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George Denton Hirst: a remarkable Sydney amateur astronomer

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Abstract

Australian businessman George Denton Hirst was a prominent amateur astronomer for four decades. He was an observer at the 1874 transit of Venus, and he also successfully observed a transit of Mercury in 1894. He observed the planets Mars and Venus and made micrometric measurements of double stars. Thanks to his superb drawing skills, his drawings of Jupiter at opposition brought him to international prominence. Hirst joined a number of scientific societies, starting with the Royal Society of New South Wales, to which he enthusiastically contributed papers in astronomy and in another interest, microscopy. Not only did Hirst contribute papers, but he was always willing to serve on committees, as a member, as a secretary, as chair or as president.

Introduction

George Denton Hirst (1846–1915; Figure 1) was a highly respected amateur astronomer in Sydney during the late 19th and early 20th centuries. He was active in the field for four decades, until his death in 1915. At the time, with few New South Wales professional astronomers, and with little difference between them and the leading amateurs, there was a growing group of local amateurs (see Figure 2), who made serious contributions to astronomy. As well as Hirst, these included the famous Windsor (NSW) astronomer and comet discoverer, John Tebbutt (1834–1916; Orchiston, 2017a); Hirst's longtime friend William John Macdonnell (1842-1910; Orchiston, 2001a); Robert Thorburn Ayton Innes (1861–1933; Orchiston, 2001b), who went on to become a professional astronomer in South Africa; Charles James Merfield (1866–1931; Orchiston, 2015), who also became a professional astronomer, but in Australia; and the comet discoverer Walter Frederick Gale (1865–1945; Wood, 1981). As we discuss here, Hirst made a variety of useful astronomical observations, such as observing transits of Venus and Mercury and measuring double stars, but he is best known for his drawing skills, especially when deployed on observations of Mars and Jupiter. He also played a key role in early New South Wales formal astronomical groups. Apart from astronomy, Hirst was also interested in microscopy. There have

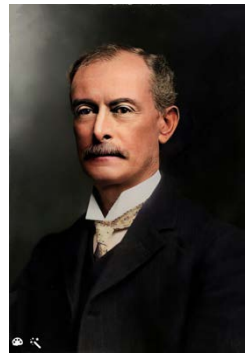


Figure 1: George Denton Hirst in the 1890s. Courtesy Museums Victoria (MM 139568). Colourised image.

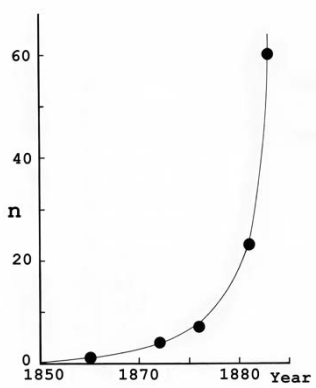


Figure 2: A plot of the number of amateur astronomers in the Sydney-Windsor region between 1850 and 1899, after (Orchiston, 1991a).

been a number of short articles describing Hirst's life (Anonymous, 1916; Holland, 2014; Orchiston, 2017a: 299–300). In this paper, we expand on those brief summaries.

A biographical sketch

Early life and interests

Hirst was born in Sydney on 7 April 1846 and educated at Sydney Grammar School (Jarratt, 1987: 37). He was the son of George Robert Hirst (1820–1874) and Caroline Louise Tucker (1822–1893). Hirst Snr had arrived in Sydney from Yorkshire in 1840 at the age of 19 and worked as a wool buyer for English companies. At age 19, George Denton Hirst was a member of the Voluntary Artillery; at artillery practice he scored a creditable 14 points, as did his younger brother Henry (1847–1903), while the highest score achieved was 20 (Anonymous, 1865). In the following year he was elected to the committee of No 2. Battery Voluntary Artillery (Anonymous, 1866), beginning a lifetime of contributing to organisations by serving on their committees. Such voluntary artillery units were formed in the various Australian colonies to support locally stationed British troops in case of a feared Russian attack. Sailing was also a major interest, with Hirst being part of the crew of the prominent businessman Alfred Fairfax's (1824–1901) locally built yacht *Magic* (Anonymous, 1901). He sailed on the yacht's first race in 1874 and later considered it as a most successful boat with 23 wins out of 32 starts. Fairfax was also a well-known amateur astronomer.

Tucker and Co.

At age 16, Hirst joined the firm of Tucker & Co., wine and spirit merchants, as a junior clerk (Jarratt, 1987: 37). This firm had been founded in 1838 by his mother's brother William Tucker (1814–1888). Soon after Hirst entered the business, William Tucker retired and management of the firm passed to his younger brother James Cawley Tucker (1816–1906), a master mariner. The latter was often away, and Hirst became increasingly important to the firm. In 1895, he was offered the chance to buy shares in the company and become a partner (Jarratt, 1987: 43). The other partner was Hirst's cousin Charles Churchill Tucker (1857–1917), who had a reputation as a sportsman and was only the 877th person to climb the 4806-metre-high Mount Blanc and supposedly the first Australian to do so (Jarratt, 1987: 39). Hirst became an expert on wine and spirits; in 1903, he told a reporter from the *Sydney Morning Herald*:

> By paying a good price you can always depend on getting a pure-grape brandy from several of the leading firms. If you go buying unknown brands of Cognac, however, you will likely receive stuff made in Germany and which never saw Cognac, and more than probable distilled

> from potato peelings or something you might regard as equally objectionable. (Anonymous, 1903)

Until 1908, the firm was located at 379 George Street, Sydney (John Sands Ltd., 1909). This and surrounding buildings were replaced in about 2018 by a massive residential and retail development called York & George (Mladenovski, 2016). The building's ground floor now hosts the Sydney flagship stores of Vodafone and Optus.

