

The WHT begins operation

The world's best optical telescope is now working successfully.
IAN RIDPATH reports from La Palma

WHEN astronomers from the Royal Greenwich Observatory built the world's newest and best optical telescope, called the William Herschel Telescope (WHT), they never gave it an eyepiece to look through. It's not another example of the underfunding of British science, but rather an illustration of the changing nature of modern astronomy.

These days, astronomers don't put their eyes to large telescopes. The human eye has been superseded by electronic detectors that analyse the weak light collected by telescopes to reveal the composition and motion through space of objects that are millions of times fainter than can be seen by the naked eye.

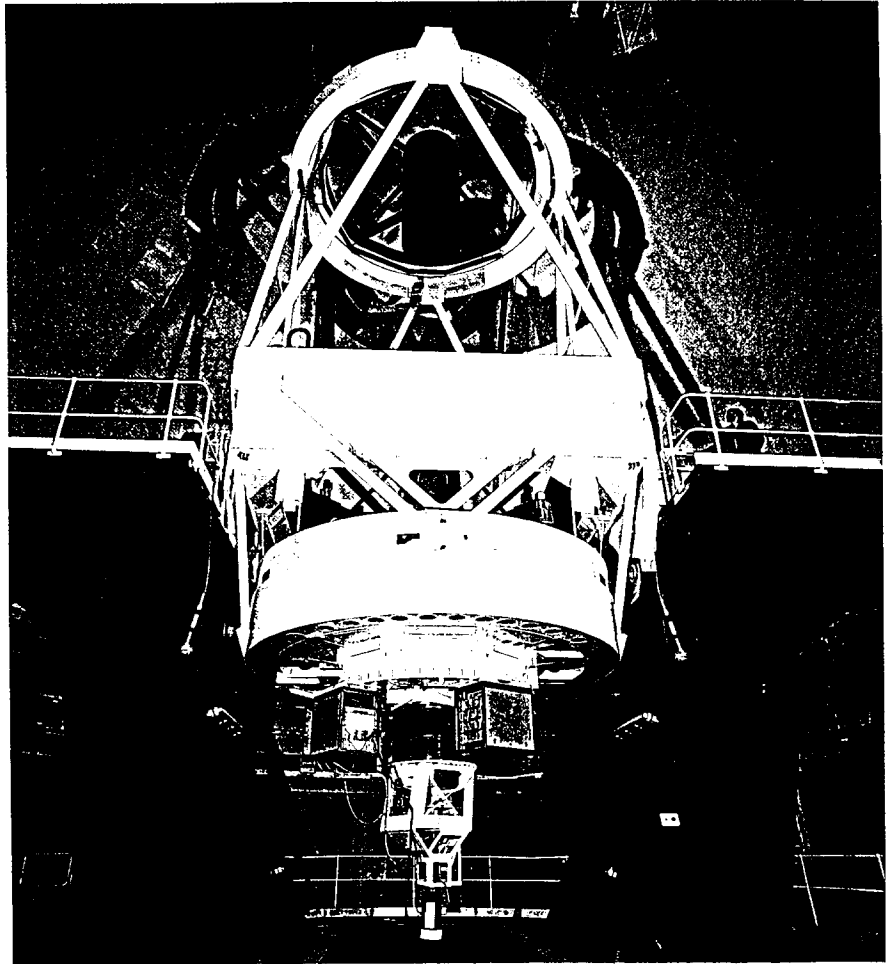
Astronomers using the WHT are particularly interested in galaxies and quasars so distant that their light has been travelling towards us since before the Earth was born. In a sense, the Herschel telescope is a time machine that allows us to see back towards the origin of the Universe, between 10 and 20 billion years ago.

The WHT is currently the most powerful optical telescope in the world, even though it's not the largest. Crucial to this high performance is the exceptional quality of its main mirror, 4.2 metres wide, precisely ground and polished by Grubb Parsons of Newcastle upon Tyne into the most accurate telescope mirror ever made. The mirror is made not of conventional glass but of a glass ceramic called Cer-Vit, produced by Owens-Illinois of Toledo, Ohio, which has zero expansion, so that the mirror's focus remains sharp despite changes of temperature.

With this gleaming eye the WHT can see fainter and more distant objects than even the Mount Palomar 5-m and the Soviet 6-m reflectors, both of which are larger but are technically less advanced.

Another advantage of the WHT is its location—the summit of the Canary Island of La Palma. Here, 2,400 metres up, it sits above the clouds (for most of the time, anyway) in a smooth airflow from the Atlantic that gives some of the clearest and steadiest sky views in the world.

