

The Melbourne Observatory Dallmeyer photoheliograph and the 1874 transit of Venus

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Abstract

An improved form of De La Rue's photoheliograph built by Dallmeyer was installed at Melbourne Observatory in time to observe the 1874 transit of Venus. Photographs obtained included some made with De La Rue's version of Janssen's rapid sequence photographic camera. A succession of adverse circumstances has led to the preservation of the photoheliograph at Melbourne, unaltered from its nineteenth century form. It is expected to be usable again in its original domed building for the 2004 transit of Venus.

Keywords: *Dallmeyer photoheoliograph, Melbourne Observatory, 1874 transit of Venus, astronomical photography, heritage preservation.*

1 INTRODUCTION

Warren De La Rue was a wealthy nineteenth century English amateur astronomer and pioneer photographer (Dreyer and Turner, 1987:154-157). In 1857 he devised the photoheliograph, an adaptation of a telescope for recording heliograms or photographs of the Sun (King, 1979:226; Phillips, 1992:27). In an age when pocket telephones can capture, transmit, and display images we may think this nothing special, but recording celestial images of any sort was a leading technological challenge in the formative days of astronomical photography (see Lankford, 1984; de Vaucouleurs, 1961).

The first Daguerrotype showing sunspots was taken by Foucault and Fizeau in 1845 April (Abrahams, 2004), and experimental lunar photographs made in the 1870s with wet plates at the prime focus of the Great Melbourne Telescope were regarded at the time as the best ever taken (Baracchi, 1914a). Five photoheliographs of an improved design by De La Rue were made for the Royal Observatory, Greenwich, by JH Dallmeyer of London, in preparation for the eagerly-awaited 1874 transit of Venus (Howse, 1975).

2 THE MELBOURNE OBSERVATORY PHOTOHELIOGRAPH

Melbourne was the capital of the gold-rich Colony of Victoria. Its astronomical observatory was already Australia's foremost, equipped with the world's largest fully-steerable reflector, the ill-fated Great Melbourne Telescope (Gascoigne, 1996). A Dallmeyer photoheliograph was delivered on 1874 August 28 and installed in a new domed building at the Observatory shortly before the transit. The Government Astronomer's own copy of one of the Observatory's annual reports (White, 1875:5) has a handwritten marginal note indicating that the photoheliograph was purchased for £364 (more than double a junior professional's annual salary at that time), so it was certainly not a gift from England.¹

This instrument still exists. It has a flint-first air-spaced objective with an aperture of 102 mm and a focal ratio of $f/15$. In its original state, a secondary 'Rapid Rectilinear' type lens projects a 100-mm

diameter solar image onto a ground-glass screen for focusing, or onto the 6-inch (152-mm) square glass photographic plate. A two-part cast iron triangular webbed pillar supports a Fraunhofer-type equatorial mount that is adjustable for latitude, and has slow motions, setting circles and a falling-weight clock drive. The year '1869' is scribed on the polar axis. The tube can be rotated as a whole against a degree scale in position angle, allowing the plate to be aligned with the Sun's rotational axis. The total mass is about 464 kg.

Other Dallmeyer photoheliographs of similar vintage were present in British possessions at the time. For instance, Sydney Observatory had a photoheliograph with a similar optical tube assembly (now in Sydney's Powerhouse Museum) but a much earlier style of equatorial mount (see Russell, 1892). There was also a photoheliograph at the Cape Observatory in South Africa (Warner, 1979), and another, called Dallmeyer No. 4, in India (Kochhar, 1991). Howse's (1975) brief description of each of the five Greenwich instruments does not indicate if the Melbourne photoheliograph was one of them.

3 OBSERVATIONS OF THE TRANSIT

As Victoria would be in sunlight throughout the 1874 transit (weather permitting), Melbourne Observatory Director, Robert L J Ellery (1883), planned an ambitious programme involving four separate observing stations and eight different telescopes. Modest refractors and a single reflector were assigned to the three remote stations, located at Mornington, Sandhurst (now known as Bendigo) and Glenrowan, while at Melbourne Observatory Ellery and his associates planned to use the Dallmeyer photoheliograph, an 8-in (203-mm) Troughton & Simms refractor, the 48-in (1.22-m) Great Melbourne Telescope, and a small altazimuth surveying instrument (Greig, 2001).

