Ordinary Meeting, 2004 May 26
held at The Geological Society, Burlington House, Piccadilly, London W1

Tom Boles, President

Ron Johnson, Nick Hewitt and Nick James, Secretaries

Mr Boles opened the seventh Ordinary Meeting of the 114th session, and invited Dr Hewitt to read the minutes of the previous meeting, which, having met the approval of members, were duly signed. Mr Johnson announced that two presents had been received since the previous meeting. Mrs Hazel McGee had donated a number of books, in addition to three gifts from Gordon Taylor: *A Handbook of Solar Eclipses*, by I.M. Lewis, *The Indian Eclipse 1898*, edited by E.W. Maunder, and a large number of issues of past *Memoires*. Members showed their appreciation to the donors. The President announced the proposal of 21 new members. Members approved the 17 new members who had been proposed at the previous meeting, and Mr Boles welcomed any newcomers to introduce themselves after the meeting. Mr James announced that Council had accepted two papers for publication in the Journal:

The aurora in 2003, by Ron Livesy
Detection and measurement of the white dwarf spin period in the January 2004 outburst of DO (YY) Draconis, by David Boyd

The President pointed out that Wednesday meetings now started at 17:30, whereas in the past they had started at 17:00. He asked members for a show of hands as to which time would be preferable for future meetings. There was no clear consensus. Finally, Mr Boles announced that the next meeting would be the Exhibition Meeting on June 26, held this year once again at the Cavendish Laboratory in Cambridge. The President then invited Mr Peter Hingley, librarian to the Royal Astronomical Society, to deliver the evening's first talk, on the topical subject of historical transits of the planet Venus.

Historical Transits of Venus

The speaker explained that he would describe the observations of past transits of Venus based on research undertaken using the collection of the Library of the Royal Astronomical Society. Some might look upon the forthcoming transit with a certain sense of apathy: what could be interesting about a small dark blob crossing the face of the Sun? Its rarity would excite some – for it was surely one of the rarest of all easily observable events – but studying the historical context of past transits also allowed observers to appreciate the importance of such events in past times. Though there was limited scientific interest in the transit of 2004, the same was not true of historical events, and extraordinary lengths had been taken by some to make their observations.

The speaker explained that the primary problem which made transit observation so difficult in the past was one of selecting an observing site. The average duration of a transit was around six hours, and to observe it in its entirety, the Sun had to be above the horizon throughout. This was only the case for a quarter of the world for any given transit – the UK by chance having the good fortune of lying in this quarter for the forthcoming transit on June 8. The speaker explained that it was of crucial scientific interest to past observers to measure the start and end times of the transit, and so viewing the whole event was vital, yet this often necessitated long voyages to distant places.

Historical research into transit expeditions often proved a frustrating business. The infamous black-drop effect – to be explained in more detail later – would give rise to substantial imprecision in the timings of first and last contact, and, as these measurements were scientifically vital, the expeditions would be seen largely as failures. The jury still seemed to be out as to the exact cause of this phenomenon which so troubled past observers. As a result, few of the observations were properly recorded, and many were discarded. To his excitement, however, Mr Hingley had found a substantial album in the RAS library recording detailed observations of the 19th century transits. The identity of its owner, and how it had found its way into the library, was unknown, though the speaker had strong reason to believe it to have belonged to a certain Father Stephen Perry. The subject of this album would be returned to later.

The speaker started with the first observed transit – that of 1639. One of the most important outstanding questions in 17th century astronomy was the scale of the Universe. For the preceding 2000 years, the Earth had been viewed as the centre of the Universe, and the planets and fixed stars as being attached to revolving spheres of various radii around it. The speaker used the famous illustration from Thomas Digges' *A perfit description of the Caelestial Orbes* (1576) to depict this view, advocated for so long by the Pythagoreans. In 1543, however, Copernicus had published his *De Revolutionibus*, proposing the heliocentric system, which by the 17th century was winning favour. The publication of Kepler's Laws of Planetary Motion had come in the early 1600s – explaining planetary orbits in terms of ellipses around the Sun – and shortly thereafter came Galileo's telescopic observation that the planets could be resolved to appear as whole new worlds with moons orbiting around them. The speaker showed a

corresponding figure of the Copernican system.

