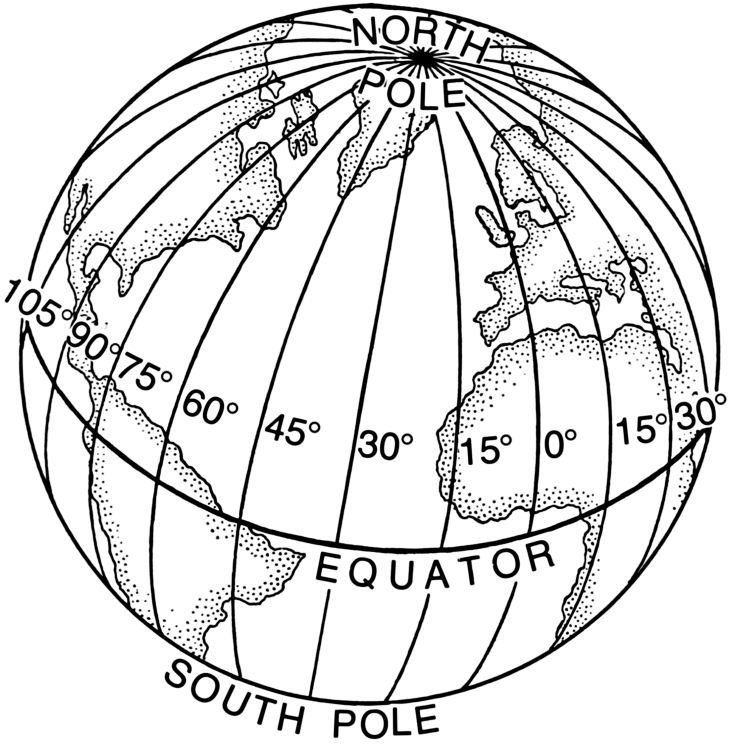
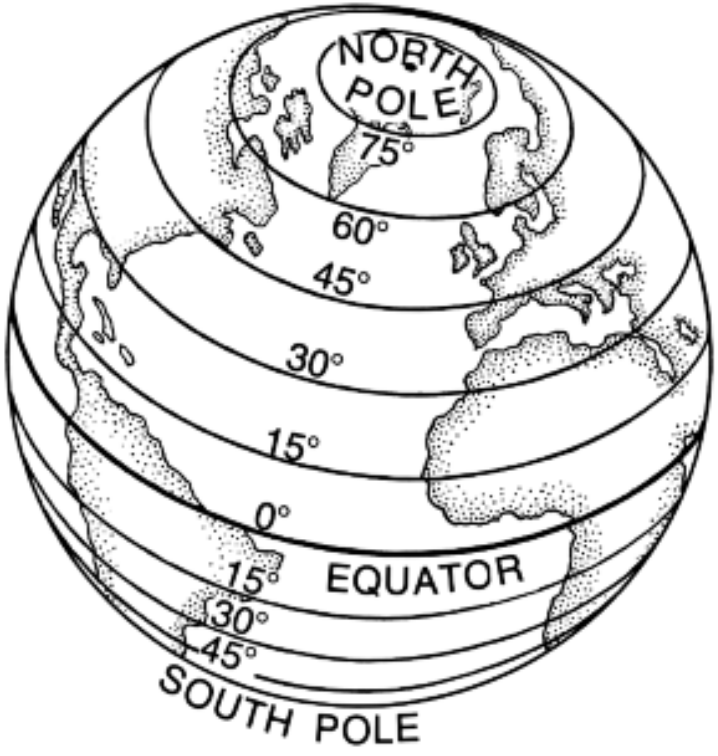
The Longitude Problem

