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# The Great Melbourne Telescope: A Contextual History

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**Abstract.** The Great Melbourne Telescope promised much when erected in 1870. Its design was overseen by leading British astronomers. Its maker, Thomas Grubb of Dublin, was a highly skilled instrument maker and designer. The Royal Society committee superintending the design and construction proclaimed that Grubb had created a telescope that would make great discoveries through studies of the southern hemisphere nebulae. Yet the telescope never lived up to expectations.

Historians have tended to blame one or more aspects of the telescope design: the speculum mirror, its focal length, or wind vibration. Yet none of these issues, taken separately or collectively, are sufficient to account for the telescope's modest performance. Instead the telescope needs to be placed into its technical, institutional, astronomical and cultural contexts, for it was the interplay between these many aspects that shaped the telescope's working life.

## Keywords

Great Melbourne Telescope - Melbourne Observatory – Reflecting telescopes - Speculum mirrors

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## **The Great Melbourne Telescope: A contextual history**

Great hopes were held for the Great Melbourne Telescope (GMT) when it was erected in Melbourne, Australia in 1869. Its design and construction was overseen by leading British astronomers. They agreed that its maker, Thomas Grubb in Dublin, had excelled in creating a telescope that would make great discoveries through studies of the southern hemisphere nebulae. The primary aim was to detect if any changes had occurred in the southern nebulae since Herschel's observations in the 1820s; were they sufficiently changed to confirm the 'nebular hypothesis' or were they resolvable into stars?

Yet the telescope never lived up to early expectations. Historians have tended to blame one or more aspects of the telescope design: the speculum mirror, its focal length, or wind vibration (Gascoigne 1995, King 1955, Perdrix 1992, Ritchey 1904). Yet none of these issues, taken separately or collectively, are sufficient to account for the telescope's modest performance. Instead the telescope needs to be placed into its technical, institutional, astronomical and cultural contexts, for it was the interplay between these many aspects that shaped the telescope's working life.

### **The Southern Telescope**

The idea of erecting a large telescope in the southern hemisphere first emerged in the late 1840s; it was proposed by British scientist Edward Sabine. He found an enthusiastic supporter in Romney Robinson, director of Armagh Observatory. Robinson was a close associate of Lord Rosse, whose 3-foot and 6-foot reflectors at Birr Castle in Ireland suggested the possibility of resolving all nebulae into stars. In the 1830s, John Herschel had spent several years at the Cape of Good Hope, cataloguing southern stars and nebulae. But Robinson argued that a much larger telescope was needed in the southern hemisphere to test the resolvability of nebulae and record their changes.

Following a report by Robinson and Rosse on their nebulae observations at Birr Castle, the British Association for the Advancement of Science at its meeting in Belfast in 1852 established a Southern Telescope Committee with the Royal Society of London. The Committee endorsed a design by Thomas Grubb of Dublin, who had previously made a 15 inch reflector for Robinson at Armagh. Grubb proposed a 4-foot reflecting telescope, mounted equatorially; like in Rosse's telescopes the mirror would be speculum metal. One eminent member of the Committee, Astronomer Royal George Airy, opposed the design, arguing that the difficulties of mounting such a large mirror equatorially were far beyond Grubb's understanding, and that Robinson had turned the whole matter into a 'Grubb-job' (Airy to Sabine, 25 Oct 1853, Airy Papers, RGO6, Cambridge University Library). In the event, no government funds were forthcoming and the telescope project was mothballed.

### **The Great Melbourne Telescope**

The Impetus to build the telescope now shifted to Melbourne, Australia. William Wilson had been appointed the foundation professor of mathematics at the new University of Melbourne in 1855. He had previously taught in Belfast and founded an observatory there. The committee that selected Wilson for Melbourne included Romney Robinson and was chaired by John Herschel. Once in Melbourne, Wilson threw himself into finding support to build the Southern Telescope at a new observatory in Melbourne, seeking funds from the gold-rich Victorian Government, while corresponding with Sabine, now president of the Royal Society in London (Wilson 1855-6).

Sabine coordinated the British scientists' discussions over the final telescope design. Robinson, Herschel and others opted for the ten-year-old Grubb design (Royal Society of London 1871). Although Jean Foucault had recently built a 33-inch silver-on-glass primary mirror, the British scientists felt the technology was unproven and it would be a 'most hazardous experiment' (Herschel to Sabine, 22 Feb 1863, Herschel Papers, M1938, Royal Society of London). The Anglo-Irish technology was preferred to the French.

