Surveying

Technological advances in the middle of the eighteenth century initiated a succession of innovations and improvements to surveying and navigational instruments.

LATITUDE

The quadrant or, more properly, the octant was developed by John Hadley who gave the first account of it to the Royal Society in May 1731. It was suitable for elevations of the sun and stars from which reasonably accurate values of latitude could be determined. It rapidly replaced the surviving backstaff, cross-staff and astrolabe.

LONGITUDE

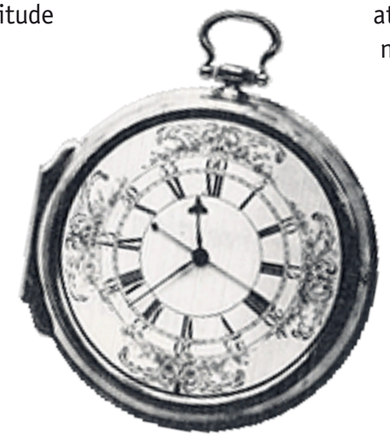
Astronomers determined longitude by lunar eclipses and eclipses of Jupiter's moons in the 16th and 17th centuries but these methods could not be relied on at sea.

In Britain, the Board of Longitude was established in 1714 because *"... nothing is so much wanted and desired at sea as the discovery of longitude, for the safety and quickness of voyages, [and] the preservation of ships and the lives of men ..."* The Board was empowered to award £20,000 for a reliable resolution of the longitude problem.

Longitude by Lunar Distances

In 1763 Dr Nevil Maskelyne, Astronomer Royal, published instructions for *" ... the discovery of longitude ... by observations of the distance of the Moon from the Sun and Stars, taken with Hadley's Quadrant"*.

The first official *Nautical Almanac* was published in 1767 with predictions for 1768 and 1769. Cook used these tables for the determination of longitude on his first voyage in the *Endeavour*. Cook's longitudes for the Pacific islands he visited and New Zealand were more accurate than those for the east coast of Australia as this method was not available to him in 1770. British charts were constructed using Greenwich rather than London as the prime meridian from the time of publication of these tables.



The sextant, which was more accurate and could measure larger angles, was developed from the quadrant by the mid 18th century. This additional accuracy was required by surveyors and the more scientific navigators such as Cook. Its development facilitated more accurate determination of longitude by lunar observation.

Lunar observations were used into the 20th century. In 1908 lunar distances were omitted from nautical almanacs.

Longitude by Chronometer

Mariners knew from the time of the first ocean voyages that if they could carry the local time of their point of departure with them using a reliable clock, they could determine their longitude from astronomical tables and trigonometry. It was not until the 18th century that technology had progressed sufficiently to realise this goal.

The work of John Harrison, a Yorkshire clockmaker, provided the first series of marine clocks which were ultimately successful. In his first piece the usual pendulum was replaced by sprung weights. It was approved for testing by the Board of Longitude in 1735. A second improved clock was completed by 1739 but was not tested at sea. The third timekeeper of different design was completed in 1758 but not tested at sea until 1761. On a voyage from Portsmouth to Jamaica the accumulated error was 1 minute, 53 seconds, 28 minutes of longitude or 18 nautical miles at Portsmouth. A second trial on a voyage to the Barbados resulted in an error of 54 seconds.

Harrison had completed his fourth chronometer, a large watch, similar to a modern chronometer during the testing of Number 3. The fourth piece was the most accurate and reliable but had to allow reproduction by an independent clockmaker. Larcum Kendall, a London clockmaker, was engaged to do the work. This watch was taken by Cook on his second voyage in the *Resolution* (departing in 1772) and performed reliably. It was not until 1774 that Harrison received the full £20,000 reward after the intervention of Parliament.

Chronometers were improved, became cheaper and increasingly accessible to mariners and by 1840 were carried in most well found ocean going vessels.