It was in this context that the 17th century transits of Venus in 1631 and 1639 came. The former was predicted by Kepler, who also asserted that such events should follow a 120-year cycle. His calculations were not of sufficient accuracy to reveal that the timing of the 1631 event would be such that it would not be observable from Europe, but following his death in 1630 it was not even clear whether there was any attempt at observation. Kepler's calculations also predicted a near-miss transit in 1639. However, Englishman Jeremiah Horrocks (sometimes Horrox), observing that the old tables of planetary positions were substantially in error, realised the need for new measurements. Thus, with less than a month before the event, he came to realise that a transit would in fact occur. On November 24 (Julian calendar) of that year, at 3.15pm, he obtained the distinction of being the first person to have observed a transit of Venus. Only the first half-hour of the transit was visible, before the Sun set.

Mr Hingley noted that it was also Horrocks who realised the scientific value of the event. He used it to refine the orbit of Venus and its angular size. He was thus able to produce more accurate tables of planetary positions. He even, though his method was flawed, derived an estimate of the Earth-Sun distance of 59,000,000 miles from his observations – within a factor two of the presently accepted value. The speaker explained that whilst Kepler's Laws gave the ratios of the sizes of the orbits of the planets from their orbital periods, the overall scale of the solar system remained undetermined. Horrocks realised that by determining the size of any one of the planets' orbits, Kepler's Laws gave all the others. He would die in 1641, aged a mere 22, and his work was not to become widely known until 1662, when it reached the attention of Polish astronomer Johannes Hevelius, who published it at his own expense. However, the speaker remarked that Hevelius chose to add his own commentary and notably modified Horrocks' results as he didn't believe the huge scale they implied.

Moving ahead to the 18th century transits, the speaker noted that the repeating periodicity of 105 years, 8 years, 120 years and 8 years between transits had by this time been well established. It was Edmund Halley who in 1678 proposed that by timing transits of Mercury, or even better Venus, and comparing results from widely spaced geographic locations, the distance of the planet could be triangulated. Sadly, whilst Halley was to observe a transit of Mercury, Venus would not transit in his lifetime. Once again, Mr Hingley emphasised the importance of historical context here. Terrestrial surveying was becoming widespread at this time, and it would be expected that any seafarer should be familiar with the technique. Halley's inspiration in proposing that it could be extended to the solar system was thus clear.

The next such transits would be on 1761 June 6 and 1769 June 3. Whilst a variety of circumstances would preclude useful observation of the former, valuable data would be gathered from the second. It was rarely remembered that the official justification for Captain Cook's First Voyage of 1768-1771 aboard the *Endeavour* was to obtain scientific measurements of the transit of Venus from Tahiti. The voyage was proposed by the Royal Society, keen to ensure British involvement in this scientific opportunity, and one result of this was that the young Joseph Banks secured a place amongst the crew. He was later to be appointed President of the Royal Society and knighted. The purpose of the trip was in truth twofold: the navy themselves had great territorial interest in mapping the South Pacific, searching for the proposed *Great Southern Continent*, supposedly required to counter-balance the northern landmasses. They jumped at the opportunity, as under the cloak of a scientific expedition, such exploration would be less likely to run into trouble from rival sea-faring nations sailing the same trading routes. To this day, the achievements of Cook's voyage in charting New Zealand and discovering Eastern Australia were remembered best. Perhaps one reason for this was the infamous black-drop effect, or 'oil-drop effect' as Cook called it – the blurring of the edge of the planet with that of the Sun at second and third contact. Charles Green, the official astronomer on the expedition, found himself unable to obtain the level of precision he sought in his timings, and thus the transit observations were broadly considered a failure.

The speaker also recalled the story of another of the 18th century observers, Frenchman Le Gentil. Hoping to travel to Pondichery in India to view the transit, his plans were foiled when he arrived only to discover it to have been taken by British forces, with whom France was at war at the time. With only two weeks to go before the transit, Le Gentil was forced to set sail to Mauritius, and whilst he would be treated to a fine view of the transit from the deck of his ship, the all important timing of the event was impossible at sea. He decided to spend the following eight years exploring the Indian Ocean, and then observe the 1769 event. This he did, and he would eventually find himself back in Pondichery on the day of the second transit, 1769 June 3. However, a change of wind the preceding evening would bring thick cloud and render observation impossible. As a final blow of misfortune, when the dejected Le Gentil returned to France in 1771, he would find his heirs dividing up his estate, presuming in his long absence that he was dead.

