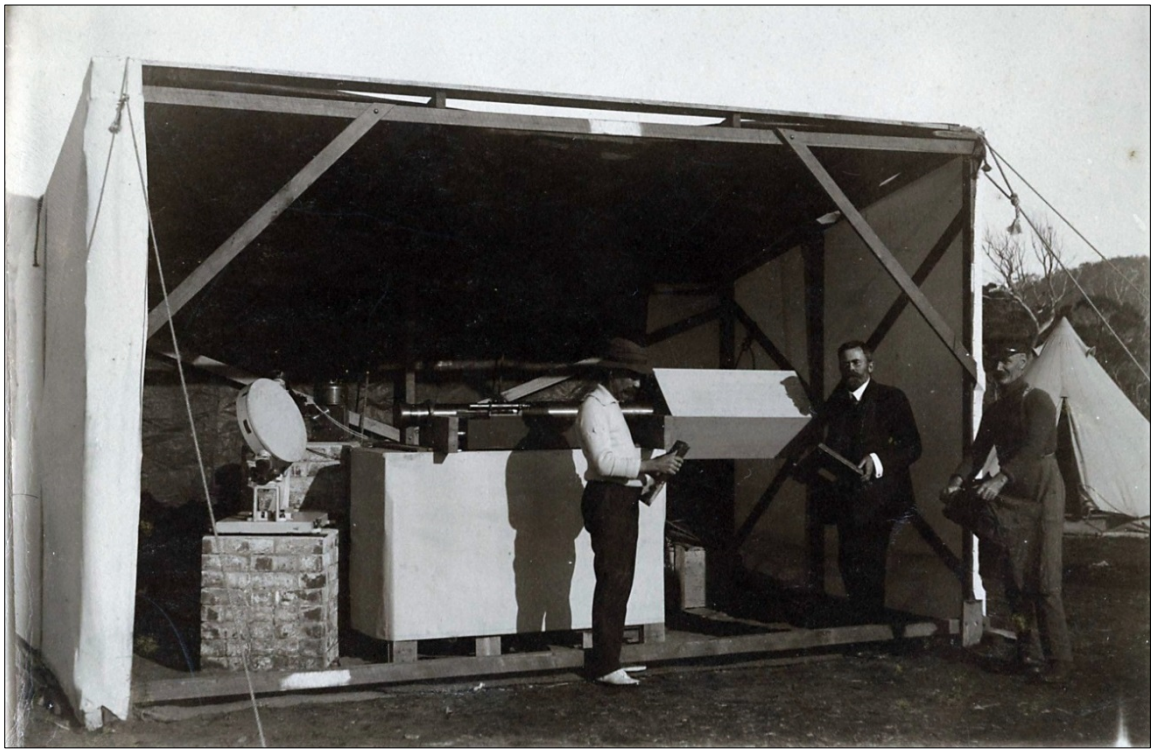

Figure 7: One of the instruments sent from Britain, the Greenwich coronagraph set up with its coelostat. Charles Merfield, Assistant Observer and Computer at Melbourne Observatory is in the middle of the three people in the photo and is holding a dark-slide or plate holder (Collection: Museum of Applied Arts and Sciences, Sydney, P3549-183).

a photographic record as the conditions were deemed unfavourable for spectroscopy. At Bruny Island the Melbourne contingent was joined by teams from Adelaide Observatory, Sydney University and from New Zealand. Time was obtained by exchanging clock beats with Melbourne Observatory using a specially set up telegraph line (Baracchi, 1914a).

On eclipse day, Baracchi (1914b) reports that 27 well-prepared observers stood ready with the instruments, while the roped off perimeter of the fence was protected from the spectators that had come from Hobart and elsewhere by three policemen. The day, however, remained

> … completely overcast since early morning, and light rain fell during the 200 seconds of totality. Thus the Expedition entirely failed in its main object.

James Short attached himself to the other expedition, the one organised by McClean. Having been preceded by the instruments, McClean arrived in Hobart on 24 March. His first task was to decide on an observing location. In this task he was assisted by Joseph Brooks, the retired surveyor who had a leading role at the Flint Island eclipse, and a new volunteer, James Henry Worthington. Worthington was a keen amateur astronomer who came from a wealthy English family (Mobberley, 2018). He was elected a member of the British Astronomical Association in 1908, by which time he already had a BA and was a member of the Royal Astronomical Society. During his extensive travels he met George Ellery Hale at Mt Wilson Observatory and Percival Lowell at Flagstaff, both in the United States. He was a strong supporter of Lowell's theory of Martian Canals and the discrediting of that theory may have led to his loss of interest in astronomy after the 1920s (Mobberley, pers. comm., 2018).

As the official Australian party was at Bruny Island on the east coast, sites on the west coast were considered instead for McClean and his group. The site chosen was Port Davey (see Figure 6), as that was relatively easy to access by ship, though it was notorious for heavy rain in winter.[4] On a preliminary visit McClean, Brooks and Worthington found a small promontory or peninsula then called Hixson Point, now known as Tonguers Point, which is Nomenclature Number: 6130D (Placenames of Tasmania, 2019). This strip of land in a protected channel is about 400 metres wide and about 30 metres above sea level at its highest point. At one end is an island that McClean refers to as Sarah Island but is now known as Turnbull Island, which is Nomenclature Number: 3502A (Placenames of Tasmania, 2019). Figure 8 shows both Hixson Point and Sarah Island.

The expedition proper arrived by ship at Port Davey on the morning of 10 April 1910 (McClean, 1910). It consisted initially of eight people, with the main ones being McClean, Brooks, Worthington and the photographer Henry Winkelmann, who had been at Flint Island. Ernest Jeffs was again the steward, while he was joined by a local man from Hobart, Arthur Wilson, as carpenter and assistant steward. There were two new observers: the mining engineer Allan Edwin Young (b. 1891), who had accompanied McClean from England, and S.G. Dowsett from Auckland, about whom not even his given names could be ascertained. James Short arrived three weeks after the original group.

After the 32 cases of instruments had been landed and secured with a tarpaulin, a camp was set up near a stream. From then on paths had to be cut through the scrub to the observing location at the summit and from there to the landing spot with the instruments. Hauling all the instrument cases to the summit was arduous

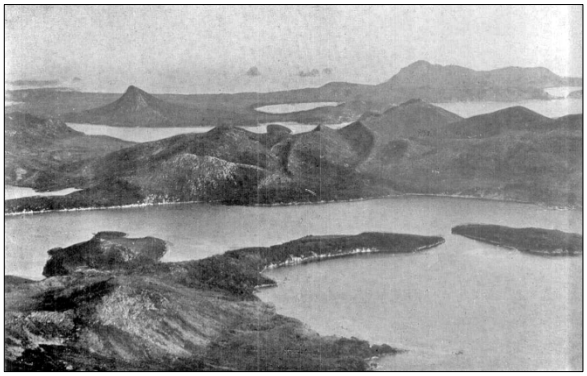

Figure 8: A photograph by Henry Winkelmann of Hixson Point and Sarah Island at Port Davey, as seen from a nearby mountain (after McClean, 1910: Plate 3).

work made more difficult by constant rain, so that it took ten days after arrival for all the cases to be at the summit. Before all the cases had been brought up, the eclipse party narrowly escaped disaster. An instrument case with straw packing left open, while the party went to lunch, caught alight and lit the surrounding area. Alerted by the smoke, the small group managed to save the instruments "… by continuous beating …" and then had to turn their attention to the camp itself. Fortunately, all the rain had saturated the ground and most of the fire quickly burnt out, though in some places it continued to burn under the ground for a few days (ibid.).

