Great British telescopes

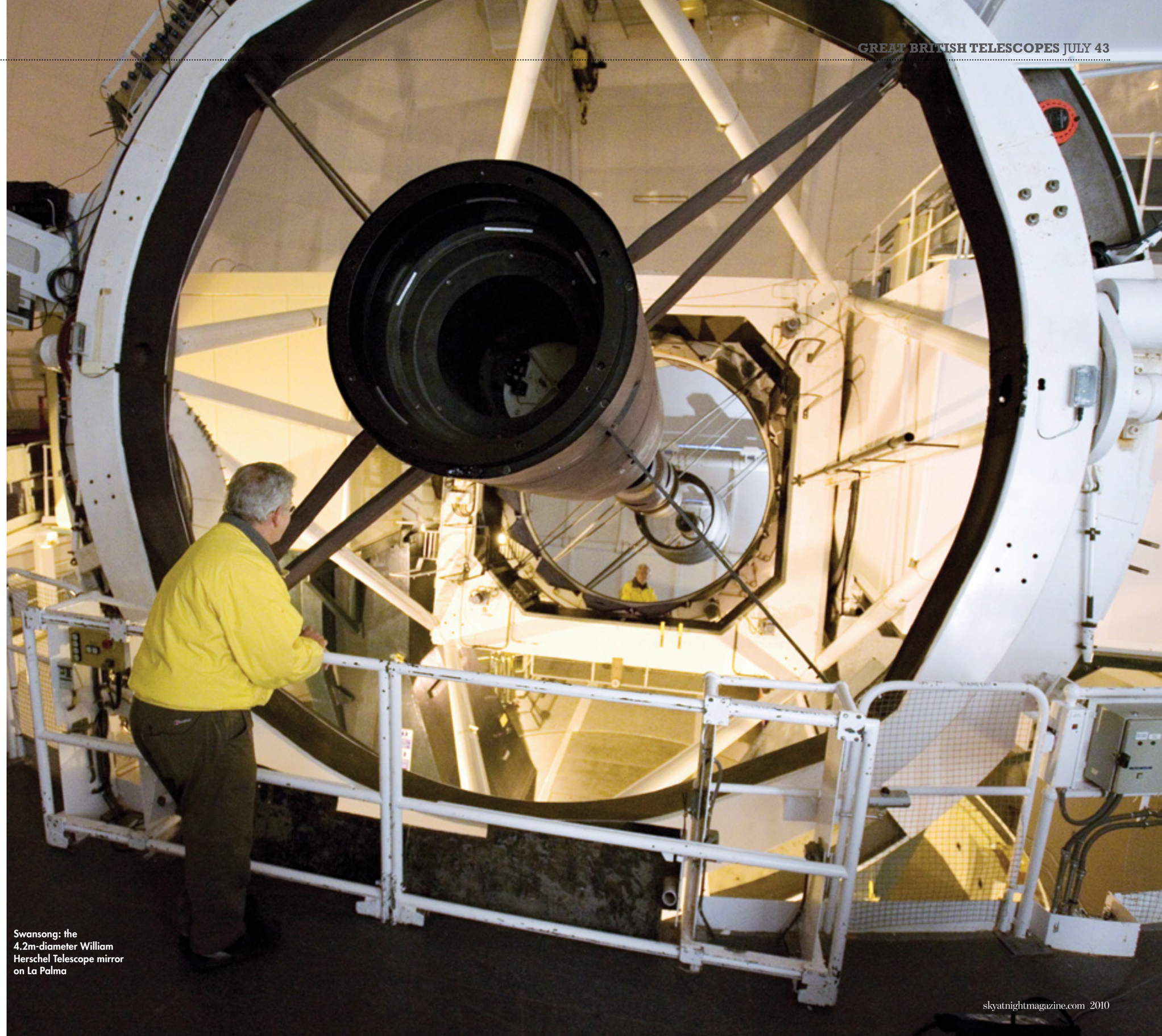
On the anniversary of the demise of Britain's last major telescope maker, historian Allan Chapman ponders the industry's rich history

WORDS: ALLAN CHAPMAN

Twenty-five years ago, one of Great Britain's oldest and most distinguished builders of major telescopes went out of production: Messrs Grubb Parsons, of Newcastle. The company's swansong was a magnificent 165-inch (4.2m) mirror for the William Herschel Telescope on the island of La Palma in the Canaries. The precision optical manufacturing that Grubb Parsons excelled at was, alas, a victim of changing technological and economic circumstances; the same circumstances that sent motor vehicles, electrical goods, heavy engineering and many other British manufacturing skills down the same slide to oblivion.