At Melbourne much of the transit was successfully observed (ibid.), and the photoheliograph was used to take 37 whole disk photos of the Sun on wet plates. A team of four (presumably engineering students) handled the plates, operated the instrument

and recorded actions and times under the control of W C Kernot, who later became the foundation Professor of Engineering at the University of Melbourne.

A Janssen Rapid Photography Attachment² was fitted to the photoheliograph near the time of transit contacts (White, 1875:9). This invention was designed to take a sequence of photographs around an annular area of a circular wet plate that was rotated between exposures. The Attachment used at Melbourne was different from those used with the Sydney and Indian photoheliographs, although all were made by Dallmeyer and based on a simplified design provided by De La Rue (1874). The Melbourne version was contained within a flat wooden box (184-mm wide and 20-mm thick) arranged to fit in the slot normally used for the plate-holder, and because of space and construction time constraints took only 20 exposures per 6-inch diameter plate rather than 60. It was operated by a small crank handle. The Sydney device and one uncoated glass disk for it survive at the Powerhouse Museum, Sydney (N Lomb, pers. comm., 2004).

All of these instruments had electrical contacts to allow the instant of each frame exposure to be recorded on a chronograph. They could take a series of photographs much faster than could be achieved using the photoheliograph's own shutter and the rather cumbersome standard wet plate holders. About 180 images were recorded with the Janssen Attachment at Melbourne near the contact times during the 1874 transit of Venus (White, 1875:9), so at least nine plates were exposed.

A woodcut of the transit observations with the Melbourne photoheliograph (Figure 1) shows interesting detail such as a barrel chronograph with a Huygens parabolic pendulum governor, a box chronometer with the lid open, a temporary plate-changing enclosure, and most interestingly, Kernot reclining in a position not generally required for ordinary solar photography once the focus has been set on the ground glass. Moreover, he appears to be in the off-axis position necessary for visual alignment of the disk of Venus within the eccentric frame field of the De La Rue device.

No information is to hand about how the Janssen Attachment came to be in Melbourne in 1874 or what became of it afterwards. It is not mentioned in the Annual Report from Melbourne Observatory that includes a brief description of observations of the 1882 transit of Venus, nor does it feature in Ellery's (1883) detailed report on the 1874 transit that was published in the *Memoirs of the Royal Astronomical Society*.

In 1875 March Ellery took all "... the photograms of the transit..." (Board of Visitors, 1875:3) and other related Victorian observations and calculations with him when he departed for England on a year's leave of absence, and these data were used by Tupman in his overall analysis of transit observations made at British possessions around the world. His final result, however, left much to be desired: "Although the above results of Ingress and Egress present such an unexpected agreement, it cannot be said that the mean 8".8455 is entitled to much confidence, since all the observations would be fairly well satisfied by any mean solar parallax between 8".82 and 8".88." (Tupman, 1878:455).

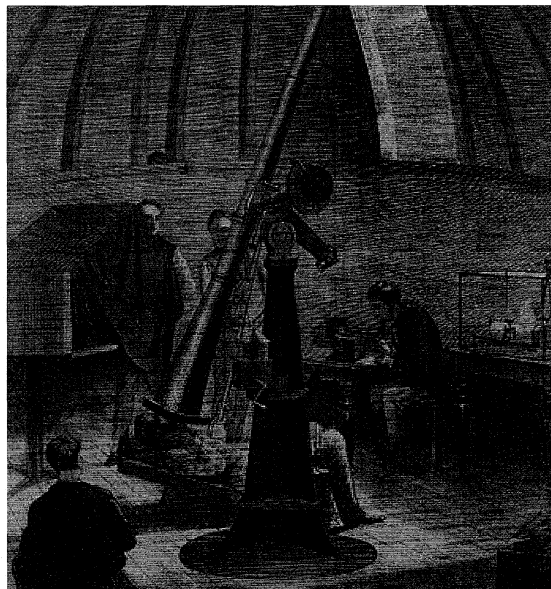


Figure 1. Woodcut from the *Australasian Sketcher* of 30 December 1874, showing the Photoheliograph Room at Melbourne Observatory during the 1874 transit of Venus. The observer is W.C. Kernot. Parts or maybe all of the barrel chronograph on the right still exist. (after Greig, 2004; cf. Haynes *et al.*, 1996: Figure 4.5).

