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THE 1922 SOLAR ECLIPSE AT CHRISTMAS ISLAND: "OUR DISAPPOINTMENT IT IS IMPOSSIBLE TO DESCRIBE"

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Abstract: The 21 September 1922 total eclipse of the Sun offered the next opportunity to obtain the measurements of the deflection of starlight that could confirm Einstein's General Theory of Relativity and the results obtained during the 1919 eclipse. The Royal Observatory, Greenwich, mounted an expedition to Christmas Island, 350km off the coast of Java, whose work programme also included photographic photometry of southern stars. There they were joined in a spirit of 'friendly rivalry' by a Dutch–German group also planning similar deflection measurements. However, early on in the assembly of their telescope the British astronomers realised that the weather was going to cause trouble and that the meteorological records from the island were of limited value for astronomical purposes.

Keywords: 1922 total solar eclipse, Christmas Island, Harold Spencer Jones, Philibert Melotte, 13-in Grubb astrograph

1 INTRODUCTION

After the May 1919 eclipse of the Sun with its first verification of Einstein's General Theory of Relativity by Arthur Eddington (1882–1944) through measurement of the deflection of starlight by the gravitational field of the Sun, the next opportunity to obtain confirmatory observations was to be during the eclipse of 21 September 1922.

Eclipse observations formed a regular part of the work of the Royal Observatory at Greenwich during those early years of the twentieth century (Royal Observatory …). Soon after the publication of the 1919 eclipse results (Dyson et al., 1920) and at the request of the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies, the Astronomer Royal, Sir Frank Dyson (1868–1939), started making preparations for an expedition for the 1922 eclipse.

For this, one of the two Chief Assistants Harold Spencer Jones (1890–1960; Figure 1; Woolley, 1961) and one of the several Junior Assistants Philibert Melotte (1880–1961; Figure 2; Hunter, 1962), were selected for what was to be a major expedition lasting more than six months. In addition to observations of the eclipse, the intention was to obtain photographic plates of southern stars in order to extend the photometric scale standardised for the northern sky.

The path of the 1922 eclipse was to pass across the Maldive Islands, Christmas Island and Australia from the north-west to south-east (see Figure 3). In selecting an observing site the Maldives were rejected with nothing to commend them, Spencer Jones (1923) writing: "… not easily accessible, very unhealthy, and

Figure 1 (left): Harold Spencer Jones (courtesy: John Hunt). Figure 2 (right): A young Philibert Melotte (courtesy: Anne Pater).

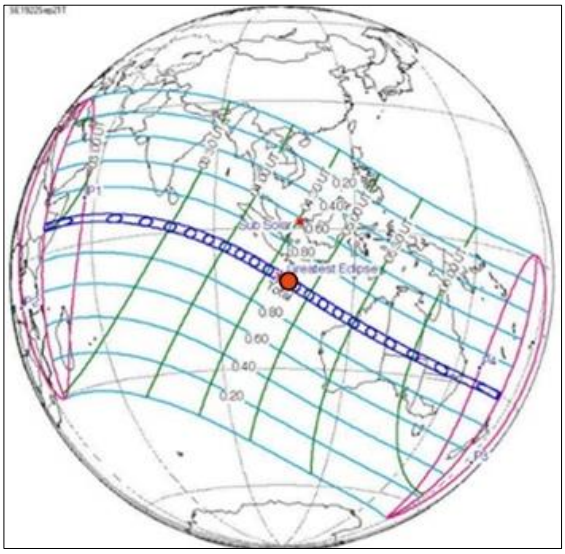

Figure 3: A map showing the path of totality of the 21 September 1922 total solar eclipse, which extended from Africa to beyond Australia. Christmas Island is indicated by the red circle near present-day Indonesia. Most eclipse observers were located in Australia, either at Wallal on the Western Australian coast or at sites near the east coast in south-eastern Queensland (https://alchetron.com/Solar-eclipse-of-September-21%2C-1922).