January 20, 2012

Longitude vs. Latitude



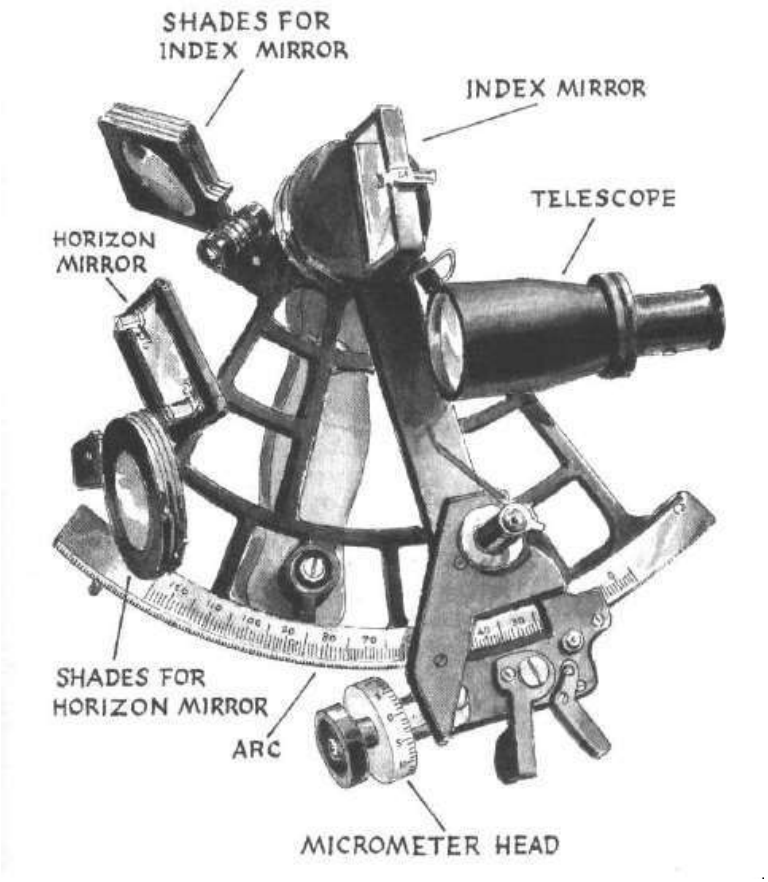
Longitude



Latitude
(Latitudes are **Flat**)

Finding Latitude

Using a sextant and essentially the same ideas as Eratosthenes, navigators could find their latitude at sea by measuring the position of the sun at noon.

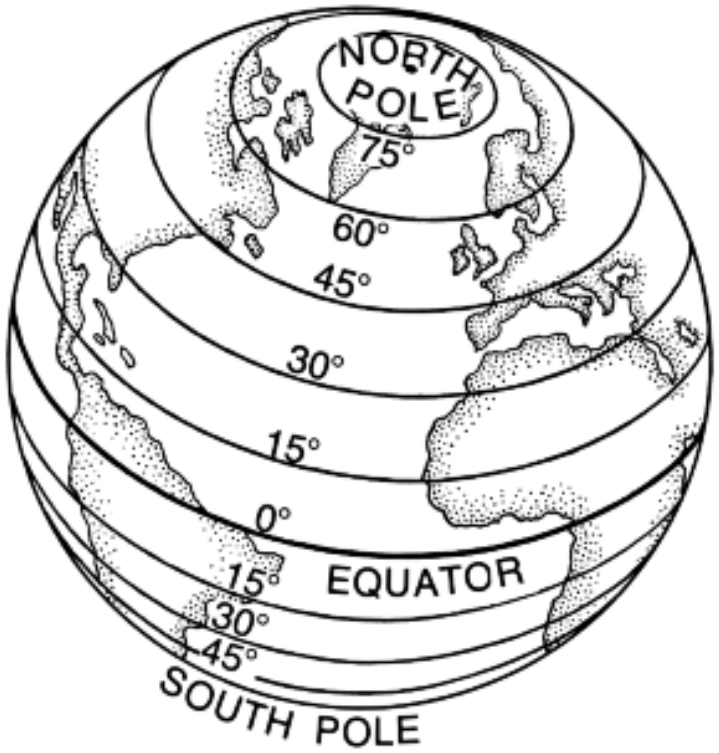


Finding Latitude

Before sextants were perfected in the 1700s, sailors used a cross staff to find the angle of the sun. This caused many sailors to eventually go blind.