4 POST-TRANSIT SOLAR OBSERVATIONS

After the transit, the photoheliograph continued in daily use to photograph the Sun, weather permitting, from 1874 to 1895. Dry plates were introduced in 1883. Accumulated negatives were sent to London in 1885 March, arriving with only 13 of the 1,712 plates broken (Ellery, 1885:6).

Figure 2 shows the photoheliograph in 1885, after the dome was braced in June but before introduction of the 200-mm image diameter used with similar instruments at South Kensington and elsewhere. Later a new dust-excluding centre section carrying the focal plane shutter, cross wires, and secondary magnifier (Figure 3) was constructed in the Melbourne Observatory workshop (Ellery, 1891:5), along with other improvements (Ellery, 1892:4).

An economic depression in 1892 led to photographs being taken only on days when sunspots were visible, both to economize on materials and to try to cope with enforced staff retrenchments.

The photoheliograph was used less frequently after Ellery's retirement in 1895 (Baracchi, 1896-1914), but the photographs were still sent to England. The 100-mm image diameter was eventually restored (Baracchi, 1896:4), but a return to 200 mm was offered with a proposal for Melbourne to be a station in an international solar research programme (Baracchi, 1908:9). A new automatic time exposure shutter was made, along with a new lower brass tube having a 10-inch plateholder to give a 2°.5 field for coronal photography. These went with the photoheliograph on an expedition to Bruni Island near Tasmania for the eclipse of 1910 May 9 (Baracchi, 1910:4). Unfortunately, light rain fell throughout totality there.

In 1911 the Melbourne photoheliograph was taken on a successful expedition to Vavau in Tonga for the solar eclipse of April 29 (Baracchi, 1914a). After 1914, surviving records from the Melbourne Observatory are sparse. However, solar photographs from Mauritius, Dehra Dun, Melbourne and Harvard

were used to fill gaps in order to get an almost unbroken record for the Greenwich photoheliographic study (ROG, 1976) that produced the famous 'Butterfly Diagram' showing the change in sunspot latitudes as the 11-year solar cycle progressed (Phillips, 1992:27)

5 CLOSURE OF THE OBSERVATORY AND DISPOSAL OF THE PHOTOHELIOGRAPH

From the reports of the Melbourne Observatory by Ellery (1860-1895) and Baracchi (1896-1914; 1914a), it is clear that the Observatory performed well in astrometry, time-keeping and signalling, geodesy, metrology, geomagnetic recording, meteorology, tidal studies, seismology, and instrument development, but its activities in geodesy, meteorology, seismology and terrestrial magnetism were eventually taken over by other government bodies. Meanwhile, visitors to Victoria, persons with a genuine interest in astronomy, and apparently others with influence, continued to be admitted to the Observatory at night (despite published bans on night-time visits), seriously reducing the time that staff could devote to scientific research (see Perdrix, 1961). As if to compound this, regulation of trade weights and measures became a responsibility of the Observatory after Federation of Australia in 1901, despite its minimal relevance to observational astronomy. Furthermore, the allocation of Astrographic Catalogue and Chart work accepted by

the Observatory (Turner, 1914) proved far more burdensome than expected.³ Finally, the Observatory's primary services to the public and to shipping—time-keeping and time-signalling—slowly became less important in the 1920s and thereafter as transmission and reception of radio time signals on local and global scales improved and clocks and watches became more reliable and affordable.

The Great Melbourne Telescope was a liability to maintain (Perdrix, 1992) but it nevertheless remained in use for visitors right up to the start of WWII in 1939 September (W. Fiddian, pers. comm., 2004), when it was finally laid up. Extra-meridional observations at the Observatory always had low priority, and led to little in the way of discoveries. Meanwhile, a doubling of artificial skyglow every decade (see Clark, 2003: Figure 1) was increasingly hampering observations of faint objects at night. Resources dried up in the Great Depression and were never properly restored, and by 1940 the Observatory was doomed. It was officially closed down in 1944, while WWII was still in progress (Perdrix, 1961), and the wholesale disposal of everything began with sales and gifts to other observatories, transfers to other government departments and agencies, and public sales. In the end, whatever was left was ordered by bureaucrats to be smashed, burnt and dumped, and this happened with few exceptions.

