By 1912 there were a number of methods in use to work out a ship's position. Captain T. H. Sumner of Boston discovered one such method on the 17th of December back in 1837 on a passage from Charleston to Greenock.[1] After being without any celestial sights for several days he finally got a break in the clouds at 10am, and was lucky enough to get a single altitude measurement of the sun; i.e., a measurement of the angular height of the sun above the horizon. If only he knew his latitude with any degree of certainty it would be relatively easy for him to get his longitude from this one observation of the sun using a method that was called "longitude by chronometer." Essentially he would be able to solve what is called the Navigational Triangle (see Figure H-02) using the sun as his celestial body to determine his *meridian angle*, the difference in degrees between the local meridian that his ship was on, and the meridian over which the sun was located on that particular date and time.[2] With this angle he would get his local apparent time; i.e., the time interval in hours, minutes, and seconds from local apparent noon, the time that the sun would be at its highest point in the sky on his local meridian. Then, by correcting his apparent time by what is called the equation-of-time for that particular date,[3] he would get what is called the local mean time (LMT) of the meridian that his ship was located on. With that information he would easily determine his longitude by comparing his LMT to the time displayed on his ship's chronometer (Figure H-03) that kept precise Greenwich Mean Time (GMT).

Unfortunately, Captain Sumner did not know his latitude with any degree of confidence needed to determine his meridian angle. What he did know, however, was that he was getting dangerously close to the southern coast of Ireland and was being pushed along by a southwesterly wind. He had to do something.

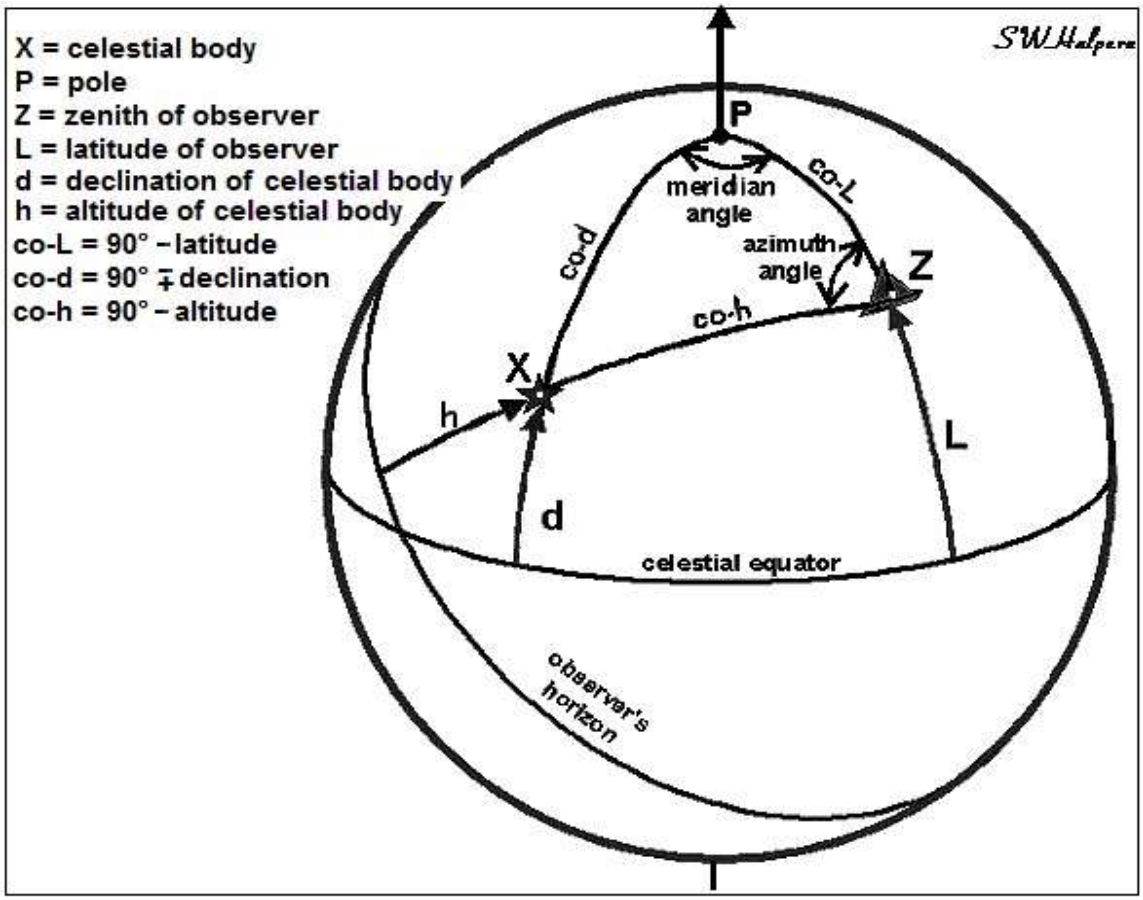

Figure H-02. The Navigational Triangle formed by the points X, P and Z.

Fig. H-03. A typical chronometer of the period.

Using his dead reckoning latitude as the starting point, Captain Sumner worked out a longitude by chronometer and found out that he was 9 miles further east than he expected from his DR position. He was quite concerned with the result because of his uncertainty in latitude. So what he did was to assume a different latitude, one 10 miles to the north of his DR latitude. When he worked up the new position from the same sight data, it turned out to be 27 miles to the ENE of the first position. He then assumed another latitude that was 10 miles further north from his last assumed latitude, and worked up a third position which turned out to be 27 miles to the ENE of the second position he derived. What Captain Sumner realized was that the three separate positions he came up with were all located on one common line which meant that his ship must be somewhere on that line. That line is what is called a line-of-position, an LOP, and can be worked for any celestial body or combination of bodies. With two or more lines of position taken from two or more celestial bodies, or the same body at different times allowing for the run of the ship in between, the lines of position must cross at the place where the ship is really at. As Captain Sumner described it:

> "And likewise if two altitudes [angular heights above the horizon] be observed, the times being noted by Chronometer, and the two lines, corresponding to the two altitudes, be projected as before, then both the true Latitude and the true Longitude is found at the intersection of the two projected lines."

Today we call this intersection a celestial fix.

Around 7:30pm ship's time on April 14, 1912, a set of star sights were taken on board *Titanic* to establish a celestial fix. To understand exactly how that was done, we first have to understand a little bit about how a stellar position was actually determined at sea during the period of time known as nautical twilight, when it was dark enough to see the stars yet still bright enough to see a sharp horizon.