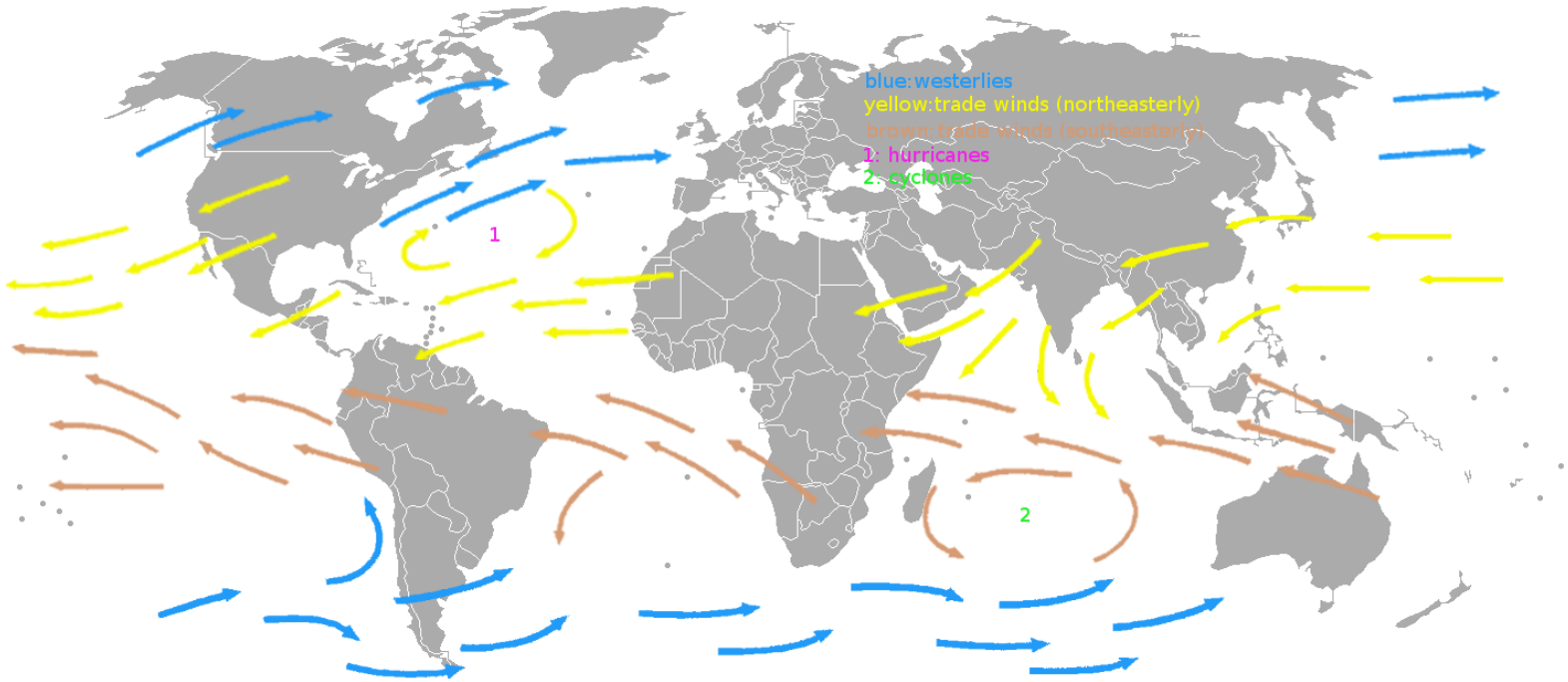
Finding Latitude

By sailing on the same latitude, you can sail East or West, follow the trade winds, and know where you will eventually hit land.



Trade Winds

Finding Latitude is immensely important if you need to catch the prevailing winds.



Longitude is Harder

Finding Longitude is harder than latitude. To find longitude, you need to have an accurate way to measure time.

Time matters so much because sunrise, sunset, noon, and midnight all happen at different times in different places. In England, noon happens when it is still night time in India (which is why they used to say *"The sun never sets on the British Empire!"*).