It was generally surprising how few observations appeared to have been made of the 18th century events, however some relics of observing programmes had been left behind. These included the Kew Observatory in Richmond, built by King George III, himself a keen amateur astronomer, in order that he might make his own observations. The Observatory continued to function until 1840, whereupon it became primarily a meteorological observatory. The speaker showed the clock used by the King, as well as his telescope, both now in the collection of the Armagh Observatory. Mr Hingley went on to show the records of the King's observations, as well as those made from the Greenwich Observatory, remarking that whilst observers at the latter were said to have differed in their timings by several seconds, it was noted that none differed from the King's by more than a second.

Moving forward to the 19th century transits in 1874 and 1882, the speaker explained that the prime mover in both the British and the international observing programmes on these occasions was to be Sir George Airy, the man who held the post of Astronomer Royal for nearly half of that century. In studying his papers, the speaker had come to the conclusion that Airy worked with certain terms of reference held firmly in mind. He appeared to value measurement very highly, as was shown by his efforts in 1854 towards improving the precision with which the Gravitational Constant was known. But he seemed less concerned about making discoveries – perhaps this was why his response appeared to have been lacklustre when presented in 1845 with Adams' prediction of the location of the new planet Neptune. Thus, he saw the transits of Venus as a tremendous opportunity to refine the scale of the solar system. His excitement would go so far that he would propose a trip to Antarctica for the 1874 transit, but though the importance of this event was appreciated, the expedition was deemed too costly.

Mr Hingley returned to the subject of the anonymous album mentioned at the start of the talk, found in the Library of the RAS. Upon the front were embossed the words 'Ad majorem Dei gloriam' (translated 'to the greater glory of God'), the motto of the Society of Jesus. This would suggest its owner to have been a Jesuit, and combined with the content of the album, seemed to identify him to be Father Stephen Perry. This figure was known to have accompanied the British transit expeditions of both 1874, aboard *HMS Volage* to Kerguelen Island, a desolate place in the Indian Ocean of comparable size to Wales, and of 1882, to Madagascar. The primary scientific achievements of Perry's life appeared to be in the field of geomagnetism, and he made full use of the transit expeditions to collect magnetic samples. He would go on to accompany several other voyages, including finally an expedition to observe the total solar eclipse of 1889, on which he would lose his life at sea through sickness, five days after the eclipse. The speaker felt one of the most interesting aspects of studying transit records was the great many names of astronomers that cropped up. It was a unique opportunity to learn about figures other than the most famous, such as the Herschels, whose names seem so ubiquitous in other 19th century astronomical records. The speaker also identified the era of these two transits as an especially interesting one in Naval history, coming partway through the transition from wind-powered sailing to steam power. Perry's voyages would have been on ships which combined both, as it was not yet possible to maintain steam-power for long periods.

A notable feature of Perry's album was the number of photographs of the inhabitants of his observing locations which appeared amongst its pages. It was clear that Perry saw this as an important part of the trip, and the speaker recalled a comment, said by David Dewhirst to have been made by Arthur Eddington, that meetings of the RAS shortly after eclipses invariably included so many images of the local population around the observing sites that they seemed like a meeting of a missionary organisation. Also featuring heavily amongst its pages were images of the mobile observatories set up in preparation for the transit. The speaker noted that these observatories were typically built from wooden panels which had been carefully designed so that they could be collapsed in such a way as to double as a packing crate for transporting the telescope. In Perry's photographs, stencilled lettering could be seen on the walls of some observatories, revealing the observing station to which it had been sent.

Mr Hingley pointed out that the 19th century transit observers were, in the very truest sense, great explorers. Stories came back of ships rolling through 45° as they were buffeted by typhoons in the South China Sea, and in one instance of a telescope being lost overboard. Upon arrival at their destination, observers had to determine the local sidereal time and the longitude of their observatories before their timings could be useful. It was also necessary to carefully align the polar axes to account for the latitude of the observatory. In an attempt to minimise the black-drop effect, Airy devised a Transit Simulator, which was viewed through a telescope and used to practice making timings of ingress and egress. In the event, however, it was concluded that timing the model was very much easier than timing the real transit, and despite Airy's efforts to ensure the most accurate timing possible, observers disagreed as to the exact timings by several seconds.