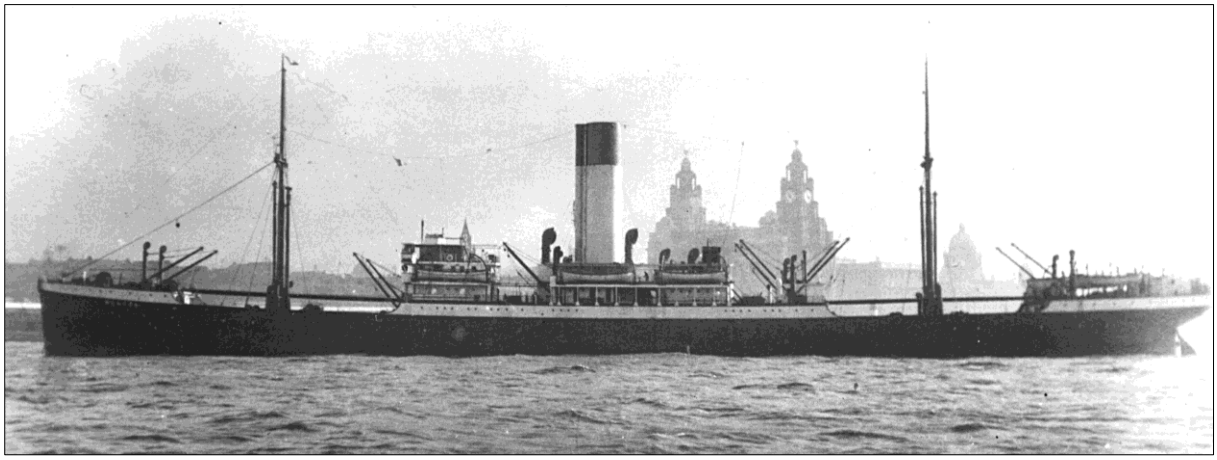

Figure 4: An Allen Collection photograph of the Blue Funnel Lines passenger and cargo ship *SS Mentor*, which conveyed the 1922 British solar eclipse expedition to Singapore (https://www.benjidog.co.uk/allen/Images/ImagesB/BLFUN090.jpg).

where there might have been trouble from vibration due to the surf." In the event, and from the point of view of access alone, this proved a correct decision. John Evershed (1864–1956), Director of the Kodaikanal Solar Observatory in southern India, made representations to go there as the closest to his location, but he was unable to secure suitable transport (Evershed, 1923).

The north-west coast of Australia—the site eventually occupied by the Lick Observatory (Pearson, 2009) and Evershed's (1923) expedition—was similarly rejected, leaving Christmas Island with its easier access and facilities for the landing and erection of heavy instruments. In addition, while its climate was regarded as not so favourable as that of the north-west coast of Australia, it possessed the advantage that with the eclipse occurring at local noon, the Sun would be very high in the sky at the time. Eventually, the Australian Government offered facilities to those expeditions that decided to go to the north-west coast, but by then the Greenwich preparations were too far advanced to make it possible to change.

The reason for the long lead-in time was because alterations had to be made to the mounting of the Greenwich 13-inch astrographic telescope due to the different latitude of Christmas Island (these were undertaken by Grubb), along with other adaptations for eclipse observations. Rather than use a coelostat, with the possibility of heat distortion, such as had given rise to the discordances of the 1919 eclipse results, the decision was made to use an equatorially mounted instrument, with the astrograph large enough for the task but still manageable for erection in a remote location.

The telescope, one of a number of similar telescopes commissioned around the world ca. 1890, was constructed to participate in the International Astrographic Catalogue and Carte du Ciel Project to map the heavens (see Turner, 1912). It survives to this day, albeit on a modern mounting, at the Observatory Science Centre at Herstmonceux, which is a privately run interactive science centre. The astrograph was transferred to Herstmonceux when the Royal Observatory moved there from Greenwich.

In addition to the programme for the Astrographic Catalogue, the objective glass of the Grubb astrograph was used for the eclipses of 1905 and 1919, and the complete telescope with the Christmas Island mount was shipped to Siam for the 1929 eclipse, under the charge of Melotte (Dolan, 2022; for details of the Siamese eclipse see Soonthornthum et al., 2021).

2 DEPARTURE FOR CHRISTMAS ISLAND

Spencer Jones accompanied by his young wife Gladys (in later life she preferred her second name Mary) and Melotte departed from Liverpool on 28 January 1922 on the Blue Funnel liner *Mentor* (Figure 4) bound for Singapore, with the telescope and other equipment totalling around four tons packaged in crates.

After an apparently uneventful voyage they arrived in Singapore on 26 February. There, except for Gladys who continued on to visit Shanghai, they transferred to the *SS Islander*, the Christmas Island Phosphate Company's vessel, for the four-day trip to Christmas Island, which they reached on 14 March. Spencer Jones (1922a) wrote to Dyson that

> The journey passed pleasantly enough, with warm sunshine, smooth seas, and occasional showers until we came towards the southern end of the Straits of Sunda … [but] as we were passing near Krakatoa, where the great Earthquake of 1883 occurred, we began to get a strong breeze. That evening we got our first taste of the behaviour of the

> 'Islander' when there is any motion on the sea."

As they approached the island the weather deteriorated and after "… a very unpleasant day, pitching and rolling about …", Spencer Jones without any luggage was able to land on the sheltered east side of the island from a small boat when the mails were delivered. However, Melotte chose to stay on board the *Islander*, which was only able to tie up 10 days later, on 23 March, when conditions had improved.

