How Did Early Sailors Navigate the Globe?

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We know there are questions around travel amid the coronavirus (COVID-19) outbreak. Read our note here.

Long before modern cargo ships and luxury ocean liners plied the world's seas, the ocean has seductively beckoned sailors and explorers to venture from the safety of their inland waters. Today, sea captains rely on sophisticated navigation tools such as computers, global positioning satellites, and storm tracking systems. In contrast, courageous ancient mariners relied on their ancestral knowledge, meticulous observational skills, and environmental aides. The sun, stars, waves, wind direction, clouds, birds, marine animals, and even seaweed provided essential clues that enabled them to cross thousands of open ocean miles. Here's how they did it.

DAILY QUESTION

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Landmarks: The Earliest Navigation Method

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Ancient Phoenicians, Polynesians, and Chinese sailors have been navigating the Earth's oceans and seas for thousands of years, long before Christopher Columbus set sail in 1492. The earliest seafarers began venturing beyond their local waters around 1500 B.C. The Phoenicians — an early civilization who lived in independent city-states in what is modern-day Syria, Lebanon, and Israel — sailed between their ports scattered around the Mediterranean Sea. About the same time, Polynesian, Chinese, and East Asian sailors set out from their Southern and Northern Pacific homelands.

At first, early seafarers stayed within sight of land and made notes about recognizable characteristics such as rock formations, clumps of trees, and man-made structures. They sailed during the day, visually aligning pairs of landmarks to help them sail in a straight line, and found safe places to anchor at night. Some also knew the depths and bottom conditions (such as mud versus sand) by dropping a weighted, marked line overboard to measure depth and pull up bottom samples.

The Sky: An Essential Navigational Companion

Credit: bjdlzx/ iStock

It didn't take long for ancient sailors to venture out of sight of land, either to find new trade routes or new homes. They looked to the sky for navigational help. During the day, they watched the sun as it traveled across the sky and could easily determine north, south, east, and west. When they sailed toward or away from the equator, they watched the sun's position gradually shift on the horizon, which helped them assess distances.

When the sun sank below the horizon, early navigators looked to the moon and stars. In the Northern Hemisphere, they relied on the

North Star (official name Polaris) to determine north from south. You can easily spot the North Star if you can find the Big Dipper constellation. (And you might be surprised to learn that Polaris is *not* the night sky's brightest star!) Its significance to navigators is that it appears fixed in the sky. All the other stars rise in the east and set in the west every night, appearing to rotate around the North Star. The farther north they sailed, the higher the North Star sat above the horizon. And conversely, it appeared lower as they sailed south.

Southern Hemisphere seafarers couldn't see the North Star because they were too far south. However, they had their own version of a North Star — instead of a single star, it was a group of five stars. The Southern Cross (official name Crux) is part of a cross-shaped constellation that helped navigators find due south. When they sailed north, the Southern Cross traveled across the sky in a lower arc each night, and vice versa when sailing south. Southern Hemisphere nations still place great value on the Southern Cross — it appears on the flags of Australia, Brazil, New Zealand, Papua New Guinea, and Samoa, and is included in Australia and Brazil's national anthems.

These early astronomers also monitored other constellations and stars for assistance. As their boats positions changed over time, they noted where the stars rose and set on the horizon, which helped them determine how far north or south they were. The night sky served as an invaluable resource. However, celestial navigation had a significant limitation — it only helped with north and south distance estimates, not east and west.

Birds: Surprisingly Reliable Navigational Tools

Credit: Menno Schaefer/ Shutterstock

Mariners in both hemispheres also relied on birds to help them determine direction and distances. Certain seabirds travel long

distances from land to hunt fish during the day and then return at night. By carefully observing which way the birds flew in the morning and again in the evening, sailors knew where land lay. They also recognized the difference between land-based birds and seabirds. If sailors spotted birds that appeared to be land-based when they arrived in a new area, they knew some kind of landmass had to be close.

Early navigators also followed birds' seasonal migratory patterns. Some researchers believe Polynesians first sailed north from Tahiti to Hawaii around 400 A.D. by following the migration of the Pacific golden plover. In 1778, while exploring the South Pacific, famed British Captain James Cook wrote about observing plovers' flight paths and speculated that the birds were migrating to an unknown landmass to breed.

Carrying shore-sighting birds on voyages also aided these explorers. Scandinavian sailors couldn't rely on stars during the summer since the sky never darkened enough (due to their proximity to the North Pole). While trying to find Iceland and Greenland, some traveled with cages of ravens and released one when they thought they were nearing land. If the bird circled aimlessly and then returned to the boat, they knew land was far away. If the bird took off, the sailors followed it. Polynesians may have carried frigate birds, which unlike most seabirds, can only float on water for a short period. Once their feathers become too wet, they are unable to fly, so they stayed close to the Polynesians' canoes if they couldn't detect land.

