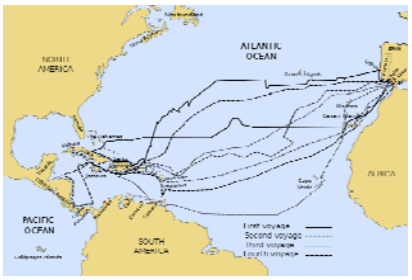
Christopher Columbus claiming the New World for Spain

The Voyages of Columbus, 1492-1504



Voyage of Vasco de Gama, 1497-99

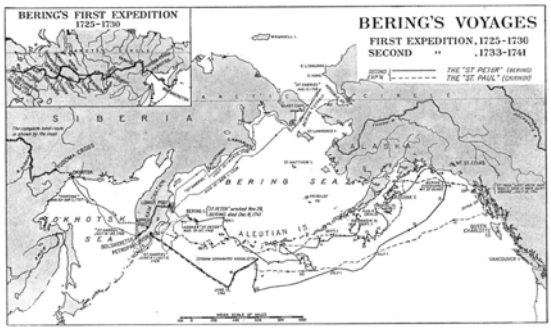
The Circumnavigations of Magellan and Drake

World map by Abraham Ortelius, 1570

World map by Plancius, c. 1590

World map by Johan Lemarchand, 1598

Map by Nicholas Visscher, ca. 1680



"So geographers, in Africa maps,
With savage pictures fill their gaps,
And o'er uninhabitable downs
Place elephants for want of towns."

-- Jonathon Swift (1667-1745)

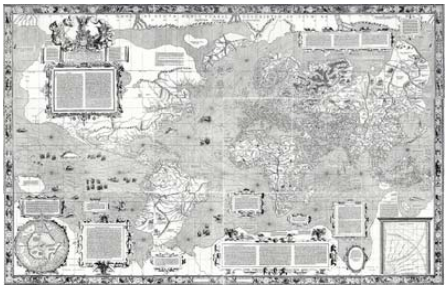
Gerardus Mercator
(1512-1594)

- **born Gerard Kremer**
- **Flemish cartographer**
- **Principally remembered for the map projection that bears his name, and which greatly aided oceanic navigation by allowing mariners' to plot a course to a desired destination that followed a single compass bearing.**
- **The map's success led to its unintended general use, despite distortion of land masses.**
- **Published the first book of maps, which happened to depict Atlas (a Titan who supported the heavens) on the cover.**

Mercator/Hondius Atlas cover, 1634

Mercator Atlas cover

Mercator Projection, 1569

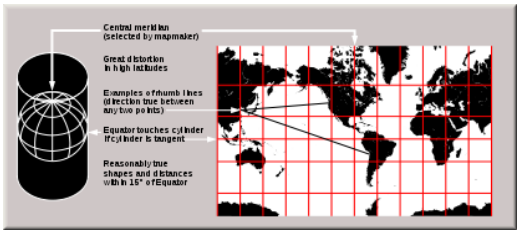


The Mercator Projection

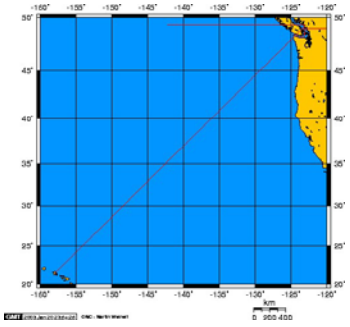
- A cylindrical map projection devised in 1569 by Gerardus Mercator, a Flemish/Belgian cartographer.
- Became the standard map projection for nautical purposes because of its ability to plot lines of constant course, called *loxodromes* or *rhumb lines.*
- To achieve this desired attribute – constant bearing in all directions from a point – the size of areas is increasingly distorted (i.e., enlarged) with distance from the equator, resulting in substantial misrepresentation of the relative sizes of land masses and water bodies.
- Nevertheless, because of the map's great utility for navigation, it became the most popular "general information" map of the world – something which Mercator never intended.