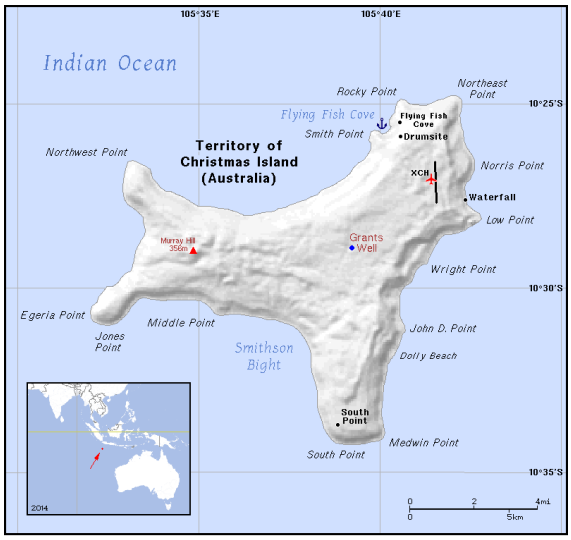

Figure 5: A map of Christmas Island, showing the settlement of Flying Fish Cove on the northern coast, and South Point, where the astronomers erected their observatories (ian.macky.net/pat/map/cx/cx_blu.gif).

3 CHRISTMAS ISLAND

Christmas Island (Figure 5) was first recorded in 1615 but remained uninhabited until 1897, when, following the discovery of phosphate there by John Murray during the HMS *Challenger* scientific expedition in the early 1870s, a phosphate company was established (Hunt, 2011). At the time of the 1922 eclipse, the population numbered around 30 Europeans, mainly males, and about 800 Chinese and Malay labourers.

Gladys Spencer Jones, then in her 26th year, was not an official member of the expedition but was seemingly unconcerned with the limited company or facilities—indeed, what is believed to have been her first overseas trip seemed to engender a love that lasted throughout her life, with a 10-year stay in Cape Town, regular trips to the US and Canada to visit her sister, and to other parts of the world.

In a newspaper report, she was quoted as saying:

> Although I am not an expert astronomer, I think I shall be of use not only in connection with my husband's work but in making the island home comfortable. I am sure a woman's help will be needed in that direction." (Off to Christmas Island, 1922).

Figure 6: A view across Flying Fish Cove looking due south-west (courtesy: John Hunt).

In reference to her luggage of only "… a few small trunks containing the flimsiest of clothes …", she said:

> One will not need to dress fashionably and to have special gowns for particular occasions. I understand there are only two other women on the island, and such things as social functions will be unknown … [and added] It will be pleasant to get away from cities and live a free life for a while, and it will be strange, too, not to have any shops to tempt one to buy. It is sometimes said that women cannot live without shops, but my coming experience will enable me to prove that one woman at least can be happy without one for a time.

4 MAKING PREPARATIONS

The observers settled in the main settlement, Flying Fish Cove in the north of Christmas Island (Figures 6 and 7), but the site selected for the observatory was at the southern end about 20 km distant, where a new quarry was just being opened and a railway line had been constructed to transfer the phosphate.

The day after landing Spencer Jones went out to South Point (Figure 8) to inspect the site and the progress being made by the Company

Figure 7: The bungalow where Dr and Mrs Spencer Jones and Dr Melotte initially stayed on Christmas Island (courtesy: John Hunt).

in preparing the ground for the observatory building, which was on a terrace levelled for labourers' accommodation.

This building, which he himself had designed, consisted of a wooden framework covered with corrugated iron with an area of 40 by 20 ft. (Figure 9). The observatory itself was 20 ft square and east and west were two smaller rooms serving respectively as a living room and dark room (see Figures 10 and 11). The central portion of the roof was constructed to slide back in two halves on rails, so the astrograph (Figure 12) had access to the sky.

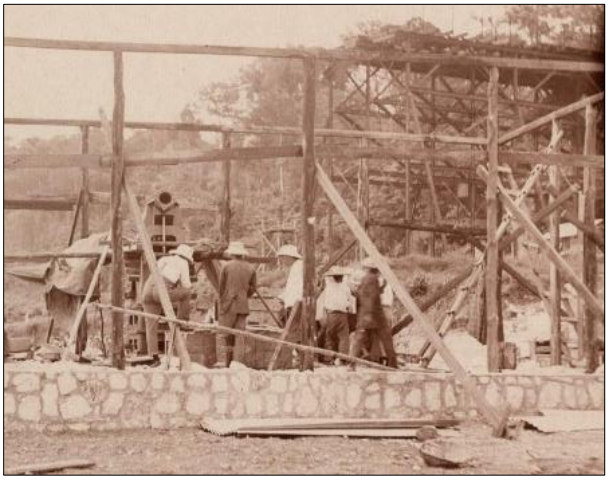

Figure 8 (left): Gladys Spencer Jones and Phosphate Company members riding the 'Christmas Island Rolls Royce', which the astronomers would travel on daily between Flying Fish Cove and South Point (courtesy: John Hunt).