The speaker concluded his talk with a series of images from Perry's album of the various observing stations he visited in the 1874 expedition, including the German and US observatories. It appeared that the British had missed out on the best observing locations, since they had been preparing to sail on the *HMS Encounter*, but had had to find a replacement ship at short notice when the rudder of the Encounter was found to have been damaged during the Ashanti War. This somewhat surprised the speaker, whose understanding was that this had been a land war. After some delay, they set sail aboard the Volage. Yet, despite the amount of effort put into observing the 19th century events, surviving photographic plates remained so very rare. The observing sites, the speaker commented, were increasingly becoming recognised as such, with plaques being erected. Monuments now stood at the (believed) site of Horrocks' 1639 observations, and of Captain Cook's observatory on Tahiti. The latter was known to this day as Point Venus.

To close, the speaker listed those great achievements which he felt had only come about when they did as a result of transit expeditions: first and foremost those of Captain Cook's First Voyage – the discovery of Australia and the mapping of New Zealand. The invention of the Jansen Revolver, a camera capable of taking a series of exposures at speed, designed by Jules Janssen for use during the 1874 transit, was surely another. In many ways this could be thought of as a precursor to the modern video camera. Perhaps the greatest achievements of all were in learning about the inhabitants of the islands visited, sampling the local cuisine, and returning home with stuffed specimens of the local wildlife.

Following the applause for Mr Hingley's superbly researched talk, The President expressed his gratitude to the speaker before inviting questions. Mrs Hazel McGee enquired as to whether the 19th century observers had used filters or projection in their solar observation. The speaker said this was difficult to answer, as it was usually not recorded. Writers had evidently considered it too obvious to note such mundane detail. However, he presumed that filters had been used. Dr William Sheehan, in the audience, added that it was documented that as an exception, Horrocks had used solar projection.

The President wished members clear skies for June 8, and took the opportunity to remind members of the IAU Colloquium 196, to be held June 7-11 in Preston, which would be centred around the transit, and include an opportunity to observe it from the Alston Observatory. For observers wanting to see the event naked eye, information about how to do so safely would be included in the June Journal. Mr Boles then welcomed Mr Martin Mobberley to present his Sky Notes.

The May Sky

The speaker opened with the lunar eclipse of May 4, for which the UK had not been an ideal observing site, the eclipse taking place at Moonrise. The eclipse also had a relatively short 1h16m period of totality because the Moon passed only just within the umbra. These factors combined, totality had ended when the Moon had risen to an altitude of only 11° above the horizon. In addition, there had been patchy cloud on the night, though all of these factors had not deterred Association members, and the speaker proceeded to show a fine crop of images from Maurice Gavin, Nick James, as well as his own. Perhaps the finest of all was an evocative image of the partially eclipsed Moon through thin cloud, taken by Damian Peach, normally a name associated with rather higher resolution images.

Mr Mobberley congratulated the Association's resident supernova hunters on an exceptionally fruitful period: Mark Armstrong had discovered five events since the previous meeting. His latest and 62nd discovery, 2004bs, had been classified as a type Ib supernova on the grounds of its spectrum, as obtained by the ESO Calar Alto Observatory in Spain. It was estimated to have been three weeks past maximum at discovery. In addition, the President had made two further supernova discoveries. After the discovery of 2004bd, Ron Arbour had found several pre-discovery images from two weeks earlier amongst his observations of host galaxy NGC 3786. He had failed to claim the discovery himself as it was so close to the nucleus that it had been missed. Reviewing the progress, Tom Boles now had 65 discoveries, with Mark Armstrong coming up fast behind with 62.

Presently an easy variable star to catch was χ-Cygni, variable between mag 3.3 and 14.2 on a 407-day period, and presently close to maximum. Moving onto the comet scene, the big news was that Comet C/2001 Q4 (NEAT) had arrived in the northern hemisphere in early May, peaking at around mag 3 at closest approach to the Earth on May 7, slightly fainter than had been hoped. Loke Tan had obtained exceptionally clear images from the Atacama Desert on April 18-19, around a month before its May 15 perihelion. Association members James Weightman, Maurice Gavin, and the speaker himself, had all obtained their first images on May 10, though not with favourable seeing. The speaker showed a number of images by these members, and Nick James, on the proceeding nights. Michael Jäger, an expert cometary photography had caught a fine image of the comet and tail.