But what was it that made Grubb Parsons both a technological and a commercial market-leader for so long? In short, it was the rapid development of science and precision engineering that took place in 19th-century Britain. Complex technologies are inevitably the product of complex and fast-moving scientific and economic circumstances, and nowhere were these things changing so rapidly as in Victorian Britain.

Here, the wealth and technical expertise of the Industrial Revolution, combined with a burgeoning, highly motivated community of independent 'grand amateur' astronomers, resulted in the devotion of large amounts of brain-power, ingenuity and money to unravelling the structure of the Universe. And it was this combination of circumstances that, in 1834, first led Thomas Grubb, a Dublin machine-tools fabricator, iron-bed billiard table manufacturer and 'Engineer to the Bank of Ireland', into large-scale astronomical engineering. His first commission in this field was for the wealthy private astronomer Edward Joshua Cooper of Markree Castle, County Sligo, who had ▸



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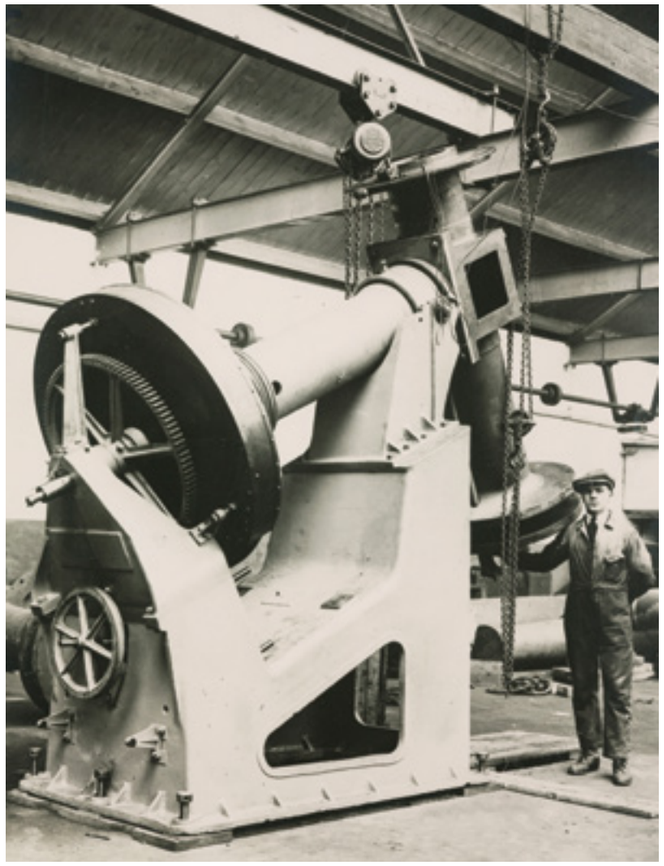
Swansong: the 4.2m-diameter William Herschel Telescope mirror on La Palma



SCIENCE MUSEUM PICTORIAL, NMEM, UNIVERSITY OF CAMBRIDGE, SCIENCE MUSEUM

The company founded by Thomas Grubb (pictured below) pioneered the mounts (above) used by many big Victorian telescopes

lenses, mounts and clock-drives that could keep an 8th-magnitude star automatically in an eyepiece micrometer's wires for half the night, leaving the astronomer's hands free to make measurements. In other words, several tonnes of iron, brass and glass had to move with horological precision.

Then, as the century progressed, telescopes of increasing size – both refracting and reflecting – needed to be capable of carrying the burgeoning technologies of spectroscopy, then photography and even early stellar photometry. All of these required that a single ray of starlight should not deviate within a telescope's optical train during a long observing session. Thomas Grubb and his son Sir Howard became world leaders in this field up to 1925 with their Dublin and later St Albans-based company. The firm then went into partnership with Sir Charles Parsons and moved to Newcastle.