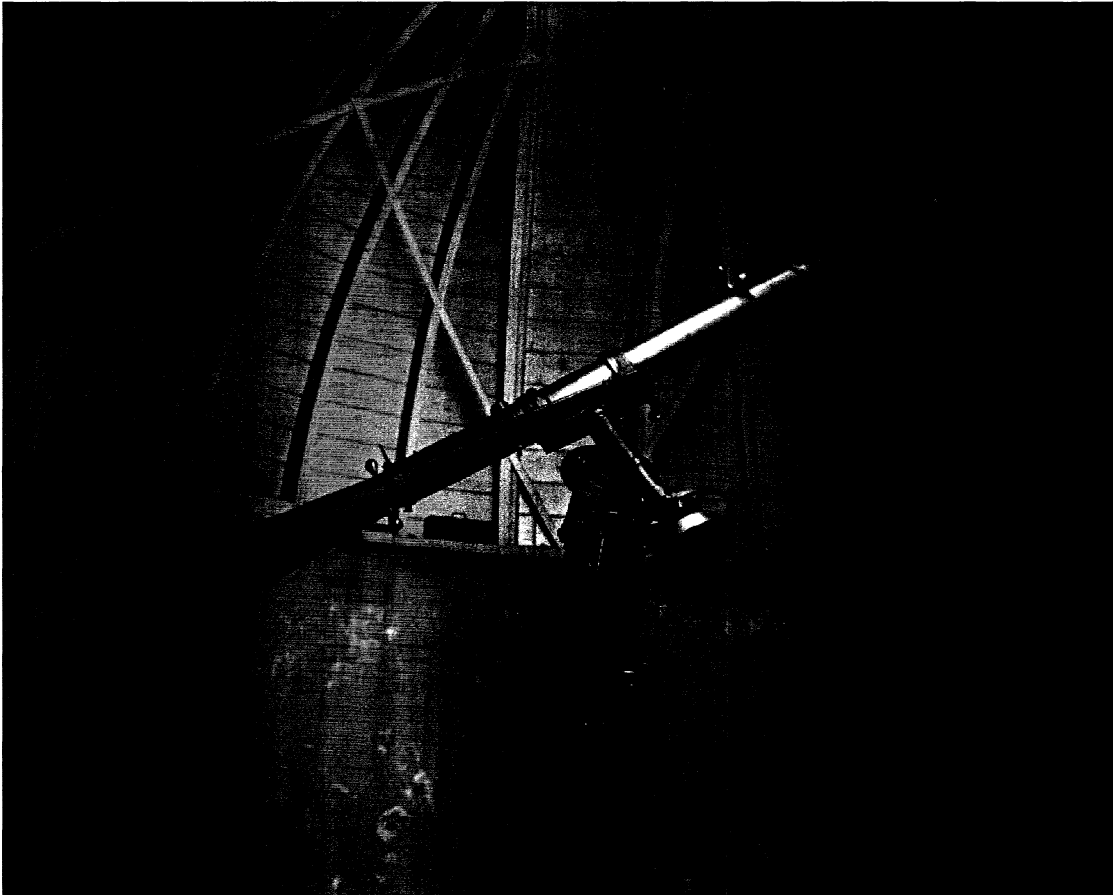


Figure 2. The Photoheliograph in its dome at Melbourne Observatory, from a 10-inch by 12-inch glass plate negative. The plate-holder shown is the one for 6-inch square plates. The tube section between the tapered lower end and the cradle is the original one, as shown in Figure 1. This section survives but now has no shutter (if it ever had one) and no secondary lens. The steel bracing strips were fitted to the dome in June 1885, so the photo is later than that.

