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A GLIMPSE AT THE ASTRONOMY HERITAGE OF THE SCIENCE MUSEUM, LONDON[1]

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Abstract: The astronomy collections at the Science Museum, London, are probably the richest in the world with respect to their diversity and size. Amassed over the last 150 years, they contain items as diverse as a model exhibited at the London Great Exhibition of 1851 to instruments used on today's robot space probes. To give a glimpse of the wealth of the collections, this account will focus upon a number of objects under four themes. These are early telescopes, people associated with astronomy, scientific expeditions and models in astronomy.

Keywords: astronomical collections, Science Museum, London

1 EARLY TELESCOPES

Although priority for the invention of the telescope is uncertain and may never be resolved (see van Helden, 1977), definite landmarks in the instrument's evolution are known. Key objects in our collections illustrate the twin track development of both reflecting and refracting telescopes. This is epitomized by Christopher Cock's drawtube telescope dated 1673 (Baxandall *et al*, 1926; NMSI 1926-419). Made in London, this is the oldest complete telescope at the Science Museum (Figure 1).

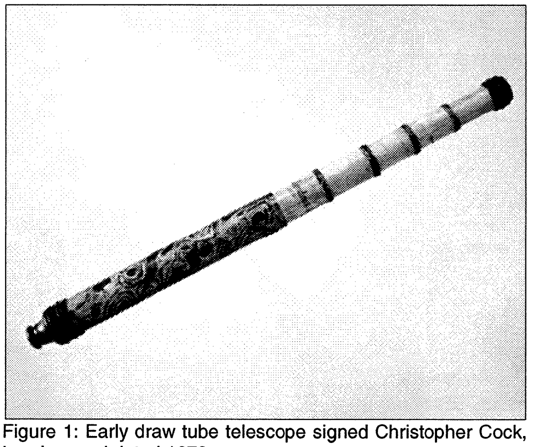

Figure 1: Early draw tube telescope signed Christopher Cock, London, and dated 1673.

The evolution of the non-achromatic refracting telescope is further illustrated by Huygen's aerial telescope (Smith, 1738: 354-362 and Plate 52). With a focal length of 150 feet (46m), the telescope dispensed with the need for a tube; instead the object lens was mounted aloft a high pole connected to the eyepiece by means of a taut cord (NMSI 1932-461; see Figure 2). At night objects were located using the image of a candle flame that reflected from the reverse side of the main object lens via a lantern adjacent to the observer. The poor quality glass used in early telescopes can be judged from an early lens in the collections (Howse, 1975) that Pierre Boreal (1629–1689) of the French Academy of Science is thought to have made (NMSI 1932-460). Like the Huygens' telescope, it also originates from the Royal Society of London. John Flamsteed (1646–1719), the first Astronomer Royal, is believed to have used it with the 90-ft (27.4m) Well Telescope at the Royal Observatory, Greenwich, in his search for stellar parallax (Laurie, 1956).

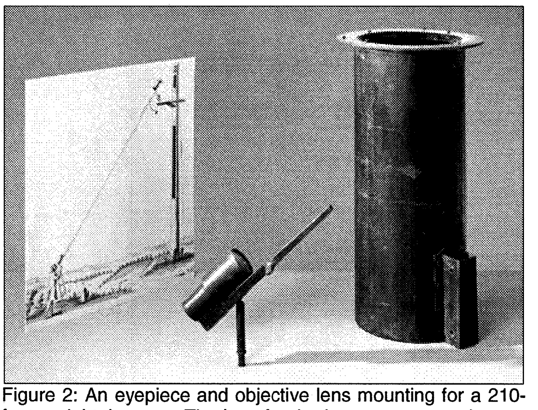

Figure 2: An eyepiece and objective lens mounting for a 210-foot aerial telescope. The lens for the instrument was given to the Royal Society, London, by Christiaan Huygens.

