Technology in the Age of Exploration

By Malcolm F. Purinton

The age of exploring the oceans began in the 1400s. It was enabled by ideas and technologies from across Afro-Eurasia that came together in Europe.

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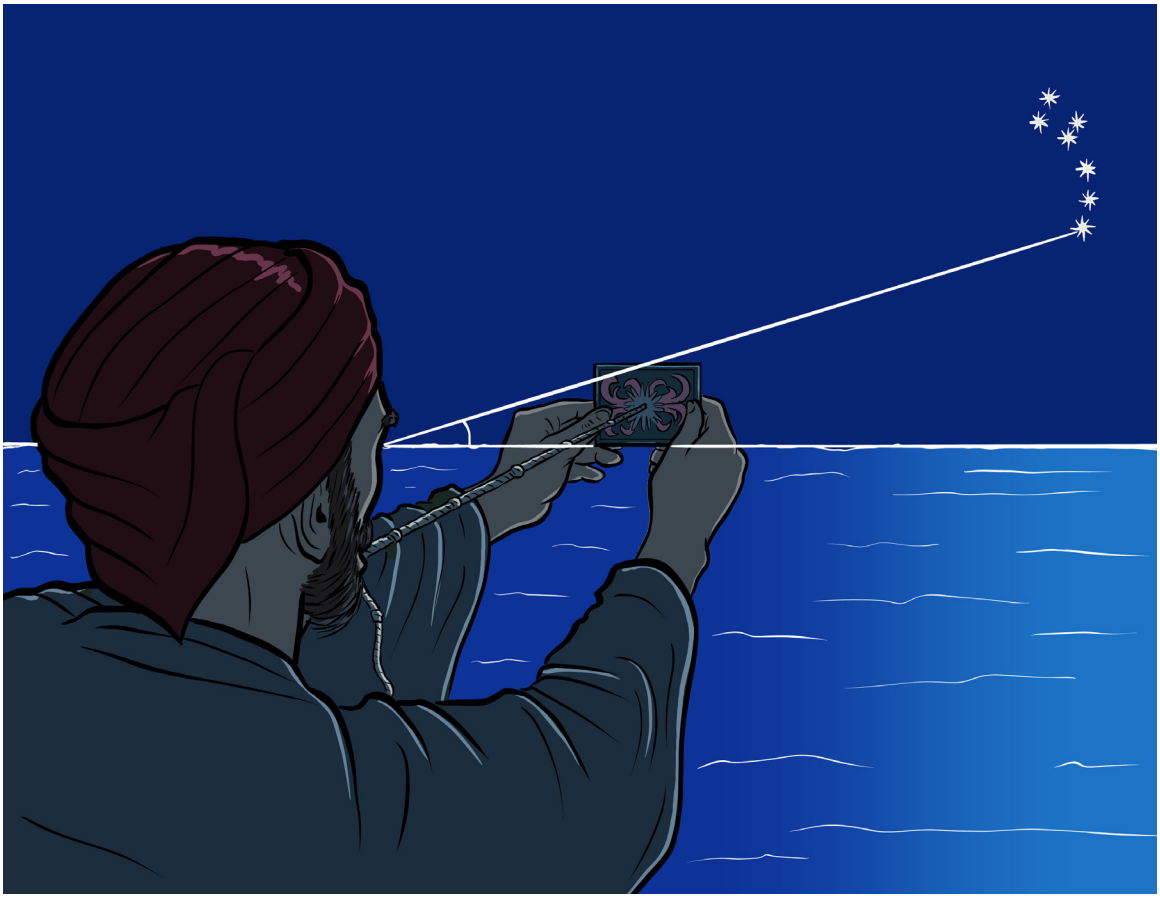
Introduction

During the 1400s, global networks developed in new ways. The crossing of the Atlantic and the beginning of the Columbian Exchange helped expand exploration and trade. Such oceanic voyages became more common because of technology. The tools that traders and explorers used were based on innovations that developed in many parts of Afro-Eurasia.

Kamal

One navigation tool was the *kamal*. It measured altitude to figure out latitude, meaning the north or south position of a ship. Altitude is the height of something above sea level. The kamal helped sailors find their way home after a voyage.

The kamal was developed by Arab sailors. It was a piece of wood with rope attached to it. At their home port, the navigator would tie knots into the rope and used the position of the knots relative to the North Star to determine the ship's latitude. When sailing back home they would hold the kamal in the same way to be at the same latitude.



An illustration of how a kamal was used to determine latitude. By WHP, CC BY-NC 4.0.

Quadrant

On clear nights north of the equator, the North Star helped sailors navigate. They needed a way to measure 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—was the quadrant. When you knew this height, then you knew your latitude.

An astronomer using a quadrant. © Getty Images.

