The Astronomical Museum at 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.

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. It is believed that the Victorian standard weights and measures, which used to be kept at the Royal Observatory, are still languishing in some storeroom of the South African Museum.

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 fluorescent 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. Robin organized for the ancient hydraulic pump which operates the rising floor of the telescope to be enclosed in a glass case.

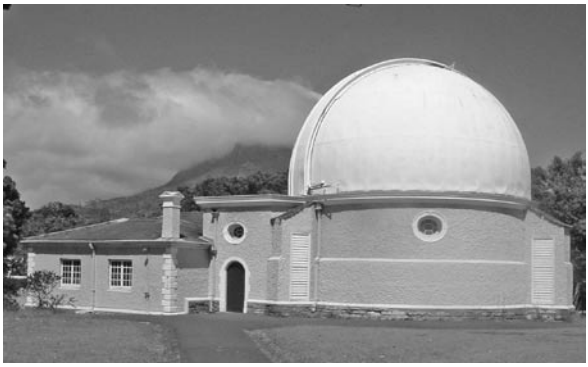
When we announced our intention of creating a museum, various people came forward with small instruments etc that they had been 'saving'. We were spoilt for choice. A great many interesting items of moderately large size, such as Hartmann spectro-comparators and various measuring machines, could not be fitted into the limited space available. Other antique items, such as regulator clocks and chronometers, 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 current or recent 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 Auditorium contains exhibits and posters about recent astronomy in South Africa, both at the SAAO and elsewhere. This has left the museum in the McClean free to concentrate on its original plan of preserving old equipment.

There is at present 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 such as my (retired) self. We are fortunate that past employees were able to make contributions. Ethleen Lastovica (former librarian) contributed many of the graphic displays. Recently, Isobel Bassett has collected together pieces of equipment jettisoned when several photographic darkrooms were abandoned and has laid them out in the McClean darkroom, the last remaining one at SAAO.

The Building

The building which houses the museum, although officially named the Victoria after the then Queen, 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. It was designed by the famous architect Sir Herbert Baker (1862–1946), who was responsible for many colonial buildings, and was finished in 1896.



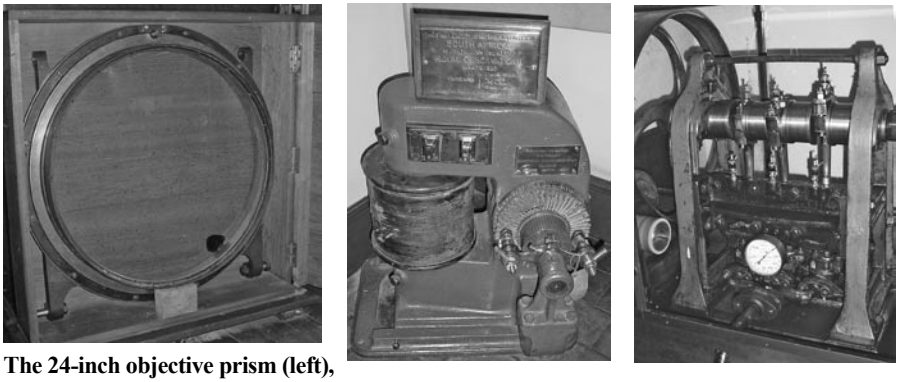
The Herbert Baker designed McClean dome and adjoining laboratory (above) with its Grubb telescope inside (right)

The McClean Telescopes

The main telescope was designed for spectroscopy – at the time 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 this 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 ultra-violet 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 and is still used today for viewing by the public. 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.

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 24-inch objective prism (left), Victorian DC motor (centre) and Victorian 3-cylinder hydraulic pump (right).

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. At the entrance to the building is a reservoir, in the form of a massive weight, which stores the hydraulic power. When the reservoir gets too low, a 3-cylinder pump restores it automatically. The original DC motor 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 (today known as the "1896 Building" from the date on its gable). 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.

