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An Early Photographic Refractor at the Cape

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Summary: The building of an early photographic telescope for use at the Cape is described. Some features of its design were later incorporated in the Cape Photographic Durchmusterung and Carte du Ciel ‘Astrographic’ instruments.

Introduction

As is well known, Sir David Gill, H.M. Astronomer at the Cape from 1879 to 1907, was the first person to make a photographic sky survey. This came about as follows: In 1882 he had photographed a very bright comet (1882c, Comet Finlay) by means of a Ross camera lens of 2 1/2 inches aperture and 11 inches focal length which he attached to the mounting of a 6-inch telescope. He had been surprised by the number of background stars that appeared on the newly available ‘dry’ plates that he used. Deciding to experiment further, he obtained in 1883 a ‘Rapid Rectilinear’ lens of 4 inches aperture from the Dallmeyer photographic concern. In 1884, he borrowed from them a similar lens of 6 inches aperture and 54 inches focal length. With this particular lens he was ultimately to make the survey known as the ‘Cape Photographic Durchmusterung’ (Gill, 1896). The ‘Rapid Rectilinear’ lens was of symmetrical form and consisted of two well-separated, cemented, achromatic doublets with a stop between them. The images it gave were relatively sharp and free of distortion over a large field. It was, in addition, reasonably fast, an essential attribute in those days of insensitive plates. This lens was mounted by Gill at the end of a square wooden tube which slid for focusing purposes within a larger one forming the main body of a telescope. A simple plateholder was fixed to the bottom end and the whole ‘instrument’ was carried by a solid mounting which had been purchased with his own money in 1879 as a base for his heliometer.

Early in 1885 Gill conceived the idea of constructing a special photographic instrument, with three telescopes mounted together, to do the definitive Durchmusterung. One was to be a 5-inch guider, making use of the lens from an old Dollond transit instrument. Another was to be fitted with an improved Rapid Rectilinear lens from Dallmeyer and the third was to have a specially made large objective, intended for photographing the centre of each Durchmusterung field to greater depth, the idea being to study the law of stellar distribution with magnitude.

Correspondence with Howard Grubb

In February 1885 Gill wrote to the leading telescope manufacturer, Howard Grubb of Dublin, as follows:

‘Have you any ideas about a perfect photographic telescope to cover a field of at least $2\frac{1}{2}^\circ$ radius . . . Dallmeyer has lent me a 6'' rapid Rectilinear Lens which we shall try but I am doubtful about it. The brothers Henri of Paris have produced what appears to be a highly satisfactory lens. I write to know if you have considered the matter and to ask particulars & prices for such a lens of 6'', 7'' and 8'' aperture & whether you w^d go in for a double combination’.

Further negotiations were conducted partly through Sir William Huggins¹, who was perhaps Gill’s most intimate friend in England and whom he often asked to undertake delicate tasks. Gill wrote to Grubb on 13 May:

‘. . . Dr Huggins writes to me that you will undertake to make a Photographic objective of 9 inches aperture and 9 feet focal length for £150 as good as Henrys of Paris – that is to say of the highest perfection in definition and to cover perfectly a field of $4\frac{1}{2}^\circ$ in diameter, and that you will complete such a lens within 5 months from date of order. [The Henrys were two brothers who were astronomers and amateur opticians, attached to the Paris Observatory.]

I have wired to Dr Huggins to accept your offer, but I understand of course that you will guarantee the performance of the lens.’

The new lens appears to have been a simple doublet, corrected for chromatic and spherical aberration, but without any special property as to size of field. However, it represented quite a challenge to Grubb as he had not before constructed an achromatic telescope lens corrected for ‘chemical rays’, i.e. light from the blue end of the spectrum to which alone early photographic plates were sensitive. It was to be known as the ‘Nasmyth Lens’ because James Nasmyth (1808–1890), a leading amateur astronomer of the time, has made a grant of £200 towards it. Nasmyth was an innovative engineer who had acquired a fortune in the machine tool industry, to the development of which he made many important contributions.

It was arranged that Dallmeyer would take care of the tube and photographic arrangements for the 6-inch lens and Grubb would make the rest. In July, the blanks for the lenses were acquired from Chance. The following further extracts from the Gill–Grubb correspondence illustrate the progress of the work:

Gill (date missing): ‘About the Photo lens I suppose you have duly got my letters. I have just received from Paris a photo of a part of the Milky Way with the new Henry lens. It is simply magnificent [right to the] edge and each star absolutely and perfectly round – for my sake, and if you love me – don’t let the Frenchman beat you.’