Construction of the telescope was undertaken by Thomas Grubb in new telescope works at Dublin, supervised by his 21 year-old son Howard Grubb. The southern telescope was to be the project that firmly established him internationally as a major telescope maker. Making the speculum mirrors was the most complex and dangerous part of the job. Each speculum required 1370 kg of alloy to be melted in a furnace, poured from the crucible into the mould, then drawn into an annealing oven for 24 days. Two mirrors were then ground and polished to the correct shape by a machine designed by Grubb (Robinson & Grubb 1869).

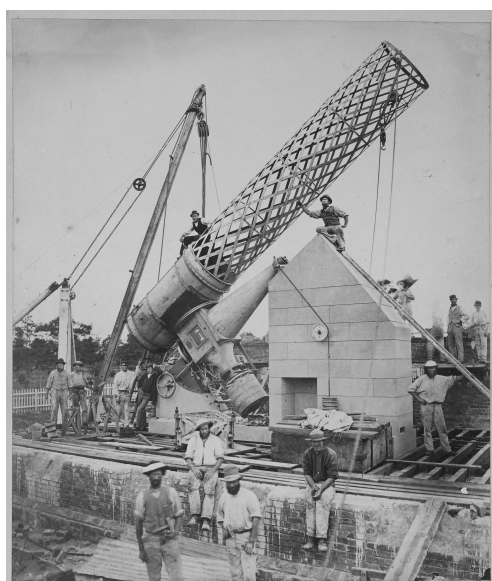


Figure 1. Erecting the Great Melbourne Telescope at Melbourne Observatory, 1869. Source: Museum Victoria

The Royal Society's telescope committee inspected the completed telescope in early 1868, and concluded that it was a 'masterpiece of engineering' (Rosse, Robinson & De La Rue 1868). Nests of triangular levers at the back of the speculum distributed weight in all positions of the telescope, preventing flexure and distortion of the image. Although the telescope weighed over 8 tonnes, one person could raise the telescope from horizontal to vertical in only 20 seconds. Most importantly, the optical powers of both specula were excellent; for example Nebula 46M 'was revealed as a ring, bright even on the dazzling background of surrounding stars' (Rosse, Robinson & De La Rue 1868). Robinson in Armagh was lyrical about the telescope: 'What strange nebular forms it may reveal, what new configurations of stars, what new cosmical laws it may unfold, what new elements it may disclose, we shall soon know...' (Robinson & Grubb 1869, 156).

### **Trouble in Melbourne**

The Great Melbourne Telescope, as it was now formally called, arrived in Melbourne in November 1868, in the care of its trained observer. The Royal Society committee had toyed with the idea of sending either the young Howard Grubb or John Herschel's son as observer,

but in the event selected a young Cambridge mathematician, Albert Le Sueur. He was present in Dublin for all the critical stages in the construction and testing of the telescope.

By mid 1869 the telescope was ready for use, and Le Sueur was soon writing enthusiastically to Robinson and Herschel, reporting great changes in the nebula in Argo since Herschel had observed it in the 1830s. Herschel replied that this suggested that the Nebula was indeed a vast cosmical cloud interposed between Earth and the stars (Herschel to Robinson, 21 Aug 1869, Herschel Papers).

But while Robinson and Herschel were enthusing, a letter from the Government Astronomer at Melbourne Observatory, Robert Ellery, was on its way to George Airy at Greenwich Observatory. Ellery reported to Airy: 'I am not satisfied with the performance of this Great Instrument, and I do not think the mirrors are at all perfect in figure. I have not yet seen anything like good definition of a planet with the lowest power. Of course we get plenty of light even with the Nebulae, but no definition with bright objects' (Ellery to Airy, 13 Aug 1869, Airy Papers). Worse still for Grubb, reports of difficulties with the telescope appeared in British newspapers; suddenly Grubb's reputation as a telescope maker was in the balance.

The British scientists leapt to the defence of the telescope, pointing out that it had been in excellent condition when tested in Dublin by the Royal Society committee. Privately, though, the British scientists began to question Le Sueur's abilities and actions: he had clearly used the wrong substance to clean the mirrors, and his reports from Melbourne betrayed a lack of understanding of some of the technical decisions made during construction, even though he had been present. Thomas Grubb confided to Ellery that he had always found Le Sueur a 'very rough experimenter' (Grubb to Ellery, 27 Oct 1870, VPRS 780, Box 3, Public Record Office of Victoria).