The production line

In the same way, one Thomas Cooke of York began to manufacture telescopes in the 1840s. Cooke's firm, along with its subsequent reincarnations as Cooke, Troughton & Simms, and Vickers Instruments, manufactured small- and medium-sized telescopes, theodolites and precision graduated instruments. It also built some very fine large instruments, including the Newall Refractor. But it was problems involved in planning, financing and building this great 25-inch (63.5cm) aperture telescope for the wealthy Gateshead grand amateur RS Newall that contributed to Thomas Cooke's relatively early death in 1868. He was 61. Contemporary lens-grinding technology

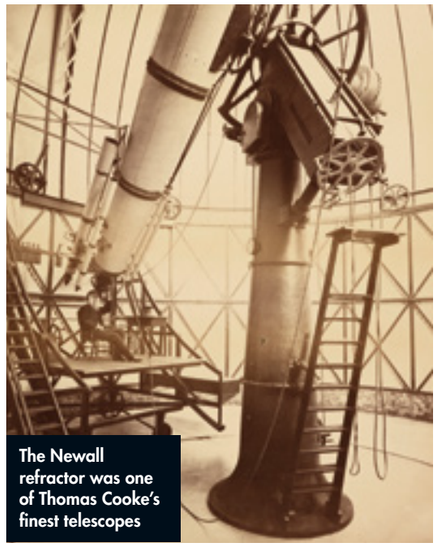
The new Victorian big telescope: a piece of machinery the size of a railway locomotive, built with the precision of a chronometer watch

▸ purchased a magnificent 13.3-inch (34cm) diameter objective lens of 25ft (7.6m) focal length, made by Robert Aglaé Cauchoix of Paris.

No doubt inspired by Joseph von Fraunhofer's beautiful 'German mount' equatorials from Munich, Thomas Grubb designed and built a mount for this Markree refractor. It became the prototype for most big refractors built thereafter, embodying the secret of the new Victorian big telescope: a piece of machinery the size of a railway locomotive, built with the precision of a chronometer watch.

In 1834, cutting-edge astronomy was about accurate double star measurement, asteroid and comet orbital work, and astrometry, aimed at confirming the action of Newton's Laws in the depths of stellar space. And such delicate observations demanded telescopes with fine in particular was stretched to the limits when faced with figuring 25-inch (63.5cm) glass blanks and sadly, the great telescope achieved nothing significant in the way of discovery. In 1890 it was given to Cambridge University Observatory.

It was indicative of the increasing diversification and specialisation of late Victorian industry that Thomas Cooke was a pioneer of manufacturing telescopes and fittings in a factory setting, as opposed to a workshop. His firm received commissions to build not only telescopes but heavy precision mounts, large metal domes and other ancillary fittings. By 1900, Cooke telescopes and big observatory parts were to be found across the globe; the firm's large domes alone had gone to Rio de Janeiro, Madras, Odessa, Liège and the Cape of Good Hope.



The Newall refractor was one of Thomas Cooke's finest telescopes

But British telescope making goes back further than the industrial age. Our nation's first recorded telescope maker was one Christopher Tooke. He knew Thomas Harriot, who had obtained a newly invented 'Dutch Truncke' – or simple telescope – in the early months of 1609, dismantled it, and discovered the optical theory behind it. Tooke made him several more, and by 1612 had produced an instrument giving 50x magnification. It's worth remembering that Harriot's drawing of the Moon, dated 26 July 1609, is still the oldest telescope drawing in the world – nearly four months older than Galileo's first drawing.

Of course, by 1609 spectacles had been in use across Europe for several centuries, so the techniques needed to grind simple lenses would have been readily available. By the early 1660s, Robert Hooke, in the early Royal Society, was designing a machine with which he hoped to grind a lens over a foot in diameter, having a focal length of a couple of hundred feet. It was not a success. But by 1670, Constantijn Huygens (brother to Christiaan, who discovered Titan) of the Hague – himself a Fellow of the Royal Society of London – was figuring beautiful lenses 9 inches (23cm) in diameter and of over 120ft (36.6m) focal length.