Tucker & Co's 150th anniversary book says of Hirst, "He was an unsmiling man, exacting in his requirements of others and intolerant of everything but facts" (Jarratt, 1987: 45) and "[He] thrived on the challenge of extracting order from chaos, of making things run like clockwork" (Jarratt, 1987: 51).

Mosman and later life

In about 1898, George Hirst, together with his wife Mary and two young children, Enid and Harold, moved from Balmain to 28 Muston Street, Mosman (Sands, 1899). The house, named "Berowra," is shown in Figure 3. It is in the Queen Anne Federation style, incorporating elements such as an octagonal mini tower with bay windows, front porch and veranda, fretwork, an asymmetrical design and a complex roof (Ruwolt, 2023).

According to an article in the *Sydney Mail and New South Wales Advertiser*, written five years after the Hirst family move, "A few years ago Mosman was a wilderness … the place has been transformed into one of Sydney's prettiest and most popular marine suburbs" (Anonymous, 1904). The article was written in relation to the bowling green, tennis courts and quoits pitches that the Mosman Recreation Company had recently set up in the suburb. Hirst, with his predilection to contribute was, of course, one of the company's directors.

Figure 3: Hirst in front of his home at 28 Muston Street, Mosman. His daughter Enid is standing at the top of the steps holding a cat, with son Harold and wife Mary on the right. A portable telescope is displayed on the verandah. Courtesy Museums Victoria (MM 137404).

To Hirst, an even more appealing aspect of Mosman would have been that within a few years of moving there he was joined by a good selection of fellow amateur astronomers as neighbours. These included the Reverend Dr Thomas Roseby (1844–1918), Hugh Wright (1868–1957), William Macdonnell (1842–1910), Alan Cobham (1880–1961), Ernest Beattie (1864–1943) and Nathaniel Basnett (d. 1944). All these took part in some capacity in the New South Wales Branch of the British Astronomical Association, as president, vice-president, secretary or as a committee member during the early years of the branch, e.g. (see Orchiston, 1988). Figure 4 shows Hirst with some of his astronomer neighbours.

George Hirst died at home on 20 May 1915 (Anonymous, 1915). The house remained with the family until it was sold in the mid-1970s and was, more recently, demolished to make way for a modern building with two apartments.

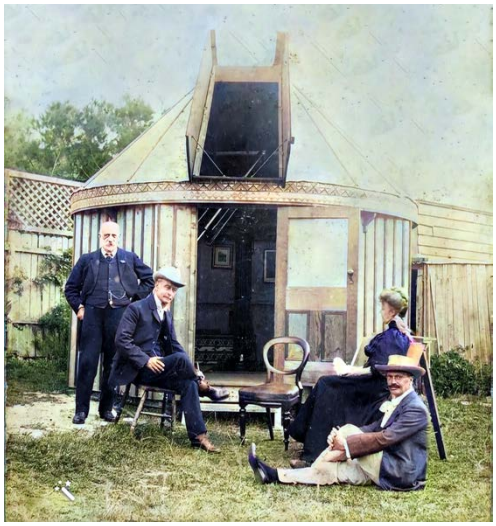


Figure 4: Hirst with fellow amateur astronomers at William Macdonnell's Gardonal Observatory, Shadforth Street, Mosman. Macdonnell is standing at the left, behind Hirst, who is seated. Mrs Emily Macdonnell is seated on the right with Nathaniel Basnett seated on the grass in front of her. Courtesy Museums Victoria (MM 137406). Colourised image.

Astronomy

Planetary transits

The 1874 transit of Venus began Hirst's astronomical and scientific flowering and seems to have led to his joining the Royal Society of New South Wales in 1876 (Royal Society of New South Wales, 1876). He was one of a party of observers at Woodford in the Blue Mountains, to the west of Sydney. The Woodford observers were among a number of groups that the NSW Government Astronomer and Sydney Observatory Director, Henry Chamberlain Russell (1836–1907; Figure 5; Bhathal, 1991) had sent out to various places in the colony of New South Wales (Lomb, 2011: 112–131). How Hirst came to be among the Woodford party is unclear. He could have had previously demonstrated

Figure 5: Henry Chamberlain Russell in 1889, (from Anonymous, 1889)

astronomical prowess, or, more likely, it was because he knew the owner of the Woodford property, Alfred Fairfax, through yachting.

Hirst was in charge of the main instrument at Woodford, the 4-inch (10.2-cm) f/15 Dallmeyer photoheliograph, a telescope specially designed to photograph the Sun (Lomb, 2011: 120–121). This was used together with a Janssen apparatus that allowed a series of short-exposure photographs to be taken in rapid succession on a large circular glass plate, (see Launay and Hingley, 2005). This apparatus is also known as a photographic revolver and can be regarded as the forerunner of the movie camera. Both objects still exist and are in the collection of the Powerhouse Museum in Sydney: the photoheliograph is object no. H10211, while the Janssen apparatus is object no. H10213.

