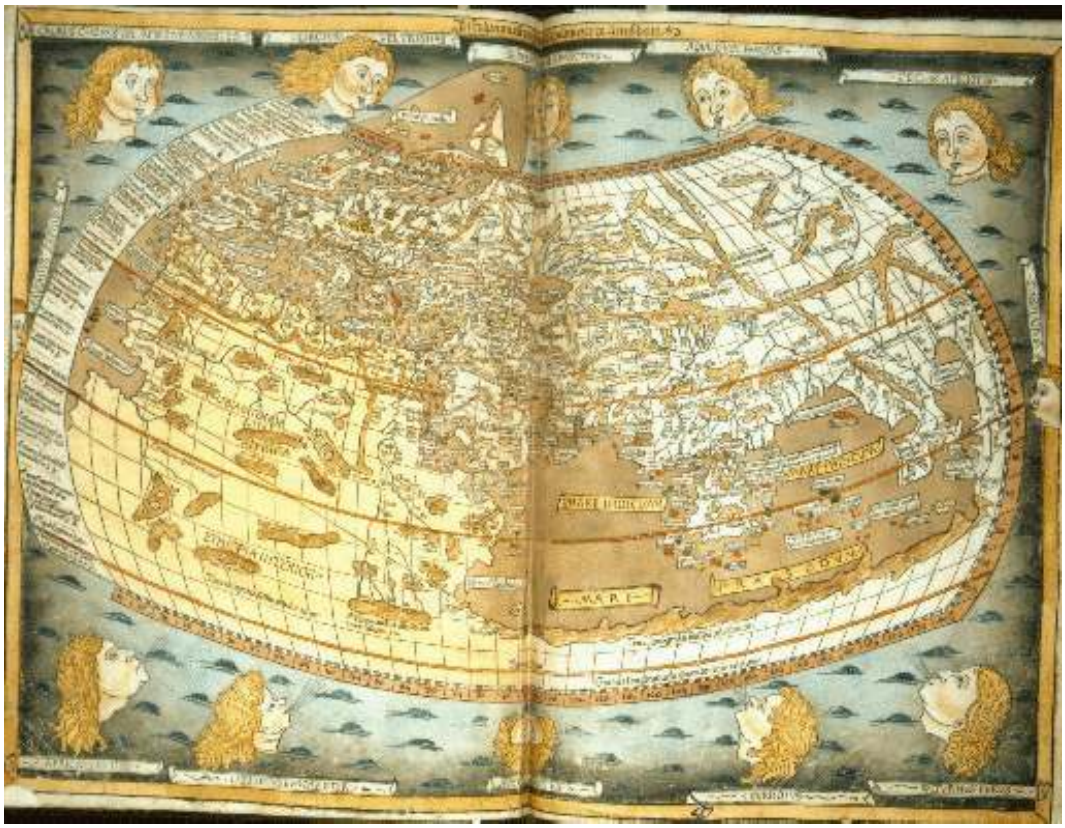
The Birth of Navigation



Ptolemy's world map drawn in 130 A.D. His works, rediscovered at Constantinople in 1400, formed the basis for the rebirth of ocean mapping in the two succeeding centuries, stimulated by the discoveries of navigators like Columbus, Diaz and da Gama.

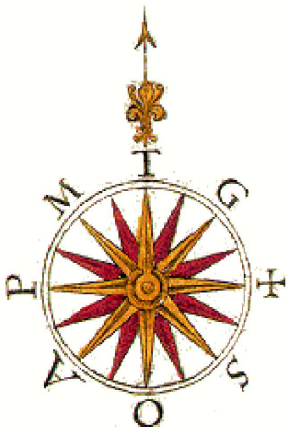
Navigation (a term derived from the Latin "*navis*" a ship, and "*agere*", to drive) is the art of taking a ship from one place on the earth's surface to another by sea, safely, speedily and efficiently. Today it is done by means of charts, compasses, logs (to record a ship's speed and distance run), accurate sextants (to measure the angle of heavenly bodies), automatic sounding machines to gauge the depth of the water, broadcast time signals, and a host of electronic aids, which give the navigator his exact position on the surface of the globe; the first navigators in history had none of these aids. It took hundreds of years for the first seaman to evolve as simple an implement as a lead and line to measure the depth of water under his ship. Usually, in this very early period of travel by sea, ship always sailed by day, and within sight of land, hugging the coast, then anchoring as night fell. When, occasionally, they were blown out to sea beyond sight of the shore, they were lost until they had the good fortune to make a landfall somewhere else. We read that, even as late as A.D. 61, when the ship in which St. Paul was voyaging from Caesarea to Rome was driven out to sea in a storm, no one on board knew when the ship was until the wind blew the ship to Malta and safety.

