

READ: Technology in the Age of Exploration

The age of oceanic exploration was made possible when technologies and ideas from across Afro-Eurasia came together in fifteenth century Europe. Created by World History Project.

Technology in the Age of Exploration



By Malcolm F. Purinton

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Introduction

The fifteenth century saw a great growth in global networks. The crossing of the Atlantic and the development of the Columbian Exchange were part of a transformational expansion in both exploration and trade across the oceans of the world. Such voyages became more common, and easier, over the next few centuries. But how did this growth happen? What allowed these dangerous, expensive, long-distance ocean journeys to become commonplace? You guessed it: technology! It turns out, the tools that these traders and explorers used were based on innovations that developed in many parts of Afro-Eurasia and were brought together in Europe during this period.

Kamal

One of the simpler tools of navigation was the kamal, which would measure altitude to figure out latitude (the north or south position of a ship). This device helped sailors find their way home after a voyage.

The kamal was developed by Arab sailors and consisted of a piece of wood and rope attached to it. The navigator would tie knots into the rope. At their home port, the navigator would hold up the kamal and tie a knot that would allow him, by holding the chord in his teeth, to see the North Star at the top of the piece of wood and the horizon at the knot. While sailing back home they could hold the kamal in the same way to figure out if they needed to sail north or south to be at the same latitude.

A simple kamal that one could make today. Older versions could be made of fine mahogany wood with intricate carvings. By Bordwall, CC BY-SA 3.0.

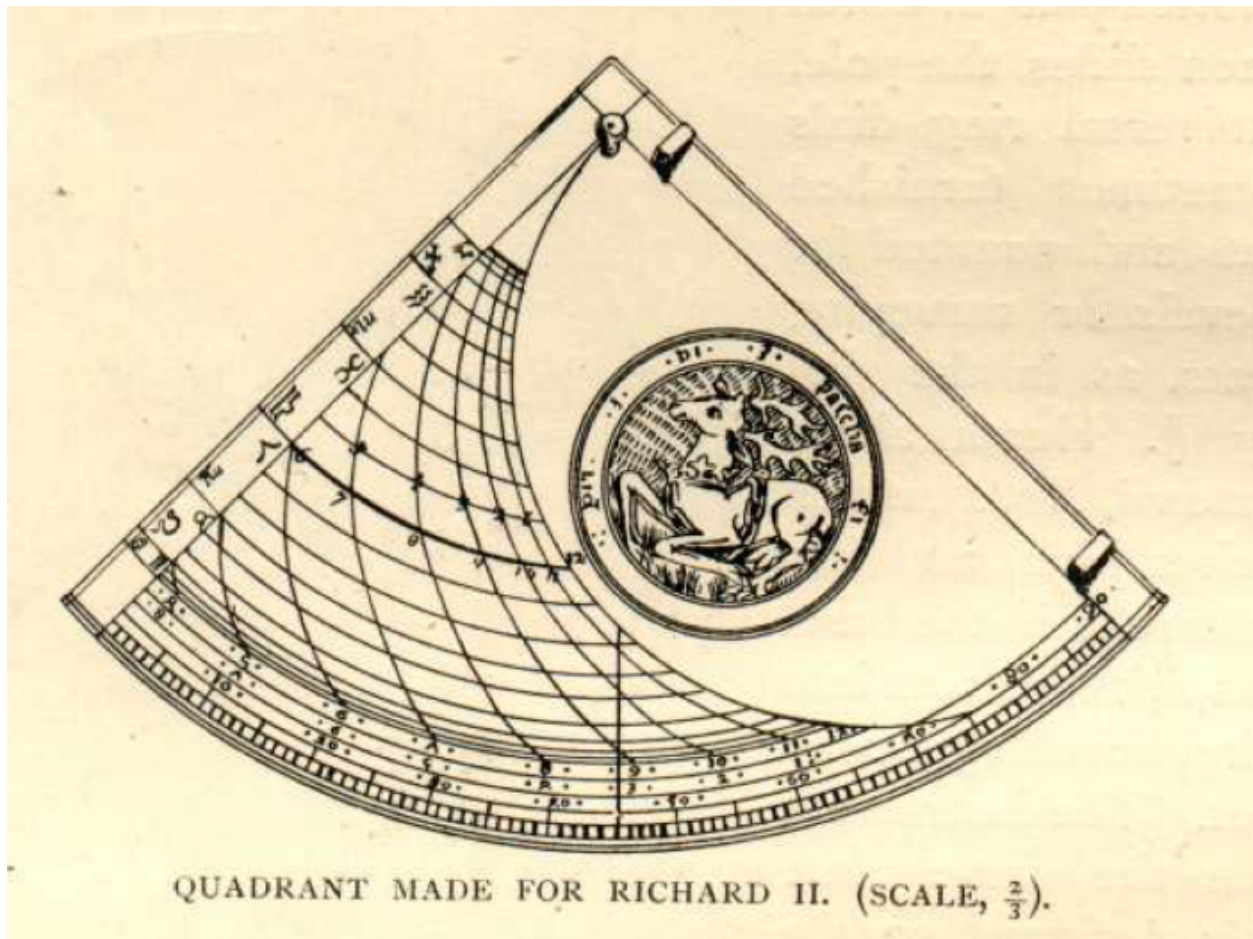
Quadrant

If the sailors were north of the equator, and it was a clear night sky, they could depend upon the North Star, also known as



Polaris, to help them know which direction they were going. They just had to have a consistent way of measuring the height of the star above the horizon.

