The Astronomical Museum at the SAAO
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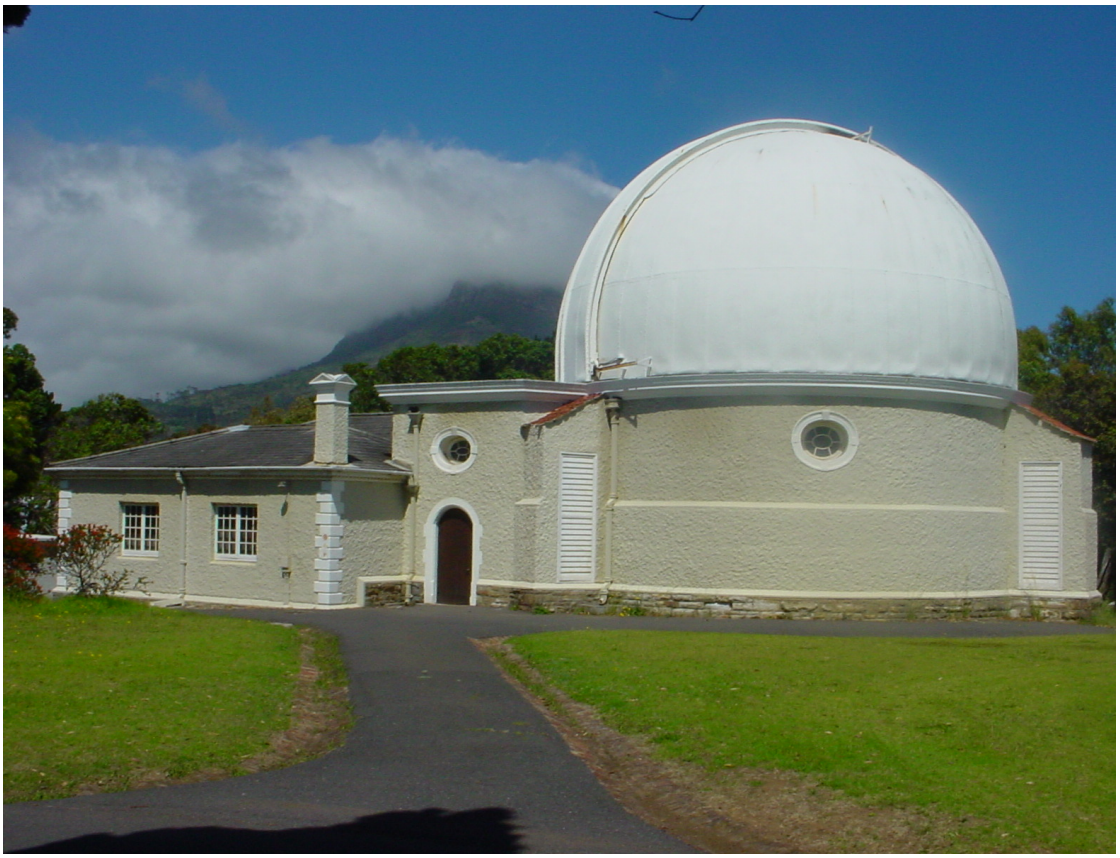
Summary: The origin of the Astronomical Museum at the South African Astronomical Observatory is related. Descriptions are given of its home in the McClean building and of some of the instruments on display.



Above: The McClean dome

Introduction

The SAAO Astronomical Museum came into existence about 1987 when the Technical Building was opened and the infrared laboratory was moved from the old McClean Laboratory to the new location. Robin Catchpole and I had been concerned about the slow disappearance of historical items from the Observatory and we obtained permission to convert the old laboratory into a Museum. This was not a moment too soon: for example, when we searched for the Gill heliometer we found that it had been stolen from the storeroom where it had been kept. Other items, such as densitometers by Moll and Casella had also disappeared. They were almost certainly sold for scrap.

There is unfortunately no science museum in South Africa to which institutions such as SAAO can donate historical equipment. It does not take much imagination to realize, given the many discoveries, instrumental and otherwise, made in this country, what an interesting collection could be formed if the many items stored in various laboratories could be put together. Two of the most interesting original instruments from the foundation of the Royal Observatory, the Mural Circle and the Transit telescope, were scrapped in a fit of official vandalism around 1950.