At the previous meeting, Mr Mobberley had mentioned the close-pass of C/2001 Q4 past M44. The show had been not quite as exciting as hoped as the comet appeared much smaller than the cluster, however many Association members had caught images of the two objects in the same frame. Moving onto perihelion, the speaker showed mosaic images from May 15 by himself and Mike Holloway in Van Buren, Arkansas. In all cases, it was clear that the ion tail was slightly spoiled as it was superimposed on a wide swathe of dust, reducing the contrast. In the coming months, C/2001 Q4 would remain in the northern hemisphere, fading to mag 10 by the end of October, and remaining a circumpolar object from the UK until 2008.

The other comet-of-the-moment was C/2002 T7 (LINEAR), and was performing rather better, having peaked at mag 3 in mid-May. However, despite being tantalisingly close to northern-hemisphere visible, its path presently took it a few degrees south of Orion, perching it on the horizon in civil twilight. Southern observers, by contrast, were returning fine images. A 10-minute exposure by Vello Tabur, in Australia, showed the comet to have an anti-tail feature on April 17. This same feature was also apparent in an image by Masi and Mallia from a 14" reflector in Chile on the same night.

Bill Bradfield, an Australian comet hunter, had on April 12 made his 18th discovery, C/2004 F4 (Bradfield). Southern hemisphere comet hunters did, of course, enjoy somewhat of an advantage over their northern counterparts, as the southern skies were not scanned by robotised surveys, and the speaker noted that of all Bradfield's 18 discoveries, he did not share any with a co-discoverer. All were named simply 'Bradfield'. The speaker proceeded to show SOHO LASCO images of C/2004 F4 from April 16-20, around perihelion. It was curious that the comet should have been discovered only four days earlier – its pre-discovery orbit had wound a zig-zag path through Aries for some months previously, brightening from around mag 18 in early 2003, to mag 8 at discovery. Now a fine northern hemisphere comet, the speaker showed superb images by Michael Jäger in Austria, reporting a tail of >9°, and another by Endo in Japan of the comet streaking up above sunset. In early June, C/2004 F4 would be around mag 10, before passing through Cassiopeia and fading to around mag 12 by

early August.

Comet C/2003 T3 (Tabur) was one to watch at around mag 9, but was skirting along the north-eastern pre-dawn horizon, hiding from easy view. C/2003 K4 was passing from Vulpecula into Cygnus at the time of the meeting, now approaching mag 10. By mid-June, it would reach mag 8, then in Hercules, perhaps reaching mag 6 by August, but plunging south before reaching perihelion in mid-September.

Meteor observers might be treated to a return of the Bootid/Pons-Winneckeds shower on June 26, the day of the Exhibition Meeting. After a 70-year dormancy, this shower had returned in 1998 to yield a rate of 50-100 per hour. A ten-day-old Moon would set at 0h27 UT that night, but summer twilight would likely be a greater bother.

The Cassini probe was now drawing very close to its target, and on 2004 March 24 took its final image of Saturn such that the whole planet could fit within a single frame. Close-up images of the rings on May 10 showed a complex spiders-web-like network of shadows of the rings cast down onto the surface below. Insertion into Saturnian orbit was scheduled for July 1. The speaker then displayed the fine results being obtained by the Association's own planetary observers in tracing surface details on Jupiter. Having contributions from observers with wide geographic spread, the Jupiter Section was often able to obtain images of the surface on every rotation, allowing features to be monitored with precision previously only available to costly space missions. The speaker remarked that this work was ideally suited for amateurs, since good images could be obtained from a standard 8" or 12" instrument, with no benefit gained by using giant apertures.