Figure 9 (right): Erecting the observatory building (courtesy: John Hunt).

Figure 10 (left): The completed observatory building (courtesy: John Hunt).

Figure 11 (below): The location of the observatories. Part of the British observatory building is visible on the right and beyond it is the Dutch–German building (courtesy: Anne Pater).

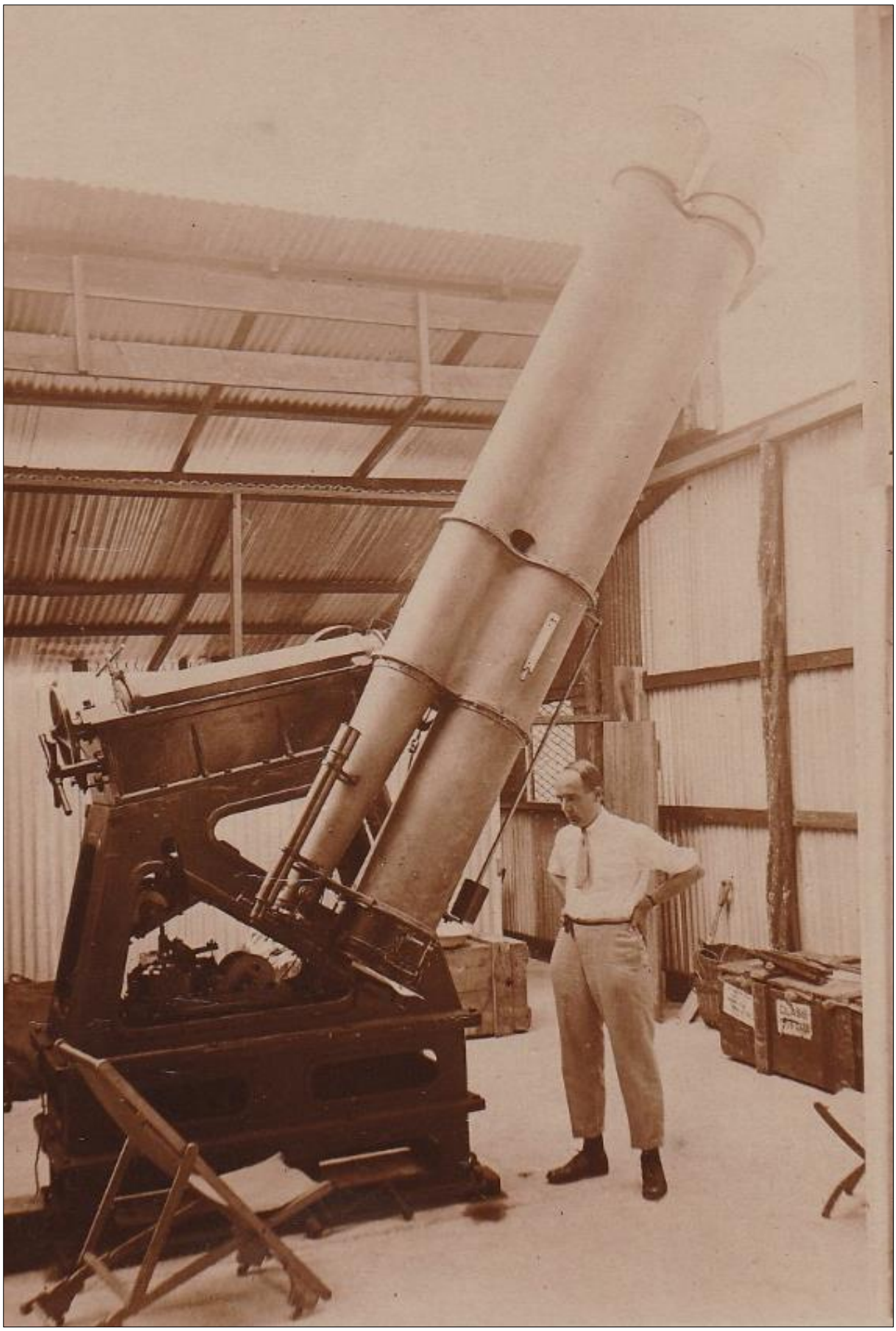

Figure 12: Harold Spencer Jones and the 13-inch Grubb astrographic telescope (courtesy: John Hunt).