The whole SAAO Museum project was part-time and very low-budget. It barely met with official approval, being regarded as a diversion from our main task of astronomical research. The main change we made to the laboratory was to have concealed lights installed in its Victorian glass-fronted cupboards. The room was also re-painted. A number of display boards were found in storerooms and installed in the room. These have since been replaced. Robin organized for the ancient hydraulic pump which operates the rising floor of the telescope to be enclosed in a glass case.

When we announced our intention of creating a museum, various people came forward with small instruments etc that they had been 'saving'. We were spoilt for choice. A great many interesting items of moderately large size, such as Hartmann spectro-comparators and various measuring machines, could not be fitted into the limited space available. Other antique items, such as regulator clocks, are still distributed through various offices.

At first, the Museum was the only display area available for showing off the work of the Observatory and some of the poster displays concentrated on relatively recent scientific activities, such as the work on the Magellanic Cloud Supernova SN1987A and the Comet Shoemaker-Levy/Jupiter collision, which we had observed successfully in the infrared. Nowadays, however, the lobby of the SAAO Auditorium is used for recent astronomical work and temporary exhibitions. Also, a new Visitors' Centre is in preparation (2021). This has left the museum in the McClean free to concentrate on its original plan of preserving and displaying old equipment.

There is no particular person assigned to look after the Museum, so that the updating of displays and the cleaning of the insides of the display cases, which requires some sensitivity, has to be done by a volunteer, my (retired) self. We were fortunate that several other interested people were able to make contributions. Ethleen Lastovica (former librarian) contributed many of the original graphic displays. Isobel Bassett collected together pieces of equipment jettisoned when several photographic darkrooms were abandoned and has laid them out in the McClean darkroom, the only one remaining.

The Building

The building that houses the museum is usually called the McClean, after its donor, Frank McClean (1837--1904) of Rusthall, Kent, a prominent English engineer and amateur astronomer in the late 19th Century, although it was officially named the Victoria, after

the then Queen. It was designed by the famous architect Sir Herbert Baker (1862--1946), who was responsible for many colonial buildings, and was finished in 1896.

The McClean Telescopes

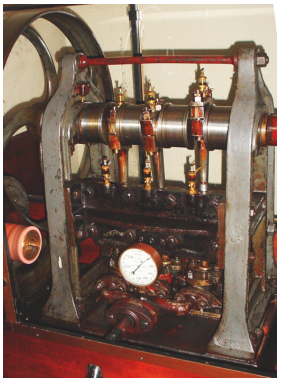
The main telescope was designed for spectroscopy -- a departure from the traditional positional work that was carried on at the Royal Observatory. It was for some time the largest refractor in the Southern hemisphere. During the 1930s, spectroscopy was supplanted by parallax work. This programme drew to a close in the 1970s, and the telescope is now used only for occasional projects. In fact, three telescopes of about the same focal length are mounted side-by side. They were built by Sir Howard Grubb of Dublin and have glass objectives - a problem for many modern observations because they do not transmit most ultraviolet and infrared wavelengths. The largest lens, of 24 inches diameter, was designed to perform best in blue light as the photographic plates available in those days were insensitive to other colours. The next largest telescope, of 18 inches diameter, was designed for visual observations. A third telescope, also designed for use by eye, was used as a guider for long photographic exposures. Another, shorter, telescope called the 'Old astrometric Camera' is also attached to the same mount.

The McClean telescope.

In the Museum is a huge objective prism, the largest ever made at the time. When it was in use in front of the telescope, the star images were spread into spectra.

The telescopes were originally driven to follow the stars by a heavy-duty clockwork motor regulated from the observatory time service by means of a special pendulum which is still to be seen in a cabinet on the wall. Every time the pendulum tip passed through a blob of mercury on the contact at the bottom an electrical impulse was generated. This impulse was used to check if the drive was fast or slow and to regulate the speed accordingly. Nowadays an electric motor driven at sidereal 50Hz frequency is used instead.

The rising floor of the dome is driven by hydraulics so that the observer can stand or sit at a convenient height for looking through the telescope. There is a reservoir which stores the hydraulic power at the entrance to the building. When the reservoir gets too low, a 3-cylinder pump (right) restores it automatically. The original DC motor (left) that drove this pump is on display. It was returned to us from the Fort Wynyard Naval Museum when it closed down. Electrical power for the



motor came from the battery house next door. The batteries in turn were charged by a steam-powered generator.
The dome was made by Cooke of York and was originally driven by a hydraulic motor working from the same supply as the floor.

