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The longitude question☆

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Abstract

This essay discusses the National Maritime Museum exhibition *Ships, Clocks and Stars: The Quest for Longitude* whose 2014 timing marks the 300th anniversary of the 1714 Longitude Act. The exhibition presents the story of longitude: the problem, the answers proposed, and longitude's solution and at-sea testing. Longitude was a significant navigational, astronomical, and geographical problem, its solution a matter of political and public concern. The exhibition illustrates how longitude's working-out in the eighteenth century brought together the worlds of science, technology, commerce, politics, personal credibility, and the public. It affords an opportunity to reflect not only upon how such matters, vital in their interconnectedness in the past, may be presented effectively to the modern public but also upon the association of science, technology, research, funding, and public engagement in the contemporary context. *Ships, Clocks and Stars* is at the National Maritime Museum, Greenwich, until January 2015 before going on tour to the United States and Australia.

Keywords: Longitude; National Maritime Museum; Exhibition; Exploration

Longitude is at once an abstract notion and a now taken-for-granted global metrological convention. In the past, especially for oceanic navigators, astronomers and map makers, it was a very real problem. Longitude is the east-west measurement of the earth, in degrees from 0° to 360°, from a declared base point—by convention 0°, the first or prime meridian. Longitude is measured as +180° (west) or −180° (east) from that initial meridian. Since 1884, the world's prime meridian has been the Royal Observatory at Greenwich, UK. Before 1884, different prime meridians were in use. Some sailors took their initial bearings from the last land sighted, not from an observed position or a line on a map or chart. Long-distance oceanic navigation in particular presented great difficulties in calculating longitude and in knowing one's position or, vitally, one's time relative to the point of departure or the destination. Long-distance maritime trade depended upon goods and ships arriving safely and, for their crews, knowing where they were en route. Many did not. Lives, ships and valuable cargoes were regularly lost for the want of a solution to the longitude problem.

Ships, Clocks and Stars begins with a dramatic portrayal of the perils of longitudinal uncertainty. The visitor is confronted upon entrance by depictions of a storm-lashed ocean. Thunder rolls. Lightning strikes from a threatening sky. High winds scream, whipping the waves to crests and troughs. On a facing wall, the consequence of not knowing one's position at sea is vividly depicted: a painting of two English ships, de-masted, breaking up fast in the raging surf, while rescuers vainly throw lines to drowning men (Fig. 1). Storms and inadequate charts were dangers of course. Knowing one's longitude could be a matter of life and death.

In order to determine longitude and so know one's position west or east of a given position on the earth's surface, it is necessary to compare the local time with that of a given meridian. Until the invention of dependable marine chronometry, or the use of a reliable nautical almanac, there were three ways to do this. The first was by the observation of eclipses: the eclipses of the satellites of Jupiter were preferred given their frequency, but this method was not used at sea. The second was by observation of the position of

☆ *Ships, Clocks and Stars: The Quest for Longitude*, An exhibition at the National Maritime Museum, Greenwich, 11 July 2014–4 January 2015. A touring version of the exhibition will visit the Folger Shakespeare Library, Washington DC, 16 March–23 August 2015, Mystic Seaport, Connecticut, 14 September 2015–28 March 2016, and the Australian National Maritime Museum, Sydney, 5 May–30 October 2016. The associated book is published as Richard Dunn and Rebekah Higgitt, *Finding Longitude: How Clocks and Stars Helped Solve the Longitude Problem*, Collins, National Maritime Museum, 2014, 256 pages, 153 illustrations, £25 hardback, £15 paperback (available at the exhibition).

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Fig. 1. Two English ships wrecked in a storm on a rocky coast, by Willem van de Velde the Younger, c. 1700. © National Maritime Museum, London.

the moon in relation to the stars, principally through lunar occultation, that is, as the moon comes between the observer and more distant celestial objects. The third was by observation of the moon's passage across the local meridian. These three methods, each theoretically possible, in practice required consistent observations, complex and quite time-consuming computation, and some form of tabulation or written register—an ephemeris or equivalent catalogue of the stars and tables of the Moon's motion—produced for the chosen meridian. Difficult enough to do on land, each of these three methods was seriously impracticable at sea. The fourth method was by knowing the time of the given initial meridian by means of a clock that either never varied, or varied only at a known rate. This method was practicable at sea provided a timepiece could be invented that kept time as it, and the ship on which it travelled, moved from place to place.

Longitude, a definable technical problem with commercial and navigational implications, was of interest to mathematical practitioners and to watch and clock makers as well as to seamen. In Britain, the passing of the 1714 Longitude Act and the appointment of Commissioners, later the Board of Longitude, signalled that longitude was a political matter—even, with £20,000 available to the originator of a proven solution, that it was a matter of research and design for financial reward. It was also of great public interest; in satirical verse, newspaper reportage, the art of William Hogarth, and conversation in London's coffee houses. The exhibition thus moves the visitor from an encounter with the problem and its dangers if left unsolved to longitude's practical, intellectual, political and public articulation. Here, we are invited to understand, was a compelling problem widely understood as such in Georgian Britain (and, by implication, elsewhere). The visitor is then brought face to face with the means to longitude's solution, the clocks—properly, the marine timekeepers—of the Lincolnshire-born carpenter and clockmaker, John Harrison (1693–1776).

The history and the historiography of longitude have been studied before. The title of one best-selling account, that of Dava Sobel's *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Age* (first published in 1996) leaves little doubt as to her interpretation and explanation regarding Harrison. *Ships, Clocks and Stars* discounts simple stories of lone genius, though it affords ample space to Harrison and his clocks and to men like Larcum Kendall, John Arnold and Thomas Earnshaw who further refined his achievements. We are presented with more complex narratives of technical accomplishment, shared endeavour and the routes in aggregate to longitude's solution. The exhibition is, nevertheless, strongly technical in content and orientation. Instruments have starring roles, Harrison's several clocks being *primus inter pares*. On one of the occasions on which I visited the exhibition, in July 2014 during the Longitudes Examined conference, a small group of horologists and historians of instruments stood rapt over Harrison's clocks, necks craned and bodies stooped in postures of devotional reverence, gazing in wonder at the instrumental reliquaries before them. And so they might. This is the first time the different gestations of Harrison's clocks have been displayed together in a generation (Fig. 2); with the longcase clock as the progenitor of his sea-clocks, the first time ever. Where others thought the solution to longitude could only come from portable pendulum clocks, Harrison persevered with the idea of a clock, the first now termed H1 (Fig. 3) and, latterly, of a pocket watch, H4, driven by a balance whose regulated and temperature-compensated oscillations, once put in motion, provided the beating heart of a portable, reliable and easily read device (Fig. 4). Would that all scientific problems had solutions of such elegance and beauty.

Longitude's story is also one of textual, mathematical and observational accomplishment. These themes are likewise clearly set out. Harrison spent years refining questions of technical tolerance (he spent 19 years on H3 alone). Similarly, Nevil Maskelyne, Britain's Astronomer Royal, worked to gather together the work of the German astronomer-mathematician Tobias Mayer and others to produce the *British Mariner's Guide* from 1763 and, from 1767, the *Nautical Almanac and Astronomical Ephemeris* as a compendium of astronomical measurements for use in timekeeping at sea. Greenwich, Maskelyne's observatory, was the stated 0° baseline against which time and space was to be measured, for the British at least. We are shown how producing the *Nautical Almanac* depended also upon Maskelyne's coordination of geographically dispersed 'computers'