Spencer Jones (1922b) wrote that "The erection of the telescope proceeded without hitch …", and he mentioned that the Chinese labourers worked splendidly:

> The manner in which they lifted heavy parts weighing several hundredweights by man-handling, which we would ourselves have lifted with shear legs and tackle, was surprising.

However, a difficulty arose:

> They cannot resist the temptation to abstract any small piece of brass, etc., which they can detach.
>
> The difficulty was overcome by warning them that the telescope took photographs, and if any of them were to touch it, it would take a photograph of them and they would be detected. Thereafter it was left severely alone. (*ibid.*).

The observatory was completed by the end of April but Spencer Jones records that by then they had begun to realise the weather was going to cause trouble, with both a fair amount of fast-moving low cumulus as well as a persistent high thin cirrus. With this, the photometric programme seemed impossible. Indeed, "This trouble persisted to the end, and during the whole period of my stay on the Island, I never once saw the sky completely cloudless …" (*ibid.*).

Spencer Jones (*ibid.*) also commented on the "… very troublesome …" treatment of the photographic plates in the warm damp weather:

> It is very difficult to dry the plates, while they deteriorate quickly at the edges if kept undeveloped for any length of time after being unpacked.

Despite the weather during June and July they secured a good series of comparison plates of the eclipse field,[1] with this work and the subsequent tests also serving as a rehearsal for the sequence of plates to be exposed during the eclipse.

The proposal was that to avoid causing vibration to the telescope, the exposures would be made by means of a shutter held by hand in front of the object glass by Spencer Jones, who would be seated on a platform supported by the roof of the observing house. From there, directions would be given to Melotte below on when to change the plateholders or to move the position of the instrument, via seconds counted by one of the voluntary helpers from the beats of a pendulum.

5 THE DUTCH–GERMAN EXPEDITION

The British expedition was not the only one to Christmas Island and was joined in early August by a Dutch–German group led by Erwin Finlay Freundlich (1885–1964), Professor of Astrophysics at Potsdam University (see Batten, 1985; 2014; Freundlich, 1923; Hopmann, 1923).

Freundlich had first shown an interest in the measurement of the displacement of star-light in 1911, which initially at Einstein's suggestion he attempted to do from earlier eclipse photographs (Hentschel, 1994). However, finding that this did not yield sufficiently precise results, his attention turned to future eclipses. He made his first expedition to the Crimea for the 1914 eclipse where—just like Spencer Jones, who had gone to Minsk in Russia, also on his first solar eclipse expedition—he was caught in the outbreak of World War I.

Other members of the 1922 Dutch–German group on Christmas Island were August Kopff (1882–1960) from Königstuhl-Heidelberg Observatory (Wielen and Wielen, 2013) and Josef Hopmann (1890–1975) from Bonn Observatory (Ferrari D'Occhieppo, 1976), while representatives from the Dutch East Indies were Joan Voûte (1879–1963) from the Magnetical and Meteorological Observatory in Java (O'Connell, 1964), E.K. Weber a Swiss engineer, Lieutenant Gastmann from the Royal Netherlands Navy, as well as a mechanic and two auxiliaries. Most of these astronomers are shown below in Figure 13, together with Freundlich, Spencer Jones and his wife. Only Melotte is missing (but see Figure 14).

At the time German nationals were unable to land at British ports without special permission. While permission for entry of the expedition to Christmas Island had been submitted by the German Foreign Office together with the Netherlands Colonial Ministry, Freundlich (1922) approached Lord Haldane, a leading intellectual who had hosted Einstein during his 1921 visit to London, requesting his assistance for ports *en route*.

Referring to the request to the British Government, he wrote on 4 April 1922:

> I do not think any difficulties are to be expected on this point, especially as the lessees of the island, the Christmas Island Phosphate Company, have given their consent in the most accommodating manner. (*ibid.*).

He elaborated later in the letter:

> Apart from the fact that it is rather hard on the German members of the expedition not to be able to land on the occasion of their first visit to the Tropics … I am concerned about the following matter … In view of the serious financial situation we are obliged to travel on a freight steamer under quite prim-

Figure 13: Some of the astronomers at South Point. Standing (left to right) are Josef Hopmann, Harold Spencer Jones, August Kopff and Joan Voûte; sitting are Erwin Finlay Freundlich, unknown, Mrs Spencer Jones and unknown (courtesy: John Hunt).

> itive conditions and it might so happen that one of us fall ill without a doctor being available … In those circumstances it might be of the greatest importance for us to be allowed to land. (*ibid.*).