Going to great lengths

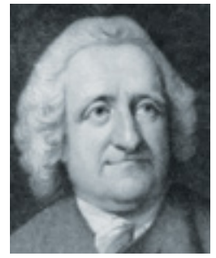
But why did astronomers in the 1670s commission lenses with such long focal lengths? Popular legend has it that it was to reduce chromatic aberration colour distortions, but in reality it was to obtain the largest possible prime focus images, especially of the planets. Astronomers at this time were searching for permanent, Earth-like features on lunar and planetary surfaces, as well as planetary satellites. The best way to do this was with a very long focus object-glass, the large prime focus image of which enabled the highest magnification.

While Newtonian and Gregorian reflecting telescopes had been around as experimental devices since the 1670s, it was really in the mid-18th century that specialist telescope makers began to emerge, such as the Scottish optician, James Short. In the 1740s, he brought together all the necessary technologies to manufacture fine reflecting telescopes in commercial quantities.

Short's business died with him in 1768, but one firm of this period made a success of the manufacture of achromatic, colour-distortion-free lenses, to become an enduring British optical business – that of John Dollond and his successors. Dollond and his son Peter laid the foundation of their family's fortune when, by means of industrial espionage, ingenuity and original optical research, they were able to secure a patent for a new type of lens that had become hot commercial property. This wonder solved the problems inherent in designing achromatic lenses by employing a compound of crown and flint glass in one unit, the crown cancelling out the distortions of the flint and vice versa, to give an aberration-free image.

The superior quality of Dollond achromats was demonstrated in their extensive use for the observation of the Venus transit in 1769. It must have weighed heavily on the mind of the lawyer and amateur optician who first thought of this optical breakthrough, Chester Moor Hall, that he never developed the invention himself. Dollond's shrewd actions initiated a British optical dynasty; one that has survived, given partnership changes, to the present day.

While the Dollonds were growing rich on their British patent proceeds, opticians in Switzerland ▸



John Dolland (above) established a successful business and created telescopes such as the 2-inch achromatic (below) used to observe the Venus transit in 1769

Britain's greatest telescopes

◀ BRITAIN'S FIRST BIG TELESCOPE, CIRCA 1665

This 60ft (18.3m) refractor, probably made by Richard Reeves, was a wooden tube controlled by ropes and pulleys. Robert Hooke observed from the quadrangle of Gresham College, London, with this and a similar 36ft (11m) telescope. It produced 173x magnification. Using these and other long telescopes between 1664 and 1666, Hooke observed six distinct zones on Jupiter (and possibly the Great Red Spot) and surface features on Mars. He also made the first detailed study of a lunar formation: the crater Hipparchus.

◀ SIR WILLIAM HERSCHEL'S GREAT 40FT TELESCOPE AT SLOUGH, 1789

With its 48-inch (122cm) aperture and 40ft (12.2m) of focal length, this great iron tube could be winched around to any part of the sky thanks to an elaborate timber scaffold and rigging. Generally, though, it would be set to a given declination, and from the gallery, Herschel would observe objects as they crossed the field of view. However, it produced fewer cosmological discoveries than its handier 18-inch (45.7cm) aperture prototype. It was only surpassed in size in 1845 by Lord Rosse's 72-inch (1.8m) 'Leviathan'.