The Laboratory

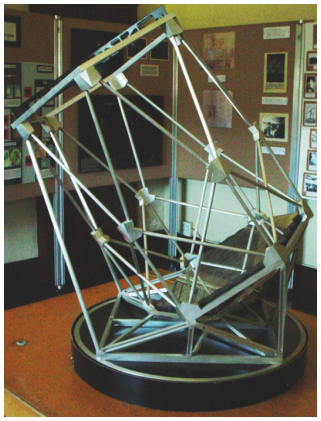
The laboratory was used until the1920s for making measurements of the spectra of substances that might be found in the atmospheres of stars. The spectra of substances found on the earth could be compared with those obtained from the stars. It is believed to have been the first spectroscopic laboratory in South Africa.



Above: Views of the Museum at different stages of its existence

Telescope Models

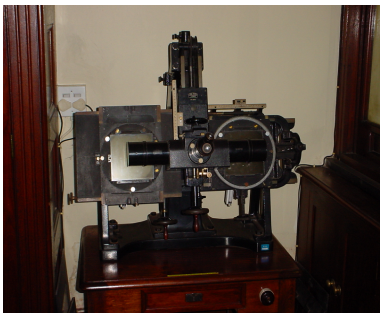
The Museum contains three pre-construction models of telescopes currently in use and located in Sutherland – the SALT (Southern African Large Telescope 2005-2010), the 74-in (1.9m; 1938-1948) and the 40-inch (1m; 1964).



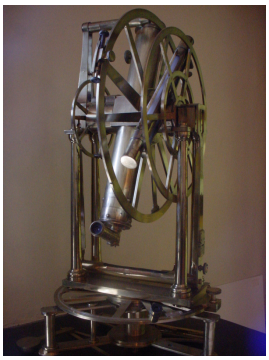
SALT model: The Southern African Large Telescope (SALT) is now operating at Sutherland. This model was the first one built and was used to persuade funding agencies to support the project. The telescope was officially opened in November 2005, after taking about 5 years to construct. The design is an updated version of the Hobby-Eberly telescope of the University of Texas and it offers a large light collecting area at a fraction of the cost of a conventional telescope, though at the expense of some versatility. It is currently the largest single telescope in the world in terms of usable primary mirror area.

74-inch Grubb Parsons model: This wooden model was made about 1934 to show what the 74-inch telescope would be like. The actual telescope was finished mechanically in 1938 and erected in Pretoria for the Trustees of the Radcliffe Trust, a private British foundation. Problems relating to World War II delayed optical completion until 1948. It was bought by SAAO from the Trustees and has operated since 1976 in Sutherland. It was once the 5th largest in the world and the largest in the Southern hemisphere. A turret was used instead of a dome so that a moving platform could give easy access to the Newtonian focus at the top of the telescope tube. Wind tunnel tests in later years suggest that, in fact, a turret is better than a dome for giving the best optical conditions in wind.

Miscellaneous Instruments

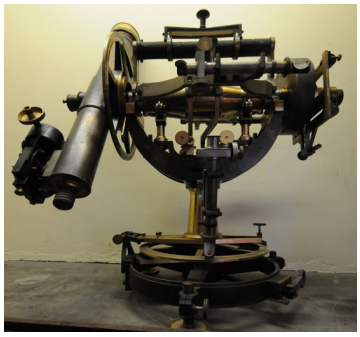


Zeiss Blink Comparator: Among the larger instruments is a Zeiss blink stereo-comparator (left), dating from the first decade of the 20th century. This was used for comparing two plates taken at different times to look for changes. These could have been due to moving objects such as asteroids or stars that vary in brightness. With a similar instrument, the nearest known star (Proxima Cen) was found at the Union Observatory, Johannesburg, by R.T.A. Innes.



Dollond Repeating Transit: The so-called 'repeating Transit,' built abut 1820, was one of the original instruments of the Royal Observatory and was used temporarily by Rev Fearon Fallows, the first HM Astronomer, in a wooden Settler's Hut, while he waited for the permanent Observatory buildings to be completed. Used for finding the positions of stars, it is essentially a large theodolite and is called 'repeating' because its circles can be read in two places to increase accuracy. It was described in the first issue of *Memoirs of the Royal Astronomical Society*. This instrument was found damaged and in pieces in a cardboard box in the Instrument Workshop. Its restoration is due to Doug Metcalfe.