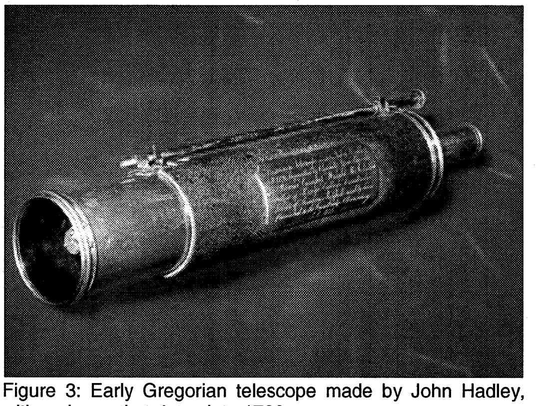

Figure 3: Early Gregorian telescope made by John Hadley, with a plaque that dates it to 1726

The collections hold similar icons relating to the early development of the reflecting telescope. While Sir Isaac Newton's first telescope might be seen as the prototype, it was John Hadley (1682–1744) who was the first to make useful reflecting telescopes. Preserved at the Science Museum are two telescopes built by Hadley that illustrate these changes. The first (NMSI 1932-459) consists of the optical components of Hadley's first Newtonian reflecting telescope that he made in 1723. Hadley (1723) first demonstrated and later donated this instrument to the Royal Society. The other is a Gregorian reflecting telescope (NMSI 1937-601) that has been credited as being the oldest surviving example (Figure 3). Although James Gregory (1638–1675) first proposed this optical design in 1633, the difficult optical surfaces could not be made by the opticians of the period. Today there is some doubt as to this claim, as stylistic details suggest a later date. It seems more likely that this relic was made at the end of Hadley's life, perhaps as a representation of his first Gregorian instrument. This historical object from the early history of the telescope has a documented provenance (Rigaud, 1835). It owes its survival to having been kept within the Hadley family circle before being donated, in 1874, to the University Observatory, Cambridge, in England.

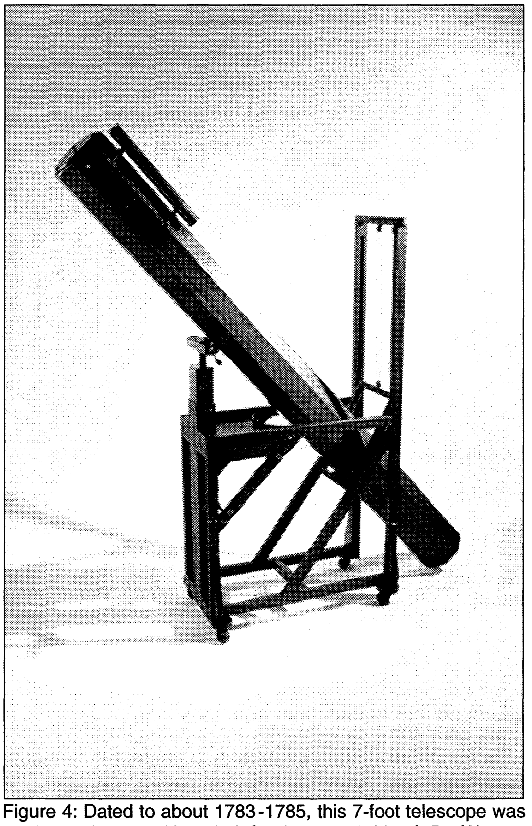

Figure 4: Dated to about 1783-1785, this 7-foot telescope was made by William Herschel for his good friend Dr Watson whom he first met in Bath whilst observing the heavens.

2 PEOPLE IN ASTRONOMY

For much of its history, the discipline of astronomy has been the domain of the amateur. Prior to the emergence of professional astronomers during the nineteenth century, individuals of independent financial means funded most astronomical research. Employment in this field was limited to a small band of people in the service of a rich sponsor. These were more likely to be influential aristocrats rather than the government itself. The national observatories of both France and Britain, established in the seventeenth century, are rare examples of state-funded astronomical institutions. Their function was strictly utilitarian, to help commerce through maritime trade, by developing a solution to finding longitude at sea. Pure research tended to lie in the realm of the amateur scientists, who could follow their own programmes of investigation, free from interference or accountability to government (see Chapman, 1998).