◀ REV TW WEBB'S 9.33-INCH SILVER-ON-GLASS REFLECTOR, 1865

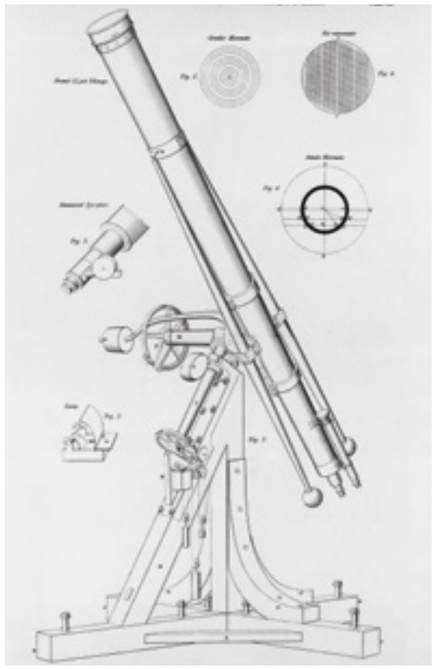
Franco-German techniques for depositing silver on glass in the 1850s gave rise to the popular, high-quality reflector for amateurs of modest means. Thus was born the reflector for serious astronomical work. This example was made by George With for the famous astronomer and author of *Celestial Objects For Common Telescopes,* Rev Thomas William Webb. By 1870, many British amateur astronomers were skillfully figuring and silvering 6- to 15-inch mirrors of their own from industrially available glass blanks.

◀ GRUBB'S PHOTOGRAPHIC AND SPECTROSCOPIC TELESCOPE, 1869

During the 1860s, spectroscopy and photography began to transform astronomy. The great pioneer was the English grand amateur Sir William Huggins. In 1869, Thomas Grubb built a new type of 'double telescope' for Huggins; a 15-inch (38cm) aperture refractor for visual and spectroscopic work, counterbalanced on the same polar axis by an 18-inch (46cm) photographic reflector. It was a great research success, and paved the way for the development of specialist spectroscopic and photographic optics.

◀ THE WILLIAM HERSCHEL TELESCOPE, LA PALMA, 1986

The 165-inch (4.2m) mirror for this telescope was the last big piece of optical engineering to leave the Newcastle workshop of Grubb Parsons in 1985. Joining the 100-inch (2.5m) Grubb Parsons Isaac Newton Telescope under the clear skies of La Palma, the William Herschel Telescope was designed with a versatile optical system enabling the great mirror to be used at the prime, Cassegrain and Nasmyth foci, to act both as a giant camera and as a spectroscope.



Joseph von Fraunhofer designed his lenses mathematically, outpacing British manufacturers

▸ and Germany were tackling the technological problem that hindered the development of achromatic lenses: making high-quality, dense flint-glass blanks bigger than four inches in diameter. By 1820, Fraunhofer in Munich had taken the achromatic lens to its next stage: first, by using a technique for making flint glass blanks almost 10 inches in diameter, and then by designing lenses mathematically, rather than empirically, as the Dollonds did, to produce superior definition.

As a result, the cutting edge of big lens production shifted to Munich and Paris by 1820. British import taxes on flint glass did not help the situation. Indeed, cases were on record of English astronomers, returning from travels on the continent, smuggling fine German and French lenses into Britain inside false bottoms in their bags, and then having the lenses worked into complete telescopes by British engineers.

And while Edward Joshua Cooper seems to have obtained his 13.3-inch (34cm) Cauchoix lens legally, it was this growing practice of importing unmounted continental optics that brought Thomas Grubb into big telescope engineering in 1834. Not until the 1850s, when firms like Chance Brothers of Birmingham mastered the technique for casting great slabs of pure glass, did indigenous big-telescope making companies such as Grubb and Cooke begin to flourish. They made British lenses that were competitive on the world market.

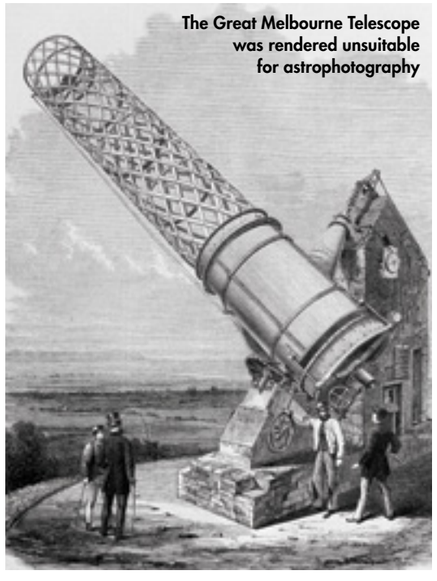
And it was a global industry. By 1870, telescopic optics had become highly competitive internationally, especially when American firms such as Alvan Clark of Boston and John Alfred Brashear of Pittsburgh came into free market competition with Grubb, Cooke, and the great Franco-German opticians.

