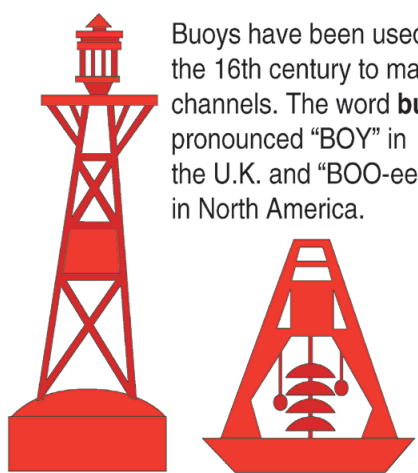




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Buoys have been used since the 16th century to mark channels. The word **buoy** is pronounced “BOY” in the U.K. and “BOO-ee” in North America.

WORLD OF WONDER

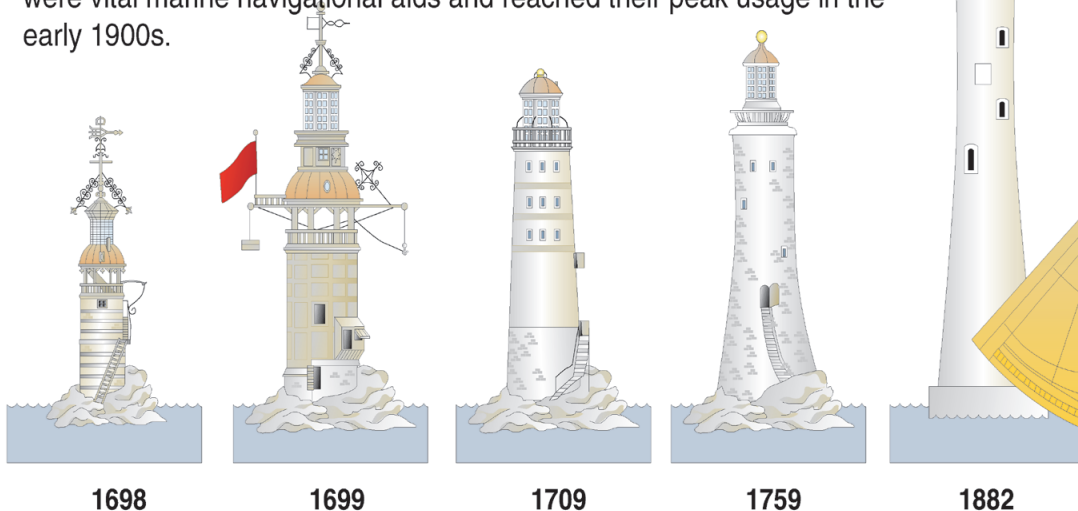
Exploring the realms of history, science, nature and technology

NAVIGATION

Early sailors sailed close to the shore and used landmarks, celestial bodies and primitive compasses to find their way. Today, navigators have a variety of sophisticated technologies to help them identify their location and heading. This article focuses primarily on maritime navigation.

Lighthouses

A lighthouse is a tower with a bright light at the top that serves as a navigational guide for ships. Lighthouses warn sailors of dangerous rocks or reefs, help ships determine their position and let them know that a harbor is near. Lighthouses date as far back as 280 B.C. They were vital marine navigational aids and reached their peak usage in the early 1900s.



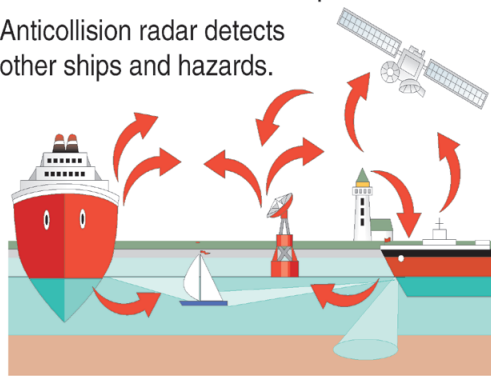
For centuries, ships were wrecked on a dangerous reef called Eddystone south of Plymouth, England. Henry Winstanley, a merchant, lost several ships on the reef and decided to build a lighthouse on the rocks. The Eddystone lighthouses (shown above) are interesting examples of how lighthouses have changed.

Finding a way

Early sailors navigated by landmarks, as well as by the sun and stars. Today, we use nautical charts and instruments such as electronic gyrocompasses.

Radar and **sonar** identify the locations of other ships and underwater hazards, and **global positioning systems** (GPS) make use of data sent via satellite to calculate a vessel's exact position.

Anticollision radar detects other ships and hazards.



A sonic depth finder determines the water's depth.

