THE SAAO ASTRONOMICAL MUSEUM OBSERVATORY, CAPE TOWN

by I.S. Glass

The South African Astronomical Observatory was founded in 1972 by combining the Royal Observatory, Cape of Good Hope, with the Republic[1] Observatory, Johannesburg. The Astronomical Museum was set up during the 1980s to preerve some of the small instruments used in former times.

[1]formerly known as the Union Observatory, and before that as the Transvaal Observatory

THE BUILDING

The building which 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) and constructed during the 1890s (Fig 1). The laboratory was added as an afterthought, almost immediately. The main telescope of 24 inches aperture, by Grubb of Dublin, was intended for the study of stellar spectroscopy – a departure from the traditional positional work that was carried on at the Royal Observatory. 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 ocasional projects.

THE TELESCOPES

Three telescopes of about the same focal length are side-by side on the same mount. They were built by Sir Howard Grubb of Dublin and use glass lenses to focus the light rays - a problem for many modern observations because glass does 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.

Figure 1: The McClean dome, completed 1896, with Devil's Peak in the background.

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 telescopes were originally driven to follow the stars by a huge clockwork motor regulated from the observatory time service by means of a specal 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 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 restores it automatically. The original DC motor that drove this pump is on display. Electrical power came from the battery house next door. The batteries were charged by a steam-powered generator.

The dome was made by Cooke of York and was also driven by a hydraulic system working from the same supply as the floor.

THE LOBBY

As one enters the building one sees the hydraulic reservoir for the rising floor on the right. Directly ahead are some photographs of the telescopes at Sutherland in the Karoo, where most of the SAAO's observational work is nowadays done. The Sutherland telescopes are all reflectors - i.e., the light is focussed by mirrors instead of lenses.

THE LABORATORY

The laboratory (Figs 2, 3, 4) was used until the 1920s for making ground-based measurements of the spectra of elements 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. The 24-inch telescope had a large spectrograph attached to it.

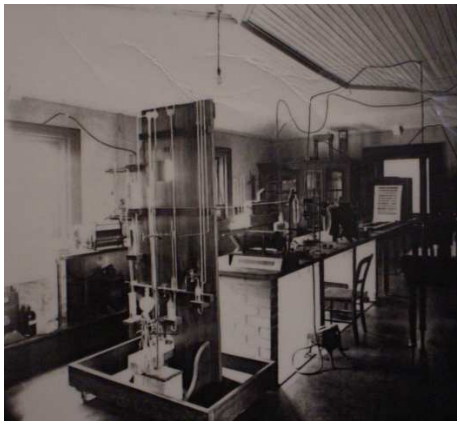

Figure 2: The McClean Laboratory as it looked around 1900.

Figure 3: Infrared laboratory (ca. 1980).

Figure 4: The Laboratory today, in use as a museum.

Central Bench

74-inch model

This wooden model (Fig 5) was made about 1934 to show what the 74-inch telescope would be like. The actual telescope was finished in 1938 and erected in Pretoria for the Radcliffe Observatory. It was bought by SAAO from the Radcliffe trustees and has operated since 1976 in Sutherland. A photograph of the telescope as it now exists appears on the wall. 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 a turret is better than a dome for giving the best optical conditions in wind.

Alt-azimuth telescope model

This model was made when the first proposals for a new telescope was put forth. A 3.5m instrument was then being contemplated. This type of design is very common among the world's largest telescopes. However, the proposal did not sell and the project was abandoned when the SALT came along.

The SALT model

The Southern African Large Telescope (SALT) is now operating at Sutherland. It has the largest collecting area of any telescope in the Southern hemisphere. This

Figure 5: Model of the 74-inch telescope (now at Sutherland).

model is 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.

NORTH WALL

There is a picture of Frank McClean, the donor of the building and telescope.

A Zeiss blink stereo-comparator (Fig 6) is on display. This instrument 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.

Figure 6: Zeiss blink comparator (early 20th-C).

Display Cupboard 1

Shows some old apparatus for spectroscopy, mostly used in the McClean Laboratory. 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 a star, 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 form of Adam Hilger, London.

Display Cupboard 2

Shows some typical office equipment used at the Royal Observatory. At the top are mini-computer components

Figure 7: Primeval multi-hole punch (3rd qtr of 19th C).

from the 1970s. In the middle is a roll of 'red tape", used by civil servants for tying up bundles of documents. The multi-hole punch (Fig 7) 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 and the Astronomer Royal, Sir George Biddle Airy. Letters were strung together in files, using shoelaces.

The Royal Observatory used to employ people called "computers" to do the extensive arithmetic involved in the reduction of data. The advertisement shown seeks "girl computers". "COLA" referred to cost-of-living allowance, not Coca-Cola. Among famous people employed in this monotonous task were the radio personality Eric Rosenthal, the Nobel prizewinner Allan Cormack and Willem de Sitter (Fig. 8), who discovered that the field equations of general relativity had a solution allowing an expanding universe.