Mercator Projection

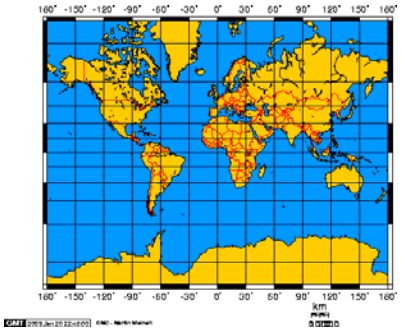
The Mercator Projection



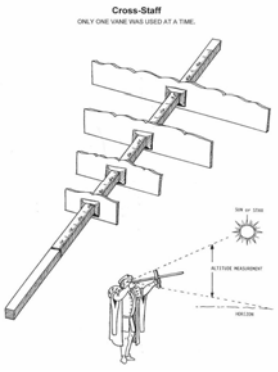
A plotted course from Vancouver to Oahu on a Mercator Projection



Mercator Projection



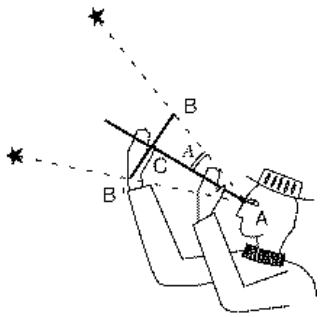
Cross-Staff



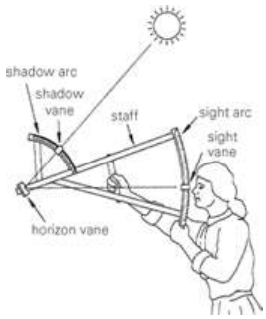
An early 16th Century device used to calculate the angular elevation of a celestial object. Made the astrolabe obsolete.

Claudius Ptolemy
(90-168 AD)

- **Roman scholar/scientist famous for two great treatises written in Greek.**
- **The *Almagest*: a treatise on astronomy and celestial mechanics. Includes data on 48 constellations identified in classical times.**
- ***Geography*: A compilation of received knowledge of the world that spanned the classical period, to which he added his own judgments and interpretations. Includes a world map. "Discovered" around 1300; translated into Latin; influenced voyages of discovery.**



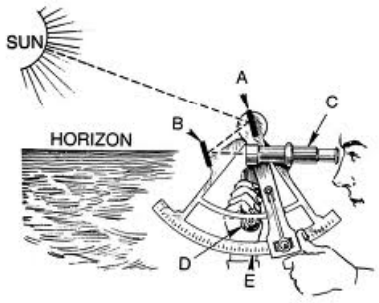
The Davis Quadrant (backstaff)
Early 17th Century
(replaced the cross-staff)



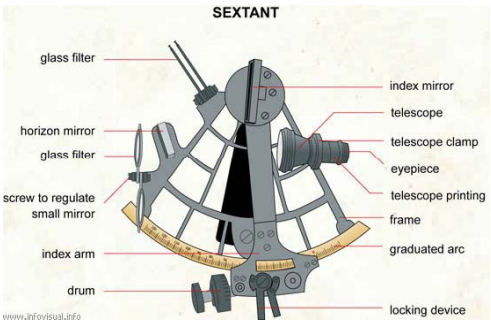
Sextant

- **An instrument used to measure the angle between any two visible things, particularly the horizon and a celestial object.**
- **Allowed for far superior readings than those obtained by a Davis Quadrant, which it replaced sometime around 1730.**
- **Facilitated accurate measurement of latitude.**
- **Used optical principles invented by Sir Isaac Newton.**

Using a Sextant



Using a Sextant

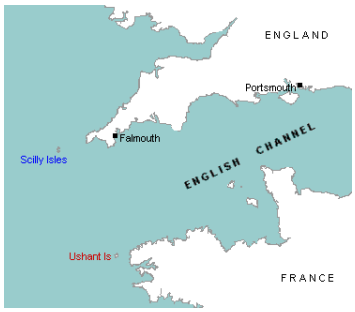


Sextants

World map by Nicholas Visscher, c. 1680

Admiral Sir Cloudesely Shovell

- 1650 – 1707
- Commander-in-Chief of the British Fleets
- Died at sea along with 1,400 sailors in the Scilly naval disaster of 1707.



The Isles of Scilly

("The Western Rocks" are at lower left)

On October 22,1707 four large ships in a British naval fleet were wrecked on the Isles of Scilly with a loss of 1,400 men because the navigator had miscalculated the longitude.

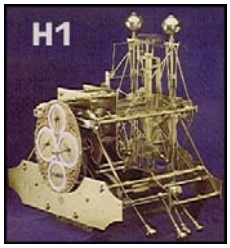
The Longitude Prize

- A reward offered by the British Government (pursuant to Parliament's passage of the Longitude Act, 1714) for a simple and practical method to determine a ship's longitude at sea.
- Offered £20,000 (roughly equivalent to $1,000,000 in today's money).
- The desired accuracy was an estimated location that was within 30 nautical miles of the actual location.