Finally, the speaker closed by continuing the theme of the previous talk, giving the details of the forthcoming transit of Venus on the morning of June 8. This would be the first transit of the planet for 122 years – its rarity was a result of the 3° inclination of Venus' orbit with respect to that of the Earth. Thus a transit was only observed from Earth on the rare occasions when inferior conjunction coincided with the passing of Venus within 0.25° of the ecliptic – the radius of the Sun. To good approximation, the orbits returned to their start-point and repeated themselves every 243 years, and hence transits were observed in cycles of four, with 122, 8, 105, 8 years (total 243 years) between successive events. The appearance of eight-year interludes was because in this time the Earth completed eight orbits in almost exactly the same length of time that Venus took to complete five. Because of the non-exactness of this match, however, the accuracy of alignment required for a transit was only retained for one eight-year interval; after sixteen years a near miss would result.

Mr Mobberley showed several computer-generated images to simulate the apparent angular size of Venus during the transit – around a 30th that of the solar disk. He noted that the ratio of Venus' angular size to that of the Sun was three times the ratio of physical sizes, as Venus was three times closer. Finally, the speaker showed an animated video sequence of the 1882 transit, which had been compiled by Dr William Sheehan from photographic plates taken by the Lick Observatory.

Following the applause for Mr Mobberley's lively and complete account, Mr Maurice Gavin asked whether there were any plans to observe the transit with the space-based SOHO solar observatory. The speaker replied that SOHO was sufficiently far from the Earth that the geometry was different, and SOHO would not see Venus pass in front of the Sun at all. The President then invited Dr Richard McKim, director of the Association's Mars Section, to deliver the evening's final talk.

Henry McEwan of Glasgow

Dr McKim opened his address by introducing Dr William Sheehan, in the audience, who had created the animation of the 1882 transit of Venus shown by the previous speaker. Members expressed their appreciation of Dr Sheehan's work.

Henry McEwan, the speaker explained, had been an exceptionally active figure in the Association's history, but whose contribution was often forgotten. He was the first Director of the Mercury and Venus Section upon its foundation in 1895, and would go on to hold this post for 60 years, until his death in 1955. This made him the longest standing Section Director in the Association's history. However, despite the length of his service and the important contributions he made to the observation of these two planets, relatively little was known about his life. Living in Scotland, he was somewhat isolated from much of the Association, and his relatively limited means rarely permitted him to travel to meetings in London.

The speaker took personal interest in McEwan's life for several reasons beyond his astronomical work. Living in the Victorian era, the historical context of McEwan's contribution to the Association was markedly different from that of the present day: he was twenty years old at the time of William Gladstone's 1884 Reform Act, which extended voting rights to the working classes. The age of steam was now fully underway – a matter close to McEwan's professional training as an electrical engineer. In 1873, James Clerk Maxwell's now famous equations describing electromagnetic fields were published for the first time. Yet certain historical details were very familiar to modern astronomers – for example, McEwan's interest in amateur astronomy stemmed initially from the wonder of seeing the northern aurora.

McEwan's astronomical achievements included the publication of a highly accurate map of Mercury in 1929. He made positive observations of the Ashen Lights of Venus on several occasions. And his lifelong ambition was to measure the rotation periods of these two planets. He also made contributions to other Sections, submitting sketches of Jupiter and Mars. It was evident from these that he had fine eyesight and an excellent interpretation of colour. His diagrams for the Journal undoubtedly benefited from his professional training as an engineer. Yet McEwan never owned a large telescope – the bulk of his work was undertaken with a 5-inch refractor he bought in 1895.

He never fulfilled his aim of measuring the rotation period of Venus, though no other observers had any better luck in his lifetime. It was perhaps tantalising, given that the now-accepted rotation period of Mercury is 4.4 days, that McEwan should have identified in 1914 a curious indentation in the terminator on February 14, which reappeared on 19th. Venus proved substantially more challenging – McEwan had great difficulty in identifying any form of surface features which all observers could agree on and follow. Many observers claimed to see no surface detail at all. Observers would argue over claimed measurements of the period, but no consensus was ever reached, and none of the historical observations matched the retrograde rotation of 243-day period that is now accepted.

A more detailed account of Dr McKim's presentation can be found in the talk's accompanying paper.[1] Following the applause for the speaker's thorough historical account, the President said there was no time for questions. The meeting was adjourned until Saturday June 26 at the Cavendish Laboratory, Cambridge.

Dominic Ford

References

[1] McKim, R., *JBAA*, [in press at time of writing]