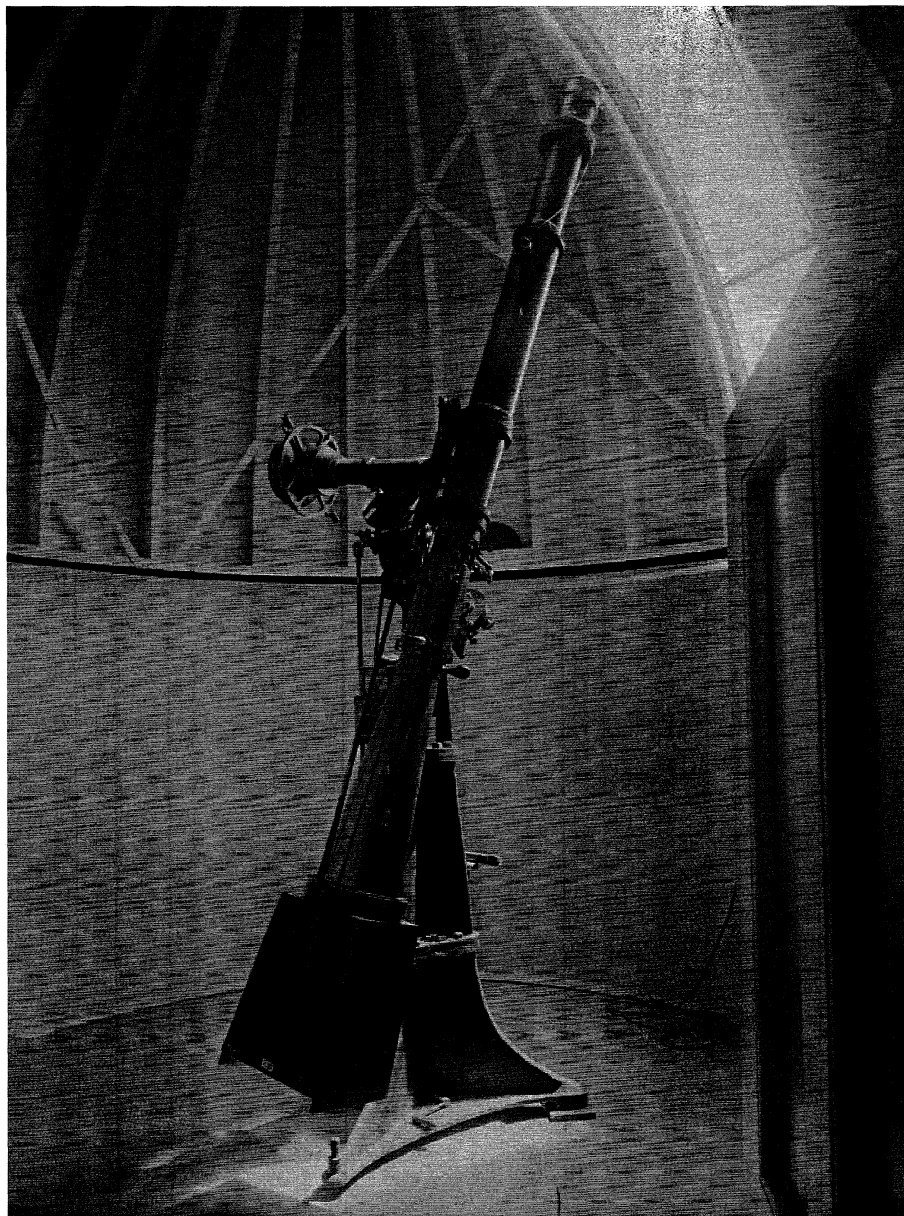


Figure 3. The Photoheliograph, from a 6-inch by 8-inch glass plate negative. The new (1891) 'central' tube section has an adjustable focal plane shutter and bevel gears for convenient secondary focus adjustment. The camera fitted in place of the original plateholder at the lower end of the tapered brass tube has a plateholder for 10-inch square plates. High magnification shows 'J. H. DALLMEYER' (probably) above 'LONDON' on the camera nameplate. A separate large conical brass tube with a 10-inch square plateholder survives. The objective cap has a cord-operated shutter. The lead counterbalance near it is extant. Two open-ended spanners rest on the driving weight behind the pillar. (One spanner survives.) The camera, supplied in 1886 (Ellery, 1886:7), extended the tube enough to require northwards displacement of the pillar. A triangular stone plinth was installed later. The floor had dry rot and was removed (Ellery, 1891:4), dating the photo to 1891 or not much earlier.

6 THE PHOTOHELIOGRAPH IN PRIVATE OWNERSHIP

Apparently other observatories showed no interest in the Dallmeyer photoheliograph, so it was advertised for sale by public tender. The only bid, a modest one by a local amateur astronomer named Les Claphan, was accepted in 1946, in spite of his condition that the instrument should stay in its domed building at the Observatory during his lifetime. At the time, Claphan was the Director of the Solar Section of the Astronomical Society of Victoria (ASV), and also served as the Science Museum's Curator of the Telescope (i.e. the 200-mm Troughton and Simms

refractor that was also left on site; its dome and that of the photoheliograph are only metres apart).