Modern navigation

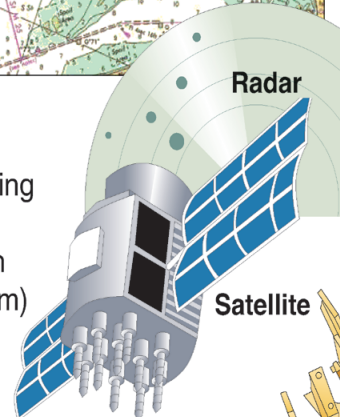
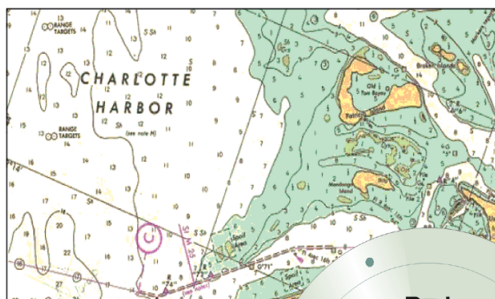
The invention of radio and satellite navigation made identifying location and charting a path much easier. The first practical **radar** (radio detection and ranging) system came into use in 1935. The **Loran** (a hyperbolic **long range** navigation system) was developed in the early 1940s.

The world's first operational satellite navigation system was launched by the U.S. Navy in the early 1960s. Today people use their phone's **GPS** (Global Positioning System) to know where they are and to find their way around. Scientists and engineers continue to work on new technologies to make navigation even more accurate.

Charting a course

In the 13th century, mariners began to make nautical charts called **portolan charts**. These loosely accurate maps did not have latitude or longitude lines.

Modern nautical charts are one of the most basic and essential mariner tools. Nautical charts show the shape of coastal regions, water depths and general topography of the ocean floor. These charts also note tidal information and locations of lighthouses, bouys and other human-made navigational aids.



Navigation satellites orbit Earth at an altitude of about 12,000 miles, completing two full orbits per day.

Observation

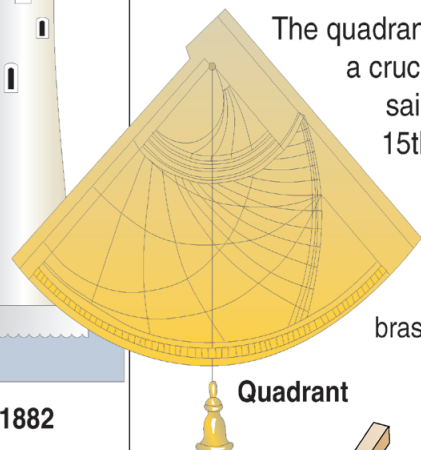
Early star navigation involved observing the positions and movements of celestial bodies to determine direction and location at sea.

The **astrolabe** has served since ancient times as a star chart and physical model of the visible dome of the sky.



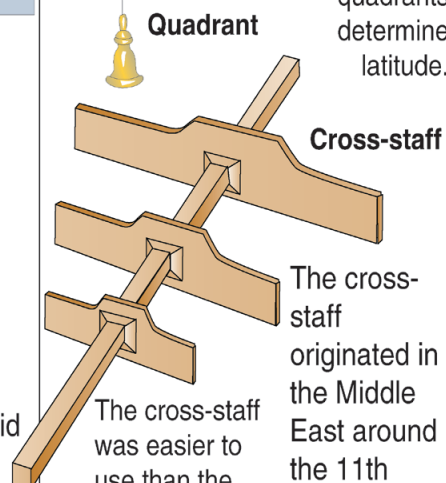
Astrolabe

The movement of ships made astrolabes unreliable.



The quadrant became a crucial tool for sailors in the 15th century.

Made of brass or wood, quadrants determine latitude.



Cross-staff

The cross-staff originated in the Middle East around the 11th century.

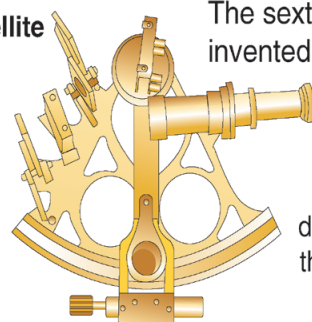
The hourglass was used to keep time on board a ship. Accurate longitude depended on turning the hour glass in a timely manner.



Chronometer

Hourglass

The chronometer was invented in 1675. It is an accurate clock used in measuring longitude.



Sextant

The sextant was invented in 1730.

A sextant measures the distance between the horizon and a celestial body.

SOURCES: World Book Encyclopedia, World Book Inc.; <https://en.wikipedia.org>; <https://www.britannica.com>; U.S. Naval Institute; <https://kids.kiddle.co>; <https://seahistory.org>

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