Within the ranks of the amateur astronomy there are many examples, both from the eighteenth and nineteenth century, of amateurs having instruments preserved at the Science Museum. By far the best known is Sir William Herschel (1738–1822), a trained musician from Germany, who came to England as a refugee to escape the French occupation of his native Hanover. His subsequent achievements, which placed him at the forefront of the developing discipline of astronomy, have been well documented by Hoskins (1963) and Schaffer (1981). The Science Museum is fortunate to possess an unrivalled selection of his telescopes, along with a range of associated material. At present, the majority of these can be seen on display at the Museum in the 'Science in the Eighteenth Century' and 'Making of the Modern World' galleries. Preeminent amongst these Herschel relics are two of his, so-called, '7-foot telescopes'. The first (NMSI 1876-1000), with a mahogany tube and stand (Figure 4), was made around 1784 (Lubbock, 1933: 138) for Sir William Watson the younger (1744–1825?). Longstanding friends, Watson first met William Herschel outside his house where he was observing with a telescope (Lubbock, 1933: 73). Through Watson's influence, William Herschel published his first research paper and was introduced into the circle of Britain's scientific elite. The second 7-foot telescope (NMSI 1908-160 and Dreyer *et al*, 1923), which is made of black painted deal (pine), was once the property of Caroline Herschel (1750–1848). Acting as amanuensis, Caroline recorded William's observations at the telescope and was an able observer in her own right, discovering eight comets during her lifetime (Herschel, 1876; Hoskin, 2003). The telescope, made after 1795, is a copy of the one William used to discover the planet Uranus (Herschel, 1876: 313). Caroline is thought to have taken the telescope to Hanover after William Herschel's death; it was later given to the Royal Astronomical Society.

Other Herschel material (Steavenson, 1925: 210-220) includes a large selection of eyepieces (NMSI 1925-466 and 467; see Figure 5), a mirror grinding/polishing machine (NMSI 1876-1019) and a selection of mirrors (1925-464 and 1971-465; see Figure 6). Though most of Herschel's mirrors are made of speculum metal, an arsenic-rich bronze alloy, the Museum has a rare example of a glass mirror (NMSI 1925-463) that he made, and another made of the white ceramic known as Tassies compound (Steavenson, 1925: 221-238). The largest Herschel item currently on display is the original 48-inch mirror (Figure 7) that was cast for his Forty Foot Telescope in 1785 (NMSI 1932-567 and Dreyer 1912).

In stark contrast to William Herschel, Dr James Lind (1736–1812) is almost unknown outside historical circles. As a medical doctor and gentleman scientist he was familiar with most of the prominent scientist of his day. Later in life he retired to Windsor, England, where he was doctor to the Royal household. By chance his telescope (Figure 8), which he used to observe the 1769 transit of Venus (Lind 1769), is preserved in the collections of the Science Museum (NMSI 1906-71). The instrument has recently gained more significance as it has been suggested that this

Scottish physician was the role model for the figure of Dr Frankenstein in Mary Shelley's famous novel. It is argued that Mary Shelley (1797–1851) drew her inspiration for the character from recollections of Dr Lind by her husband, the poet, Percy Bysshe Shelly (1792–1822) (Goulding, 2002). During his education, Shelly attended Eton College School near Windsor, where Dr Lind was his science mentor (as the school did not teach the subject).

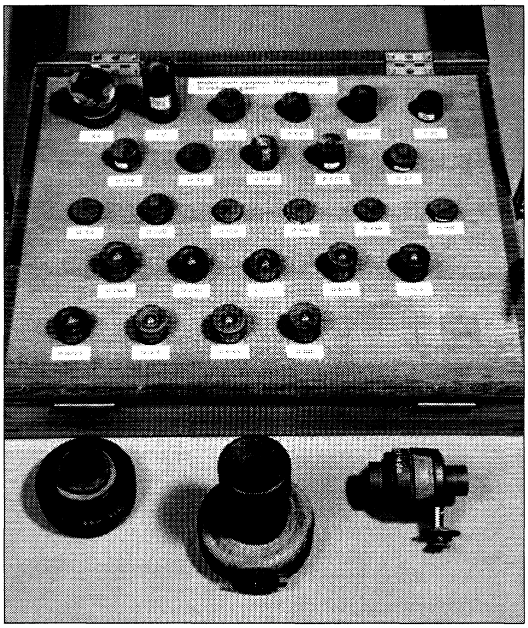

Figure 5: Selection of twenty-six eyepieces and two filar micrometers made and used by Sir William Herschel with his telescopes.

