Little-Known Horologist Made Waves with His Revolutionary Chronometer

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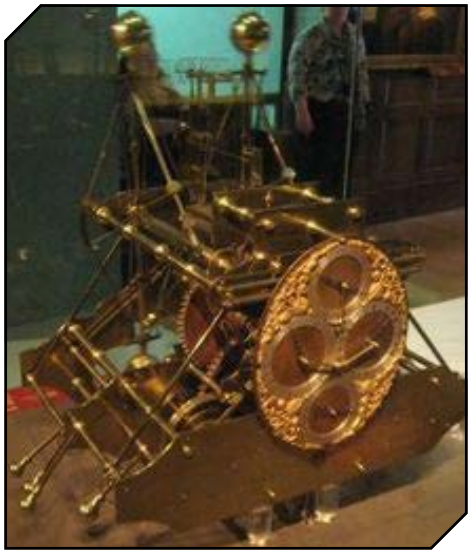
Faithful followers of this space are aware that we sometimes like to spotlight important—but virtually unknown or remembered—historical figures that have made a significant contribution to society or everyday commerce with mechanical engineering breakthroughs.

Next up—John Harrison (1693–1776)—a British clockmaker (and carpenter) whose extremely precise chronometer enabled seafarers to calculate longitude (also known as east-west axis) with a degree of accuracy that until then was unheard of. A marine chronometer is defined as a timepiece that is precise and accurate enough to be used as a portable time standard; it can therefore be used to determine longitude by means of celestial navigation. When first developed in the 18th century, it was a major technical achievement. Continuously improving his creation became Harrison's raison d'etre—spanning more than 30 years of persistent experimentation and testing that revolutionized naval (and later aerial) navigation, and served to facilitate the emergence of the Age of Discovery—a good thing—and colonialism—a not-so-good-thing—to accelerate.

For many years navigators used the positioning of the sun or North Star to calculate *latitude*—that is, the distance from the equator in the north-south direction (The Conversation). But calculating *longitude* was extremely more complicated and therefore often far off the mark. For example, there were many instances where explorers "discovered" the same island multiple times, particularly in the Pacific region, where 18th century navigators were obsessed with plotting the islands reliably.

Getting this right was vitally important, given that miscalculating longitude could spell economic—and often—fatal disaster. Consider just one example: In 1707 a five-vessel "pile-up" near the Cornish coast led to the deaths of *1,400* people. This was merely one of numerous maritime incidents involving navigational failure and resultant loss of life. Meanwhile, the British Navy finally was stepping up its efforts to determine a reliable method of calculating longitude. But it was not until 1714 that the British Board of Longitude (no, it's not a Monty Python creation) announced a competition by which £20,000 ($2,039,850 U.S. dollars today) would be awarded to whoever developed the most practically accurate method to calculate longitude.

So Harrison entered the competition with a hand-crafted clock that could keep precise time—even at sea. (How the contest played out is a story in itself. The Board arbitrarily decided to award Harrison a partial prize—£10,000. He later received the balance of the award upon the insistence of King George III. There was a later competition as well, in 1761, also not without controversy.)



John Harrison's H1 marine chronometer. Photo by Phantom Photographer (CC BY-SA 3.0).

Harrison's approach to the challenge was to design a highly reliable clock that could keep the time-of-reference place. The difficulties involved included: producing a clock that was impervious to the often wild variations in temperature, pressure, or humidity; maintaining accuracy over long time intervals; resisting corrosion in salt air; and being able to function despite a seagoing vessel's constant movement.

It took Harrison five years to build his first (of five—H1-H5) sea clock. He demonstrated it to members of the Royal Society who spoke on his behalf to the Board of Longitude. The clock was the first proposal that the Board considered to be worthy of a sea trial. In 1736, Harrison sailed to Lisbon on HMS *Centurion* under the command of Captain George Proctor and returned on HMS *Orford* after Proctor died at Lisbon in 1736. The clock lost time on the outward voyage. However, it performed well on the return trip: both the captain and the sailing master of the *Orford* praised the design. The master noted that his own calculations had placed the ship sixty miles east of its true landfall, which had been correctly predicted by Harrison.

In 1730, Harrison designed a marine clock to compete for the Longitude Prize and travelled to London, seeking financial assistance. He presented his ideas to Edmond Halley, the Astronomer Royal, who in turn referred him to George Graham, the country's foremost clockmaker. Graham must have been impressed by Harrison's ideas, for he loaned him money to build a model of his "Sea clock." As the clock was an attempt to make a seagoing version of his wooden pendulum clocks, which performed exceptionally well, he used wooden wheels, roller pinions and a version of the 'grasshopper' escapement. But instead of a pendulum, he opted for two dumbbell balances, linked together.

Today it is accepted wisdom that Harrison's device revolutionized navigation accuracy and enhanced the safety of long-distance sea travel. Harrison was 39th in the BBC's 2002 public poll of the 100 Greatest Britons. Indeed, time has looked kindly on Harrison's inventions. In 2015, the Guinness World Records association declared one of his clocks to be the most accurate swinging pendulum clock in the world. (*Sources: theconversation.com and online article by Rachel Becker at theverge.com.)*