

## HOW DID PEOPLE MAKE MAPS BEFORE THERE WERE MAPS TO COPY?

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Today, we can click on a web site or open a book to find maps of any area on Earth. We don't usually think about how the maps were made or whether they are accurate. But that wasn't always the case. Early cartographers (people who make maps) needed to learn some important things about Earth before they could make accurate maps. They needed to learn about the shape of the Earth, the size of the Earth, and how to calculate the distance between two points on the surface of the Earth.

### Understanding the shape of the Earth

Although sophisticated maps were made by many cultures, for example, the Chinese, the maps we use today descend from the maps and map-making techniques of the ancient Greeks. Among the most influential thinkers about the shape of the Earth were three Greeks: Pythagoras, Aristotle, and Claudius Ptolemy. In 500 B.C., Pythagoras hypothesized that the Earth was round after observing that the height of stars was different at different locations and noticing how ships appeared on the horizon (he noticed that the top of the masts appear first, then the sails, and finally the hulls). In 300 B.C., Aristotle noticed that the Earth cast a rounded shadow on the moon during lunar eclipses. In about 150 A.D., Claudius Ptolemy, a mathematician, geographer, and astronomer, created an eight-volume work called *Geographia* that showed many maps of the world. All of his maps were curved, indicating his acceptance of the idea of a round Earth. Ptolemy also was the first to use lines of latitude on maps. Lines of latitude are imaginary lines that help describe the location of a point on Earth. The lines start at the Equator at 0° and go up to the North Pole (90°N) and down to the South Pole (90°S).



Ptolemy, *Geographia*, 1522.

Courtesy James Ford Bell Library, University of Minnesota.

### Knowledge lost and regained

The fall of the Roman Empire and the destruction of libraries and schools created an intellectual void that led to the dominance of church dogma and myth. It was during this period that Ptolemy's maps were temporarily lost. This set back accurate mapmaking in Europe for a thousand years. Abstract, symbolic maps were common in the Early Middle Ages (from about 450 to 1100 A.D.) These maps located Jerusalem at the center of the universe, showing continents and oceans as rectangles with little or no detail. Rediscovery and reintroduction of ancient learning and maps, by way of Islamic civilization, occurred during the Late Middle Ages (from about 1100 to 1450 A.D.) These maps showed countries, oceans, rivers, cities, and coastlines but were also embellished with monsters and biblical references (such as the Garden of Eden). Mapmakers disliked empty space and filled it in, inspired by the Bible, myths and fanciful travel stories. Though quite beautiful, these maps were inaccurate. After the fall of the Byzantine Empire, in 1453, Ptolemy's *Geographia* was rediscovered, translated and reintroduced to Western Europe.



7th century map.

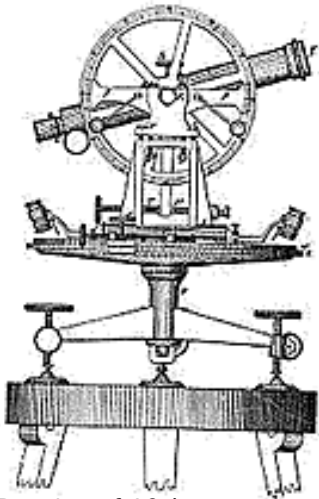
Courtesy U.S. Library of Congress.

## Making detailed measurements

In the third century B.C., the Greek astronomer and mathematician Eratosthenes estimated the Earth's size by comparing the shadows cast at two locations at noon. He used his knowledge of triangles, circles, and angles to calculate the Earth's circumference to within one percent of the actual measurement.

Throughout history, mapmakers have been able to provide detailed maps of small areas, but it wasn't until the 17th century that mapmakers could make accurate measurements over larger areas. At that

time, a new technique of measuring distance called triangulation revolutionized mapmaking. To determine the distance to a far-off point, mapmakers first measured the distance between two relatively close points and then measured the angle between each of these two points and the distant point using a transit or a theodolite. Once these angles and the distance between the two baseline points were known, the distance to the far-off point could be calculated using geometry.

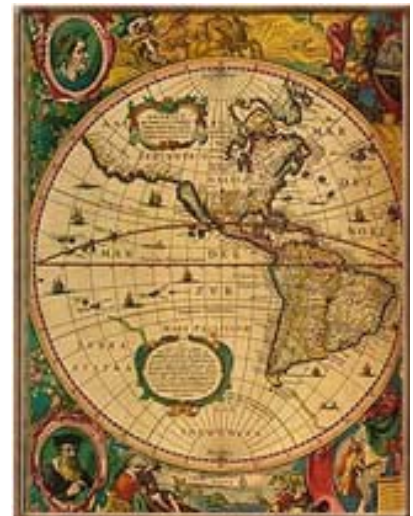


*Drawing of 19th century  
Theodolite.  
Courtesy NOAA/NASA.*

One of the first official uses of triangulation for mapmaking was in 1669 when King Louis XIV of France commissioned Jean Picard and Jean Dominique Cassini to map the coast of France. This first accurate measurement of France showed it to be significantly smaller than earlier maps did. The King is said to have declared, "Your work has cost me a large part of my State!"

## Explorers add information

Explorers have provided information about coastlines and distant lands throughout history. One explorer, Ferdinand Magellan led the first expedition to circle the globe, in the early 16th century. Magellan and his crew found the passage between the Atlantic Ocean and the Pacific Ocean at the southern tip of South America. Although Magellan was killed in the Philippines, his crew completed the journey, returning home in 1522, three years after they set sail. This trip provided accurate information about the size of the Earth, the distribution of land and sea, and the coastlines of countries and continents. Today, satellites can circle the globe in about 100 minutes. Satellite technology allows scientists to view large areas that could not be entirely seen from a ship and to view the Earth in different parts of the electromagnetic spectrum. Close observations and measurements on-site, such as documenting the change in the thickness of sea ice in Antarctica, can be measured only by going there. Even today, observations at the site itself, in addition to satellite images, are important to get a complete picture or map of an area.



*1633 Atlas of the Western  
Hemisphere.  
Courtesy U.S. Library of Congress.*