Freundlich (*ibid.*) also commented in the letter:

> Einstein is at present in Paris and is endeavouring to solve a difficult problem and one demanding courage. At first he wished to take part in the expedition but he is afraid of the large amount of time involved.

The Dutch–German group set up their equipment adjacent to that of the British astronomers at South Point. This comprised a horizontal camera of 8.5-m focal length with a coelostat (Figure 15) and an astrographic telescope with a 21-cm objective mounted equatorially (Figure 16), both by Zeiss.

6 ECLIPSE DAY

In his last published letter to Dyson, dated 28 August, Spencer Jones (1922c) wrote:

> I am hopeful—but at the same time anxious—about the weather … It is of no use to try and disguise the fact that our chances on the day are a pure gamble.
>
> Should it be cloudy, I cannot say how deeply I shall be disappointed. Given good conditions, I do not think that any expedition is likely to get better results than we shall.

After several days when good observations could have been secured, the day of the eclipse

Figure 14: P.J. Melotte (left) with a member of the Dutch–German group (courtesy: Anne Pater).

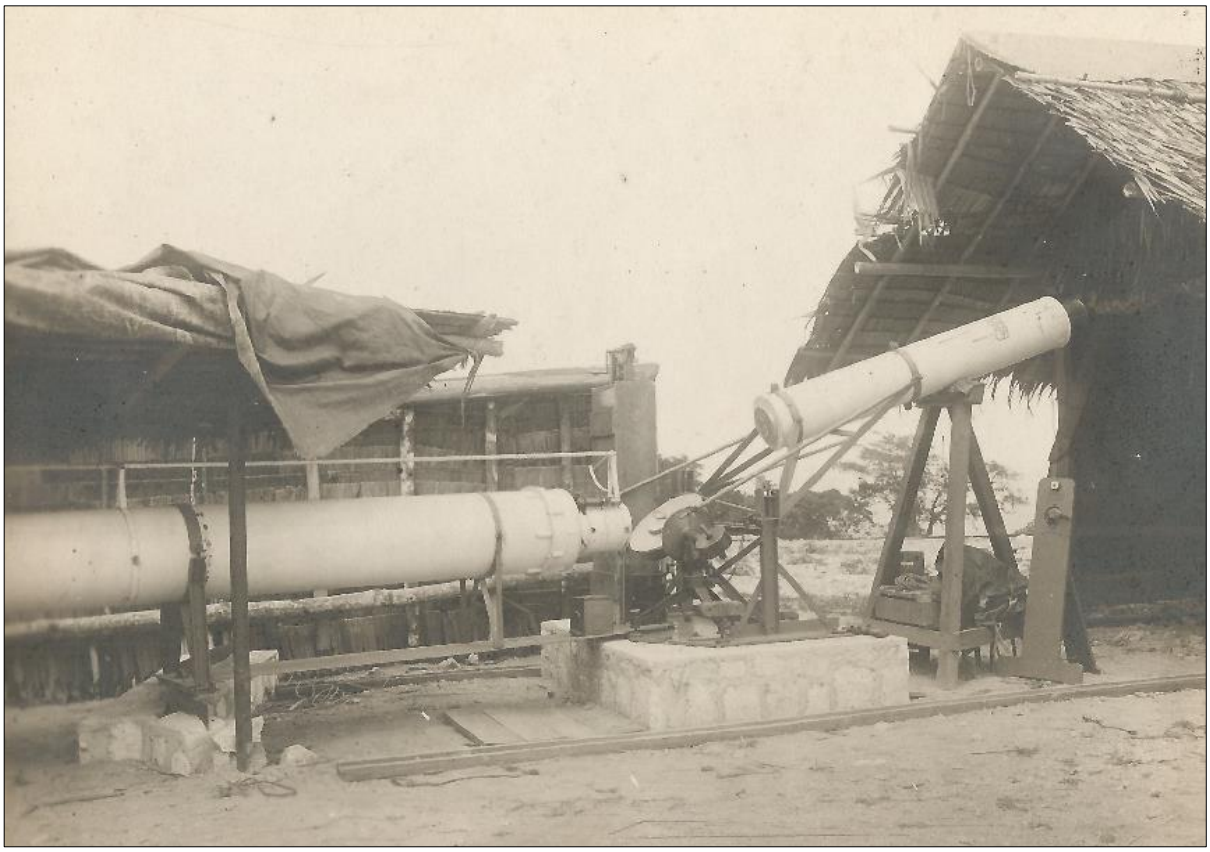

Figure 15 (above): The Dutch–German coelostat–camera system (courtesy: Anne Pater).