Initially Robert Ellery had left Le Sueur to manage all aspects of the telescope, and to correspond with the English scientists. But as he was drawn into the controversy, he became more actively involved in the operation of the telescope. Le Sueur resented what he thought was interference; he seemed to believe that he had been given sole charge of the instrument by the Royal Society. In May 1870 Le Sueur resigned, less than 12 months after the telescope had been erected; he returned to his native Jersey, not making any contact with the English scientists, and disappeared from view.

With Le Sueur gone, Thomas Grubb and Ellery now formed a rapprochement, based on the desire to get the telescope working effectively. Letters flowed constantly between the two, as they gradually sorted out difficulties with the complex instrument. In retrospect they should have always anticipated that it would take some time for the telescope to be adjusted, and for the observers to become acquainted with its peculiarities. By July 1871 Grubb could write to Ellery that 'it gives me much pleasure to learn that the Great Melbourne Telescope is now being worked satisfactorily' (Grubb to Ellery, 27Jul 1871, VPRS 780, Box 3).

Grubb still felt the need to protect his reputation, however. Word of the difficulties with the telescope had reached European and American astronomers. Grubb prepared a pamphlet, carefully outlining the mistakes that had been made by Le Sueur and refuting other criticisms of the design (Grubb 1871). None other than George Airy was deeply impressed by Grubb's evident mathematical as well as technical skill, conceding that 'Grubb has risen greatly in my estimation' (Airy to De La Rue, 10 Jan 1871, Sabine Papers, M1940, Royal Society of London). Coming from Airy that was praise indeed. The Royal Society printed copies of Grubb's paper and the other correspondence, and circulated it privately to astronomers around the world (Royal Society of London 1871). Grubb's reputation remained intact, and was even enhanced by the controversy; Thomas and son Howard would soon win the contract to construct a 27-inch refractor for the Vienna Observatory.

### Putting the telescope to work

Robert Ellery now threw himself into working the telescope, corresponding with the Grubbs and Robinson. He purchased new eyestops to replace those altered inappropriately by Le Sueur, and began experimenting with polishing smaller mirrors, preparatory to re-polishing the large specula. Le Sueur was replaced as observer by Joseph Turner, a local photographer and amateur astronomer. Ellery admitted to Robinson that Turner 'would not set the Houses on fire'; he was an excellent photographer and good sketcher, but lacked mathematics and 'his eyes are not strong enough I am afraid' (Ellery to Robinson, 15 Jul 1873, VPRS 776, Public Record Office of Victoria).



Figure 2. The Great Melbourne Telescope, 1870s. Source: Museum Victoria

Despite his limitations, Turner would prove to be the only solid observer that the telescope ever had as its companion, and for the next 10 years he produced excellent drawings and observations of Herschel's nebulae, and spectroscopic analysis of their chemical makeup (Melbourne Observatory 1885). It was also used for other work, including study of lunar eclipses, comets, and observations of Jupiter and its moons.

Although more sensitive photographic plates were being developed in the 1870s, attempts to photograph nebulae were unsuccessful, owing to the long exposure times required and the difficulty in keeping the telescope tracking precisely on the faint objects. As the telescope

was not protected by a dome, wind could also be a problem, although this is only occasionally cited as a problem in the observation diaries.

The results on whether nebulae had changed since Herschel observed them in the 1830s were necessarily equivocal. Turner used the position and magnitude of stars in the vicinity of the nebulae as constants; if they seemed the same as in Herschel's drawings, yet the nebulae itself seemed to have changed, this suggested that real changes had occurred. Yet the differences in optics, observer and atmospheric conditions could plausibly account for most of these apparent changes.

While the telescope was being built in Dublin, the English astronomer William Huggins had used the newly invented spectroscope to examine nebulae; the spectra clearly showed that some nebulae were clouds of gas, not faint stars. While a spectroscope was used on the Great Melbourne Telescope, Turner continued to rely primarily on his sketches. By the time of Turner's death, new sensitive photographic plates were being used at other observatories in association with smaller silvered-glass reflectors, and producing photographs of nebulae that started to eliminate the idiosyncrasies of the observer.

### **Repolishing the mirrors**

By the late 1870s the main speculum was clearly tarnishing and the resultant images of nebulae fading (although for a while Turner tried to explain this in terms of Herschel's nebulae becoming fainter). Ellery had avoided attempting to repolish the main mirrors, as his earlier experiments with polishing smaller test mirrors had convinced him of the difficulty of the task. Ellery asked Howard Grubb what it would cost to repolish them in Dublin. Grubb clearly did not want to take on the task, and proposed that a new glass or metal mirror be made.