A fixed routine made all the hard work easier to bear. Wakeup call was between 6:00 and 6:30 am, followed by breakfast at 8:00 am. Lunch was at 1:00 pm, with dinner and the end of the working day at 6:30 pm. Evening amusements consisted of cards and music played on an accordion and a concertina plus a fortuitous

pair of bones remaining from a sirloin of beef that had been accidentally forwarded to the expeditioners, "… instead of going to a Dr. Brooks living near Hobart." (ibid.).

By the time James Short arrived on 1 May, during a major storm, the other members of the party were busy installing the instruments. These were difficult to set up, adjust and use due to the constant wind and the lack of sunshine. To avoid the wind, they installed windbreaks over a metre-high, consisting of posts filled in with brushwood, around each cluster of instruments. As well, the instruments were kept low but that risked spattering from the muddy ground, which was made worse by the boots of the people setting up the instruments. Keeping the delicate equipment dry was an impossible challenge and some instruments started to show rust. Among the instruments was not only the 21-inch (53-cm) siderostat that McClean had brought with him for the Flint Island expedition but also a coelostat with a 16-inch (41-cm) mirror. This device has a similar purpose to the siderostat to reflect sunlight to stationary telescopes but has a different principle. It is set up with its diameter coinciding with the polar axis and is driven at half the diurnal rate, that is, one rotation every 48 hours (Mills, 1985).

As two years earlier, Short brought with him a double coronagraph. He had constructed this instrument specially for the occasion using whatever suitable lenses he could find. One part of the coronagraph had a Dallmeyer lens 5-inch (13-cm) in diameter and 5-foot (1.5-m) focal length and gave an image of the Sun ⅝-inch (1.6-cm) in diameter. This device was not the photoheliograph that he had taken to Flint Island. The other part of the coronagraph had a lens 3-inch (7.6-cm) in diameter and a 47-inch (119-cm) focal length together with an enlarging lens, so that the arrangement provided a solar image of 1⅛-inch (2.9-cm) in diameter. Short had planned to place this instrument on an equatorial mount but on arrival McClean (1910) told him about the constant wind and suggested that instead it be placed horizontally and fed with light from the siderostat using a mirror. This was done and, as shown in Figure 9, Short instead placed on the equatorial mount a small camera with a telephoto arrangement that he had brought with him together with a small camera from Worthington.

The observers carefully rehearsed prior to the eclipse with their respective instruments and arrangements were drawn up for Allan Young, who was to be equipped with a chronometer, to call out the time before and during totality. However, all was to no avail as at the time of totality on 9 May the sky was covered by cloud and it was raining. There were occasional indications of the clouds parting, as Short reports:

> At 130 seconds after the commencement of the total phase a light break in the clouds showed in the south-west (light Naples yellow in colour) and gradually extended across the sky from S.W. to N.W. At 180 seconds

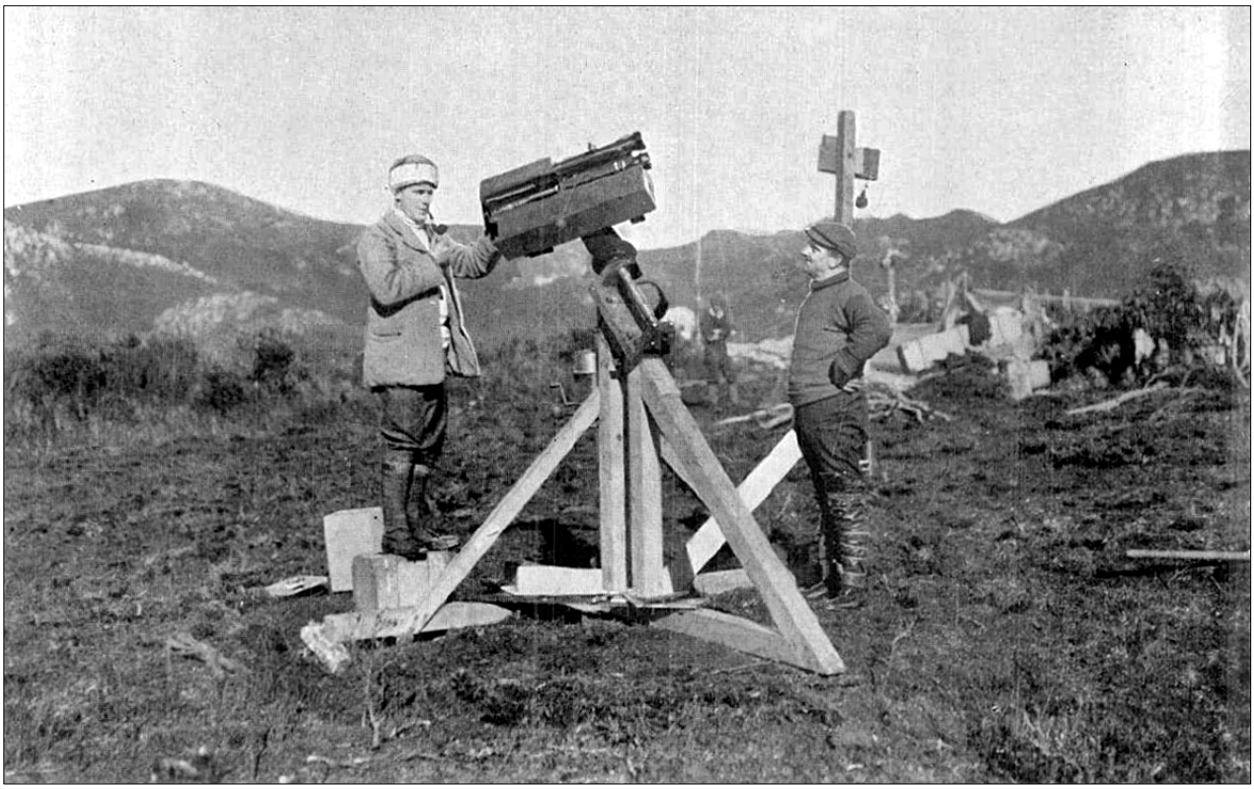

Figure 9: James Worthington (left) and James Short setting up their cameras on an equatorial mount brought by Short (after McClean, 1910: Plate 21).

> after commencement of total phase a general brightening developed suddenly, and continued fitfully until the end of totality. This fitful brightening towards the end of the total phase was probably due to the varying density of the clouds, and is supported by the fact that the rain ceased soon after the ending of the total phase, and to a hazy sun being seen later through the thin clouds and through the break in the clouds above mentioned. (cited in McLean, 1910: 16).

Dismantling of the instruments began immediately after the eclipse. A sled devised by Mr Dowsett made it easier to carry the heavy cases to the planned embarkation point. The ship *Wainui* that had brought them and had called in a few times to bring supplies on its regular commercial run between Hobart and Melbourne, arrived the next morning on its way to Hobart. James Worthington left with it, while the others finished packing the equipment and the tents and waited for the ship on its return run to Melbourne. Figure 10 shows the group on the way to Melbourne.

At Melbourne the instruments were dried, repaired and oiled and the tents were left to dry out in a warehouse. All of these were to be required at the following eclipse in Vavau. The eclipse party dispersed: Short and Brooks to Sydney, Winkelmann and Jeffs to Auckland, McClean and Young to England, and Dowsett to Durban, South Africa. It is unknown why Dowsett did not return to Auckland, however, he does appear in a photograph of the VIP party at the opening of the Athlone Bridge in Durban in July 1929 (Getty Images, n.d.).