Figure 16 (left): The Dutch–German astrograph (courtesy: Anne Pater).

dawned with thick clouds and heavy rain setting in, although shortly after improvement began to appear. By about 9.30 a.m. the sky was about the clearest Spencer Jones had seen during the whole stay, but there was still an hour before totality. Then,

> The clouds began to gather again; first contact of the sun and the moon was well observed. Thereafter, it steadily grew more and more hopeless …
>
> The commencement of the total phase was dimly seen through cloud. One plate was exposed … But then even the glow of the corona through the clouds was lost, and the sun was not seen again until after the last contact, heavy rain following. So ended our hopes. Our disappointment it is impossible to describe. It seemed cruel to be sitting unable to do anything whilst the few valuable minutes for the coming of which so much preparation had been made were passing beyond recall. (*ibid.*).

The neighbouring Dutch–German

expedition also obtained some photographs with both of its instruments (see Figures 17 and 18). To add further salt to the wound, the eclipse was seen at Flying Fish Cove, where Spencer Jones was told it was "… a wonderful and a sublime sight …", with several stars and planets, including Mercury, Venus and Jupiter, visible to the naked eye (An Interview with Mr. Spencer Jones, 1922).

7 AFTER THE ECLIPSE

Following the eclipse, the Spencer Joneses went to Java where they spent three weeks, also meeting there Robert Trumpler from the Lick Observatory team who was *en route* to Switzerland. Meanwhile, presumably Melotte oversaw the packing of the equipment, with both arriving back in Singapore on 23 October.

Melotte must then have returned directly to England while the Spencer Joneses went on to Colombo to meet Harold's brother Cyril, a member of the Indian Civil Service stationed in Tanjore (now Thanjavur). He and his wife only arrived back in England at the end of 1922, having been away almost the whole year.

Although the eclipse expedition interrupted his regular astronomical work, during his time on Christmas Island Spencer Jones (1922d; 1922e) completed a paper that expanded Michelson's theory of interferometer measurements, and he also put the finishing touches to his book *General Astronomy*.

With good conditions at Wallal in north-west Australia and access to excellent instrumentation, the Lick Observatory team (Pearson, 2009: 135–143), and a Canadian team also based there, had clear views of the eclipse. Both obtained observations with which they could confirm Einstein's predictions (Treschman, 2014). Nevertheless, expeditions continued to be mounted to later eclipses to make further deflection measurements.

For instance, Freundlich went to Mexico in 1923, Bengkulen, South Sumatra in 1926 and Takengon, North Sumatra in 1929. At Takengon he was rewarded with excellent views of the eclipse (see Noor and Orchiston, 2021).

Melotte, as mentioned, was a member of a Royal Observatory expedition to the May 1929 eclipse. First, he went to Alor Star in Malaysia with Dr John Jackson (1887–1958), one of the Chief Assistants, and his wife Mary (*ibid.*), and from there he went to Pattani in Siam (Soonthornthum et al., 2021), joined by Professor F.J.M. Stratton (1881–1960) from the University of Cambridge and Dr Thomas Royds (1884–1955), who had succeeded Evershed as Director of Kodaikanal Observatory—but there again he was clouded out (Jackson, 1929).

The only subsequent total eclipse expedition Spencer Jones participated in formally was that of 30 June 1954, when he and Donald Sadler (1908–1987), Superintendent of the Nautical Almanac Office, travelled in a Royal Air Force plane along the track of totality between Greenland and Iceland. His part was to attempt observations of a daytime aurora, although none was seen (Spencer Jones, 1954).

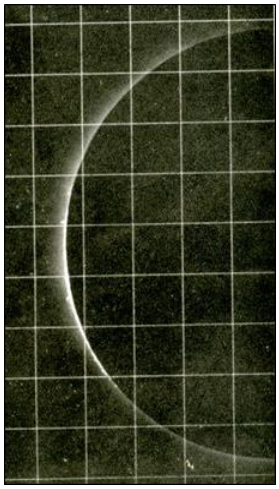

Figure 17 (right): A photograph of the eclipse obtained by the Dutch–German astronomers with the horizontal camera (after Hopmann, 1923), courtesy: Regina von Berlepsch).