Repolishing was a thankless task. After months of work, sometimes involving four staff full-time, the mirrors were no better; if anything they had lost their figure, and had imperceptibly small ridges, which meant that light would not be focused into hard points in the eyepiece. Ellery and Grubb discussed placing a new 24-inch refracting telescope on the GMT mounting; Grubb recommended that it be placed inside the tube, an indication that he no longer considered the original telescope worth saving.

Two events meant that the idea was never pursued. Melbourne Observatory joined the Carte du Ciel project to photograph and chart the heavens, and was allocated a substantial zone of the southern skies. Observatory resources were increasingly channelled into this project, and a new telescope was purchased from Grubb for the purpose. At the same time, the 1890s depression cut into government expenditure, and several staff were forced into early retirement. The Great Melbourne Telescope was left idle.

### **Accounting for failure**

Historians of astronomy have tended to argue that the Great Melbourne Telescope was a flawed telescope from the start; a hybrid design that, while pointing to the future with Grubb's advanced equatorial mounting and drives, carried a large metal mirror from the past. Certainly with hindsight we can see that research astronomy in the second half of the 19<sup>th</sup> century increasingly used the new techniques of photography and spectroscopy. While a spectroscope and camera were mounted on the telescope, it was not well suited to their use.

But the history of the telescope can also be understood by considering the institutional context of the Melbourne Observatory. The primary astronomical function of the colonial government observatory was positional astronomy – observing transits of known stars in order to maintain an accurate time service, establishing star catalogues for the geodetic survey, establishing

longitude with increasing accuracy. In addition Ellery participated in many international projects, including eclipse expeditions, transits of Venus, observing new comets, searching for new satellites of planets, photographing sunspots, and measuring daily and hourly variations in the earth's magnetism. In collaboration with the astronomers in Adelaide and Sydney, Ellery established meteorology in Australia, and provided a daily weather service.

The Great Melbourne Telescope had to fit into this busy round of daily work, yet in the 1870s the Melbourne Observatory had a scientific staff of only five, a messenger and a workman. When Ellery became more involved in the operation of the telescope following Le Sueur's departure, he complained to a correspondent that 'The Great Reflector is as much trouble as all the other work together', and in a letter to Robinson in Ireland sardonically called it 'the Monster' (Ellery to James Simms, 28 Dec 1872, Ellery to [Robinson] 19 May 1874 VPRS 776).

Such monsters were more the province of wealthy gentleman astronomers, such as Lord Rosse at Birr Castle, or of astronomers such as the Herschels who had found royal patronage to support their work, and did not have a busy government observatory to run. Rosse in particular had the wealth and estate workers to experiment endlessly, making improvements in his great reflectors. Astronomy, at least in Britain, could be broadly divided into two institutional and cultural camps: the professionals engaged in government observatories and focusing on positional astronomy; and the gentlemen in privately funded observatories, undertaking more specialist research programs on nebulae, comets or double stars. Placing the Great Melbourne Telescope at Melbourne Observatory was creating an institutional hybrid.

### **The Telescope reborn**

The telescope lay unused for decades until, following the closure of Melbourne Observatory in 1945, Mount Stromlo Observatory purchased it for the price of scrap. At Mount Stromlo the telescope was given a new 50-inch glass mirror, and became an integral part of Mt Stromlo's work from 1959 into the 1970s. In the 1990s the telescope was rebuilt with two detector mosaics for the MACHO project, to search for evidence of dark matter. Then in January 2003 a bushfire swept across Mt Stromlo, its firestorm destroying the majority of the telescopes and buildings.

Since the early 1980s Museum Victoria had progressively been retrieving discarded parts of the Great Melbourne Telescope as Mt Stromlo rebuilt the instrument. This included one of the primary mirrors, the telescope tube, eyepieces, right ascension axis circles and clamps, bearings, declination axis parts, and the polishing machine. The remaining parts of the telescope at Mt Stromlo will be dismantled in November 2008 and returned to Melbourne, including the cube, polar axis, primary mirror support system, declination axis spacer and north polar axis bearing.

Museum Victoria, Astronomical Society of Victoria and Royal Botanic Gardens, Melbourne have agreed to undertake a feasibility study to restore the Great Melbourne Telescope and return it to its original building at the former Melbourne Observatory site, which is now part of the Botanic Gardens. The Astronomical Society and Botanic Gardens already run public viewing nights using a Troughton & Simms 8 inch refractor and an 8 inch reflector. A detailed conservation plan has yet to be completed, but it is proposed to restore the mechanical integrity of the Great Melbourne Telescope to its 1869 condition, although it is likely that a modern optical system will be put in to enable its effective use as a publicly accessible telescope. 'The Monster' will be reborn.

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