Though neither of the eclipse parties at Bruny Island and Port Davey managed to get even a glimpse, totality was seen from elsewhere in Tasmania. The *Zeehan and Dundas Herald* reported 10 days after the eclipse on observations from a hill in Queenstown by Mr E. Carus Driffield (1910), a railway engineer and a friend. As the prospects of seeing the Sun seemed unlikely, they did not take any observing instruments with them. Fortunately, totality occurred in a gap in the clouds and they could do nothing except observe the rare phenomenon. Driffield (ibid.) described it, possibly with some artistic licence:

> Encircling this moon's disc, intensely black, was the beautiful pulsating chromosphere of the Sun, emitting fluctuations of yellow and orange colored, flame-like rays, from which streamers; in all directions rays of multi-colored lights streamed out, pink and orange predominating.

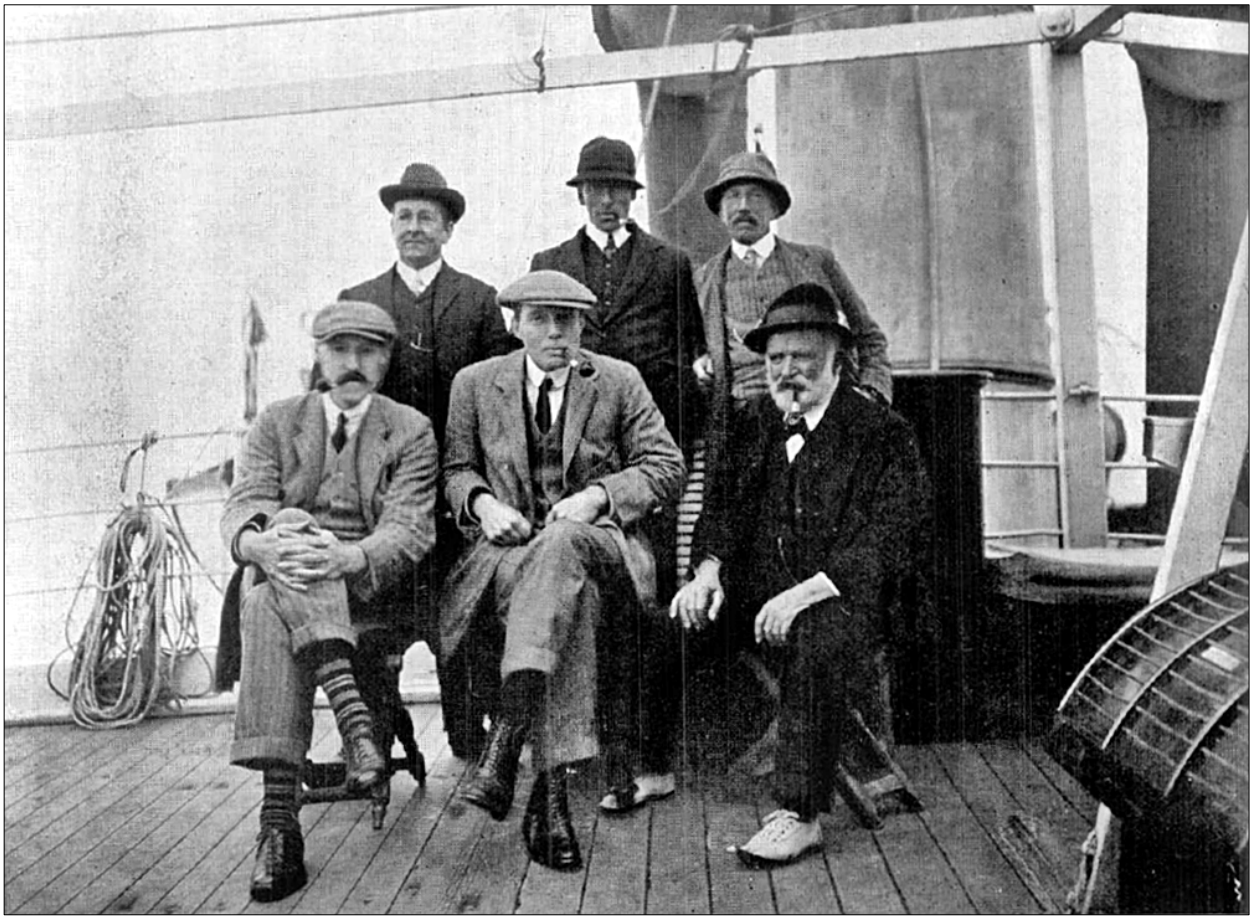

Figure 10: On board the *Wainui* on the way to Melbourne. From left to right, front row: Allan Young, Francis McClean, Joseph Brooks. Back row: James Short, S.G. Dowsett, Henry Winkelmann (McClean, 1910: Plate 31).

5 THE VAVAU ECLIPSE OF 29 APRIL 1911

The weather prospects for this eclipse to be visible from a Pacific island seemed much more favourable than at the previous Tasmanian eclipse, so that several separate expeditions converged on the island of Vavau, which is part of Tonga. The eclipse would have been visible from four other islands but Vavau was selected because it had supplies available, as well as having safe anchorage. There was an official Australian expedition, two official British expeditions, a private expedition organised by James Worthington, which was the one that James Short joined, and a one-man expedition by the Slovak/Czech/French astronomer Dr Štefánik.

Milan Rastislav Štefánik (1880–1919) was born in Slovakia, educated in Prague and worked as an astronomer at the Meudon Observatory in Paris (Government Information Centre Czech Republic, 2010). Štefánik set up his observing camp in the Catholic Mission compound. The two cement instrument piers that he constructed and inscribed on the day after the eclipse were recently identified at Vavau. Careful castings were made and these are now at the Partizánske Observatory in Slovakia (Vilikovská, 2012). During the First World War Štefánik became an important figure in the French military, being appointed as a General, as well as becoming the Minister of War in the provisional Czechoslovak Government. He died in an air crash soon after the war. Among numerous other memorials in Slovakia, France and the Czech Republic, one is the public observatory in Prague, Czech Republic, that carries his name.

The Australian eclipse party was again organised by the Eclipse Committee set up by the Australasian Association for the Advancement of Science with assistance of a grant of £500 from the Commonwealth Government (Baracchi, 1914b). Pietro Baracchi led a large party that included Charles James Merfield (1866–1931), Assistant Observer and Computer at Melbourne Observatory (Perdrix, 1979), George Dodwell (1879–1963), who had become the South Australian Government Astronomer in June 1909 (Edwards, 1994), and William Ernest Cooke, the Government Astronomer of Western Australia at the time. Merfield had been an amateur astronomer, albeit one with an international reputation, and then crossed over to become a professional astronomer, first at Sydney Observatory, then four years later at Melbourne Observatory (Orchiston, 2015). Dodwell continued the eclipse work at Adelaide Observatory, as well as finding a meteorite on the basis of reports of a fall and becoming the co-discoverer of a comet (Edwards, 1994).

There were significant other members of the party. Elphinstone McMahon Moors (1860–1924) was an Assistant Professor of Mathematics at the University of Sydney and the Secretary of the AAAS Eclipse Committee (Cohen, 2006: 51). Moors had a Bachelor of Arts degree from the University of Melbourne that was followed by another BA from Cambridge, UK. He was an expert actuary, who introduced actuarial studies at his university. The Sydney architect and amateur astronomer Ernest Herbert Beattie (1864–1943) owned a 15-cm Grubb refracting telescope that he used to observe comets, sunspots, double stars and other phenomena (Orchiston, 2017: Bio Box 13.3). The party had its own medical officer, Augustus Leo Kenny (1863–1946), a prominent Melbourne ophthalmic and aural surgeon (Hazell, 1983), and photographer Thomas Baker (1854–1928), who was one of the two joint Managing Directors of Kodak (Australasia) (De Serville, 1979). Figure 11 shows the Australian eclipse party at Vavau.