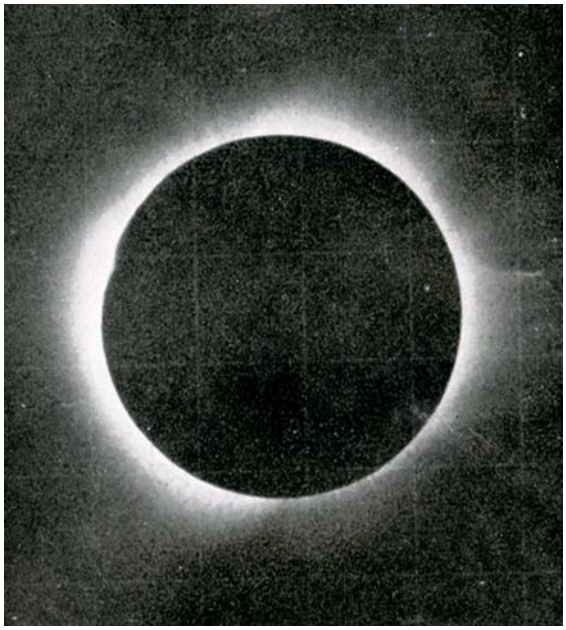

Figure 18 (below): A photograph of the eclipse obtained by the Dutch–German astronomers with the refractor (after Hopmann, 1923, courtesy: Regina von Berlepsch).

During their time on Christmas Island the two teams must have interacted frequently and Spencer Jones and Koppf seem to have developed a particularly good relationship (Wielen, pers. comm., July 2020). Spencer Jones was a driving force for an exchange of astronomical ephemerides between England, the USA and Germany during World War II (Seidelmann, 2020: 202). He assisted Kopff in establishing the Astronomisches Rechen-Institut in Heidelberg after 1945, and he was helpful with Ger-

Figure 19: The plaque recording the Dutch–German presence at the eclipse, soon after it was mounted near the observing site (courtesy: Anne Pater).

many's membership of the International Astronomical Union, which occurred in 1951 (Wielen, 2019).

8 MEMORIES OF THE ECLIPSE

The 1922 English expedition had taken with them a seismograph supplied by the Seismological Committee of the British Association, which was set up so that daily records could be obtained for the study of earthquakes, the majority of which were known to occur in the deep sea between Christmas Island and Java.

They also intended to leave the observatory building, although there is no record of what or how long this was used for.

The Dutch–German expedition took with them a plaque recording the event, which was cemented into the stone wall next to the railway siding at the observatory site (Figure 19). It remained there until 1976, when the British Phosphate Commissioners decided to demolish the by now deserted South Point settlement. One of the Commissioner's conservators Dave Powell had the plaque removed and recemented into the wall of his nursery at Flying Fish Cove.

Spencer Jones appeared on a stamp as part of Christmas Island's 'Famous visitors' series (see Figure 20).

These, then, form the most tangible memories of those expeditions.

Figure 20: A First Day Cover of the 1978 Christmas Island stamp, part of a series commemorating visits to the Island by famous people. The $2 stamp shows Harold Spencer Jones (Spencer Jones Collection).

9 NOTES

1. These Christmas Island comparison plates have not been located and may be held in the late nineteenth to mid-twentieth century Royal Greenwich Observatory astronomical plate collection, which is now housed in the Bodleian Library at Oxford and is yet to be catalogued (Lucy McCann, pers. comm., January 2022).

10 ACKNOWLEDGEMENTS

The only records of the 1922 Christmas Island eclipse expeditions are contained in the few short research papers referenced here and in three sets of photographs, and there are no diaries or other papers in either the Melotte or Spencer Jones families.

John Hunt holds the 15 pictures that originally belonged to Spencer Jones, while Mrs Anne Pater, a granddaughter of P.J. Melotte, has 23 photographs, mainly of the Dutch–German expedition. To both I extend my warm appreciation for providing me with copies of the photographs and allowing me to reproduce some of them here. I am also grateful to Anne for sharing memories of her grandfather, and to John Hunt who gave me a copy of his book, surely the definitive history of Christmas Island.

The largest archive of approximately 150 photographs is in two albums in the Melotte papers in the Royal Greenwich Observatory Archives at the University of Cambridge (GBR/0180/RGO 74).

Fran Yeoh, who is the owner of christmasislandarchives.com, the website of the Christmas Island Archives, was most helpful with information she already had gathered, and she also connected me with John Hunt.

Dr Emma Saunders, Archivist at the Royal Greenwich Observatory Archives and Lucy McCann, Senior Archivist Special Collections in the Bodleian Libraries, were helpful with information about their respective archives.

Regina von Berlepsch, Head of the Scientific Library and Documentation Centre at the Leibniz-Institut für Astrophysik Potsdam, provided copies of the Swiss–German expedition reports, including high resolution copies of the photographs therein (the whereabouts of the originals is unknown).

Finally, Professor Roland Wielen identified the various Dutch and German astronomers and provided interesting insights from his own historical research on the connection of Spencer Jones with Kopff and astronomy in Germany in general.

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After studying physics he began his career at the South African Astronomical Observatory in Cape Town, but later branched into STEM publishing as a writer and editor for popular and professional publications.

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