Telescope Models

The Museum contains several pre-construction models of telescopes – the SALT (Southern African Large Telescope), the 74-inch (1.9m), the 40-inch (1m) and a 3.5m altazimuth telescope similar to the ESO New Technology Telescope that was proposed for Sutherland before the SALT project came along.

The McClean laboratory as it appeared around 1900 as a spectroscopic laboratory (top), in the 1980s as an infrared laboratory (middle) and today as a museum (bottom).

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. SALT is currently the largest single optical telescope in the world in terms of usable primary mirror area.

74-inch Grubb Parsons model: This wooden model was made by Grubb Parsons about 1934 to show what the 74-inch telescope would be like. The actual telescope was built in 1938 and erected in Pretoria for the Trustees of the Radcliffe Trust, a private British foundation. It was bought by SAAO from the Trustees and has operated since 1976 in Sutherland. A photograph of the actual telescope as it now exists is on the wall of the Museum. 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.

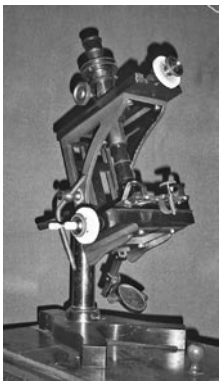
Miscellaneous Instruments

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 tem-

Models of SALT (far left) and the 74-inch Radcliffe telescope.

The instrument collection includes a Zeiss Blink Comparator (left-top), Bamberg Altazimuth Instrument (left-bottom), Dollond Repeating Transit (centre) and a travelling microscope (right).



porarily 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: $2^{5}/_{8}$-inch 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

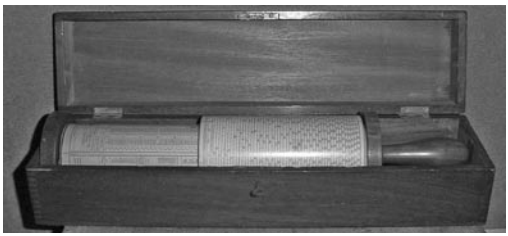
Display Cupboard 1: This is devoted to apparatus for spectroscopy, mostly used in the McClean Laboratory in its original spectroscopic incarnation. There is a diffraction grating by the pioneer Henry Rowland of Johns Hopkins University in Baltimore. Such gratings split up light like a prism and allow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

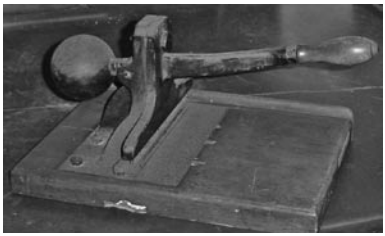
An interesting item, rarely seen, is a transmission echelon, a high-resolution grating of a kind designed by Albert Michelson. These were very difficult to construct because of the high precision required. The present example was made by the firm of Adam Hilger, London.

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.

On the next shelf down is a roll of 'red tape', 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 is thought to have come 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 reduc-





Office equipment includes a cylindrical slide rule and a very early multi-hole paper punch.

tion of data. The 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.

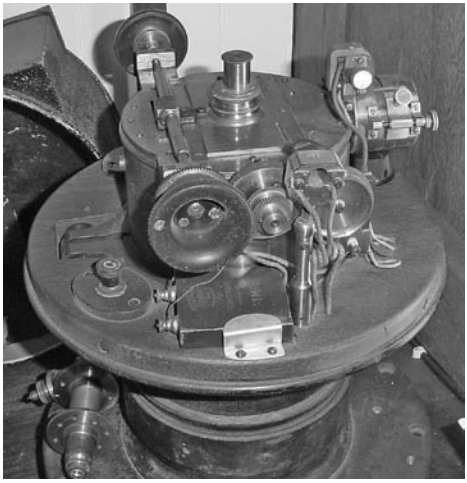
A circular slide rule and some early mechanical calculators are also shown. Astronomers frequently used 'Crelle's Tables', which were multiplication tables, to aid in their calculations.