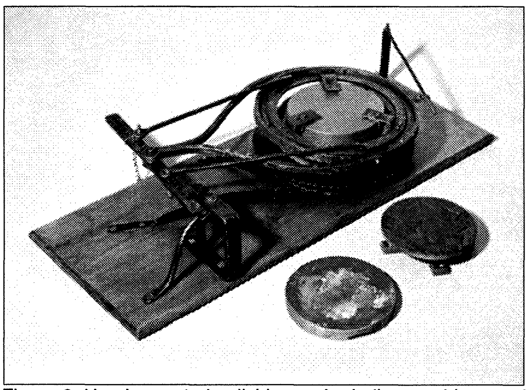

Figure 6: Hand-operated polishing and grinding machine used by Sir William Hershel to make 6-inch telescope mirrors.

Whilst the instruments of Herschel and Lind are famous by their associations, the Groombridge Circle (NMSI 1918-169) is significant because of the observations made with it. Acquired by the Science Museum in 1918, the transit circle (see Figure 9) was the first large instrument of its type to be used in England (Pearson, 1829: 402-405). Completed in 1806, it was ordered by Stephen Groombridge (1755–1832), a successful London merchant, from the instrument-maker Edward Troughton (1753–1835). Housed in a small observatory within his home, Groombridge used this transit circle to undertake an exhaustive survey of the positions of the north polar stars (Ashbrook, 1974). He would frequently excuse himself from the dinner table to make a vital observ-ation, only to return soon after and resume where he had left off. Such was the accuracy of the resulting star catalogue (Groombridge, 1838), published after Groombridge's death, that it was still of value well into the twentieth century.

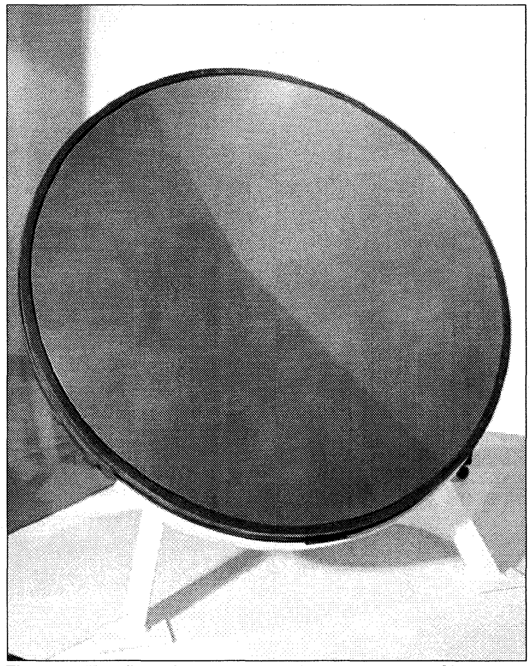

Figure 7: The first of the two speculum mirrors that Sir William Herschel made for his great Forty Foot Telescope, erected at his home at Slough, England.

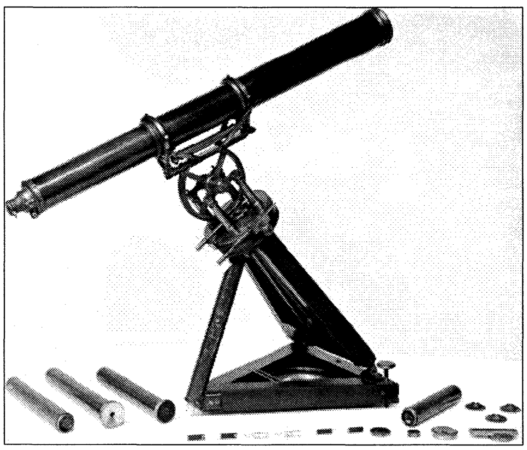

Figure 8: Dr Lind's 2-foot refracting telescope made by Jesse Ramsden with a lens by Peter Dollond and mounting by John Miller. It was used by Lind to view the 1769 transit of Venus.

