Time at the Royal Observatory

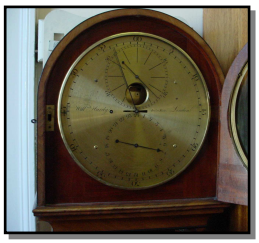
STAR TIME

The rotation of the Earth gives us two kinds of time (1) ordinary Sun-related time of 24 hours and (2) Sidereal time relating to the stars. This means that a star's position in the sky is always the same at the same sidereal time. A sidereal day is shorter by about four minutes than a solar day. It is only 23 hours and 56 minutes long because of the Earth's yearly revolution around the Sun.

NAVIGATION

When finding geographical longitudes from the stars it is necessary to know the time at Greenwich. Before radio communication became possible in the early twentieth century, ships made use of precision clocks called chronometers. These had to be checked whenever possible and Cape Town was one place where this could be done.

The Early Time Service



This is the oldest clock at the Royal Observatory, made by William Hardy in England before 1820. This type of clock is known as an Astronomical Regulator. It has a mercury-filled pendulum to compensate for temperature changes.

The site of the Royal Observatory was chosen so that it was visible from ships at anchor in Table Bay. This was so that their chronometers could be checked against an accurate time signal.

Nineteenth-century chronometer mounted in gimbals for shipboard use.

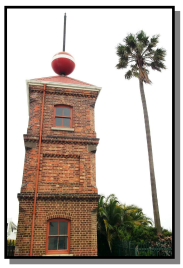
Even before the Observatory was built, Rev Fearon Fallows signalled the time by turning off an oil lamp at exactly 9.30 every evening.

In 1833, the second HM Astronomer, Thomas Henderson, made use of a signal pistol.

A Noonday Gun was fired from the early days of the British Colony (1806) and from 1864 was triggered electrically by the Observatory. At present one of the 200-year old guns located on Signal Hill is still fired from the Observatory each day.

Time Balls

From 1836 a Time Ball was Hoisted and let fall at a particular time. The picture (below left) shows an early 20th century ball on the grounds of the Observatory.



More time bells, triggered by electric telegraph, were placed around the country. That at the Cape Town Waterfront (above, right), dating from 1883 but enlarged in 1895, still receives a signal from us. The mechanism currently stands in need of some renovation [Photo: J. Forshaw].

Driving the Telescopes

The telescope axes are driven at the rate of one revolution in a sidereal day to follow the stars. Before AC electricity became available they had heavy duty weight-driven clocks controlled by mechanical governors, sometimes phase-locked to the Observatory Time Service by a clever electro-mechanical mechanism.
Every dome contained both sidereal and Solar time regulator clocks, later replaced by slave dials connected to the central Observatory time service.

It was a standard daily duty to check the clocks against each other and the stars to make sure that they were operating correctly. Precise sidereal time was necessary for measuring the positions of stars via the Transit Circles. The transit times were recorded on chronograph tapes together with time signals.

Small drive clock from the 6-inch telescope (weight not shown).

Twentieth-Century Clocks

The Riefler clock on display was one of the most accurate pendulum clocks ever made. Unlike ordinary regulators, this one had a very small drive weight that was re-wound every few seconds by an electromagnet. This action can be seen through the moon-shaped hole in its face when it is running. This particular clock came from the Republic-Union-Transvaal Observatory in Johannesburg. The Royal Observatory owned several similar clocks with vacuum housings but these were apparently sold off at some point.

In the second half of the 20th century, the Observatory's clocks (above) were based on quartz crystal oscillators and were checked by radio signals from the atomic clocks at the Republic Observatory in Johannesburg. The time was accurate to a few milliseconds.

The present-day SAAO time service makes use of the atomic clocks on the GPS satellites which yield accuracies at the microsecond level. They incorporate quartz crystal oscillators and other back-up features.