Technology in the Age of Exploration

By Malcolm F. Purinton

The age of oceanic exploration began in the fifteenth century. It was enabled by ideas and technologies from across Afro-Eurasia that came together in Europe.

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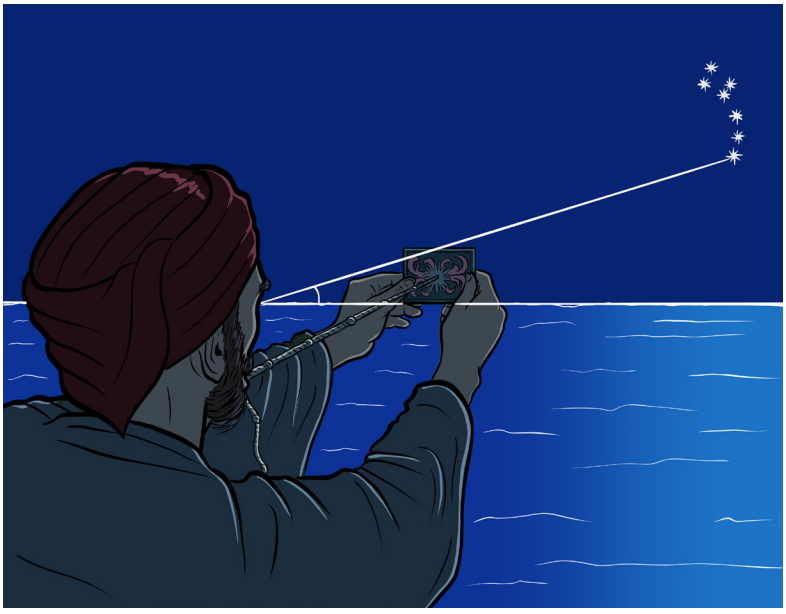
Introduction

The fifteenth century saw growth in global networks. The crossing of the Atlantic and the beginning of the Columbian Exchange were part of an expansion in exploration and trade. Such voyages became more common because of technology. The tools that these 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 (the north or south position of a ship), helping sailors find their way home after a voyage.

The kamal was developed by Arab sailors. It consisted of a piece of wood and rope attached to it. 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. Navigators would use the kamal before they left their home port and again on their returning route.



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, sailors could depend upon the North Star to help navigation. 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. Quadrants could also be used to measure the height of mountains or buildings.

An astronomer using a quadrant. © Getty Images.

Astrolabe

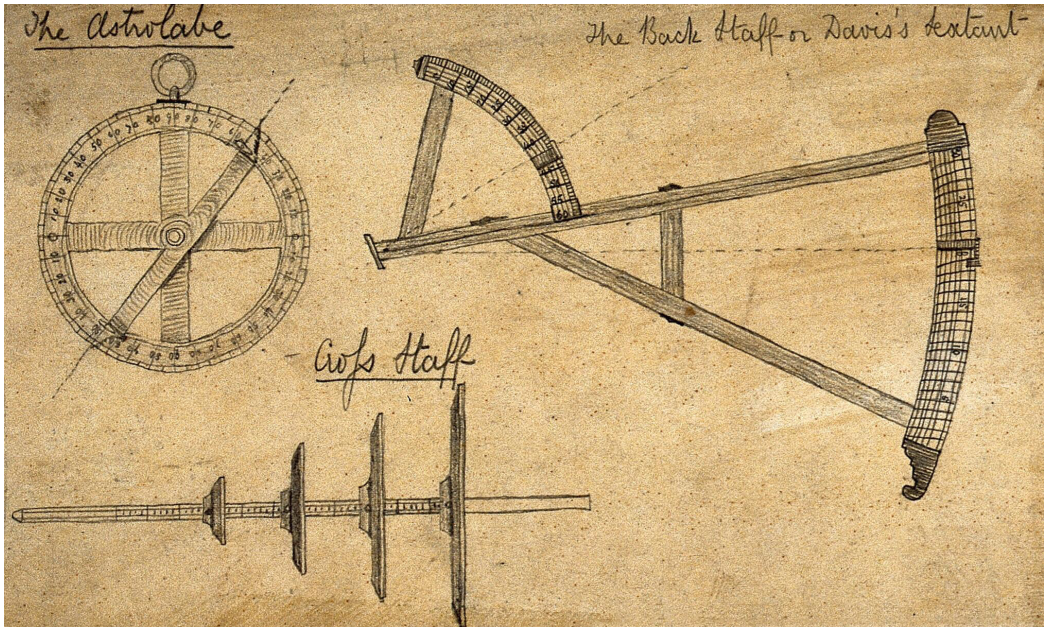
The astrolabe was an important navigation tool that was used by many European explorers, including Columbus and Magellan. It originated in the Roman Empire and remained important for centuries. With the tool, soldiers could measure latitude, time, and the position of stars or planets. The astrolabe looked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

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

Cross staff and sack 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. The bottom edge lined up with the horizon. In this way, the navigator could be sure that they were at the right latitude. However, using the cross staff in daytime forced navigators to stare directly at the sun.