Travelling microscopes used for measuring the positions of images on photographic plates are also on show. These could measure to about one micron (micrometre). That shown on the left was capable of measuring in the x and y directions and was made by the Potsdam firm of Ottto Töpfer. Its date is unfortunately not known. Other similar instruments in the Museum are two Hilger single-screw measuring machines and an unusual Zeiss spectrum-measuring double microscope, with a scale under one end and the plate of interest under the other.



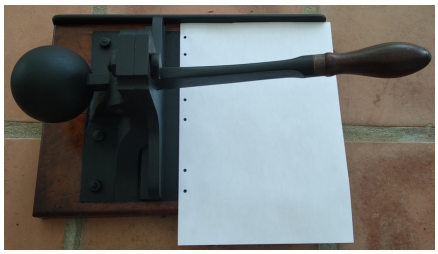
Bamberg Altazimuth Instrument: 2 5/8 – in Altazimuth instrument by Carl Bamberg (Berlin). This was borrowed in 1906 by the Transvaal Observatory (later Union and even later Republic Observatory) from Oscar Backlund of the Imperial Russian Observatory, Pulkowa, and never returned. It is located in the former fume cupboard of the Laboratory. I believe it was used for observations related to timekeeping. On one occasion I showed Alexander Boyarchuk, a senior Soviet academician, around the Museum. When he saw the Bamberg instrument, he suggested it ought to be returned. So I told him that when Russia had an Imperial Observatory again we might consider it!

Some items in the display cupboards

Display Cupboard 1: This is devoted to apparatus for spectroscopy, mostly used in the McClean Laboratory in its original spectroscopic incarnation. There is a diffraction grating by the pioneer Henry Rowland of Johns Hopkins University in Baltimore. Such gratings split up light like a prism and allow one to determine the chemical composition of its source, among other things. Another, larger, grating was ruled at Mount Wilson Observatory.

An interesting item, rarely seen, is a transmission echelon, a high-resolution grating of a kind designed by Albert Michelson. These were very difficult to construct because of the high precision required. The present example was made by the firm of Adam Hilger, London.

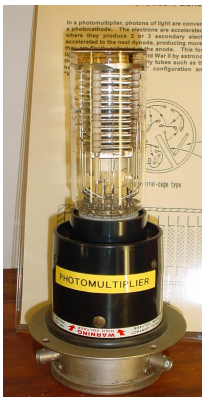
Display Cupboard 2: Shows some typical office equipment used at the Royal Observatory. At the top are mini-computer components from the 1970s and a manual card punch. Cards were the commonest input medium for the early digital computers. Red tape was used by civil servants for tying up bundles of documents. Though not strictly an astronomical instrument, the multi-hole punch is almost certainly one of the earliest ones ever made and came from the Ransomes and May factory that built special equipment for the (UK) Astronomer Royal, Sir George Biddle Airy, a consummate bureaucrat. Letters were strung together at first in files, using shoelaces, and later bound. The Royal Observatory Cape followed his system.



The Royal Observatory used to employ people called ‘computers’ to do the extensive arithmetic involved in the reduction of data. An advertisement shown seeks ‘girl computers’. Among famous people employed in this monotonous task were the radio personality Eric Rosenthal, the Nobel prizewinner Allan Cormack and Willem de Sitter, who later on discovered that the field equations of general relativity had a solution allowing an expanding universe.

A circular slide rule and some early mechanical calculators are also shown. Astronomers frequently used ‘Crelle’s Tables’, which were multiplication tables, to aid in their calculations.

Display Cupboard 3: Shows among other things some of the various detectors used at the Observatory – various photomultipliers, McGee Spectracons, a Varo image tube and a CCD chip, The Fabry photometers on the next shelf were something almost unique to the RO Cape. The image of a star was spread out and the density of the image was read to determine its brightness instead of the more usual but less accurate method of measuring the diameter of an in-focus image.
A large induction coil in the bottom of the cupboard was used for generating ‘spark’ spectra of various elements for comparison with celestial spectra.