The Greenwich astronomers chose La Palma as their new observatory site after extensive testing of the conditions at several promising locations including Tenerife (where there



Inside its dome, the 4.2-metre William Herschel Telescope on La Palma. At the bottom of the picture is the faint object spectrograph, the cylindrical object under the white cage at the Cassegrain focus. (David Calvert, Royal Greenwich Observatory)

already is an observatory), Madeira, the Cape Verde Islands, Italy, southern Spain and Hawaii.

At the Royal Observatory's current home of Herstmonceux, Sussex, the sky is cloudy on all but one or two nights per week — and even then the astronomers have to peer through dense layers of dirty and unsteady air, lit up by street lights. On the summit of La Palma, the skies are cloudless for at least six nights a week, the air is unusually steady and street lights are not yet a problem.

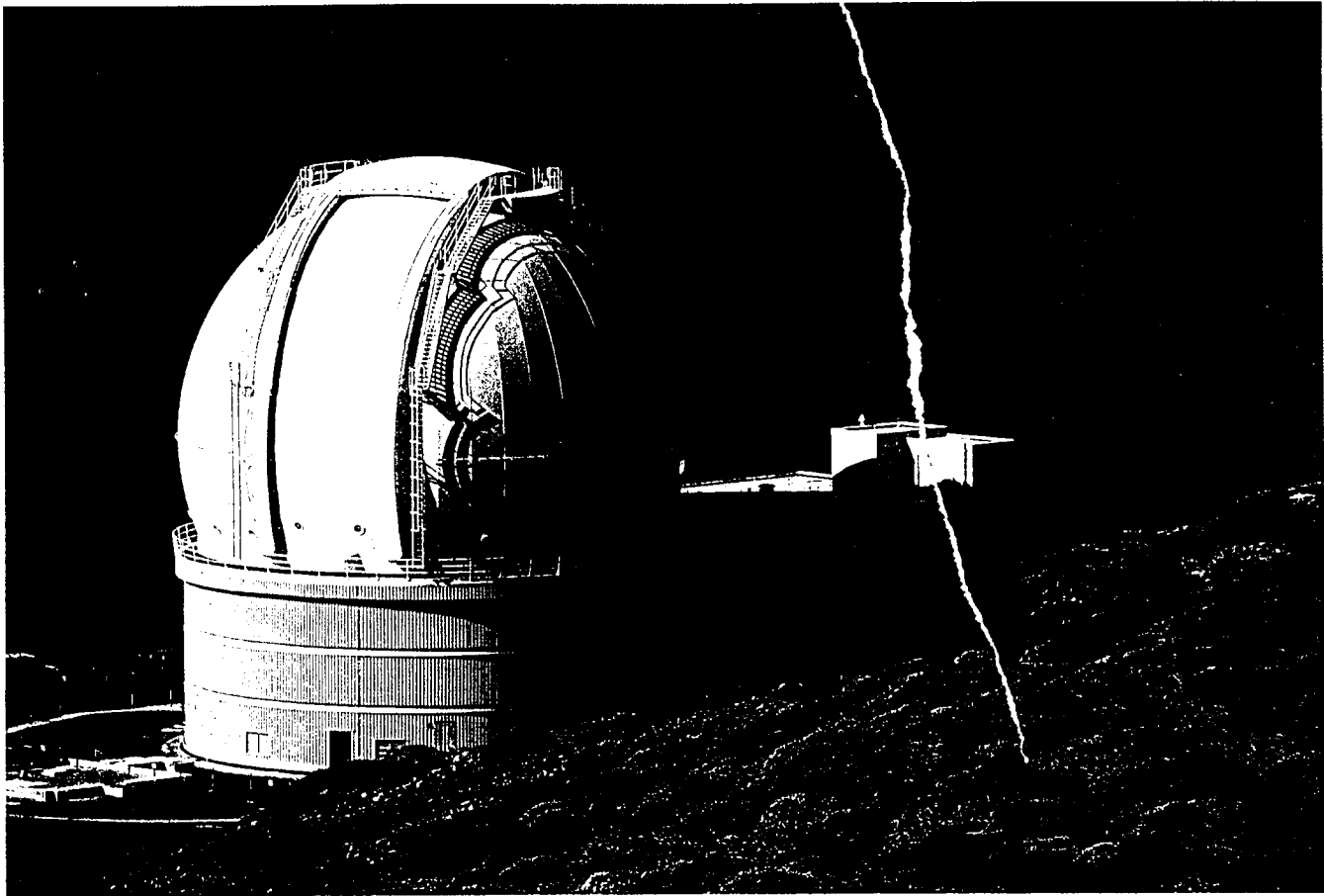
In 1979 the British astronomers signed an agreement with Spain, which owns the Canary Islands, to set up the Observatorio del Roque de los Muchachos, named after a group of eroded rocks on La Palma's peak. First the Isaac Newton Telescope, at that time western Europe's largest optical telescope, was moved from Herstmonceux to La Palma, with a new and

more accurate 2.5-m mirror to take advantage of the improved sky conditions.