John Harrison (1693-1776)

- Self-educated English clockmaker who won the Longitude Prize
- Recognized that the solution required the accurate telling of time at sea.
- Produced a series of marine chronometers with required accuracy.
- Had difficulty claiming the prize because he was not a recognized scientist.

Two of Harrison's clocks



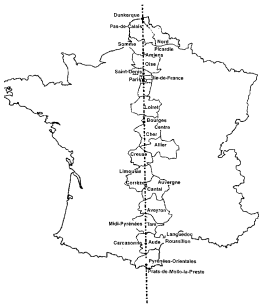
Chile

Vice-Admiral Robert FitzRoy (1805 – 1865)

Captain of HMS Beagle

Charles Darwin

(1809-1882)



Location reference map for the world's first scientifically measured prime meridian

Royal Paris Observatory

Jardin du Luxembourg, Paris

Jardin du Luxembourg

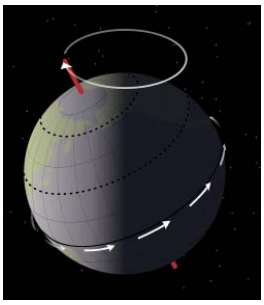
Jardin du Luxembourg

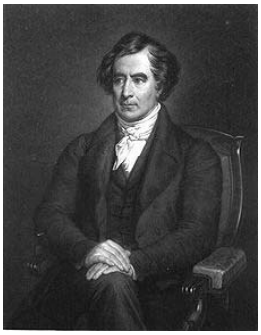
Monuments on the original Paris Meridian (the world's first prime meridian – 1667) Jardin du Luxembourg, Paris

Map of the Paris Meridian shown on the floor of the Meridian Room (a.k.a. Cassini Room), Royal Paris Observatory

The original Paris Meridian on the grounds of the Royal Paris Observatory

Precession of the Axis





François Arago (1786-1853)

French mathematician, physicist, astronomer and politician who recalculated the location and orientation of the Paris Median, which still runs through the Royal Paris Observatory, but at a slightly different angle than before.

One of the 135 "Arago medallions" that mark the Paris Meridian on the streets and sidewalks of Paris

American tourist meets Arago Medallion in the Jardin du Luxembourg, immediately north of the Royal Paris Observatory

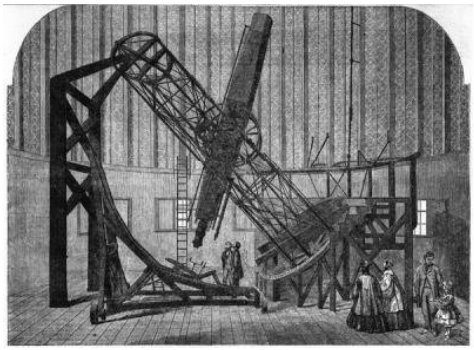
Royal Greenwich Observatory

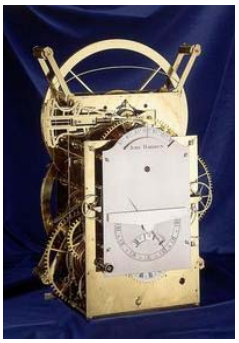
- Commissioned in 1675, built the following year.
- Four prime meridians have run through the building.
- The present one was established in 1851 by Sir George Airy.
- The complex is now a museum that houses, among other things, John Harrison's original clocks.
- Each year thousands of people are photographed at the Observatory straddling the Prime Meridian.

The Greenwich Meridian

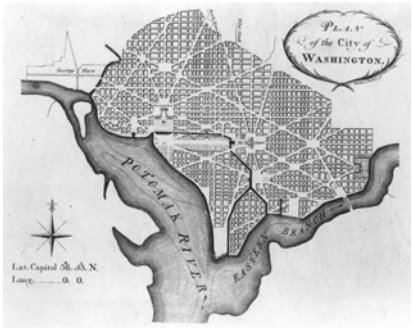
on the grounds of the

Royal Greenwich Observatory



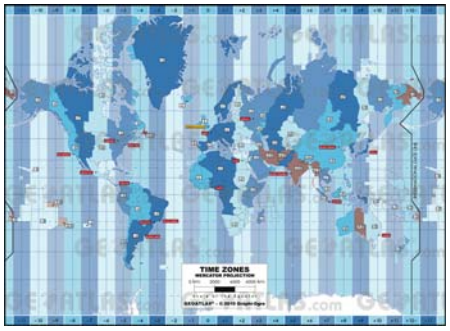


Old map of Washington, DC
(Note the longitude – 0, 0)