It is thought that it was the Phoenicians, during their voyages in the first millennium B.C., who first learned how to use the stars, or, at least, one of them, in plotting a course at night, though it is possible that the knowledge came from Eastern navigators. The Greek poet Aratus, writing about the constellation of the Little Bear, says, 'By her guidance the men of Sidon steer the straightest course,' 'the men of Sidon,' of course, being Phoenicians. "*Ursae Minoris,*" the Little Bear, contains "*Polaris,*" the Pole Star, which always lies to the north, and this knowledge gave the Phoenicians a fixed point of reference by night. They knew, too, that at local noon the sun always lay due south, and this was especially useful knowledge when combined with another navigational aid - the wind-rose.

Very early version of - The-Wind-Rose

The wind-rose was a circular card, in the shape of a compass card, on which were drawn the directions of certain named winds. It is not known who first introduced it, but it is certain that by the time Homer, around 900 B.C., Greek seamen used four quarters, as their principal means of navigation. These were Boreas, the north wind, Euros, the east wind, Notos, the south wind. Later as voyages became longer and a greater degree of accuracy was needed to reach a given destination, four more winds were added. After one of the original four had been moved through 45 deg., the eight winds were (clockwise from the north) Boreas, Kaikias, Apeliotes, Euros, Notos, Lips, Zephuros and Skiros. By reference to the sun at noon or the Pole Star by night, a navigator would identify which wind was blowing, and shape his course accordingly.

The eight wind system was adopted by the Romans, who gave their own names to the winds which became Tramontana, (T), Greco, (G), Levante, (L), Sirocco, (S), Mezzodi, Garbino, (later changed to Affricone (A), Ponente (P), and Maestro (M). The system was later expanded to twelve winds, then sixteen and finally thirty-two. As crazy as it may sound the "wind-rose" is still in use today.



It is surprising that, in a developing world where more and more trade was being carried by sea and men were inquiring more and more into the shape and nature of the earth, very few attempts were made to map the sea. Homer, in his poems, envisaged the world as an immense disc surrounded by a broad, flowing river known as Okeanus. The earliest known map, moulded in clay and now in the British Museum, dated about 700 B.C., follows Homer's model, with Babylon at the center of the disc. The earliest Greek maps share the disc concept, though they have Delphi at the center. Later Greek geographers, noting the overall shape of the Mediterranean, thought that the world must be longer along the east-west axis than the north-south, and so drew the earth as a rectangle, with a prime meridian

and prime latitude passing through Rhodes, then considered to be the maritime centre of the world.

But even before these Greek geographers got to work, the idea that the earth was a sphere had already taken hold. Pythagoras, in about 580 B.C., was the first man to grasp this. Using the Pythagorean theory, a Greek from Cyrene in Libya, named Eratosthenes, set out in 200 B.C. to discover the circumference of the earth by calculation. He measured the length of the shadow of a gnomon, cast by the sun in Alexandria at the summer solstice, and, taking the distance due south to Aswan, on the Tropic of Cancer, where the sun is directly overhead (this distance was known from the existing cadastral surveys of the Nile valley), he arrived at a figure for the circumference of the earth which differs by less than 4 % from the modern one.

On the basis of this calculation Eratosthenes constructed a new world map, using meridians of longitude and parallels of latitude, adjusted to pass through places of importance, such as Meroe (in Abyssinia, the farthest known point to the south) and the Pillars of Hercules (the farthest known place to the west). These meridians and parallels were based on Rhodes.

Eratosthenes was followed by Marinus of Tyre, who in the first century A.D. began drawing charts for seamen. His meridians and parallels were equally spaced, though he still used Rhodes for the intersection of his prime meridian and prime parallel.

There was, therefore, by this time a considerable body of knowledge about the real shape of the earth and sea, at least in the Mediterranean and in Arabian waters. Where the great difficulty lay, so far as charts for navigators at sea were concerned, was in accurately translating a curved surface (the earth) into a flat surface (a chart). This problem was solved by Ptolemy, whom we recognize today as the real father of cartography. Although born a Greek, he lived and worked in Alexandria, as a mathematician and astronomer. In about 130 A.D. he evolved a simple conic projection whereby the features of a curved surface could, with reasonable accuracy, be projected onto a flat surface. Later he evolved a more sophisticated method of doing it with his equal-area projection. Using this projection he drew a map of the world, showing it as contained within 180 degrees of longitude, from the Canary Islands in the west to China in the east. The whole of the Mediterranean Sea, Read Sea and Persian Gulf are shown with fair accuracy, although he portrays Africa as a huge continent bending round to the east and finally joining up with China to enclose the Indiana Ocean as a vast lake (See map at start of this article).

Only in one respect did Ptolemy really fail: for his world maps he accepted a figure, given by Poseidonius who lived in the first century B.C., of 18,000 miles for the earth's circumference, instead of the earlier and much more accurate measurement of Eratosthenes. This made one degree of latitude, the basis of all measurement of distance at sea, equivalent to 50 miles, instead of 60 miles as it should be, and led to considerable distortion.