EAST WALL AND BENCH

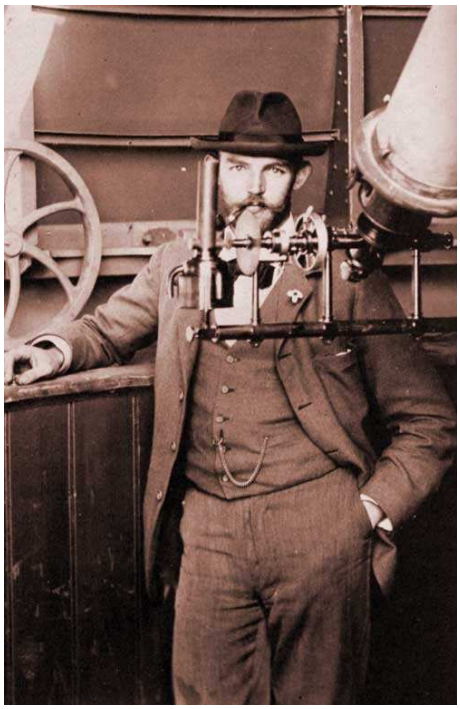

Figure 8: Willem de Sitter at the 6-inch telescope, then located in the "Wind Tower", a building that no longer exists.

Fume Cupboard

This contains a portable transit instrument made by the Bamberg firm. It was borrowed from the Imperial Russian Observatory and never returned.

Bench

Repeating Transit

The so-called "repeating Transit" (Fig 9), 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.*

Plate-measuring instruments

Two typical travelling microscopes of the type used for measuring distances on photographic plates are also on show. These could measure to about one micron (micrometre).

WEST WALL

Display Cupboard 3

Shows among other things some of the various detectors used at the Observatory. The Fabry photometers

Figure 9: Dollond repeating transit used by the first HM Astronomer at the Cape, Rev Fearon Fallows, before the Royal Observatory building was completed.

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 (Fig 10) was cast and figured 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 never even unpacked his Herschel reflector.

The smaller brass lens was used to photograph the Great Comet of 1881 and gave Gill the inspiration of making the first ever photographic survey of the sky (the *Cape Photographic Durchmusterung* or CPD) when he saw that the stars in the bachground had been registered on the plate.

The large brass lens (Fig 11) is that used by for the CPD at the Royal Observatory in Cape Town from 1885 onwards. It is a portrait lens made by Dallmeyer. Such large lenses were necessary because the early photographic plates were insensitive and needed all the light they could get. In Gill's time the skies were much clearer and freer

Figure 10: Speculum metal telescope mirror ground by William Herschel, 1811.

of light pollution than they are 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 have his research grant cut off. All the plates taken for this survey remain in Groningen, Netherlands, where they were analyzed by Jacobus Kapteyn, Gill's collaborator.

Poster Boards

The displays change from time to time. They currently include items about historical books in the SAAO Library, historical buildings of the Royal Observatory and the original Baker drawings of the building.

Some items from the scientific work of the SAAO are also shown, including photographs of the impact of Comet Shoemaker-Levy with Jupiter, the "Planet Project" and the Supernova 1987A.

Figure 11: Lens used for the Cape Photographic Durchmusterung, the first photographic sky survey.

SOUTH WALL

Display Cupboard 5

The bottom shelf shows a photograph of the "Airy" Transit Circle which used to occupy one room of the main building of the Royal Observatory. Another photograph shows the shutters in the south face of the building which could be opened for observing. Also on this 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 brass mould and some bullets used with a Colt revolver that the Observatory at one time possessed. It was used to protect officials brining pay packets from the bank.

The original Grubb governor-regulated clockwork motor of the 6-inch telescope is also on display.

Display Cupboard 6

Old chemical and physical apparatus used in the laboratory and elsewhere around the Observatory, including crucibles, radio valves, thermometers and galvanometers.

The lowest shelf contains one of the photometers and electrometer amplifiers used by the late A.W.J. Cousins to establish his photometric standards that were 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.

ANTE-ROOM TO THE DOME

This room was originally intended to be the formal entrance to the dome and has an elaborate Bakeresque front door.

The hydraulic pump, still in working order, for the dome floor is located here, as is the original DC motor that drove it.

Poster Boards

Photographs illustrating some of the history of the Observatory are on display. They include the earliest photograph of an observatory, made by Charles Piazzi Smyth, who joined the Royal Observatory at the age of 16 in 1834. He made the camera and photographic material himself. The process he used was called "calotype".

NOTE

The Museum was mainly set up by I.S. Glass, R.M. Catchpole and E. Lastovica.