One of the tools they used to measure the height of the North Star—or any star, including the sun—was the **quadrant**. When you knew this height, then you knew your latitude and could keep sailing in a straight line to your destination. Quadrants could also be used to measure the height of mountains or buildings. They were also helpful if you were aiming a cannon.



A drawing of a quadrant that was made for King Richard II. Public domain.

Astrolabe

The astrolabe was one of the most important navigation tools and was used by many European explorers, including Columbus and Magellan. It originated way back in the Roman Empire but remained important through the eighteenth century because it allowed sailors to do many

things. These included measuring the current latitude of the ship, the time of day or night, and the position of stars or planets in the sky. The astrolabe looked like a stack of disks and had detailed writing and lines all over each disk to help with measurement.

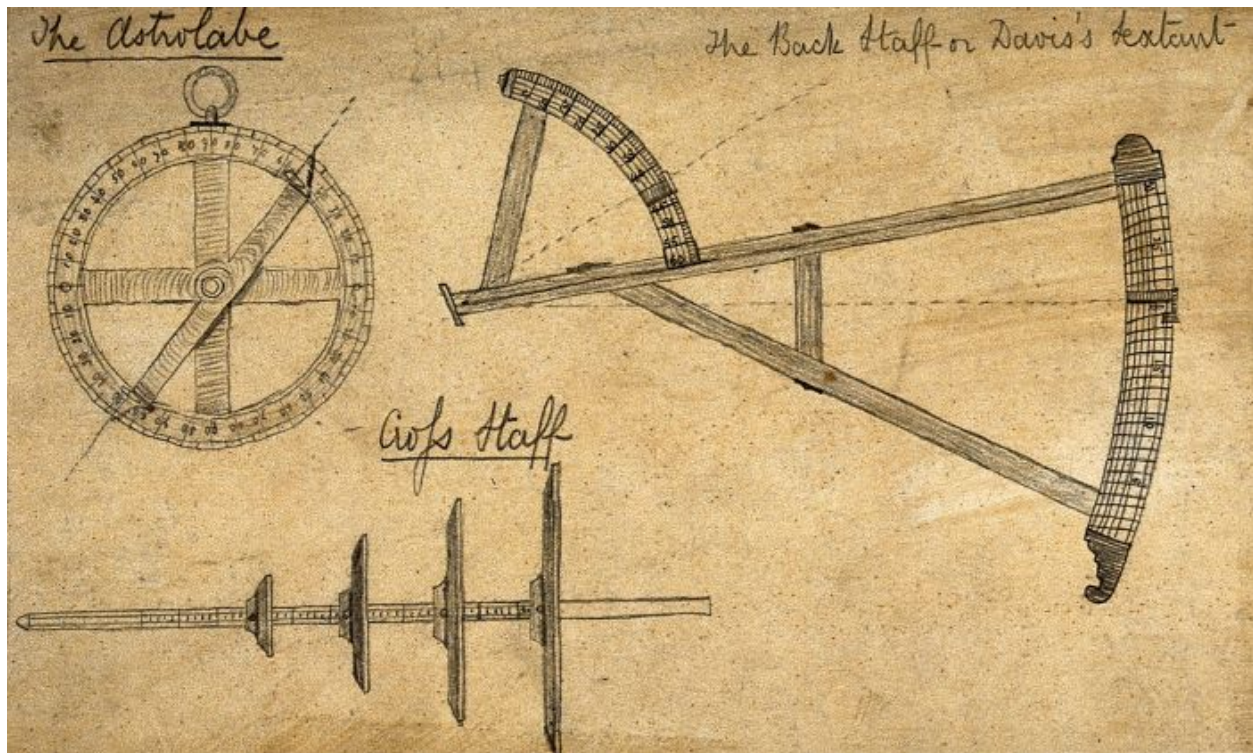


A recently made brass Iranian astrolabe. Created by Jacopo Koushan, photographed by Masoud Safarniya, CC BY-SA 3.0.

Cross Staff and Back Staff

Two other tools used to find latitude by observing altitude were the cross staff and the back staff. The cross staff was usually about three feet long with a cross piece called a transom and four movable cross pieces of different sizes. It was inspired by the design of the kamal. The cross staff was held up so that the top edge of the transom lined up with the North Star or the sun with the bottom edge lined up with the horizon. In this way the navigator could be sure that they were at the right latitude. One disadvantage: using the cross staff in daytime forced navigators to stare directly at the sun.