3 SCIENTIFIC EXPEDITIONS

When Edmond Halley proposed that the transits of Venus could be used to measure the vital Earth-Sun distance, he set in train the first large-scale scientific expeditions. These rare astronomical events, occurring at century-long intervals, were therefore a great spur for scientific co-operation between nations. Due to the Seven Years War (1756–1763) the 1761 transit of

Venus was poorly observed, but eight years later, in 1769, matters were entirely different. From both these events the Science Museum has a rich collection of instruments that were sent around the world to try and gauge the size of the Solar System.

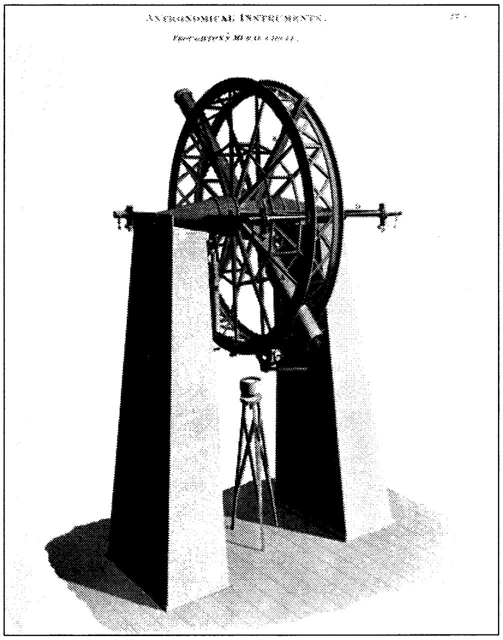

Figure 9: Print showing the Groombridge Circle, a four foot transit circle made by Edward Troughton in 1806.

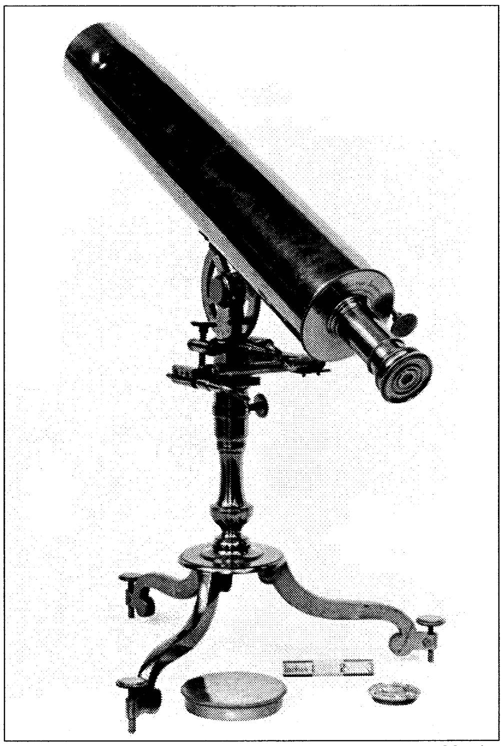

Figure 10: Gregorian telescope by Benjamin Martin, London, used by John Winthrop to observe the 1761 transit of Venus from Newfoundland.

From the 1761 transit the Museum has the Gregorian telescope (NMSI 1911-283) used by John Winthrop (1714/15–1779) to view the event from St John's, Newfoundland, in Canada (Figure 10). Originally the property of Harvard College (Wheatland, 1968: 13-14), it survived a disastrous fire in 1764, but was lost during the American revolutionary war.