Merfield (1911: 7) reported on the activities of the Australian eclipse party in a newspaper article published after the expedition reached Sydney on its return. He states that an advance party consisting of himself, Professor Moors, a carpenter from Melbourne Observatory and three volunteers arrived at Vavau on Tuesday 4 April with most of the equipment. Moors and Merfield inspected several possible sites, selecting a large open space that belonged to the King of Tonga (George Tubou II) and was being used by the natives for playing cricket, as suitable both from an astronomical point of view and for camping. After securing permission from the island Governor, ten tents lent by the Australian Defence Department were erected. Though these included living quarters, some of those in the advance party instead moved to an unoccupied house provided by a local resident. Baracchi and the rest of the eclipse party arrived eight days after the first group and the erection of instruments began in earnest.

The aim of the expedition was to secure images of the corona during totality, and hence no spectroscopic equipment was taken to Vavau. Equipment included the Dallmeyer Photoheliograph from Melbourne Observatory (Clark and Orchiston, 2004) and a coronagraph put together from two 12¼-inch (31-cm) mirrors made by a South Australian amateur (Edwards, 1994) fed by a 16-inch (41-cm) coelostat lent by the British Eclipse Committee. As shown in Figure 12, the beam from the latter instrument was fed into a dark room so that an image was formed as in a camera obscura. Figure 13 shows University of Sydney's coronagraph and a mirror camera on an equatorial mount. This is most likely the same Grubb mounting that in 2019 was on display in the foyer of the School of Physics at the University.

Figure 11: A group photograph of the Australian eclipse party at Vavau. Charles Merfield is at front left, Thomas Baker is at front right, George Dodwell is second from left standing in the second row, Pietro Baracchi is on the right in the third row and Ernest Beattie is at the back on the left (photograph: Thomas Baker; courtesy: State Library of South Australia, Dodwell Album, PRG 22/24 Volume 3).

Figure 12: The South Australian two-mirror coronagraph used with the 16-inch (41-cm) coelostat lent by the British Eclipse Committee. An image of the Sun can be seen in a screen inside the dark room. George Dodwell is on the left (photograph: Thomas Baker; courtesy: State Library of South Australia, Dodwell Album, PRG 22/24 Volume 3).

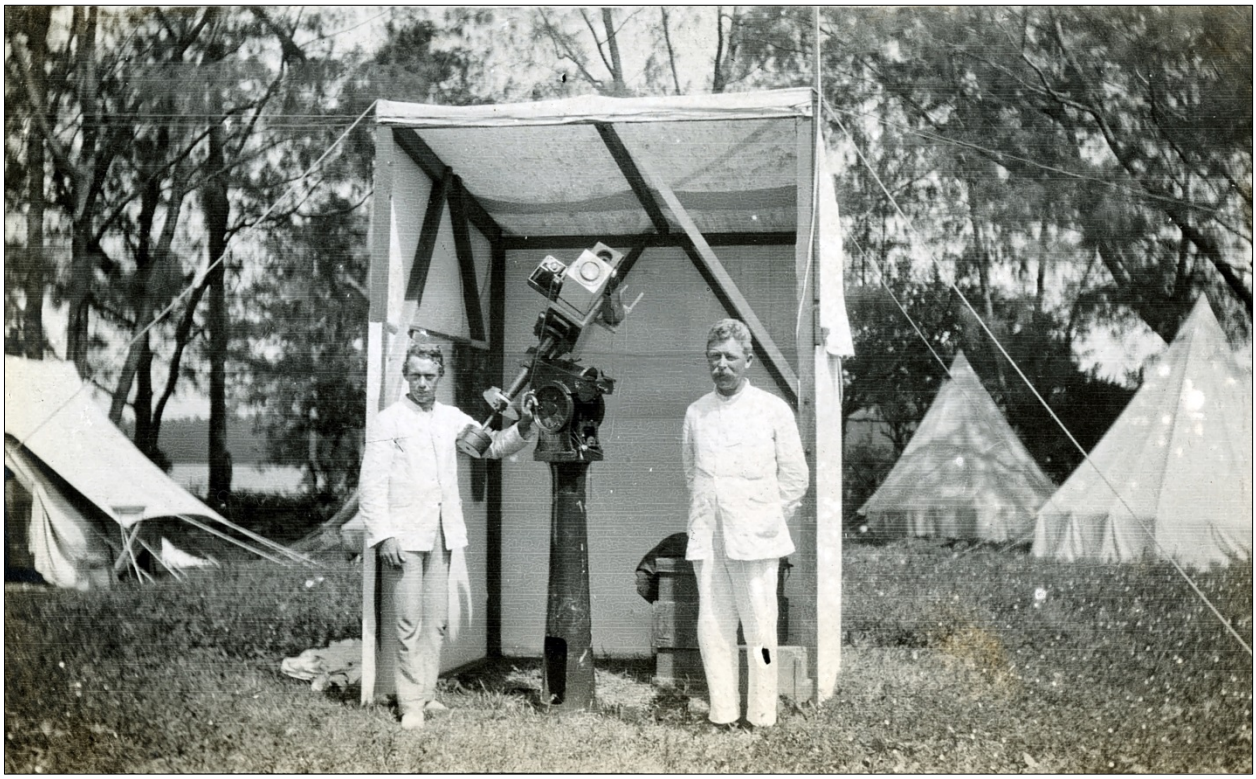

Figure 13: The Sydney University coronagraph and camera on a Grubb equatorial mount looked after by Rupert Holloway (left) and Richard Bulkeley (photograph: Thomas Baker, courtesy: State Library of South Australia, Dodwell Album, PRG 22/24 Volume 3).

With the equipment in place drills commenced, sometimes in the evening to allow for a possible dark eclipse. William Cooke oversaw the obtaining of the time and for that purpose had brought along a Troughton and Simms altazimuth instrument from Perth Observatory. For the drills, as for the eclipse itself, signals were given 10 and five minutes before totality. Dr Kenny was charged with blowing a whistle nine seconds before totality and signalling the start of totality with the word "go". From then on, he was to count down from 217, mainly at 10 second intervals and signalling the end of totality with the word "stop". By the time of the final drill on the night before the eclipse the Australian party felt confident of being able to make successful observations.

One of the two official British expeditions was led by William James Stewart Lockyer (1868–1936), who was the Chief Assistant at the South Kensington Solar Physics Observatory, an observatory founded and directed by his father, Sir Norman Lockyer (Plummer, 1937). Francis McClean, who had led eclipse parties to the 1908 and 1910 eclipses, was a key member of Lockyer's party. Many of the instruments McClean had used at those expeditions had been on loan from the Solar Physics Observatory (Lockyer, 1912). Lockyer and McClean were joined by two stalwart members from the previous expeditions, the surveyor Joseph Brooks and the New Zealand photographer Henry Winkelmann. William Raymond, who had been on the Flint Island expedition with McClean and who was Officer-in-Charge at Sydney Observatory, was also one of the party. Roger Charles Anderson (1883–1976), who subsequently became a well-known marine historian, was recruited on the voyage from the UK. In Anderson's obituary it was stated that, "… his writings are occasionally dull, but always thoroughly trustworthy." (Naval Marine Archive, 2012).