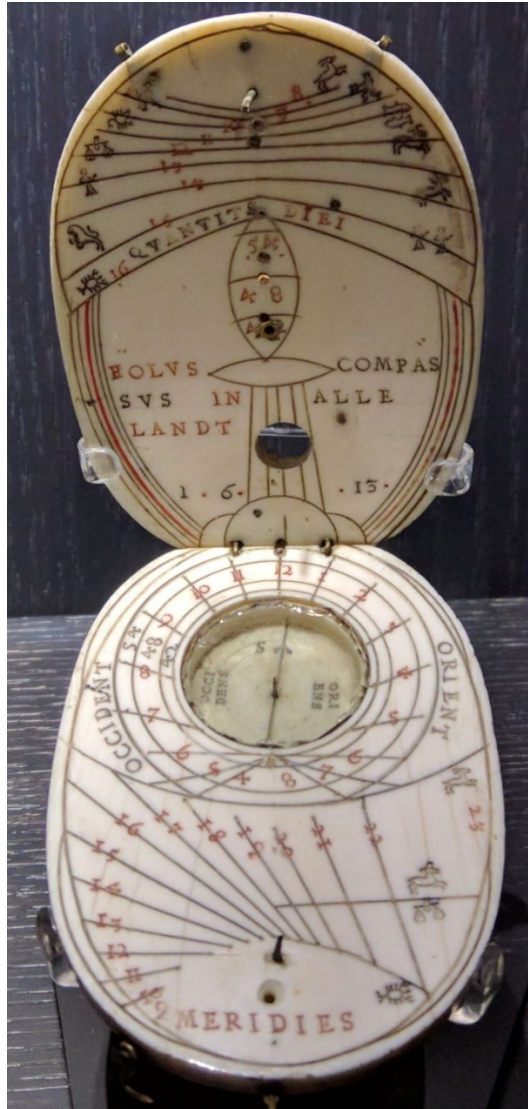
But then, in the seventeenth century, Captain John Davis developed a new navigation tool called the back staff, also known as the Davis Quadrant. This instrument relied on the *shadow* of the sun—so you didn't risk burning your retinas, as with the cross staff. The navigator would stand with their back to the sun and place the back staff on their shoulder and view both the shadow of the sun and the horizon at the same time.



Drawn examples of an astrolabe, a cross staff, and a back staff from the seventeenth century. From the Wellcome Collection Gallery, CC BY 4.0.

Magnetic Compass

The magnetic compass was also very useful in knowing your location and that your ship was going in the right direction. Using a magnetic needle that reliably points north, you can know where you are and where you need to be going. Early versions of magnetic compasses came from China. They were brought to Europe through trade with Asia. European versions would have a magnetic needle attached to a card in a wooden box that would point north.



A Dutch magnetic compass from the seventeenth century. By Dave Ross, CC BY-SA 4.0.

Traverse Board

It's important in navigation for sailors to record both the speed and direction of the ship, and that's where the traverse board came in. This wooden board had a compass rose attached to the top with thirty-two different points on it. Eight holes extended out from the center of the rose to each point on the compass. Sailors could record the direction of the ship every half hour using a compass, and the board could record a total of four hours of direction. Below the compass rose were four rows of holes with each row equaling thirty minutes as well. Instead of direction though, these rows allowed the sailors to record the speed of the ship.



A traverse board that was used to keep track of a ship's speed and direction for four hours at a time. The large circle is the compass rose, and below it are four rows, each representing a half hour of travel. Public domain.

Ships: Caravel and Carrack

Sailors used several types of ships in this age of exploration, including the caravel and the carrack. The caravel was developed specifically for long-distance trade by Prince Henry the Navigator from Portugal. It had two or three masts that used square sails on open water, but switched to triangular lateen sails when closer to shore. Due to a rounded bottom, caravels were also very fast and because of this many pirates liked to use them.

Another important ship design was the carrack, a mash-up of Mediterranean and Northern European styles of ships. The carrack had a rounded stern and two large structures on top. The one at the front was the forecastle, and the back was the aftcastle (often abbreviated as "fo'c's'le" and "aft"). They also used lateen and square sails and could have two to four masts depending on the size of the ship—which could reach 2,000 tons.



A ceramic representation of a Portuguese carrack ship with several square sails and a triangular lateen sail in the rear. By Kergeo, CC BY 3.0.

Cannon (yes, that's plural and singular)

Long-distance trade was dangerous, and anyone wanting an advantage would want to be well armed. Also, weapons might help traders get what they wanted from local ports or other ships, or even engage in a little piracy.

The best-armed ships of the day had cannon that could fire several kinds of shot. The round shot, usually made of iron, was great for damaging the hulls of enemy ships. But chain shot—which had two smaller balls attached by a chain—could destroy sails and riggings, making it impossible for the ships to maneuver away. Other kinds of shot included grapeshot and cannister shot. Each filled different types of containers with small metal balls meant to injure or kill the sailors on the opposing ship. One of the reasons the English developed such a powerful navy was their superior ship cannon.



An engraving showing carracks and galley ships in battle with smoke coming from cannon fire. Public domain.

Together, these technologies made it possible for ships to travel long distances, carrying cargo with greater safety. Of course, they weren't the first oceanic technologies. Polynesian people had for centuries used their own technology to travel the vast Pacific Ocean, and trade along continental coasts was common. But these new innovations quickly increased the number of voyages for exploration and trade—and helped to change the history of the world.

Author bio

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