Display Cupboard 3: Shows among other things some of the various detectors used at the Observatory – a photomultipliers, McGee Spectracon, Varo image tube, CCD chip, and an infrared array detector. 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 large 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-

Cupboard 3 displays a photomultiplier tube with explanatory sketch (bottom-left), while cupboard 4 contains the two famous lenses that started the photographic era in astronomy, the Ross (right) and the Dallmeyer lens (bottom-right).



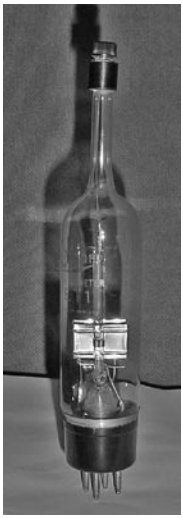
The eyepiece-end of the 'Airy Transit Circle' (left), an instrument originally mounted in the main building, and the signal pistol used for firing time signals from the Observatory roof.

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.

This small brass-mounted Ross lens was used to photograph the Great Comet of 1882 and inspired Gill to make the first ever photographic survey of the sky (the Cape Photographic 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.

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



The original Grubb governor-regulated, weight-driven clockwork motor of the 6-inch telescope (above). Chemical apparatus include a mortar and pestle (top-right) and electrometer valves (right).

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.

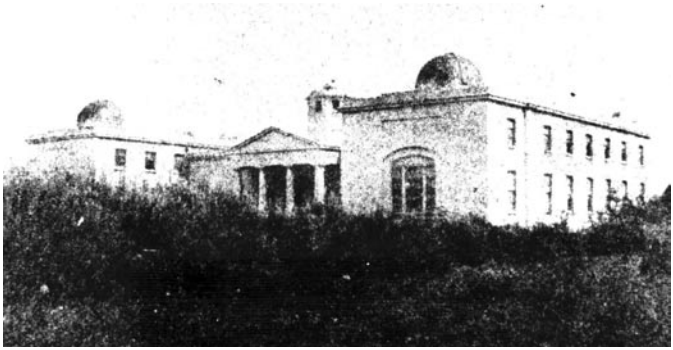
The original Grubb governor-regulated clockwork motor of the 6-inch telescope is also on display. The power was derived from a descending lead weight and the speed was regulated by a friction-controlled governor.

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

The lowest shelf contains one of the photometers and electrometer amplifiers employed by the late A.W.J. Cousins to establish his photometric standards that are still used worldwide. These are fundamental to all astronomical brightness measurements made in the southern hemisphere and ultimately, to our knowledge, of the size of the Universe.

Ante-room to the dome

This room was intended to be the formal entrance to the dome and has an elaborate Baker-style front door. An exhibition originally prepared by Ethleen Lastovica for the 175th anniversary of the Royal Observatory is displayed here. It incorporates graphic material from the earliest days of the Royal Observatory up to recent times under the SAAO. Included is what is believed to be the earliest photograph (ca 1843) of *any* observa-



This 1843 (ca) picture (left) of the Main Building by Charles Piazzi Smyth is likely to be the first ever picture of an observatory. The McClean photographic darkroom (below) has recently been restored to its former look.

tory, made by Charles Piazzi Smyth, who joined the Royal Observatory in 1834 at the age of 16. He made the camera and photographic material himself. The process he used was known as "calotype". The original print belongs to the Royal Society of Edinburgh. Smyth's photographs are the earliest to have been taken in South Africa.

Darkroom

The darkroom of the McClean dome has been restored to its approximate appearance as it was last used. Photography was one of the most important techniques in use at the Observatory from 1882 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 utilised in a kine-theodolite, used at one time for observations of artificial satellites and even 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 20h00. Special tours for groups can sometimes be arranged.

Acknowledgments

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