Grubb (16 September 1885): ‘I have just received a pair of discs from Chance and am having a rough polish put on them in order to test them. One I have good hopes of but some fears that I will have to return the other. I have a 4'' trial lens in hands’.

¹ Added 2006: Huggins was knighted only in 1897.

Grubb (30 September): ‘I have been rather unfortunate about the discs. There are slight faults in both discs I got from Chance. I have been polishing windows on various places on the edges to try and localize these faults & as far as I can see I think they will work out in the grinding but it will be 3 or 4 days more before I can quite determine this ... you speak of using a field of 8 inches which would be something like 4° ; now I am very doubtful if such an enormous field will be usefull or possible to get with good definition. The photographs I saw by the brothers Henry & which were probably the same as what you saw were only about $1\frac{1}{2}^\circ$ in length by 1° in breadth ...’.

Grubb (14 October): ‘I am very glad to be able to tell you that by a little ‘dodging’ I have managed to escape any faults of both flint & crown for your objective and we are now free to go ahead, which we will do at once.’

On 7 October Gill sent Grubb a set of detailed plans which he had had drawn up by Vogelmann, a draughtsman who was working as ‘one of my clerks’. His designs for the photographic breechpiece were to become the standard for the later astrographic telescopes and are illustrated in Figure 1. (Gill, 1892; Ambronn, 1899). Provision was made for focusing by moving the end of the telescope barrel in or out instead of adjusting the lens itself. A scale enabled the focal position to be read. The location of the plate within the plateholder, and the mounting of the holder itself, utilized proper ‘kinematic’ supports, as they would now be called. Grubb was at first a little shocked at the apparent elaborateness of the design and feared that the construction would prove very costly:

Grubb (20 January 1886): ‘It is of course very hard for a draughtsman who is not acquainted with the available tools of the workshop or what they can do to work out details of such a job as this in economical manner; however I am sticking as near as possible to your drawings & will do the best I can. Re 9 inch photographic objective. Before next mail I hope to have had my first trials. I note you want a spring in cell to keep glass up against one side as in transit circle mounting ... There is a great cry here just at present for perfect clock movement for use in celestial photography. I am making what I believe will be th most [perfect] equatorial form in this respect for Mt Roberts (President Liverpool astronomical Society).’

Grubb (2 June): ‘I am glad to be able to give you a favourable report. In making the calculation I ran it a little to fine & found that the correction for photo rays was almost perfect when the lenses were absolutely in contact & that this would be undesirable as it would leave no room for final correction, so I re-worked the fourth surface & now I think I have the correction fully under control. The last trials I had today are very promising & I expect soon to be able to report its completion.’

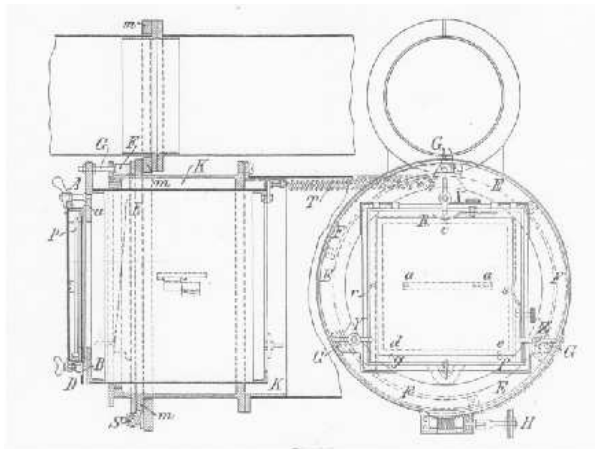


Figure 1: Section (l.) and end view(r.) of photographic breechpiece designed by Gill. Part of the guider is shown also. The plate P is in the holder which is held on by the knobs XYZ. D is the dark slide. A knob H turns a ring bearing three inclined planes FFF. When these move, the inner barrel is forced out via the pins G or pulled in by the springs T to focus the instrument. Kinematic mounting and spring loading ensure precise positioning.

Gill (21 June): ‘It really is too bad of you to neglect me thus. Yr contract time for delivery of the photographic telescope is long long past – and there seems no sign yet of your finishing it. I must insist on an immediate reply and yr sending it at once or not at all . . . If you want me to write you in a better humour you must show that you deserve it.’

Gill (28 June): ‘I hope not an hour is being lost about the photographic telescope and I trust it has left before this reaches you.’

Gill (7 September): ‘Just a line to say I shall lose all patience if the Photo. Telescope does not arrive by mail [steamer] expected tomorrow.’