After the transit, Hirst described how the photoheliograph was set up with a finder that had a 1.5-inch (38-mm) diameter objective lens and a focal length of 1.22-m (Russell, 1892: 20–21). The lens was used with a Huygens eyepiece and Hirst protected his eye by placing an orange-coloured glass filter between the eyepiece and his eye. He made

a most interesting observation through the finder just as Venus was moving onto the disc of the Sun: Venus was " ... connected to the limb by a narrow line intensely black with an ill-defined edge ... " (Russell, 1892: 20–21). Figure 6 shows Hirst's drawing of what he saw. This was the infamous black drop that had plagued James Cook (1728–1779) and Charles Green (1735–1771) in Tahiti in 1769 (Orchiston, 2017b) and other 18th century observers (Sheehan and Westfall, 2004). It did not appear in photographs and other 1874 observers did not see it through larger, better-quality telescopes. Hirst also glimpsed the black drop during Venus' egress from the solar disc.

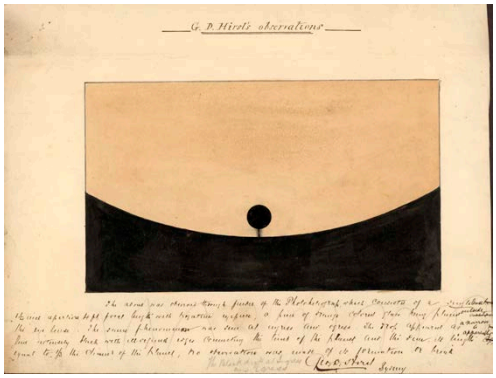


Figure 6: Hirst's original drawing of his observation of the black drop effect, drawn for HC Russell's 1892 book, *Observations of the Transit of Venus, 9 December 1874*. Courtesy Museums of History NSW (State Archives Collection A3003, Box 216).

For the 1882 transit, the egress was to be visible soon after sunrise on 7 December from the east coast of Australia. Russell again organized teams of astronomers to observe from various locations in New South Wales. Due to the low altitude of the Sun during the transit, this time he chose high mountains for the observing stations (Anonymous, 1882). Russell sent Hirst to Brothers Hill at Camden Haven, which is 40 km south of Port Macquarie by road. He was fully equipped with instruments, including a 6-inch (15-cm) equatorial by Alvan Clark (1804–1887),[1] another equatorial of 4½-inch (11.4-cm) aperture by William Wray (1829–1885), a portable transit, a chronograph, a clock and chronometers. On Brothers Hill, he was to be joined by William John Macdonnell, who had moved to Port Macquarie earlier that year as the manager of the local branch of the Bank of New South Wales (Orchiston, 2001a). Though Russell chose Brothers Hill for Hirst and Macdonnell, they set up instead on a small hill just outside of Port Macquarie, since known as Transit Hill. The hill provided the necessary unobstructed view towards the east.

In the event, it was cloudy for all the NSW observers (Russell, 1882). Hirst was the only one among them to catch a glimpse of the transit, but it was a short glimpse of only 20 seconds, when Venus was seven-tenths of its diameter off the Sun.

During his stay at Port Macquarie, Hirst had an opportunity to use Macdonnell's own telescope, a 3⅝-inch (9.3-cm) refractor by Parkes and Son of Birmingham, on a night " ... with the extraordinary stillness of the definition ... " (Hirst, 1884). He pointed the telescope at the stars of the Trapezium in the Great Nebula of Orion and managed to see its faint sixth star; both Macdonnell and his wife verified the sighting, with the latter having no prior knowledge of the

1 This telescope was later acquired by the comet discoverer Walter Gale and sold, with an inferior substitute equatorial mounting to the New Plymouth Astronomical Society in New Zealand. There it was installed in their observatory and used extensively for public viewing sessions, (see Orchiston, 1991b).

star's location. This star was either the one known today as E, or the one known as F. Both are 11th magnitude objects and today a 6-inch (15-cm) telescope is recommended for seeing them (King, 2017).

A transit of Mercury took place on 10 November 1894 (Russell, 1895). Hirst observed from his then home at Balmain with a 3¾-inch (9.5-cm) equatorial refractor. He reported to the Government Astronomer, Russell, that he reduced the aperture to 2½-inch (6.3-cm) to stop the coloured glass filter from breaking. As well, he " ... wanted to see if a small aperture had anything to do with the formation of the drop ... ." The black drop did appear, though it was different from the " ... fuzzy, ill-defined stalk connecting the limbs of *Venus* and the Sun ... " that he had seen at Woodford. This time Mercury bulged out towards the edge of the Sun and formed a sharp drop. Hirst concluded that a drop is more likely to be seen through a small aperture. This is correct, but not a complete explanation for the black drop. According to modern analysis, the two main causes are atmospheric seeing and diffraction inside the telescope (Schaefer, 2001). The first indicates that the lower the altitude, the more likely it is that the drop will be seen, while the second indicates that the effect is much greater for telescopes of small aperture.

Hirst sent his Mercury results to Russell, who was pleased with them, as they corroborated his observation of a " ... little unsteadiness ... " in the atmosphere during the transit (Russell, 1894). Russell suggested that Hirst send his results to the Royal Astronomical Society and offered to nominate him as a member. Subsequently, Hirst was elected as a fellow of the Society on 8 March 1895 (Royal Astronomical Society, 1895). Interestingly, that was an eventful time for Hirst, as he had been elected as a member of the British Astronomical Association and its New South Wales Branch just a week earlier (Lomb et al., 2024).