Wave Patterns: Complicated Navigational Assistants

Credit: jeremybishop/ Unsplash

Oceangoing explorers also carefully observed wave and swell patterns to help them navigate, especially when celestial clues were

unavailable. Waves and swells behave differently when they're near land masses as opposed to the open ocean. Islands and larger land masses block swells, creating calmer waters on the leeward (protected) sides. As deep-water swells move into shallower water, they transform and become steeper. When the swells hit very shallow water, such as an offshore reef or sandbars, they break. Waves also refract around or "bounce off" islands. Navigators often knew when they were approaching land even before they could see it by observing wave behavior.

Even far from land, skilled observers read the ocean's surface. Storms and trade winds create swells in the open ocean. Trade winds blow constantly from the same direction, creating consistent swells. Navigators understood this, so they knew which way to sail by observing the direction swells rolled. Winter storms in both hemispheres create predictable wave patterns as well, so they altered calculations based on the season.

South Pacific navigators created wave maps from bent sticks and memorized them before heading out to sea. Often, instead of watching the ocean's surface, they would lie in the bottom of their canoes and detect minuscule changes in the way the canoe pitched, rolled, or corkscrewed. Any change in motion indicated the boat had changed course, so they knew to make corrections to stay on course. When storms and local weather patterns altered predictable swell behavior, navigating by ocean swells became less accurate. It often took these wave detectives years of training to learn how to navigate by ocean swells.

Currents and Seamarks: More Navigational Clues

Credit: kryszpinDownload/ Unsplash

Like trade winds, substantial currents flow consistently in the Earth's oceans like underwater rivers. Early seafarers understood where and

from which direction these currents flowed. They also identified currents by their water temperatures; some currents are chillier and others are warmer than the surrounding water. For example, the chilly Peru Current flows from south to north off South America's West Coast. The warm Mentor Current also flows from south to north along the same coast, just farther offshore. Temperature differences like this helped sailors understand how far east or west they were. Some currents provide visual clues too, as they often appear a slightly different shade of blue or contain phytoplankton which alters their color. Many collect long lines of floating seaweed along their edges — and the type of seaweed also tells a story. Early navigators recognized these current subtleties and used them to identify their approximate location.

Sailors also developed a complex network of seamarks, which currents often influence. Like a landmark which appears in the same place each time sailors pass it, seamarks are predictable, recognizable occurrences in the ocean. To a layman, observing a pod of whales or a school of floating jellyfish is simply a random event. To an experienced navigator, these seemingly random sights were like landmarks. Whales, dolphins, sea turtles, fish, and other marine animals often follow currents as they feed and migrate. When navigators spotted a specific jellyfish, flying fish or whale species at a certain time of year, they knew where they were.

Clouds and Reflections: Another Reason Navigators Watched the Sky

Credit: zburival/ Unsplash

Mariners constantly monitored the sun, moon, stars, and birds in the sky, but they had another reason to observe the heavens. The size, shape, and locations of clouds convey useful information. Clouds often form over a landmass as warm air rises and mixes with cooler

air. The puffy white clouds that build over a landmass look different from high atmospheric and storm clouds. Sailors could spot these hovering clouds from a much farther distance than the land itself. In addition to being skilled astronomers, ancient navigators were also knowledgeable meteorologists. They watched the clouds for clues about wind currents and weather, which were crucial to understanding when dangerous storms were headed their way. For example, cloud color and height indicate whether a storm will bring more rain or more wind, and how soon weather changes will occur. Another reason early mariners scanned the horizons was to find reflections that indicated solid ground was below. Sun and moonlight sometimes reflect off tranquil lagoons and sandy white beaches, which create a loom or faint glow in the sky above. These looms are often visible from miles away.

The First Man-Made Navigational Tool: The Compass

Credit: jordanmadrid/ Unsplash

Historians and researchers are often still in awe of early navigators' astute observational skills and encyclopedic knowledge of currents, winds, celestial bodies, animal behavior, and waves. They traveled thousands of miles across vast oceans using minimal tools. Native Pacific Islanders didn't even use charts as early European explorers did. That began to change for European sailors with the advent of the magnetic compass around the 12th century. (The Chinese had been using a variation since around the second century B.C., but not for ocean navigation.)

A compass uses a magnetic needle that naturally points north when it floats in an unrestricted space, either in a liquid or on gimbals. The Earth's magnetic fields interact with the needle. The irony is that magnetic compasses point to what's known as magnetic

north, which moves as it responds to changes in the Earth's magnetic core. Unlike the North Star (which remains fixed), the compass needle doesn't always point due north. This perceived unreliability confused early users, so they still primarily looked to the sun and stars unless it was overcast.

Sailors were often a highly superstitious lot, and many feared the compass. They believed it operated by black magic and would bring bad luck to the ship. Captains sometimes had to hide their compasses from their crew. However, by the 14th century, compasses were standard equipment on most naval vessels. In subsequent centuries, other navigational aids such as the sextant, astrolabe, and chiplog made it easier to calculate distances and direction.