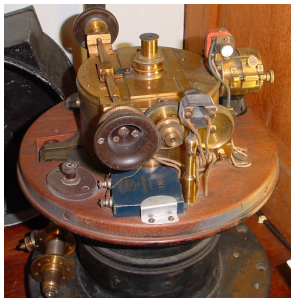


Display Cupboard 4: The 14-inch speculum-metal (a brittle copper-tin alloy) mirror was cast and figured in 1810 by Sir William Herschel and formed part of a telescope that was bought second-hand when the Royal Observatory was formed. Herschel made a considerable fortune from building telescopes, but few of these instruments were used by their owners as effectively as he was able to use them. Fallows, the first HM Astronomer at the Cape, never even unpacked his Herschel reflector [It was however used later].

This cupboard now (2021) also contains a mirror made by Sir John Herschel and used with his 20-feet (focal length) telescope in Cape Town in 1834-1838 to map *inter alia* the nebulae of the Southern sky.

This small brass-mounted Ross lens was used to photograph the Great Comet of 1881 and inspired Gill to make his photographic survey of the sky (the Cape Photgraphic Durchmusterung or CPD) when he saw that the stars in the background had been registered on the plate.

The larger brass-mounted lens is that used by for the CPD survey at the Royal Observatory in Cape Town from 1885 onwards. It is a portrait lens made by Dallmeyer. In Gill's time the sky in Cape Town was much clearer and freer of light pollution than it is now. Gill had to finance the survey himself by devoting half his salary towards it for several years, owing to the jealousy of the Astronomer Royal at Greenwich who contrived to deny him a research grant. All the plates taken for this survey remain in Groningen, Netherlands, where they were analyzed by Jacobus Kapteyn, Gill's collaborator.

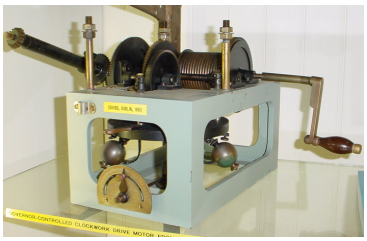


Display Cupboard 5: The bottom shelf contains remnants of the 'Airy Transit Circle' which used to occupy one room of the main building of the Royal Observatory. A photograph shows the shutters in the south face of the building which could be opened for observing. On the shelf are the objective lens and the eyepiece end of the telescope (picture at left).

A signalling pistol dating from the early 19th century was used to communicate time to ships at the harbour.

There is a brass mould and some bullets used with a Colt revolver that the Observatory at one time possessed. It was used to protect officials bringing pay packets from the bank.

The original Grubb governor-regulated clockwork motor of the 6-inch telescope is also on display. The power was derived from a descending lead weight and the speed was regulated by a friction-controlled governor.



Display Cupboard 6: This contains chemical and physical apparatus used in the laboratory and elsewhere around the Observatory, including crucibles, radio valves, electrometer valves (illustrated), thermometers, galvanometers, balance weights mortar and pestle. The electrometer valve was used for amplifying the very small currents produced by photoelectric cells.

The lowest shelves contain some of the infrared equipment used at Sutherland 1970-2005 and one of the photometers and electrometer amplifiers employed by the late A.W.J. Cousins to establish his photometric standards that are still used world-wide. These are fundamental to all astronomical brightness measurements made in the Southern hemisphere and ultimately to our knowledge of the size of the Universe.

Display Cupboard 7 (new in 2021) : Contains early equipment for measuring angles, such as Dolland and Jones Transits, theodolites and eyepiece micrometers.

Display cupboard 8 (new in 2021): Contains the original standard measures for lengths, weights and volume measures for the Cape Colony.

Ante-room to the dome

Contains the hydraulic pump that feeds the rising floor of the dome.
Also a Hartman spectro-comparator by Zeiss.

Darkroom

The darkroom of the McClean dome has been restored to its approximate appearance when last used. Photography was one of the most important techniques in use at the Observatory from 1881 until about 1980, well into the SAAO era. Every morning the lady computers would develop the previous evening's plates from the McClean and Astrographic telescopes and leave them to dry. Large plates of the Sun were taken twice daily with the Photoheliograph and a continuous record of Solar surface activity was made on 35mm film with the Lyot Coronagraph. Photography was also used to record the position settings of the Gill Transit Circle.

Access to the Museum

The SAAO Astronomical Museum is usually included in official tours of the Observatory. The general public may attend open nights on the 2nd and 4th Saturdays of each month at 8pm. Special tours for groups can sometimes be arranged.

Acknowledgments

I thank Mr Peter Robinson of George for taking some of the photographs.