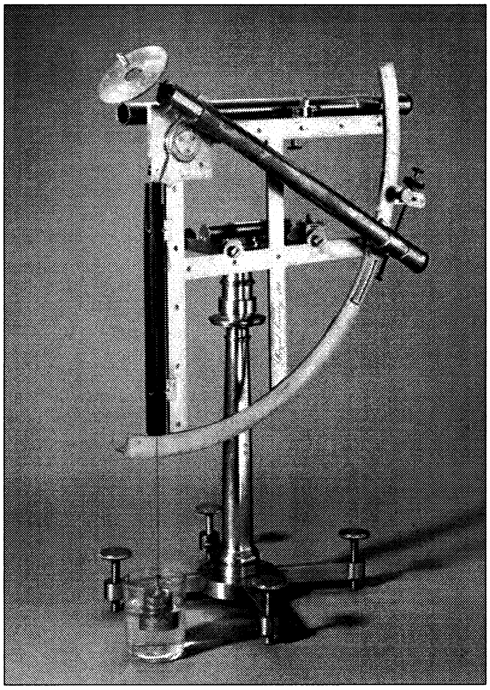

Figure 11: Two foot quadrant with a stand by John Bird, ca.1760s. Acquired by the Royal Society of London for the observation of the 1769 transit of Venus.

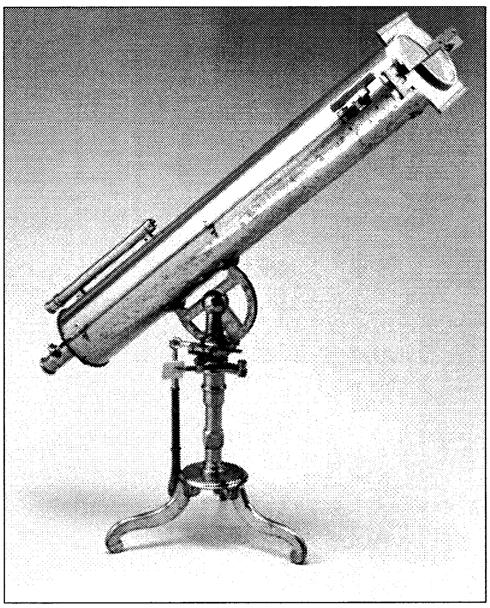

Figure 12: Two foot Gregorian telescope and stand by Sir James Short, with split-lens micrometer, ca.1763. Made for the Royal Society of London for the observation of the 1769 transit of Venus.

The Museum also has a selection of instruments that were dispatched to several sites around the world by the Royal Society of London (e.g. see Bayly, 1769; Dixon, 1769). These instruments include a pair of portable quadrants NMSI 1900-138 and 139; see Figure 11), a regulator clock (NMSI 1914-591), along with a reflecting telescope by James Short (NMSI 1900-136; Figure 12) and a refracting telescope by John Bird (NMSI 1900-133).[2] It is now impossible to distinguish the exact history of each instrument with respect to specific expeditions (Howse, 1979), but it is likely that some were used on Captain Cook's first voyage of discovery (1768-1771) to Tahiti to view the transit (see Beaglehole, 1968; Orchiston, 2005). Another item from the same source is a model to demonstrate the basis for a transit of Venus across the Sun's disk (NMSI 1900-150; cf. Calvert, 1967: item No. 17). Used to popularise the approaching event, the precious model is probably the only surviving example from this period. On loan from the Royal Society, this de-vice was recently returned, and can now be seen on display at the Society's headquarters in Carlton Terrace, London.

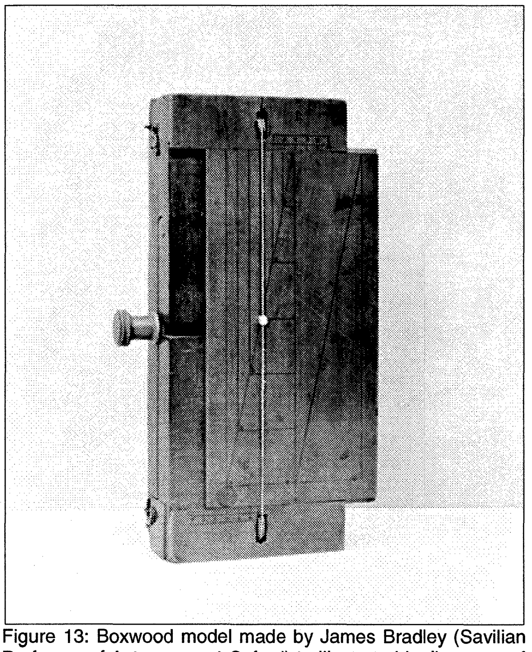

Figure 13: Boxwood model made by James Bradley (Savilian Professor of Astronomy at Oxford) to illustrate his discovery of the aberration of light. It was used by him during his lecture on the subject at the Ashmolean Museum, ca.1729.