Jupiter

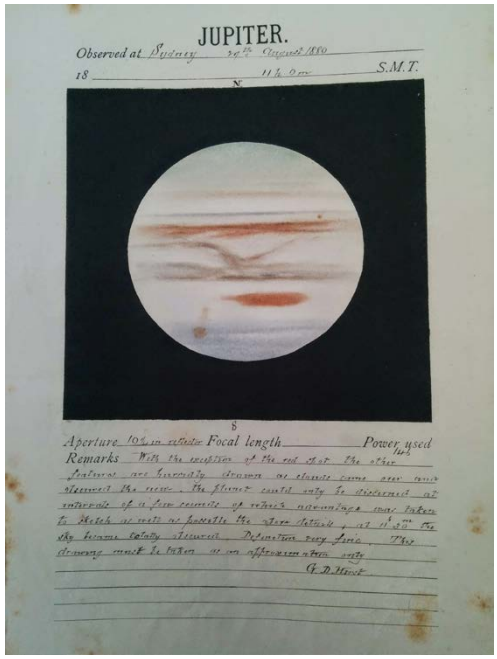
In March 1876, the Royal Astronomical Society (RAS) issued an appeal, addressed particularly to observers in the Southern Hemisphere, to make a careful study of the planet Jupiter (Hirst, 1876). This request was due to the planet's southern declination and hence poor visibility in the UK and other Northern Hemisphere countries. The society wanted drawings of the planet on standardised forms that paid particular attention to " ... the tints and colours of the belts ... ." As well, note was to be taken of the occurrence of small white and black spots.

Hirst saw the appeal at the beginning of May that year and decided to begin observing and drawing Jupiter. He began scientifically by examining all the earlier drawings of Jupiter that he could find in publications. To his surprise, he could only find " ... few and such crude attempts ... " to draw Jupiter. The drawings of some earlier astronomers were " ... said to be remarkably fine drawings, and probably the originals may be; but if this is the case a lithograph copy of one of them that I have seen must be the most woeful libel." (Hirst, 1876).

To make his own observations, Hirst had access to a 10¼-inch (26-cm) aperture silvered glass Browning-With reflector. This belonged to his friend John Ussher Cox Colyer (1846–1910), who lived at Bellevue Hill (Anonymous, 1881) and in 1877 built an observatory for his telescope (Anonymous,

1877).[2] Colyer was a fellow member of the Royal Society of New South Wales, who, like Hirst, was in both Section A, the astronomical section and in the microscopical section of the society.[3] Hirst (1876) mentioned that the telescope had a good driving-clock that kept Jupiter in the centre of the field of view, allowing both hands to be used for drawing. Unfortunately, we have been unable to find a photograph or a description of this telescope or the associated observatory.

Paying attention to the Jovian colours, as asked, Hirst noted the "… bright-orange-yellow of the equatorial zone." He showed his first sketches to Henry Chamberlain Russell, who was using Sydney Observatory's 11½-inch (29-cm) Schröder refractor (Pickett and Lomb, 2001: 40). As Russell, disagreed with his colours, Hirst went to the observatory to look through the large refractor himself. He found that through the refractor, the equatorial belt appeared a bright pink, just as Russell had seen. To try and clear up the confusion, Hirst examined Jupiter with Alfred Fairfax's 4¾-inch (12-cm) Schröder refractor (Orchiston, 1987: 66) and again saw the same pinkish tint. Firmly showing the differences between refractors and reflectors, Russell saw the same yellow that Hirst had seen through his self-made 10.7-inch (27.3-cm) reflector (Orchiston, 2000). One of Hirst's drawings of Jupiter, made in 1880, is shown in Figure 7.


JUPITER.

Observed at Sydney 27th August 1880

18 11h 0m S.M.T.

N

S

Aperture 10¼in reflector Focal length Power used 168

Remarks With the exception of the red spot the other features are hazily drawn or clouds come over and obscure the view. The planet could only be discerned at intervals of a few seconds of which moments may taken to sketch as well as possible the above details, at 11h 20m the disc became totally obscured. Definition very fine. The drawing must be taken as an approximation only.

G. D. Hirst

Figure 7: Jupiter, drawn by Hirst on 27 August 1880, using Colyer's 10¼-inch reflector. Courtesy State Library of NSW (MLMSS 223).

The different tints seen through refractors and reflectors could possibly have been explained by the better achromatism of the latter, but Hirst's observations at the 1878 opposition confused the issue (Hirst, 1878). That year he was using both Sydney Observatory's 7¼-inch (18.4-cm) Merz refractor and Colyer's 10¼-inch (26-cm) reflector. He found that the discrepancy had disappeared; in a sort of compromise, through

2 Colyer came with an impeccable astronomical pedigree. His grandmother on the maternal side was a daughter of the Reverend Dr. Henry Ussher (1741–1790), the Astronomer Royal of Ireland (Wright, 1889). Apparently, Colyer was born James Cox Colyer, but at some stage changed his name to James Ussher Cox Colyer, presumably to accommodate this illustrious ancestry. He also named his house in Sydney "Eastwell" after "Eastwell House", the mansion occupied by his ancestors in County Galway, Ireland. Further details of Colyer's Irish links and his astronomical associations will be the subject of a later paper.