Now, although it is not due to be officially opened until next year, the 4.2-m William Herschel telescope is already operating on La Palma with superb results.

Towering twice the height of a house, the telescope looks like a huge cannon, and with good reason. To keep down costs, designers abandoned the conventional equatorial mounting and gave it instead a more compact altazimuth mount (see the article by Paul Murdin in the April 1987 *Popular Astronomy*).

An altazimuth mounting requires constant adjustments in two axes to counteract the Earth's spin, but that task is easily accomplished by modern computers. In practice, the 200-ton WHT tracks objects with a hair's-breadth precision that outclasses most



*Above: The white dome of the William Herschel Telescope, at an altitude of 2,400 metres on the summit of La Palma
Below: Venus shines over the open dome as two astronomers arrive for a night's observing. (Robin Scagell)*

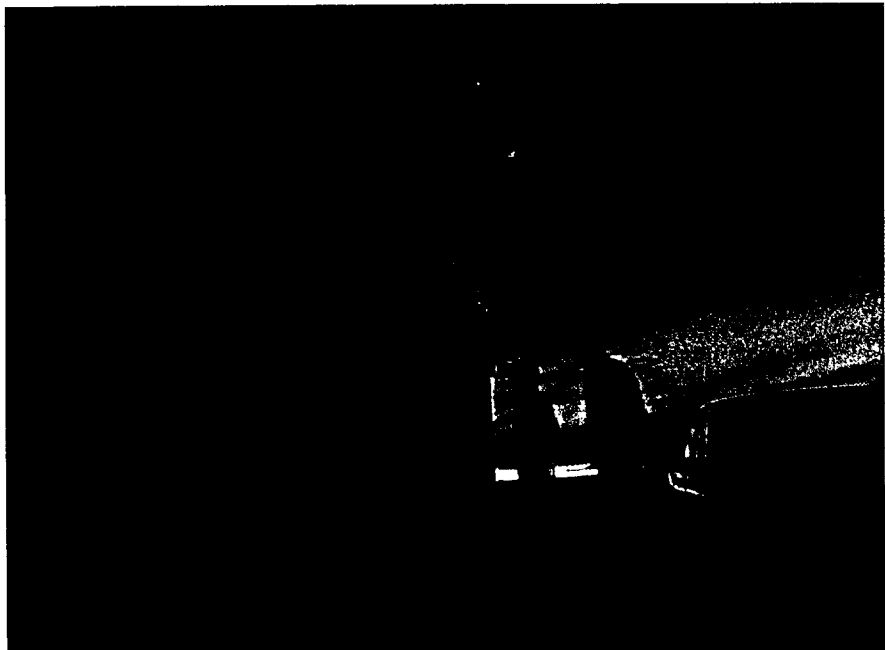
conventionally mounted telescopes, essential for long-exposure observations lasting an hour or so.

The key to the success of any big modern telescope is the instruments that go with it. Prime among these on the Herschel telescope is the device that astronomers call "the world's best redshift machine" — the Faint Object Spectrograph (FOS), built jointly by the Royal Greenwich Observatory and Durham University.

Redshift is a lengthening in the wavelength of the light from a galaxy or quasar, and it reveals how far off that object is in the Universe — the objects with the greatest redshifts are the most distant, and can tell researchers most about the origin and development of the Universe.

FOS splits up the light into a spectrum which it records on a light-sensitive silicon chip known as a charge-coupled device, or CCD, cooled by liquid nitrogen. A CCD is over 30 times more sensitive to light than a photographic plate, which reduces exposure times from hours to minutes.

Using FOS on the Herschel telescope, astronomers can obtain the spectrum and measure the redshift of a 20th-magnitude quasar in half an hour. In 1960, the spectrum of the first quasar, 3C 48, required a seven-hour



exposure with the Mount Palomar 5-m reflector — and that object was 40 times brighter than the quasars now being routinely observed by the Herschel telescope.

Currently, astronomers think they are looking 90 per cent of the way back to the Big Bang that supposedly started the Universe, and they are keen to go further back in time.

There is an informal rivalry among astronomers to set new redshift records, and the WHT is better equipped than any to push back the boundaries of the known Universe. William Herschel would have been delighted — though he would doubtless have brought along a few eyepieces in his pocket in the hope of snatching a quick look for himself.