The British Admiralty provided a light cruiser, HMS *Encounter*, to transport the British expeditions from Sydney to Vavau and to provide extra manpower to staff their instruments. The ship was then part of the Royal Navy's Australian Squadron but one year later it was commissioned as part of the Royal Australian Navy. At the beginning of World War I it captured a German ship that became Australia's first wartime prize (Royal Australian Navy, n.d.). The *Encounter* with Lockyer, McClean and Anderson aboard together with their instruments arrived at Vavau on 2 April and the ship anchored off the little town of Neiafu, where they planned to establish their observing camp. However, the town's medical officer came on board and reported that there was an outbreak of measles in the locality. This, and the lack of a suitable site in the town, led to the selection for the observing camp of an area marked on the maps as the Admiralty Coaling Station, about two kilometres from the town. There was a suitable landing place nearby and the island Governor assured them that the native who main-

tained a garden there was only doing it in a caretaker capacity. Soon, with the help of working parties from the ship, the ground was being cleared, trees were cut down, paths established, and tents were put up.

Over the month from arrival to the eclipse the instruments were erected, tested and the officers and men from the *Encounter* were trained in their use. Figure 14 shows Lockyer's eclipse camp busy with astronomers and sailors during a rehearsal. It was not all work though, as Sundays were dedicated to excursions and collecting natural history specimens at the request of the Director of the British Museum (Natural History). On the last Sunday before the eclipse, there was a demonstration of native dances in the grounds of the Roman Catholic Mission. The opportunity was also taken to visit the Australian eclipse expedition. Instruments used by the Lockyer expedition were the same or like those used by McClean at the previous two expeditions, with the addition of a large prismatic camera made up of a 15-cm Cooke equatorial with four 6-inch (15 cm) prisms of 45° angle. Objective prism type devices were introduced for eclipse work by Norman Lockyer as they were not constrained to analyse the light coming from between the jaws of the slit but could cover the distribution of the spectrum over a larger region of the Sun (Maunder, 1898).

The second official British expedition was organised by the Joint Permanent Eclipse Committee (JPEC) of the Royal Society and the Royal Astronomical Society. It was led by Father Aloysius Laurence Cortie, SJ (1859–1925), the Director of the observatory at the Catholic Stonyhurst College in Lancashire. Apart from eclipse expeditions, Cortie's main scientific interest was in sunspots and magnetic fields and the connection between them (Turner, 1926). He was joined by the photographic expert William McKeon (1851–1920) (Udias, 2013: 72) and Father Edward Francis Pigot (1858–1929) (Drake, 1988), who had been part of the official Australian expedition to Bruny Island for the 1910 eclipse. Pigot was born in Dublin and started his professional life by setting up a medical practice there. Later, as a Jesuit, he taught at St Ignatius' College, Riverview, in Sydney, where he established an observatory specialising in meteorology and in seismology (ibid.).

Father Cortie did not consider the visit to a Pacific island as a pleasure trip; at a welcome in Sydney while the two British expeditions were on the way to Vavau, he emphasised the dangers by mentioning the fate of one of his predecessors, Father Perry, who in 1889, after observing a solar eclipse, had died of fever on an island off French Guiana in South America. He added that,

> Apart from the risks attending such a tour the amount of preliminary work to be gone through to bring such an expedition to a successful conclusion was very great. (Scientists welcomed. The Expeditions to Vavau, 1911).

Figure 14: In this photograph by Henry Winkelmann, taken from a coconut tree during a rehearsal, Lockyer's eclipse camp is busy with astronomers and sailors (Lockyer, 1911: Plate 3).

In the event, the stay at Vavau did not prove that perilous. Like Lockyer's expedition Cortie's team also arrived at Vavau on board the *Encounter* and shared the same observing site (Cortie, 1912). Thus, they also had support from the officers and sailors of the ship to set up their equipment and operate them under supervision. There were four instruments, including two coronagraphs both of 4-inch (10-cm) diameter but different focal lengths. These were mounted horizontally, side by side, fed by a 16-inch (40-cm) coelostat and protected by palm-leaf thatch from the Sun to avoid differential heating in the zinc tube of the longer focal length instrument. The last two instruments were to look at the spectrum of the eclipsed Sun: a four-prism quartz spectroscope to study the ultra-violet spectrum of the corona, shown in Figure 15, and a prismatic camera with a large prism combined with a Dallmeyer portrait lens to look at the red end of the spectrum.

The final expedition was that of James Worthington, who had been one of McClean's party at Port Davey the previous year. This time he went independently and was joined by James Short. In addition, he had three recruits from Hobart, Tasmania, as well as "Several friends in the island …" (Worthington, 1911: 15). The local doctor lent his bathroom for use as a darkroom, though Worthington did complain that the temperature of the water in the bathroom was a high 88°F (31°C) while the air temperature in the bathroom was even higher at 91°F (33°C). Three of Worthington's four instruments were imaging cameras. A portrait lens of 2-ft (60-cm) focal length and a camera with an enlarging lens of 4-ft (1.2-metres) focal length were on one equatorial mount. Another camera with an enlarging lens of much longer focal length, 23-ft (7.0-metres), was paired with a prismatic camera with quartz and rock salt optical components made by the London firm of Hilger to receive light from a 12-inch (25-cm) coelostat. James Short also concentrated on imaging, as he had on the previous two eclipse expeditions, with three separate cameras. During the eclipse Short had the responsibility of calling the time that he received earlier from William Cooke of the Australian party.

Eclipse day finally arrived but unfortunately during the event there were clouds, which were highly variable even over the small distances separating the various parties. Worthington was the most fortunate with the clearest sky. George Dodwell (1911), in his letter to the Astronomer Royal, said, "… we are all pleased at his success, especially as he has come out at his own expense, and has spent so much time and trouble to ensure successful work." Dodwell saw some of Worthington's plates and considered