3 The astronomical section (Section A) of the Royal Society of NSW existed between 1876 and 1881 (Orchiston and Bhathal, 1991). The microscopical section seems to have lasted somewhat longer with Hirst presenting his papers on wool fibres to the section in 1876 (Anonymous, 1876) and diatoms the following year (Hirst, 1877a), and chairing a meeting of the section in 1884 (Anonymous, 1884). Colyer (1876) also presented a paper at a meeting of the microscopical section in 1876.

both telescopes the northern equatorial belt appeared " ... a bright coppery red ... ", while the southern appeared " ... half ochre-yellow, inclining sometimes to grey."

Hirst (1876) also saw colours in the polar regions of Jupiter: " ... a decidedly brownish green ... " around the north pole, at least through the reflector, while the south pole region appeared " ... a warm grey ... " The only earlier observation that he could find of a green tint at the poles was that of a Miss Hirst in New Zealand, who supposedly saw " ... a small oval patch of decided sea-green at the south pole ... " during the 1875 opposition (Lambert, 1875). However, there are modern doubts on whether Miss Hirst really existed (Orchiston, 2023).

A feature on Jupiter's disc, seen by both Hirst and Russell in 1876, was one that they called the "Fish" (Hirst, 1876). This bright red spot also appeared in the same position on Jupiter in 1878 (Hirst, 1878), that is, on the south side of the equatorial belt. In a letter to the *Sydney Morning Herald* on 23 July 1878, Russell (1878a) mentioned seeing the spot three nights earlier and compared it to what he saw in 1876, but he misremembered its position in the earlier year. He returned to the subject in 1880, stating that in 1878 he first saw the red spot clearly on 8 July (Russell, 1880). This date disagrees with his letter to the *Herald* and could have been an attempt to obtain priority. This may be so, since American astronomer Carr Pritchett (1879) of the Morrison Observatory in Missouri, reported seeing the spot, which we now know as the Great Red Spot (GRS), on 9 July.

The GRS possibly had appeared in earlier drawings, but, according to Thomas Hockey (1999: 125–158) in his book *Galileo's Planet*, Pritchett should be credited with its modern re-discovery. Hockey was aware of Hirst and Russell's observations of the "Fish". Ignoring Russell, he jokes that it is fortunate that it was not Hirst who was credited with the discovery, since otherwise we could be referring to the spot as the Great Red Fish!

A recent research paper examines all the available observations of large spots on Jupiter (Sánchez-Lavega et al., 2024). The authors conclude that the earliest reports of a "Permanent Spot" in the 1600s do not refer to the GRS, as that seems to have disappeared during the following century. The first report of the GRS dates from 1831, but it did not take on its present appearance of a reddish oval surrounded by the whitish area, called the Hollow, until the period

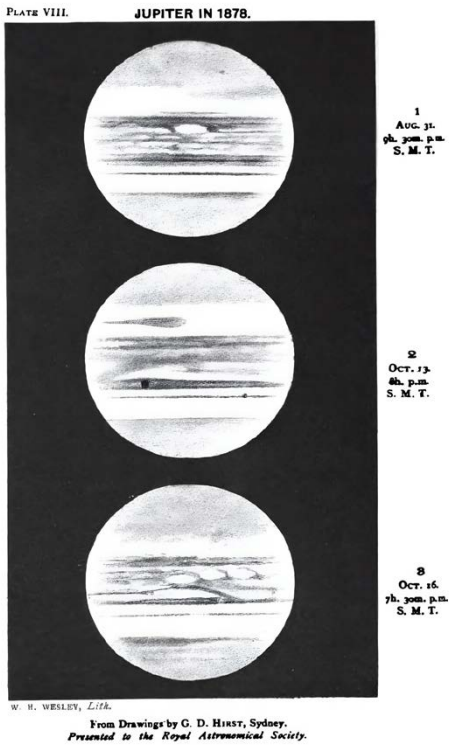


Figure 8: Hirst's drawings of Jupiter in August and October 1878 on Plate VIII of *The Sun: Its Planets and their Satellites* by Edmund Ledger.

1872–1876. Fortuitously, Hirst started observing Jupiter near the end of this period. It should be noted that during Hirst's time the GRS was three times the size it is today, spanning about 39° longitude (48,000 km) in 1880, while it was expected to be about 13° (16,000 km) in 2020 (Simon et al., 2018).

Hirst sent many of his Jupiter drawings to the Royal Astronomical Society, where 56 of his drawings are in the archives at RAS MSS ADD 18 (Bennett, 1978). His work gained international prominence when lithographs of three of those drawings were selected to appear in Edmund Ledger's book, *The Sun: Its Planets and their Satellites* (Ledger, 1882: 304–305). These are shown in Figure 8.

Shadow on the Moon

In October 1878, Russell, the government astronomer, decided to test out the suggestion that astronomical observations can be better made from a mountain than from low elevations (Russell, 1878b). Hirst volunteered to go with him as his assistant. They went to a place already familiar to Hirst, Alfred Fairfax's country residence at Woodford in the Blue Mountains, about 600 metres above sea level. Their equipment included Sydney Observatory's 7¼-in (18.4-cm) refractor, a 4½-in (11-cm) Cooke telescope plus the Hilger spectroscope that Russell had purchased in England three years earlier (Barker, 2007).