It had been the grand amateur Sir William Herschel who was the first scientist to successfully cast and figure large speculum metal mirrors in the 1780s, building reflecting telescopes that revolutionised cosmology. Likewise, the great developments in big reflecting telescope technology down to the 1870s continued to be made by grand amateurs. For example, the world's biggest telescope between 1845 and 1917 was the creation and property of an Irish earl, Lord Rosse. And it was the Liverpool brewer, William Lassell, and his friend the Edinburgh-Manchester engineer, locomotive-builder, steam-hammer inventor (and astronomer) James Nasmyth, who pioneered the next generation of giant reflecting telescopes.

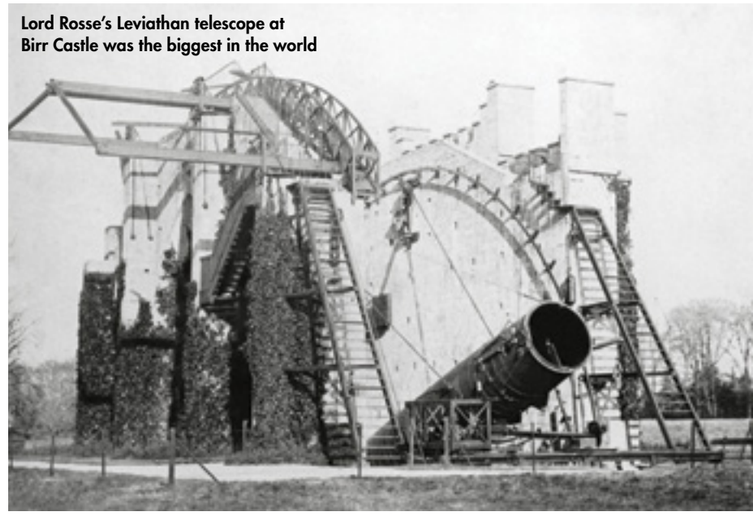
Steam power

Using the great steam-powered machines at his factory in Manchester, Nasmyth was able to realise the telescope designs of his friend Lassell. Splendid speculum metal mirrors, up to 4ft (1.2m) in diameter, could be routinely cast and then figured to perfection with specially designed precision steam-powered machines. Forty-foot (12.2m) telescope tubes could be made to turn like a clock, while Nasmyth also invented a reflecting telescope configuration for his own observatory that still bears his name, the original of which is in storage at the Science Museum (alas, not on show).

The mirror-polishing, astatic (adjustable and balanced) mirror cells and great equatorial fork mounts developed by Lassell and Grubb would establish the equatorial engineering prototypes for the large, pre-digital era reflectors. Some of these,



The Great Melbourne Telescope was rendered unsuitable for astrophotography



Lord Rosse's Leviathan telescope at Birr Castle was the biggest in the world

English astronomers smuggled fine German and French lenses into Britain inside false bottoms in their bags

such as the Hooker telescope at Mount Wilson, with which Hubble determined the extragalactic nature of what were then called 'nebulae', were used for groundbreaking observations. Others, like the Great Melbourne Telescope of 1869, were rather less successful. This 48-inch (122cm) Cassegrain reflector suffered from a varnish coating applied to the primary mirror to protect it from the elements during its voyage from Britain to Australia, rendering it unsuitable for the then new techniques of astrophotography.

Let us not forget that by 1880, serious amateur astronomy had become important in Great Britain. So important that, in addition to numerous amateur mirror-makers, high-quality telescope manufacturers were already doing a thriving trade catering largely for that market. Cooke's of York supplied excellent tripod refractors, while George Calver of Chelmsford and John Browning of London could not only sell serious (and well-off) amateurs a fine telescope with accessories, but complete observatories, such as those set up for Browning's clients by employees like Charles Grover.

Considering this immensely rich history, it is sad that today, whether you want a spotting scope or a great research instrument, it is virtually impossible to buy British. But that, alas, is how markets go. Yet when you consider the brains and skills that make sense of modern telescopic data, from professional cosmology to amateur variable star work, then Great Britain is still a world leader. S