4 ASTRONOMICAL MODELS

The impression that the astronomy collections of the Science Museum mainly consists of telescopes and associated instruments is misleading. A significant percentage of the objects are in fact astronomical models that either represent or demonstrate astronomical principles or, in some cases, accomplish both. An example of the latter category is a diminutive boxwood device (NMSI 1876-1029) created by James Bradley (1693–1762) to demonstrate the aberration of starlight (Figure 13). Made around 1729, when Bradley was the Savilian Professor of Astronomy at Oxford, it was used by him in his lectures. In operation the apparent displacement of starlight is achieved using a laterally-moving plate driven by a pulley-driven string carrying a glass bead representing a corpuscle of light. As a handle is turned both the bead and the inscribed plate moved at right angles to each other. Over a century later, in 1845, the model was described and illustrated by a later Savilian Professor, the Reverend Baden Powell (1796–1860) (see Powell, 1846).

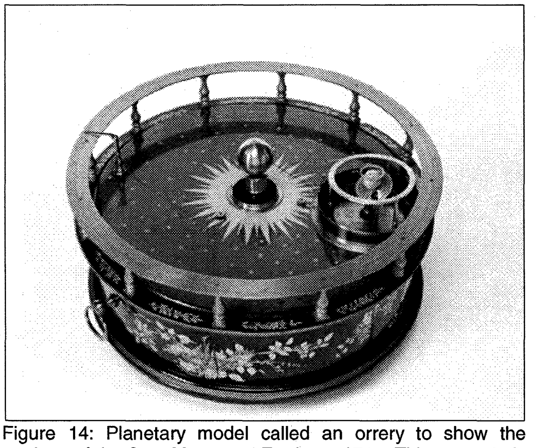

Figure 14: Planetary model called an orrery to show the motions of the Sun, Moon and Earth, ca.1715. This example is the one to which the title of orrery was originally conferred after the Earl of Orrery who commissioned it.

In comparison to Bradley's simple device, the Science Museum's original orrery (NMSI 1952-73) is an ostentatious and intricate device (Figure 14). Built by John Rowley (d. 1728), a London instrument-maker, it was made for Charles Boyle (1676–1731) the fourth Earl of Orrery around 1713 (see King, 1978: 150-167). It was not the first planetary model to incorporate gearing to show the Copernican Sun-centred system, as in 1657 a fine example was made in the Dutch city of Leiden (see Dekker, 1986). Models of this type became popular as a means to portray the clockwork Universe that Sir Isaac Newton's new theory of gravity could now predict in precise detail. Copied from an earlier example and designed by the clock-maker George Graham (1673–1751), the machine's fine qualities were soon described in print by the London wit and essayist, Sir Richard Steele (1672–1729) (see Cudworth, 1883: 81-82). Such was the publicity that it was soon being called 'The Orrery', a term that was subsequently applied to all similar devices in English-speaking countries.

The astronomy collections of the Science Museum have a broad selection of models that convey representations of the heavens and our nearest celestial neighbours. Most cherished amongst these is a celestial globe (NMSI 1910-249) thought to be the oldest known example that uses printed star maps on paper gores (Figure 15). Attributed to Johann Schöner (1477 –1547) (Zinner, 1956: 171), a German globe-maker from Nuremberg, it has been dated to around 1532 (Dekker and Krogt, 1993: 23-24). A near identical globe can be found in the composition 'The Ambassadors', painted by Hans Holbein, which currently hangs in the National Gallery, London. By contrast, John Russell's Moon globe (NMSI 1949-117) has a complex stand to demonstrate lunar libration and parallax (Figure 16). The complete assembly named Selenographia by Russell was based on his own lunar observations, which he started in 1785 using a small telescope fitted with an eyepiece micrometer. An established portrait painter, John Russell (1745–1806) believed he could create a more realistic and accurate portrayal of our lunar neighbour (Ryan, 1966). Produced in only small numbers through direct subscription, the Moon map was published in 1797. This particular example came to the Museum in 1949, being a gift from the British monarch King George VI (1895–1952).