Astrolabe

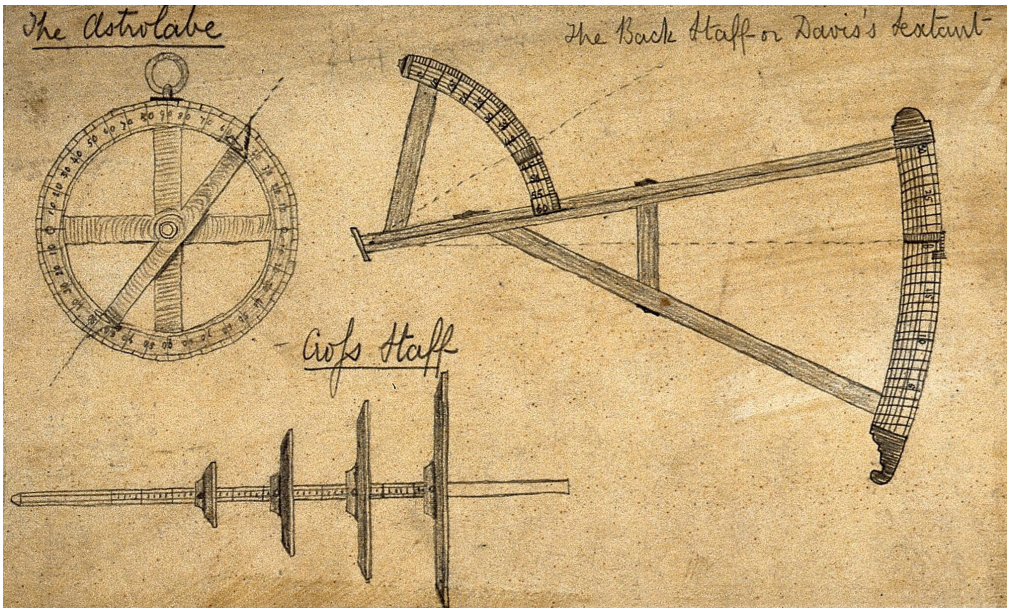
The astrolabe was an important navigation tool that was used by many European explorers, including Columbus and Magellan. It originated in the Roman Empire and remained important for centuries. With the tool, soldiers could measure latitude, time, and the position of stars or planets. The astrolabe looked like a stack of disks. It had writing to help with measurement.

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. It also had 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. The bottom edge lined up with the horizon. In this way, the navigator could be sure that they were at the right latitude. Using the cross staff in the daytime forced navigators to stare directly at the sun.

Seventeenth-century astrolabe from the Islamic world. © Getty Images.

In the 1600s, Captain John Davis developed a new navigation tool called the back staff. This instrument relied on the *shadow* of the sun, eliminating the problem.



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

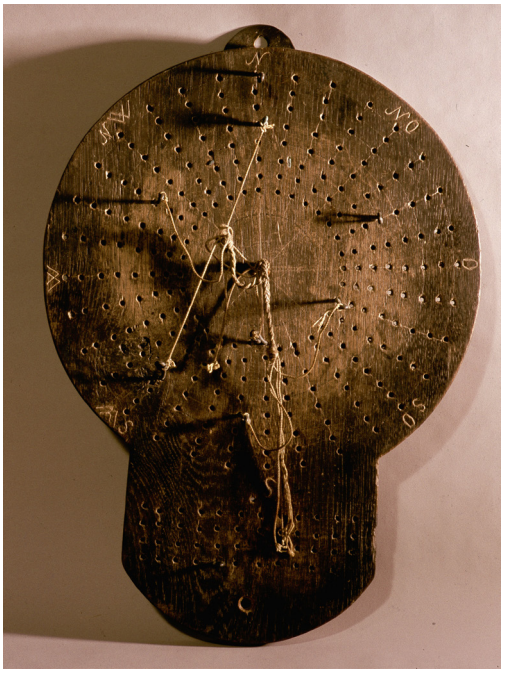
Magnetic compass

The magnetic compass was useful for determining a ship's location. Using a magnetic needle that reliably points north, you can know where you are and where you need to be going. Early magnetic compasses came from China. They were brought to Europe through trade.

A magnetic compass from the seventeenth century. © Getty Images.

Traverse board

While navigating, sailors need to record the speed and direction of their ship. 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. Sailors could also use the board 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. © Getty Images.

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 in Portugal for long-distance trade. It had two or three masts that used square sails on open water. The ship switched to triangular lateen sails when closer to shore. Caravels were very fast, and, because of this, many pirates liked to use them.

Another important ship design was the carrack, which combined Mediterranean and Northern European styles of ships. The carrack had a rounded stern and two large structures on top. They also used lateen and square sails. Carracks could weigh up to 2,000 tons.

An illustration of Portuguese carrack ships with several square sails and a triangular lateen sale in the rear. © Getty Images.

Cannon (yes, that's plural and singular)

Long-distance trade was dangerous, so ships needed weapons to have an advantage. Weapons might help traders get what they wanted from ports or other ships.

The best-armed ships of the day had cannon that could fire several kinds of shot. The round shot was great for damaging the hulls of enemy ships. The chain shot had two smaller balls attached by a chain. Chain shot could destroy sails and riggings. One of the reasons the English developed such a powerful navy was their superior ship cannon.

A painting showing carracks and galley ships in battle with smoke coming from cannon fire. © Getty Images.

These technologies made it possible for ships to travel long distances. Of course, they weren't the first oceanic technologies. Polynesian people had used their own technology to travel the vast Pacific Ocean for hundreds of years. But these new innovations quickly increased the number of voyages for exploration and trade, changing world history.

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