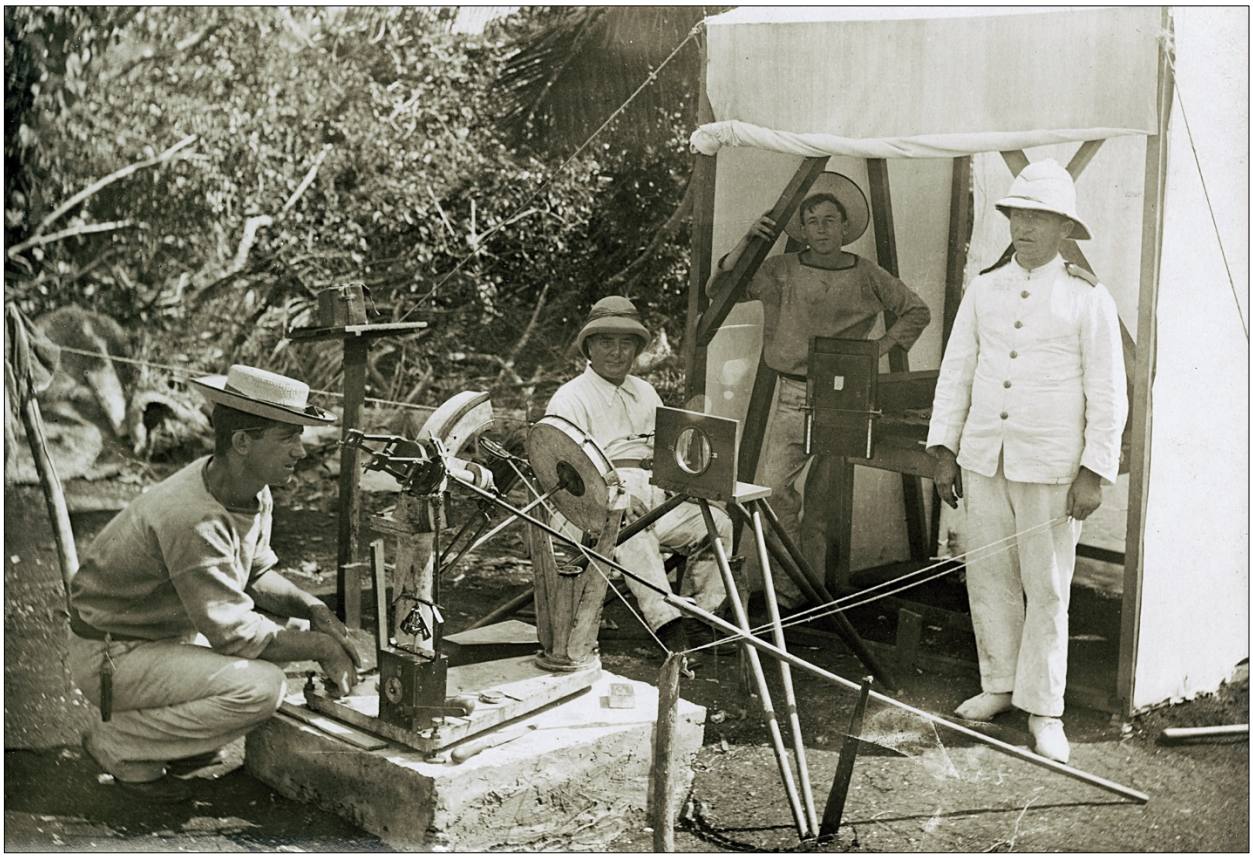

Figure 15: Father Cortie surrounded by three sailors as light from a 12-inch (30-cm) silver-on-glass mirror is focussed on the entrance slit of the quartz spectroscope (photograph: Arthur Leslie Swinden; courtesy: Australian War Memorial, Accession Number P11503.005).

them to be "excellent". Worthington (1911) showed off some of his images together with a spectrogram at the Annual General Meeting of the British Astronomical Association on 25 October 1911. The coronal photographs impressed the members present and precipitated a debate on whether the corona had been a typical solar minimum corona during the eclipse or not. James Short's results are likely to have been equally good, however, Worthington could not report on them as he had not received them by the date of the AGM.

The Australian camp was about 400 metres south of that of Worthington and managed through their various instruments to obtain good images of the inner corona and the prominences through thin cirrus cloud (Dodwell, 1911). Plates from some cameras showed the corona out to about one or one and a half solar diameters. Figure 16 shows a drawing by an Adelaide Observatory staff member based on some of the photographs. Dodwell (ibid.) reported that Štefánik, based at the nearby Roman Catholic Mission, also was likely to have had good results. The two British expeditions, only two kilometres away from the Australians, did not fare so well as the clouds were thicker for them than for the other parties. Their most valuable insight was regarding the timing of the eclipse; Brooks reported that totality began 23.0 seconds earlier than predicted by the calculations from the Nautical Almanac Office (Downing, 1908) and ended 27.8 seconds early. His conclusions were supported by the photographic evidence.

After the eclipse, packing quickly commenced and the various groups left the island within a few days. The Australians left on board Union Steam Ship Company's *Tofua*, the captain of which, Captain George Holford, had before arrival at Vavau, sailed his ship into the path of totality. There he had obtained good observations, including making a sketch of the eclipsed Sun. The ship sailed on May 3 to the sounds of locals singing the Polynesian melody "Tofa Ma Feleni" or, in English, "Oh, I Shall Never Forget You" (Merfield, 1911: 7). The English parties sailed on the *Encounter* the next day for Suva, from where they made their own arrangements to return home.

6 CONCLUSION

Of the three eclipses discussed in this paper two could be observed and yielded results that added to the slowly accumulating scientific knowledge of the Sun. Results were reported to the Royal Astronomical Society, the British Astronomical Association and very likely directly to the Astronomer Royal at Greenwich. More importantly, the expeditions to these three eclipses were well documented through published reports, newspaper articles and private photographic albums. These give us a glimpse of astronomers demonstrating their skill and ingenuity outside the routine at their observatories. This ingenuity was especially demonstrated at Port Davey in 1910, when the astronomers in an isolated hostile environment were battling strong winds, rain and even fire to be able to set up and align their observing instruments.

The three eclipses allowed Australian astronomers to interact with overseas counterparts. There was no official Australian expedition to Flint Island in 1908 but there were several Australians, both professional and amateur, who joined Francis McClean's expedition. Some of them stayed on with McClean and subsequently Lockyer for the 1910 Port Davey and the 1911 Vavau expeditions, despite official Australian expeditions to those eclipse locations. In turn, the official expeditions allowed Australian astronomers to work and cooperate with each other. They

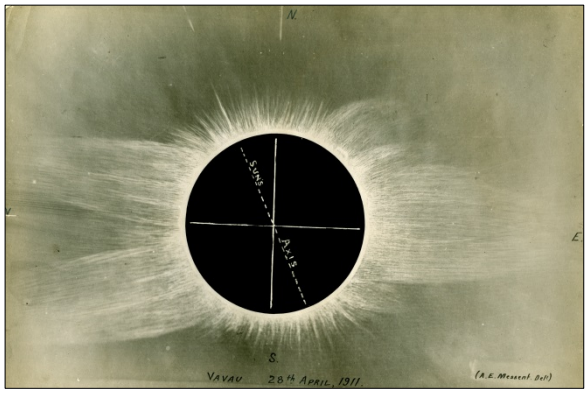

Figure 16: A drawing by A.E. Messent of the eclipsed Sun on 29 April 1911, based on negatives taken with the Adelaide two-mirror chronograph (courtesy: State Library of South Australia, Dodwell Album, PRG 22/24 Volume 3).

also mingled with the members of the British expeditions and in 1911 most likely with the Serbian/Czech/French astronomer Štefánik. All of these contacts were of great importance in the early 1900s as travel across Australia was difficult and expensive and it was even more difficult, time-consuming and expensive to travel to Europe from distant Australia.

The publicity accorded to the three eclipse expeditions in newspaper articles was also of great importance to Australian observatories as they had recently lost or gave away weather observations and predictions, which was their highest public profile activity, to the newly formed Commonwealth Bureau of Meteorology (Home and Livingston, 1994).

Sydney Observatory photographer James Short took part in expeditions to all three eclipses. On these occasions, away from supervision and public service restrictions, he could excel, exhibiting skill, determination and professional-

ism. He became a highly experienced eclipse observer, who would attend the next Australian eclipse, the important 'Einstein' eclipse of 1922 at Goondiwindi in Queensland, and would be sought after for a subsequent eclipse in the United States.

7 NOTES

1. Wayne Orchiston (pers. comm., February 2020) has noted how unreliable some newspaper accounts can be and has suggested that the reported age of 56 may merely have been a 'typo', with the two numerals reversed, and that the reporter may then have provided a garbled account, mixing up some of Short's past activities as an astronomer with his then-current situation.
2. At the time of these three eclipses a type of solar telescope designed to photograph the Sun and its corona was called a coronagraph. This instrument was not the same as a modern coronagraph that is based on the idea of French astronomer Bernard Lyot of using an obstructing disk to cover the Sun, thereby allowing observations of the corona outside of eclipses (Lyot, 1931).
3. Such cameras use lenses with multiple components arranged to give focal lengths greater than their physical lengths.
4. Modern Bureau of Meteorology statistics for Port Davey based on the years 1946 to 2011 indicate a mean rainfall of 234 mm in May and 16 as the mean number of days of rain during the month (Bureau of Meteorology, 2012).

8 ACKNOWLEDGMENTS

The author would like to thank members of the Short family, Dr Wendy Minato and Carole Short, for documents and other information about James Short. Correspondence with Dr Deborah Malor of the University of Tasmania about Short and the 1910 eclipse expedition was also of assistance. Email discussion with Martin Mobberley of the British Astronomical Association about James Worthington was also most helpful. Murray John of Christ Church, Ellerslie, Auckland, New Zealand, kindly provided details of the life of Reverend Frederick William Walker. Dr Andrew Jacob kindly allowed me access to the contents of the Short file at Sydney Observatory.