Figure 15: Celestial globe made by Johann Schöner in Nuremberg, Germany, ca.1532. This is thought to be the oldest surviving printed celestial globe.

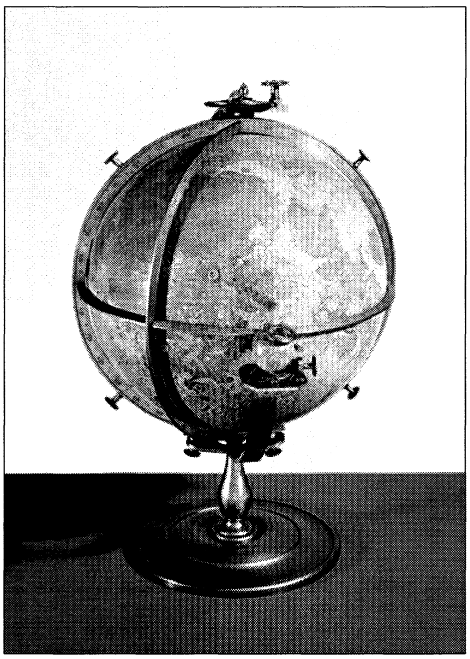

Figure 16: Moon globe with elaborate stand to demonstrate libration and lunar parallax, made by the artist John Russell.

Also under the lunar theme is an electrotype model of the lunar crater Eratosthenes (NMSI 1858-43) made by Henry Blunt (d. 1853) from Shrewsbury, England (Figure 17). Given to the Museum by the Commissioners of the Great Exhibition in 1858, it is one of the earliest acquisitions in the collection. The model was exhibited at the 1851 World Exposition in London and was awarded a prize by Exhibition jurors (Bennett, 1983: 12). The original plaster model from which the electrotype model was made now resides in the archives of the Royal Astronomical Society in London (see Royal Astronomical Society, 2000).

5 SUMMARY

This brief resume of the astronomical heritage of the Science Museum, London, offers a unique insight into the wealth and diversity of its collections. This account is intended as a stimulus to open people's eyes to the narrative of these objects and their significance to the history of astronomy. Often hidden from public view, these items need to be more widely seen, a process that is now becoming possible through rapidly-expanding multi-media avenues, including the Internet, and through changes in how museums now interpret their collections. Already an inventory of our astronomy holdings can be found at the Online Registry of Scientific Instruments website (http:// www. isin.org/) hosted by the Museum for the History of Science in Oxford, England. Likewise, the London Science Museum has launched a new narrative website called 'Ingenuity'. Amongst the topics tackled is Sky Watching, which globally explores the subject through the Museum's astronomy collections.

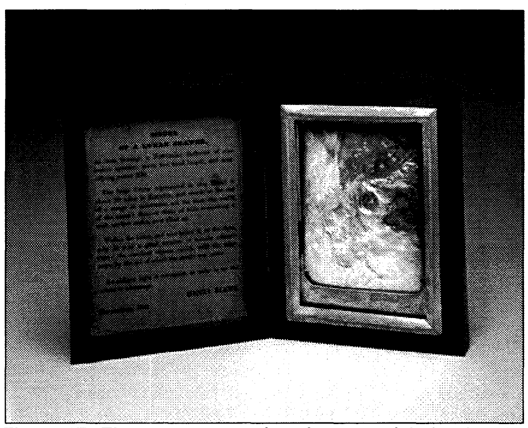

Figure 17: Electrotype copy of a plaster model showing the lunar crater, Eratosthenes. Made by Henry Blunt using lunar observations made from his home in Shrewsbury, England.

6 NOTES

1. This paper was presented in the Historical Instruments Working Group meeting at the 2003 General Assembly of the IAU in Sydney.
2. All of these instruments were used on Royal Society sponsored expeditions to observe the 1769 transit of Venus. The Royal Society's 1834 catalogue of instruments states that the Bird refracting telescope was used for transit of Venus observations, but it does not appear on the list of instruments lent to expeditions specially undertaken by the Royal Society.

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