On examining the light of the Sun with the spectroscope, Russell saw many fewer spectral lines due to the atmosphere during the day, compared to that he had seen from Sydney Observatory (Russell, 1878b).[4] The lines did come back near sunset but were much sharper than they were from the lower elevation. While Russell used the spectroscope, Hirst looked at Venus near the Sun and at double stars. On the morning of 21 October at 9:05 am (Sydney Mean Time), Hirst happened to look up and saw what appeared to be a shadow on the Moon. Figure 9 shows his drawing of what he saw. The shadow was verified by Russell, who reported that it had a generally circular outline with a width about three quarters of the Moon's diameter and did not move in three hours of observation. Neither Russell nor Hirst had an explanation, though Russell commented that it could have been due to a comet of " ... more than ordinary density ... ". There is no modern explanation either, though what they saw could have been just due to their lack of familiarity of seeing the Moon washed-out by daylight at an elevated site.

While at Woodford, Russell experimented with kites to measure atmospheric electricity. In this he benefited from Hirst's " ... experience with electric kites ... ." Hirst

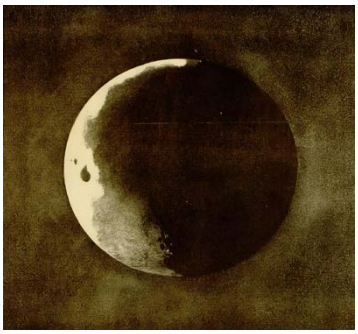


Figure 9: Hirst's drawing of a black shadow on the Moon, as seen from Woodford at 9:05 am Sydney Mean Time on 21 October 1878. The telescope was the 7¼-in (18-cm) Merz refractor. Image from (Russell, 1878b).

4 Spectral lines due to the atmosphere are known as telluric lines (Adelman et al., 1996). They need to be removed when measuring the spectra of stars and galaxies. As the main constituents of the atmosphere, nitrogen, oxygen and argon, decrease with altitude, so do the telluric lines.

made a smaller kite to attach to Russell's larger one. Unfortunately, the combined kite only reached a height of about 120 metres and no useful results were obtained. In another experiment, they used an electroscope, a device that measures charge on a body with two gold leaves that move apart when charge is detected. As part of the experiment, Hirst stood on an old bottle that they had found and had one hand on the electroscope, while Russell rubbed his clothes with a piece of glass. Maybe Russell did not rub hard enough, as only a minimal deflection of 20° was obtained.

Drawing

In 1904, a keen young amateur, Allan Blenman Cobham (1880–1961), gave a talk on astronomical drawing at a meeting of the NSW Branch of the British Astronomical Association (Cobham, 1904). In it, he gave some generic advice for those new to drawing at the telescope, some of which was taken from the writings of overseas astronomers. This led Hirst to provide his own advice on making astronomical drawings, based on his many years of experience (Hirst, 1904). He started by mentioning that the observer must be willing to put up with the discomfort of drawing in the open air or " ... in a draughty observatory ... ". The benefits of a clock drive on the telescope were emphasised. Hirst states that instead of a pencil, he uses " ... old French chalks [steatite, also known as soapstone], not the greasy ones that are more commonly used now." These allowed softness in the outlines and smoothness in the tints.

Hirst pointed out that colour is an essential element in a drawing. The difficulty with astronomical drawings was that they were made at night with artificial light, while they were viewed during the day. Hirst stated that an astronomical drawing " ... should represent by daylight exactly the appearance of the object as seen through the telescope ... ". He said that this was difficult at first but could be achieved with practice by subduing some of the colours, while making the drawing. At the same time, he stressed that once drawn at the telescope, the drawing should not be altered for artistic effect.

The Maunder incident

Hirst was president of the New South Wales Branch of the British Astronomical Association during the 1904–05 session. As was traditional at the end of the term, he gave a presidential address. In presenting his report on 17 October 1905, Hirst (1906a) summarised the activities of the branch for the year, as well as the latest advances in astronomy. There was much of interest in his address:

- The presentation by the Royal Astronomical Society of the Jackson-Gwilt Medal and Gift " ... to our esteemed Member and senior amateur astronomer in this state, Mr. John Tebbutt."[5]
- The retirement due to ill-health of the Government Astronomer, Henry Chamberlain Russell. Hirst spoke of how he worked closely with Russell on a number of projects, including the transits of Venus in 1874 and 1882. He related that "In the old days his advice and assistance were ever at my disposal ... ".

5 Tebbutt retained the Medal but donated the Gift of £25 to the New South Wales Branch of the British Astronomical Association (Anonymous, 1905).

- Hirst berated the members for the lack of original work. He said that both the astronomical and the microscopical sections of the Royal Society of NSW had collapsed as only half a dozen members did any research work in each of them.[6] The two sections were now " ... as dead as Julius Caesar."
- He asked the rhetorical question about whether scientists were " ... not approaching a limit beyond which we cannot reach ... ". Hirst answered his own question in the negative suggesting that the future held " ... some new science, some new development, some hidden law ... ".[7]

Perhaps the most interesting item in the presidential address, and one that became controversial, was Edward Walter Maunder's work on the solar origin of terrestrial magnetic disturbances. Maunder (1851–1928) was an astronomer at the Royal Observatory, Greenwich, who studied the Sun. Hirst referred to Maunder's "theory" that there is a magnetic meridian on the Sun that, when facing Earth, produces magnetic disturbances. Further, "Mr Maunder makes out a fairly strong case for his theory ... but it has been subject to strong criticism ... ".