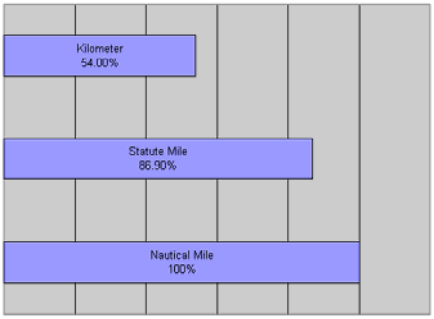


International Meridian Conference
held in Washington, D.C., October 1884

- **Convened by President Chester A. Arthur to promote global recognition of a common system of longitude based on a single Prime Meridian.**
- **Promulgated by the growing need for a common grid reference system, particularly as the basis for delineating global time zones.**
- **Conference was attended by 41 delegates from 25 countries.**
- **Outcome: The Greenwich Meridian was chosen as the global standard, and thus the British system of longitude.**



A comparison of standard distances



The English word "mile" is derived from the Latin "milia passum", or thousand paces (each pace consisting of two steps). This "Roman mile" (about 5,000 ft.) reached Britain with the Roman invasion. After the Empire fell, the Roman mile gradually ceased to be used, though in Britain "mile" persisted in the evolving English language to signify a substantial unit of linear distance.

The <u>Statute Mile</u> (5,280 feet) is so-named because it was formally defined by an English Act of Parliament in 1592. That is, the distance was set by law (or statute).

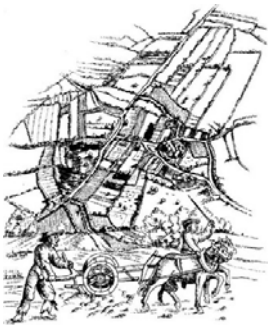
The length of the statute mile is derived from medieval English agriculture

- **The basic unit of farming was a long, narrow piece of land called a strip.**
- **The strip was a "furrow long," or furlong – originally the distance a team of oxen could pull a plow before having to stop and rest.**
- **The farmer used a long stick ("rod ") to guide the oxen.**
- **In time the rod was standardized to 16.5 feet – 5 yards.**
- **Sometime later the furlong was standardized to 40 rods (220 yards).**
- **Later still a distance of 8 furlongs (1,760 yards, or 5,280 feet) became the basis for a longer unit of measurement which eventually was codified as the statute mile.**

Interpretive plan of an English medieval manor

Medieval Plowing

Note herder carrying a rod



Medieval English agricultural strips in an old print.

Medieval Strips in the Contemporary English Landscape (bottom of photo)

Despite centuries of change in field patterns (due to inheritance, consolidation and other factors) some centuries-old strips continue to characterize the surface of Great Britain.

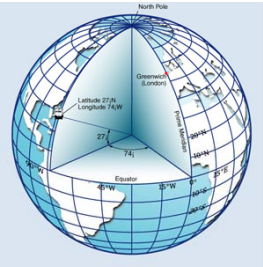
Old strip boundaries near Blakewell, England

Nautical Mile

- **A unit of length originally conceptualized as equal to one minute of arc of latitude along any meridian.**
- **The concept may have been originally proposed by Gabriel Mouton as the based for metric length.**
- **Standardized in 1929 (by the First International Extraordinary Hydrographic Conference, Monaco) as 1,852 meters, or 6,076 feet.**
- **Before that, different countries recognized different lengths.**
- **Widely used in navigation because of its conformity to the universally used system of latitude and longitude.**

The Metric System

- **From the Greek *metron* – measure.**
- **A base-10 (decimal) system of measurement.**
- **Concept first proposed in 1586 by Simon Stevin, a Flemish mathematician.**
- **In 1670, Gabriel Mouton, a French clergyman, proposed that metric measurement of length be based on the Earth's circumference.**
- **In 1790 the National Assembly of France requested the French Academy of Sciences to produce a comprehensive system of measurement.**
- **The results were adopted by the French government in 1795 and became official (general use) in the country in 1799.**
- **Subsequently, the system has been refined and adopted by most of the world's countries.**



The meter was originally conceptualized as being the equivalent of one ten-millionth of the distance between the Equator and the North Pole along a line of longitude.