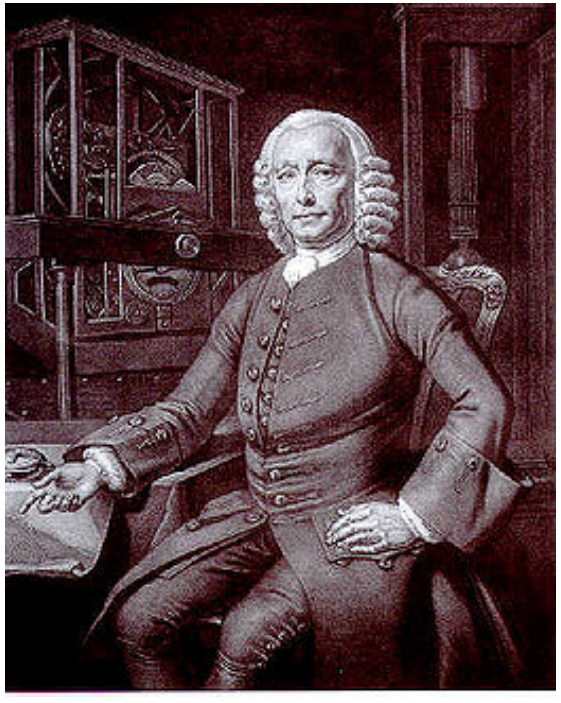
If you know the exact time when the sun is highest in the sky, then you can find your longitude.

The Longitude Prize

The Longitude prize was established in 1714 by the British parliament.

- £10,000 for a method that could determine longitude within 60 nautical miles (111 km)
- £15,000 for a method that could determine longitude within 40 nautical miles (74 km)
- £20,000 for a method that could determine longitude within 30 nautical miles (56 km).

The Man Who Solved the Problem



John Harrison (1693-1776)

Why A New Clock Was Needed

There were two main types of clocks in the 1700's.

Pendulum Clocks

Spring-Powered Clocks

Problems with the Old Clocks

Pendulum clocks cannot be moved without disturbing the pendulum. There was no way to use a pendulum clock on a long ship voyage.

Spring-powered clocks are sensitive to temperature change. In hot weather, the metal in the spring expands, and in cold weather the metal contracts. This means that spring-powered clocks on a long ocean voyage quickly lose track of time.

Harrison's Solution

Harrison's solution was to use two different kinds of metal that expand and contract at different rates to counteract the effects of temperature.

Harrison's H4 Marine Chronometer, 1760

Longitude Prize Winner

Harrison eventually won £23,065 for his marine chronometer designs, although it took nearly 30 years to convince Parliament that he had solved the longitude problem.

Other Solutions

Another solution to the Longitude problem involved measuring the distance between the moon and either the sun or a fixed star. With an almanac you can accurately measure time without a chronometer.

The chronometer method proved much more popular, however. Some historians have speculated that British Empire thrived during the late 18th and early 19th century in part because many of their ships had marine chronometers while most French, Dutch and Portuguese ships did not.

The Longitude Prize Winners

- John Harrison £14,315 Received in several payments. £4,315 was awarded during his work on his chronometers from 1737 to 1764 with the remaining £10,000 provided in 1765.
- Tobias Mayer £3,000 Contributions to the lunar distance method. His widow received the money due to Mayer's untimely death.
- Thomas Mudge £3,000 Construction of chronometers with improvements to Harrison's designs.
- John Arnold £3,000 Design and improvements to chronometers.
- Thomas Earnshaw £3,000 Design and improvements to chronometers.
- Charles Mason £1,317 Various contributions and improvements on Mayers lunar tables.
- Jesse Ramsden £615 Design and construction of a superior dividing engine (£300) and publishing the design (£315).
- Larcum Kendall £500 Construction of a copy of Harrison's H-4.
- Leonhard Euler £300 Contributions to the lunar distance method in aid of Mayer.
- Nathaniel Davies £300 Design of a Lunars telescope for Mayer

Harrison also received £8,750 from Parliament in thanks for his work, bringing his total lifetime award to £23,065.