

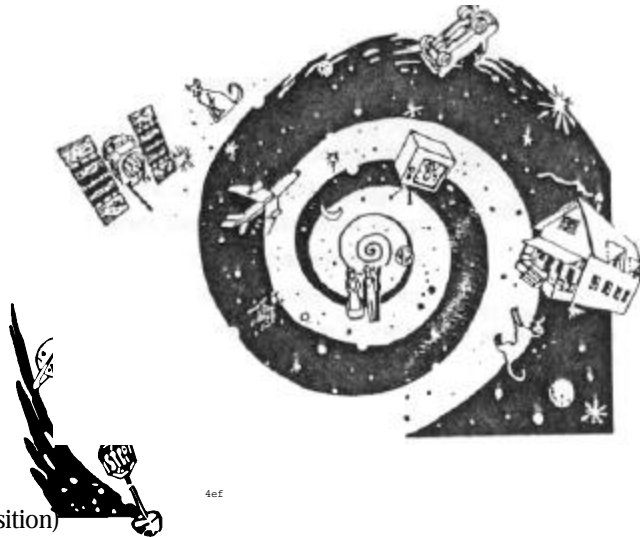
wonderfully intricate and precise as today's GPS satellites and Magnavox receivers.

### Everything is Relative

Our planet Earth is corkscrewing through the universe at millions of miles an hour. In fact, it's falling. Everything is falling: The moon falls around the earth, the earth falls around the sun, the sun fall around our galaxy—the Milky Way—and our galaxy is falling around other galaxies. Like it or not, we're all captive passengers on spaceship earth.

And here's the rub: Where anything is in space can only be accurately described for one instant of time and only in relationship to other objects. So, how well we navigate depends on how well we mark time, compute speed, and measure distance (and/or angles) to objects whose instantaneous position we know.

Pinpointing your position from three or more intersecting lines (between you and objects of known position) is called "triangulation." Triangulation is the method of finding a navigational solution. And timekeeping and distance measurement are its needed components.



### Big Problems For Early Navigators

All this moving and falling of objects and progressing of time posed big problems for early navigators. The best they could do safely was to steer close to shore. Until the invention of modern

clocks, they measured time mostly by observing the changing positions of the sun and the moon.

To determine direction, navigators gradually came to observe the stars by night, when they could see them, and the sun by day. They also observed earth-bound objects, such as rocks, trees, mountains, and shore-line features to determine direction and position. They studied the relationship of wind patterns to seasons and earth locations, using these phenomena as a rough guide to direction. They even counted oar strokes to measure speed.

Early navigators also erected land markers at prominent sites. The Greeks, for example, built bonfires on mountaintops to help mariners find their way into the harbor. The Egyptians, having a low coastline and few landmarks, constructed a 400- foot high lighthouse outside the harbor of Alexandria—an ancient wonder equal in ingenuity in their time to the development of GPS in ours.

Using every clue available to them they reckoned their heading, speed, and distance traveled to the waypoint (a destination point). And this, too, is an important principle of navigation.



591-1431