When Maunder, in England, read Hirst's comments in the *Journal of the British Astronomical Association*, he was sufficiently incensed that he wrote an article for the next issue clarifying his conclusions and stating how Hirst was mistaken (Maunder, 1906). Maunder explained that his results were purely empirical and hence fact and not a theory. He said that he had shown that magnetic disturbances are connected to the Sun, on restricted areas on it, and "That the sun's action is not radiated but restricted in direction." Moreover, his paper on the subject had met with comments, but not strong criticism.

Hirst took the chastisement well (Anonymous, 1906). He said that he did not regret his misunderstanding as it led to a second paper from Maunder, in which some previously obscure points were " ... most lucidly explained."

Mars

Hirst observed Mars during its 1877 opposition and sent a drawing to the Royal Astronomical Society. This is still in the society's archives at RAS MSS ADD 19 (Bennett, 1978). In a note dated 24 August that accompanied the drawing (Hirst, 1877b), Hirst stated that the drawing was made using a 10¼-inch (26-cm) reflector (Colyer's). He reports that "Until lately the markings on Mars have been very indistinct, or almost invisible." However, he said that in the last few days before writing the note the view had cleared, whether " ... in our own atmosphere or that of the planet ... ". Hirst continued to observe Mars after writing the note. As shown in Figure 10, he drew Mars on 3 September using Sydney Observatory's large refractor, stopped down to 7 inches (18-cm) aperture.

The 1877 opposition, at which Mars was closest on September 2 (Pearce, 1924), was a momentous one. In the weeks before Hirst sent off his drawing, American astronomer Asaph Hall (1829–1907) discovered Mars'

6 This was not a fair assessment of the demise of the astronomical section, as other non-observational factors were also involved, (see Orchiston and Bhathal, 1991).

7 This hope or prophecy soon came true, for Albert Einstein (1879–1955), a young patent clerk in Switzerland, in the same year of 1905, revolutionised science and astronomy with a series of seminal papers (Stachel, 1998).

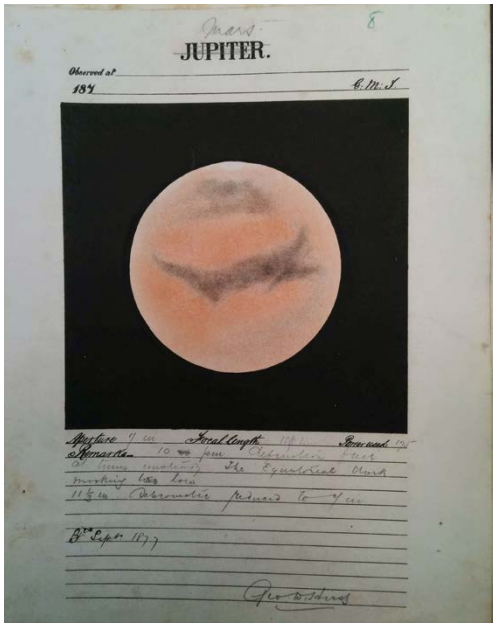


Figure 10: Hirst's drawing of Mars on 3 September 1877 using Sydney Observatory's 11½-inch refractor, stopped down to an aperture of 7-inches (18-cm). Courtesy State Library of NSW (MLMSS 223).

two moons, Phobos and Deimos, at the United States Naval Observatory (Sheehan, 1996). Moreover, that was the opposition at which the Italian astronomer Giovanni Viginio Schiaparelli (1835–1910) drew his famous map of Mars with thin markings that he called, in Italian, "canali." This began a whole plethora of people claiming that there was intelligent life on the planet, (see Putnam and Sheehan, 2021). Despite his success in mapping the whole planet, Schiaparelli explained that during his observing period from September to December 1877, large parts of the planet were obscured (Moore, 1973). This observation of a dust-storm probably explains Hirst's report of seeing indistinct markings on the planet.

Double stars

Since Hirst had access to a number of telescopes, such as Colyer's 10¼-inch (26-cm) reflector and the 7¼-inch and 11½-inch refractors at Sydney Observatory, he did not obtain his own telescope until 1904. That year Sydney Observatory disposed of the smaller telescopes left over from its various transit programs and from them, Hirst acquired a fine 4¼-in (10.8-cm) Cooke refractor on an equatorial mounting, together with a filar micrometer (Orchiston, 2017a: 299–300). Hirst put his new acquisition to good use, so much so that he had to learn how to replace the strands of spider's web on the micrometer. On 18 June 1907, Hirst shared his experiences with members of the NSW Branch of the British Astronomical Association in a surprisingly humorous presentation, titled "Some Remarks on 'Wiring' Astronomical Instruments" (Hirst, 1907). The first step, he said, was to capture a spider of suitable size, so that its web was not too coarse nor too delicate. He notes that

> Spiders do not take kindly to captivity, so that the sooner you get one to spin after it is captured the better. They are also pretty short-tempered, and after being poked about with a stick will sulkily refuse to spin.