The Telescope in Cape Town

The telescope finally was sent to Cape Town, but its shipping documents were delayed – Gill had to have the custom house searched to find it.

‘I had to make a few alterations to get the thing together . . . and put in stronger spiral springs so that the focusing arrangement would work when the Ins^t is directed to the zenith. Now all is in perfect order – and so far as I can see the whole thing will be a great success. So far as I can judge by one night of bad definition the object glass

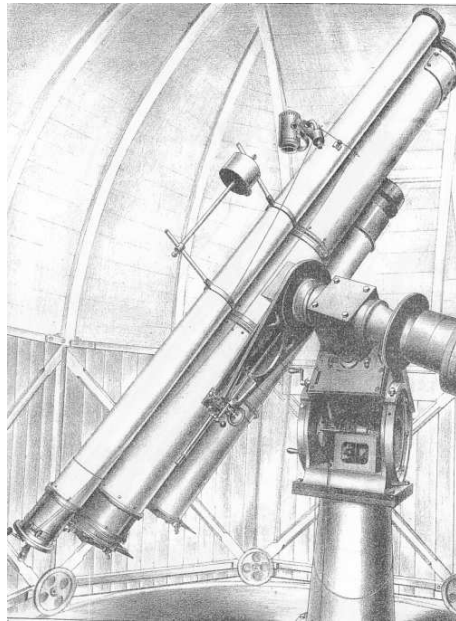


Figure 2: The complete experimental telescope in its dome. From left to right, the tubes were for the following lenses: 5-inch guider, 9-inch Nasmyth and 6-inch Rapid Rectilinear. The Grubb mounting (1879) was owned by Gill.

is exceedingly good, the chromatic correction just what it ought to be and the centering of the lens very satisfactory.’

The completion of this telescope (Fig. 2) occurred just before Gill left for the Paris Astrographic Congress of 1887 which he, together with Admiral Mouchez, originated. From this meeting stemmed a huge mapping project called the ‘Carte du Ciel’ which kept a great many observatories around the world busy for decades, photographing the sky with telescopes built to a standard specification. Unfortunately, the Royal Society, which had hitherto been financing the Cape Photographic Durchmusterung, decided not to continue doing so on the grounds that it would be superseded by the Astrographic project. Gill did not share this view and chose, at considerable personal sacrifice, to fund the survey out of his own pocket. His experimental work had, as a consequence, to be cut short.

The newer Dallmeyer lens turned out in any case to be inferior to the first one and the field of good definition on the Nasmyth lens was disappointingly small at about 2° across. For these reasons, and the expectation that the soon to be furnished Astrographic telescope would give superior results, this telescope was rather quickly abandoned. The Nasmyth lens was afterwards used as a collimator in connect with imposing ‘réseaux’ on Astrographic plates prior to their exposure in the telescope. The focusing system and plate-holding mechanism

were attached to the original wooden Durchmusterung telescope and used for that survey. The eyepiece of the guide telescope, which was made movable in r-theta fashion, turned out to be inconvenient and was replaced in later instruments by normal x-y slides. Also, instead of using a small circular hole in a piece of watch-spring as a reticle, normal cross-wires were installed.

The importance of this instrument lay not in any results it ever produced, but rather in the fact that it provided a test-bed for many of the ideas which were later incorporated in the design of the Carte du Ciel and other photographic telescopes. The problem of designing and constructing a lens which was achromatic for ‘photographic’ rays and which at the same time gave satisfactory images over a large field was still to occupy several years of hard work.

Today, little of this telescope survives. The Nasmyth and 5-inch guider lenses remain at SAAO, though unused. Curiously, the former is still listed on the inventory as being worth £200, the amount of the original grant. The mounting was given by Gill to the newly created Transvaal Observatory in 1906 (Hers, 1987) where it now carries a 9-inch objective and tube completed by Grubb in 1909. The relatively few plates taken with the telescope were sent with those of the definitive Durchmusterung to Kapteyn at Groningen.

References

- Ambrohn, L. 1899. *Handbuch der Astronomischen Instrumentenkunde*, Vol. 2, Julius Springer, Berlin.
- Gill-Grubb Correspondence, in Volume *R Instruments Grubb 1879–1890*, SAAO Archives.
- Gill, D., 1896. *Cape Photographic Durchmusterung*, Vol. 1, p. ix.
- Gill, D., *Bull. Com. International ... de la Carte du Ciel*, Vol. 1, p. 23.
- Hers, J., 1987. *MNASSA*, **46**, 39.