Emily Witt, Reference Librarian, National Library of Australia and her colleagues were particularly helpful in obtaining copies of photographs of the expeditions as were Tonia Bradstreet, Customer Contact Librarian, State Library of South Australia and her colleagues. Kathy Hackett, Photo-library, Museum of Applied Arts & Sciences was similarly helpful.

Two referees and the Editor provided corrections and helpful advice that have considerably improved the paper.

9 REFERENCES

Australasian Association for the Advancement of Science, 1911. Circular No. 2, Sydney meeting 9–14 January 1911, Victorian Public Records Office (VPRS780/0/5).

Baracchi, P., 1910. The forthcoming Solar Eclipse. Victorian Public Records Office (VPRS780/0/4).

Baracchi, P., 1914a. Melbourne Observatory expedition to Bruni Island, Tasmania, for the observation of the solar eclipse of 9th May, 1910. In Hall, T.S. (ed.). *Report of the Fourteenth Meeting of the Australasian Association for the Advancement of Science: Held at Melbourne, 1913*. Sydney, AAAS. Pp. 66–67.

Baracchi, P., 1914b. Report of the Eclipse Committee: the total eclipse of the Sun of 29th April, 1911. In Hall, T.S. (ed.). *Report of the Fourteenth Meeting of the Australasian Association for the Advancement of Science: Held at Melbourne, 1913*. Sydney, AAAS. Pp. 68–70.

Beecroft Cheltenham History Group, 1995. Cataloguing the stars. In *Beecroft and Cheltenham: The Shaping of a Sydney Community to 1914*. Sydney, Beecroft Cheltenham History Group. Pp. 270–272.

Bhathal, R., 1991. Henry Chamberlain Russell – astronomer, meteorologist and scientific entrepreneur. *Journal and Proceedings of the Royal Society of New South Wales*, 124, 1–21.

Bureau of Meteorology, 2012. Monthly climate statistic for Port Davey, (Melaleuca), http://www.bom.gov.au/climate/averages/tables/cw_097007.shtml, accessed online 25 October 2019.

Campbell, W.W., 1908. The Crocker Eclipse Expedition of 1908. *Lick Observatory Bulletin*, 131, 1–5.

Campbell, W.W., and Albrecht, S., 1908. Coronal photographs with the forty-foot camera. *Lick Observatory Bulletin*, 131, 8–9.

Clark, B.A.J., and Orchiston, W., 2004. The Melbourne Observatory Dallmeyer photoheliograph and the 1874 transit of Venus. *Joumal of Astronomical History and Heritage*, 7, 44–49.

Close call: between train & platform. *Sun*, 11 March, page 11 (1932).

Cohen, G., 2006. *Counting Australia In*. Sydney, Halstead Press.

Cooke, W.E., 1918. Indictment of Mr Short. *Public Service Board Inquiry into Sydney Observatory*, 15–17.

Cortie, A.L., 1912. Report on the total solar eclipse of 1911, April 28. (Observed by the Expedition of the Joint Permanent Eclipse Committee to Vavau, Tonga Islands, South Pacific). *Proceedings of the Royal Society A*, 87, 293–301.

De Serville, P.H., 1979. Baker, Thomas (1854–1928), Australian Dictionary of Biography, http://adb.anu.edu.au/biography/baker-thomas-5110/text8537, accessed online 28 October 2019.

Department of Public Instruction, 1904. Sydney Observatory. *Government Gazette NSW, 25 March.*

Dodwell, G.F., 1911. The total solar eclipse of 1911 April 28. *The Observatory*, 34, 267–270.

Downing, A.M.W., 1908. The total solar eclipse of 1911 April 28. *Monthly Notices of the Royal Astronomical Society*, 69, 30–32.

Drake, L.A., 1988. Pigot, Edward Francis (1858–1929), Australian Dictionary of Biography, http://adb.anu.edu.au/biography/pigot-edward-francis-8048/text14037, accessed online 28 October 2019.

Driffield, E.C., 1910. Queenstown, the recent eclipse, some pen pictures, the wonderful spectacle. *Zeehan and Dundas Herald*, 19 May.

Edwards, P.G., 1994. The Adelaide Observatory after Todd. *Proceedings of the Astronomical Society of Australia*, 11, 206–210.

Edwards, V., 1996. Winkelmann, Henry. In *Dictionary of New Zealand Biography, Te Ara - The Encyclopedia of New Zealand*, https://teara.govt.nz/en/biographies/3w25/winkelmann-henry, accessed online 24 October 2019.

Einstein, A., 1915. *Feldgleichungen der Gravitation (part 2)*, Preussische Akademie der Wissenschaften, Sitzungsberichte. Pp. 844–847.

Eire, 1989, Birth Certificate extract James Short, copy, Sydney Observatory (Short file).

Ellery, R.L.J., 1888. On the present position of astronomical knowledge. In Liversidge, A. (ed.). *Report of the First Meeting of the Australasian Association for the Advancement of Science: Held at Sydney, New South Wales, in August and September, 1888*. Sydney, AAAS. Pp. 26–39.

Fair Work Commission, 2019. Waltzing Matilda and the Sunshine Harvester Factory, Harvester Case, https://www.fwc.gov.au/waltzing-matilda-and-the-sunshine-harvester-factory/historical-material/harvester-case, accessed online 18 October 2019.

Frame, T., and Faulkner, D., 2003. *Stromlo: An Australian Observatory*. Sydney, Allen & Unwin.

Getty Images, n.d. The opening of the Athlone Bridge across the Umgeni River https://www.gettyimages.com.au/detail/news-photo/athlone-bridge-july-1929-the-opening-of-the-athlone-bridge-news-photo/115089617, accessed online 28 January 2020.

Government Information Centre Czech Republic, 2010. PhDr. Milan Rastislav Štefánik (scientist - soldier - politician), https://icv.vlada.cz/en/media-centrum/tema/phdr--milan-rastislav-stefanik-scientist---soldier---politician-75236/tmplid-676/, accessed online 28 October 2019.

Hazell, T.A., 1983. Kenny, Augustus Leo (1863–1946), Australian Dictionary of Biography, http://adb.anu.edu.au/biography/kenny-augustus-leo-6933/text12029, accessed online 4 September 2019.

Home, R.W., and Livingston, K.T., 1994. Science and technology in the story of Australian Federation: the case of meteorology, 1876–1908. *Historical Records of Australian Science*, 10, 109–127.

Hutchison, D., 1981. William Ernest Cooke, astronomer 1863–1947. *Historical Records of Australian Science*, 5, 58–77.

Lenehan, H.A., 1904. Letter to James Short, dated 19 February. Copy, Sydney Observatory (Short file).

Lenehan, H.A., 1907. Memorandum to Mr J.W. Short, dated 3 July. Copy, Sydney Observatory (Short file).

Lockyer, W.J.S., 1912. *Report of the Solar Eclipse Expedition to Vavau, Tonga Islands, April 29, 1911 (Eastern Date): Being an Account of the Observations Made by the Author, the Officers and Men of H.M.S. Encounter, and the Volunteer Observers of the Solar Physics Observatory Expedition / by William J.S. Lockyer; Under the Direction of Norman Lockyer*. London, HMSO.

Lomb, N., 2011. *Transit of Venus: 1631 to the Present*. Sydney, NewSouth Publishing.

Lomb, N., 2016. Australian solar eclipse expeditions: the voyage to Cape York in 1871. *Journal of Astronomical History and Heritage*, 19, 79–95.