In the seventeenth century, Captain John Davis developed a new navigation tool called the back staff. 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.



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 and were brought to Europe through trade.

Traverse board

It's important in navigation for sailors to record 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. Sailors could also use the board to record the speed of the ship.

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 specifically for long-distance trade. It had two or three masts that used square sails on open water but 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, a mash-up of 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 and could have two to four masts depending on the size of the ship. Carracks could reach up to 2,000 tons.

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

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.
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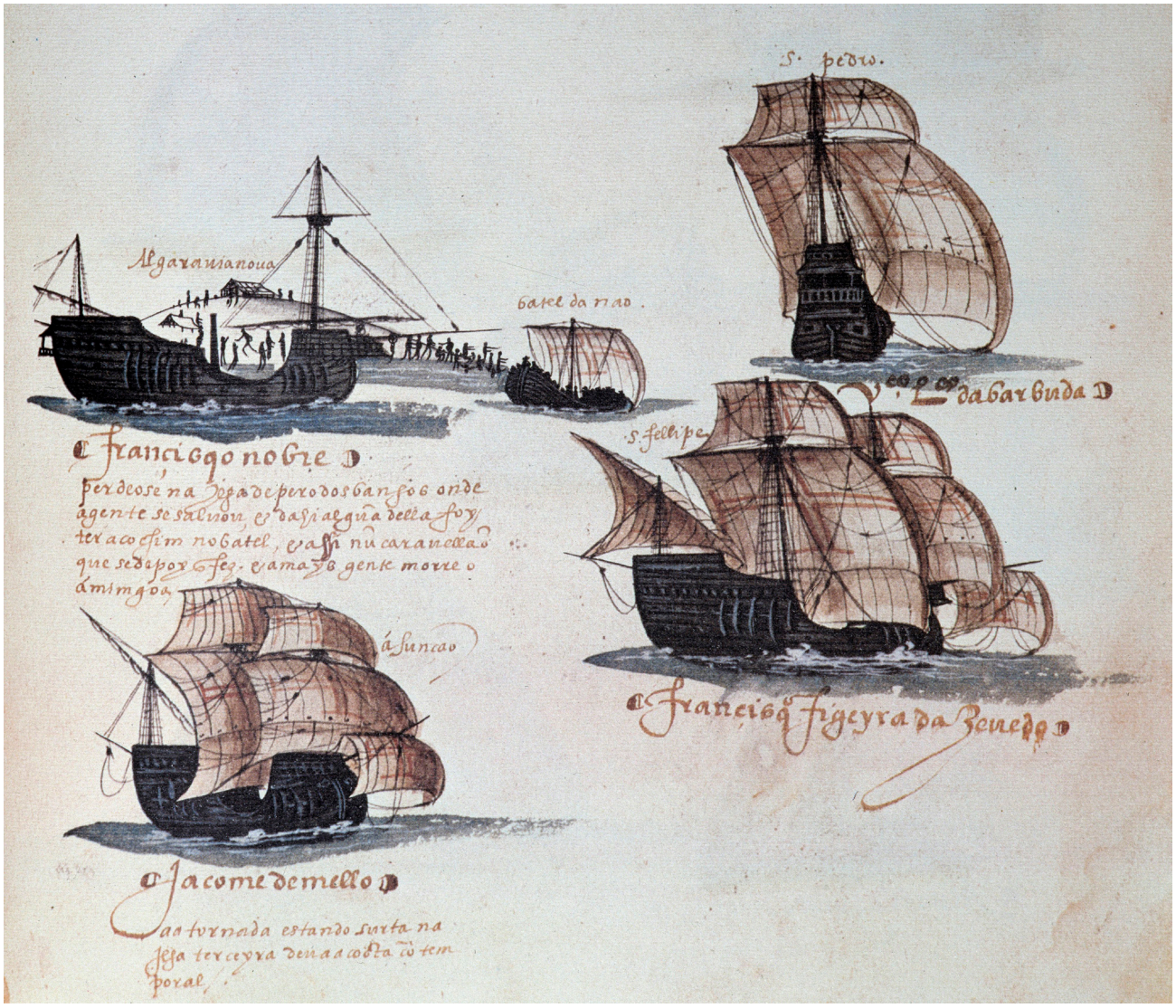

An illustration of Portuguese carrack ships with several square sails and a triangular lateen sale in the rear. © Getty Images.

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—or even engage in piracy.

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. But chain shot—which had two smaller balls attached by a chain—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.

Together, these technologies made it possible for ships to travel long distances. 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.

Sources

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