Claphan claimed that in 1946 he had discovered a method of predicting the longitudes of sunspot activity on the basis of planetary alignments, and access to the Troughton & Simms telescope allowed him to check and refine his predictions. Claphan's Deputy Curator, Bob Bryant, was a photographic technologist and he was able to get the photoheliograph working with glass plates in 1948. One of the authors (BC) became involved in 1957, and soon after this, Bryant introduced modern sheet film, which required neutral density filters and an aperture stop to avoid

overexposure. One to three photographs a week were taken and supplied to Claphan right up to his death in 1961. Subsequently, BC tried to investigate what was known of Claphan's methods but the task was difficult and inconclusive. By the mid-1980s, sufficient home computing power and extensive observational data made large numerical simulations and analyses practicable. Planetary periods were indeed present in the solar data, as were many others, but no trace of the modulation of alignment periods by ellipticity of orbits was found. The apparent successes of Claphan's predictions were therefore mere coincidences within longitude and formation-time tolerances he thought occurred naturally.

Claphan was secretive about his work, and had refused to submit his method for publication in the belief that a research paper by a non-professional would be rejected, but his ideas would eventually be claimed by others. This led to controversy within the ASV, and Claphan responded by denying most ASV members access to the photoheliograph. As a consequence of the dispute, the Museum transferred care of the Troughton & Simms telescope to the ASV in 1962, and insisted that the photoheliograph be removed from its building. This offended Claphan's widow, so instead of offering the instrument to the Museum—as Claphan had originally intended—she sold it at cost to Bryant and BC, who had nowhere to store it, however. It was soon on-sold at cost to the Department of Physics at Monash University, which was planning a new observatory at the time. In time, the academics involved realized that an historic specialized instrument like this could not be readily modified for the types of research intended, and its ongoing storage became an increasing problem. BC repurchased the photoheliograph in 1966 (again at cost), and has stored it at home ever since (apart from a few days when it was on public display in 1974 and 1976).

7 CONCLUDING REMARKS

At the time of writing, the photoheliograph's original domed room has not had a usable telescope mounted in it for over forty years but, at last, work is just about to start on reinstallation, by courtesy of the Royal Botanic Gardens, Melbourne, present custodian of the former Melbourne Observatory site. Consideration will be given to the use of full-aperture H α filters and CCTV as benign auxiliaries in due course. The intention is to enhance the last surviving astronomical function of the Observatory, showing visitors sights of the Universe.

The Melbourne Observatory Dallmeyer photoheliograph is one of Australia's most significant 1874 transit of Venus instruments, and but for Claphan's contentious theory it might not have survived at all. But even had it survived in different circumstances, it would probably have ended up with extensive modifications (such as the fitting of computerized drives and large-aperture lightweight Cassegrain optics for night-time use). Fortunately it has retained its nineteenth-century configuration unmodified, and as such is a heritage instrument of considerable national and international importance. Its preservation is now an overriding consideration.

Meanwhile, the search continues on how the Janssen Attachment came to be in Melbourne and what subsequently became of it, given the key role that this invention played in the development of motion-picture technology. It would be wonderful if the 1874

Janssen-De La Rue plates from Melbourne Observatory still exist, as they would have to be among the earliest animatable photographic sequences ever made of astronomical objects.

8 NOTES

1. Not long before, the instruments from a British eclipse expedition were presented to Melbourne Observatory by Sir Norman Lockyer "... for use hereafter in your hemisphere ..." (Ellery, 1873:9). This generous gift included "... one large long focus rectilinear photographic lens by Dallmeyer ...", which could be a description of the optical tube assembly of a photoheliograph. No record has yet been found of what happened to any of these instruments after they reached Melbourne Observatory.
2. Lucassan (2004) shows a rapid sequence photographic camera by Jules Janssen (1824–1907) and a transit of Venus. However the transit animation is not from the lost Daguerrotype plate made by Janssen in 1874 in Nagasaki but from one of three extant test plates of a simulated transit made in Paris (F. Launay, pers. comm., 2004). The mechanism of the Janssen Apparatus drove two slotted disks and the plate to give the series of exposures. De La Rue's version was less complicated.
3. The Astrographic Chart (to 14th magnitude) remains unfinished but the Catalogue (to 9th magnitude) is now available on a CD ROM called 'AC 2000.2', e.g. from the U.S. Naval Observatory, Washington DC.

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