Lyot, B., 1931. L'Etude de la couronne Solaire en dehors des eclipses. *L'Astronomie*, 45, 248–253.

Maunder, E.W., 1898. The spectroscope in eclipse work. *Popular Astronomy*, 6, 376–380

McClean, F.K., 1908. *Report of the Solar Eclipse Expedition to Flint Island, January 3, 1908*. London, Richard Clay and Sons.

McClean, F.K., 1910. *Report of the Solar Eclipse Expedition to Port Davey, Tasmania May, 1910.* London, Richard Clay and Sons.

Merfield, C., 1911. Eclipse expedition, arrival in Sydney. *Argus*, 18 May.

Mills, A.A., 1985. Heliostats, siderostats, and coelostats: a review of practical instruments for astronomical applications. *Journal of the British Astronomical Association*, 95, 89–99.

Mobberley, M., 2018. James H. Worthington (1884–1980): a quest for totality, observatories & Martian canals. *Journal of the British Astronomical Association*, 128, 331–346.

Nath, B.B., 2013. *The Story of Helium and the Birth of Astrophysics*. New York, Springer.

Naval Marine Archive, 2012. Roger Charles Anderson, Litt.D., F.S.A. (23 July 1883 – 3 Oct 1976), http://navalmarinearchive.com/research/anderson_bibliography.html,, accessed online 28 October 2019.

Orchiston, W., 2015. The amateur-turned professional syndrome: two Australian case studies. In Orchiston, W., Green, D.A., and Strom, R. (eds.), *New Insights from Recent Studies in Historical Astronomy: Following in the Footsteps of F. Richard Stephenson. A Meeting to Honour Richard F. Stephenson on His 70th Birthday*. Cham (Switzerland), Springer. Pp. 259–350.

Orchiston, W., 2017. *John Tebbutt: Rebuilding and Strengthening the Foundations of Australian Astronomy*. Cham (Switzerland), Springer.

Pang, A.S.-K., 2002. *Empire and the Sun: Victorian Solar Eclipse Expeditions.* Stanford, Stanford University Press.

Pearson, J., and Orchiston, W., 2008. The 40-foot solar eclipse camera of the Lick Observatory. *Journal of Astronomical History and Heritage*, 11, 25–37.

Perdrix, J.L., 1979. Baracchi, Pietro Paolo Giovanni Ernesto (1851–1926), Australian Dictionary of Biography, National Centre of Biography, Australian National University, http://adb.anu.edu.au/biography/baracchi-pietro-paolo-giovanni-ernesto-5121/text8563, accessed online 25 October 2019.

Placenames of Tasmania, 2019. Department of Primary Industries, Parks, Water and Environment, Tasmanian Government, https://www.placenames.tas.gov.au, accessed online 25 October 2019.

Plummer, H.C., 1937. Obituary: William James Stewart Lockyer. *Monthly Notices of the Royal Astronomical Society*, 97, 275–277.

Raymond, W.E., 1908. Eclipse of the Sun: return of the Anglo-Australian party. *Sydney Morning Herald*, 25 January.

Raymond, W.E., 1909. Letter to James Short, dated 17 December. Copy, Sydney Observatory (Short file).
Royal Astronomical Society, 1911. *List of Fellows and Associates*. London, Spottiswoode & Company.
Royal Astronomical Society, 1918. *List of Fellows and Associates*. London, Spottiswoode & Company.
Royal Australian Navy, n.d. HMAS Encounter (I), http://www.navy.gov.au/hmas-encounter-i, accessed online 28 October 2019.
Russell, H.C., 1902. Reference for James Short, dated 5 September. Copy, Sydney Observatory (Short file).
Saunder, S.A., 1909. Letter to James Short, dated 10 December. Copy, Sydney Observatory (Short file).
Scientists welcomed. The expeditions to Vavau. *The Sydney Morning Herald*, 18 March, page 16 (1911).
Short, J., 1904. Manchester School System. *Sydney Morning Herald*, 19 February.
Short, J., 1909. Aurora Australis. *Journal of the British Astronomical Asociation*, 20, 98.
Short, J., 1918. Mars and the recent occultation. *Journal of the British Astronomical Association*, 29, 16.
Short, J., 1920. Four geometrical solutions. *Journal of the British Astronomical Association*, 30, 281–284.
Stellar Photography. *Australian Town and Country Journal*, 11 May, page 34 (1904).
Stokley Jnr, J., 1923. Astronomy and photography. *Popular Astronomy*, 31, 373–380.
Stratton, F.J.M., 1956. Obituary: Sir Francis McClean, A.F.C. *Monthly Notices of the Royal Astronomical Society*, 116, 152.
Swings, P., 1943. Edlén's identification of the coronal lines with forbidden lines of *Fe* X, XI, XIII, XIV, XV; *Ni* XII, XIII, XV, XVI; *Ca* XII, XIII, XV; *A* X, XIV. *Astrophysical Journal*, 98, 116–128.
Sydney Observatory, 1923. *Total Eclipse of the Sun, 1922 September 21*. Sydney, Government Printer.
Tasker, I., 2019. Power, politics and personalities in Australain astronomy: William Ernest Cooke and the triangulation of the Pacific by wireless time signals. *Journal of Astronomical History and Heritage*, 22, 113–131.
Taverner, J.W., 1909. Letter to the Premier, dated 19 February. Original, Victorian Public Records Office (VPRS780/0/1).
The solar eclipse, references by Rev. Walker. *The Auckland Star*, 20 January, page 5 (1908).
The University of Manchester, 2005. History of UMIST, https://www.manchester.ac.uk/discover/history-heritage/history/umist/, accessed online 18 October 2019.
Treschman, K.J., 2014. Early astronomical tests of general relativity: the gravitational deflection of light. *Asian Journal of Physics*, 23, 145–170.
Turner, H.H., 1926. Obituary: The Rev. Aloysius Laurence Cortie, S.J. *Monthly Notices of the Royal Astronomical Society*, 86, 175–177.
Udias, A., 2013. *Searching the Heavens and the Earth: The History of Jesuit Observatories*. Dordrecht, Springer.
Vilikovská, Z., 2012. Štefánik tower replicas now at Partizánske Observatory. *The Slovak Spectator*, 7 May https://spectator.sme.sk/c/20043352/stefanik-tower-replicas-now-at-partizanske-observatory.html, accessed online 28 October 2019.
Warren, H.N., 1943. Letter to Mrs F. Short, dated 27 September. Original, Sydney Observatory (Short file).
Wood, H., 1958. *Sydney Observatory, 1858 to 1958*. Sydney, Sydney Observatory (Sydney Observatory Papers, 31).
Worthington, J.H., 1911. Report of the Annual General Meeting of the Association, held on October 25, 1911, at Sion College, Victoria Embankment, E.C. *Journal of the British Astronomical Association*, 22, 1–17.
Worthington, J.H., 1923. Letter to Mr. Short, dated 3 January. Original, Sydney Observatory (Short file).
Wyatt, C.H., 1888. *Science and Art Examinations, List of Successful Candidates*. Manchester, Manchester School Board.

Dr Nick Lomb obtained a PhD from Sydney University for work on short-period variable stars. Soon after he joined Sydney Observatory, it came under the auspices of the Museum of Applied Arts and Sciences and he became Curator of Astronomy. Nick is the author of several books on astronomy including the annual *Australasian Sky Guide* that is in its 30th edition and *Transit of Venus: 1631 to the Present*. He is now an Adjunct Professor at the University of Southern Queensland. With regard to solar eclipses, he has been to three and has been fortunate with the weather at all of them: South Australia 2002, Siberia 2008 and Palm Cove (Queensland) 2012.