A year earlier, he presented to the Branch some observations of the famous southern double star, α Centauri, made with the Cooke refractor and the micrometer (Hirst, 1906b; 1906c). He measured the separation of the two main stars as 21.06 arcseconds. He also measured a number of fainter stars near to the main pair that Robert Innes, then at the Transvaal Observatory in South Africa, had suggested as possible companions. Sub-

sequently, Innes (1915) found Proxima, a real part of the α Cen system (Glass, 2008) and the other supposed companions have been forgotten.

Hirst expanded his double star project with the Cooke refractor to other known southern double stars. This work culminated in two papers published in the *Monthly Notices of the Royal Astronomical Society* (Hirst, 1910a; 1910b). In the first he provided measures of 30 stars, while in the second there are 10 stars measured. Demonstrating his impressive knowledge of the sky, Hirst says that he made the measures for α Cen and another bright double star Θ Eri in daylight.

Microscopy

Hirst was an enthusiastic member of the microscopical section of the Royal Society of NSW, being at times its secretary and its chair. One of his first papers to the section was "Action of alkali on wool fibres" (Anonymous, 1876). Woolgrowers at the time used strong alkalis to clean wool after it had been sheared. Under examination with a microscope, Hirst found that after removal of the wool's natural grease, the alkali damaged the wool fibres.

Marine creatures were also studied. In 1877, Hirst gave a talk to the microscopical section on diatoms (Hirst, 1877a). These tiny unicelled algae with two-part cell walls of transparent silica, are important as they provide much of the organic matter for the marine food chain (Armbrust, 2009). As well, through photosynthesis they provide much of the oxygen that we breathe and are an important part of the carbon cycle. In his talk, Hirst related how he took a sample from " ... thick brown scum ... " underneath some logs in Darling Harbour, Sydney, and obtained a variety of diatoms. He explained how to clean the original scum, how to preserve the diatoms and how to mount them for microscopy. Hirst also studied tiny, microscopic animals from the genus *Brachionus* (Figure 11).

Figure 11: A microscopic view of a tiny animal that belongs to the genus *Brachionus*, drawn by Hirst. This appears to be an adult female with two eggs hanging off it, on either side of its foot. Courtesy Philip Moors.

As in astronomy, having good quality equipment was important in microscopy. In another talk to the section, Hirst discussed two new objective lenses from Carl Zeiss of Jena (Hirst, 1879). As one of these was an oil immersion lens, Hirst explained that if the oil matches the refractive index of the cover glass, then no correction was needed for the cover. He also evaluated a water immersion lens and concluded that "They are wonderful lenses, especially when their cost is considered ... ". This was because Zeiss' lenses were less than half the cost of similar lenses from their London rival, the then well-known firm of Powell and Lealand.

Discussion and concluding remarks

George Denton Hirst was one of a number of keen and competent amateur astronomers in Sydney, many of whom lived in the same suburb of Mosman where he did in the latter decades of his life. What made Hirst stand out among the local astronomers was his exceptional drawing and observational skills. When, in 1877, he sent his drawing of Mars to the Royal Astronomical Society, he sent it via the well-known instrument maker John Browning (c.1831–1925). In acknowledging receipt of the drawing, Browning (1877) said, "Your drawing is the best I have seen for a long time." His obituary in the *Monthly Notices of the Royal Astronomical Society*, compared Hirst's drawings of Mars with that of Nathaniel Everett Green (1823–1899), a professional artist who gave lessons to Queen Victoria (Anonymous, 1916; Baum, 2014).

During his four decades as an amateur astronomer, Hirst had a variety of interests, including observing planetary transits, making one of the most important observations among the New South Wales team of astronomers during the 1874 transit of Venus, and double stars. He was always willing to share his experiences such as in drawing or on how to "rewire" a micrometer. A small group of amateurs often met at his home in Mosman and criticised each other's observations (Anonymous, 1916). Hirst was also willing to give his time to the local astronomical group, the New South Wales Branch of the British Astronomical Association, by serving on its committee, as he did with the various other groups, scientific or otherwise, that he supported.

Hirst is best known for his observations of Jupiter. Together with Henry Chamberlain Russell, with whom he worked closely, he was among the first observers of the planet's Great Red Spot in its modern manifestation. His drawings of the planet are kept in the archives of the Royal Astronomical Society in London. He received an international reputation when three of his drawings of Jupiter were chosen from among those in the RAS archives to illustrate Edmund Ledger's book, *The Sun: Its Planets and their Satellites*.

During Hirst's time as an amateur astronomer, his fellows were carrying out on-going systematic observations of variable stars, comets, Jovian satellite phenomena, lunar occultations of stars and other phenomena of an occasional nature, such as lunar and solar eclipses, lunar occultations of planets, planetary conjunctions and conjunctions of stars and planets. Some of them were also building telescopes. Instead, when Hirst had access to Colyer's 10¼-inch reflector, he concentrated on planetary observations, and when he had his own telescope, he was enamoured with double stars. Possibly, due to lack of time, he sensibly built on his own interests and strengths, as well as on what he could achieve with the equipment that he had at his disposal.

Hirst made an important contribution to 19th and early 20th century NSW amateur astronomy. He is remembered today in Giralang, a suburb in the Belconnen district of the Australian capital, Canberra (Fuller, 1995). As Giralang is the word for star in the language of the Wiradjuri people, all the streets in the suburb are named after the names of stars and constellations, both First Nations and Western, and after notable Australian astronomers. Hence, Hirst Place is off Canopus Crescent.

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