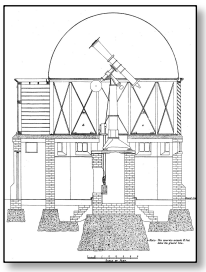
The 18-inch Telescope and Dome

The Site

Above: On this site in 1847 ***Thomas Maclear*** *had installed a 3-inch telescope and dome. By 1881, the date of this photograph,* ***David Gill*** *had changed the telescope inside to a 4-inch heliometer. In 1887 the present dome was erected with a 7-inch Heliometer inside.*

The Building

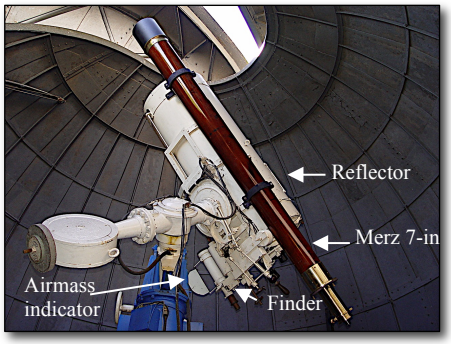


Left: The 18-inch dome as originally designed by ***David Gill*** *for use with the Repsold heliometer.*

The upper metal parts were made by **Howard Grubb** in Dublin. Two advanced design features helped to keep the air inside as steady as possible. Firstly, the walls were fitted with wooden louvres to keep the Sun from heating them. Secondly, they were equipped with triangular doors designed to be opened at sunset to allow the air inside to cool down rapidly. Originally the dome had a single shutter but when the present telescope was installed a second was added to allow for a wider opening.

The heliometer gradually fell out of use and was replaced by the **Merz** 7-inch telescope in the 1930s. This remained in place until the reflector arrived in 1955.

The 18-inch Reflector



Above: The telescope is fixed to the original ***Repsold*** *heliometer equatorial mount to follow the stars as they cross the sky from East to West.*

The main telescope (large tube) is a Cassegrain reflector with a 48-cm diameter main mirror. It was made by **Cox, Hargreaves and Thompson** in 1955. It is actually closer to 19 inches than 18! The optics are of Dall-Kirkham type, simpler to manufacture than a regular Cassegrain. The secondary mirror has a spherical figure and the primary was figured to compensate for its spherical aberration.

On the bottom of the tube was mounted the measuring instrument, usually a photometer.

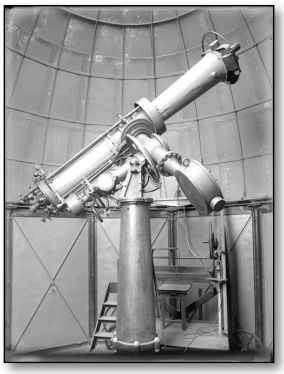
The long wooden tube is a 7-inch refractor (lens telescope) by **Merz** of Munich, made around 1848., used to guide the main telescope when measuring a star. It was originally mounted in the present photoheliograph dome.

There is also a small 3-inch telescope called a "finder" that is used when setting the telescope.

The "Airmass indicator" tells how much of the earth's atmosphere the telescope is looking through. Straight up is one airmass and obviously in other directions the "thickness" of the atmosphere will appear greater.

This telescope was in use from 1955 until 2000 for visual and infrared photometry.

The Heliometer and David Gill



Left: The heliometer was a specialised telescope made by the Hamburg instrument-maker ***Repsold*** *and used for measuring the angle between two stars with great accuracy.*

At the top end the usual lens was split. Its two parts were mounted on micrometer slides. Each star had a double image. Thus, if two stars near each other on the sky were looked at, two double images could be seen. One image of each star could be made to lie on top of one image of the other by adjusting and rotating the split lenses. The star separation could then be measured very accurately.

The distance of a nearby star can be measured by comparing its parallax against more distant ones at times six months apart. The earth's orbit then forms the baseline of a very narrow triangle whose apex angle is known.

Before the era of precise photography the heliometer was the best method for measuring the parallax angles and therefore the distances of the stars. Nowadays, these measurements are made from space to avoid atmospheric disturbance as the shaking of the earth's atmosphere limits the accuracy obtainable. Satellites such as Hipparcos and Gaia can measure stars to much greater distances.

Above: ***David Gill*** *was the most brilliant of the Royal Astronomers. He first became well-known thanks to his expertise in using the heliometer.*

While at the Cape he found precise distances for many stars, including that known to be the second-nearest, Alpha Centauri. He made the first ever catalogue of stars using photography, the *Cape Photographic Durchmusterung*. He was the leading expert on the Astronomical Unit, the distance between the earth and the Sun, which he measured using the heliometer. His value was adopted as the best-determined for decades. He was a major contributor to the Astrophotographic Congresses, the forerunners of today's International Astronomical Union. In addition he was an excellent instrumentalist who strongly influenced telescope design in the latter nineteenth century. He attracted many persons of international standing to work with him. The Royal Observatory looks today much as he left it.

AWJ Cousins and His Work

Left and below: ***Alan Cousins*** *was a photometrist interested in precise observations of bright stars. His work is of fundamental significance to many parts of astronomy. Some of his best work was done while in retirement. He was the main user of the18-inch telescope.*

Photometry

Photometry is the science of measuring the brightness of stars and other bodies. It is of central importance to astronomy and in the second part of the twentieth century the Royal Observatory and the SAAO were leaders in this field.

The colour of the light to be measured was selected by glass filters and the feeble rays passing through them were measured using a photomultiplier, the most sensitive type of detector then available.

The colours most often of interest were U (ultraviolet), B (blue) and V (green or visible), later also R (red) and I (near-infrared). By comparing them the temperatures of the stars could be measured.

Cousins enjoyed a worldwide reputation for the accuracy of his work in setting up "standard stars" upon which many other astronomers placed reliance. He was also the discoverer of a new type of variable star.

Left: One of Cousins's photometers, built to his own design. The central cylinder contains the photomultiplier (detector). The periscope is for centering the star to be measured. The knobs control which filter is to be used and how large the measuring aperture is in terms of area on the sky.

Left: "Electrometer" for measuring the very feeble currents produced by the photomultiplier. This model dates from the late 1960s and was one of the last ones he used.

Left: "Brown" recorder used to automatically plot the signals from the electrometer on paper charts. These were later measured by hand using a special ruler to a precision of about 0.1%.

[ISG]