Longitude by Meridian Passage of the Sun

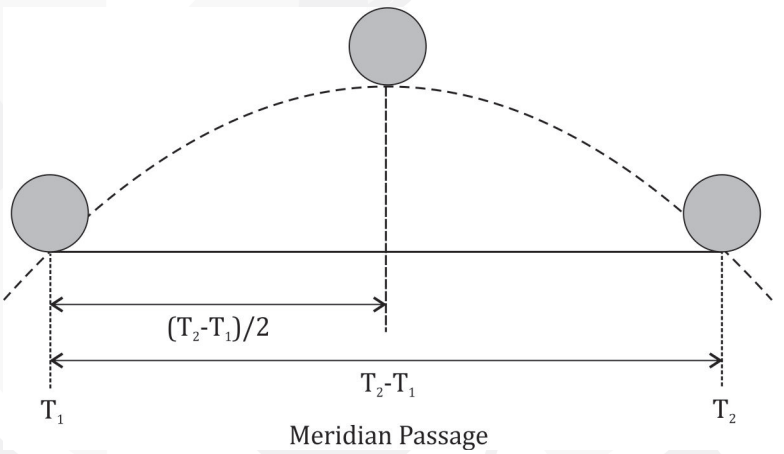
In the previous section, "Latitude by Meridian Altitude", we saw how the observer can determine the latitude when the sun is on the observer's meridian. As we know, the earth's rotation causes the sun to move across the earth's meridian in a nearly east-west direction, with an angular velocity of 15 degrees per hour. By knowing the UT or GMT when the sun is on the meridian passage, the observer can determine the longitude.

Procedure to obtain longitude by meridian passage of the sun

1. Determine UT of meridian passage of the sun;

   As the sun approaches the observer's meridian, the altitude will get larger and larger until it is on the observer's meridian, which is Local Apparent Noon (LAN) where it reaches maximum altitude, then, as is descends, the altitude will get smaller. Assuming that the sun moves along a symmetric arc in the sky, then the UT of the meridian passage of the sun can be determined by taking the times before and after the meridian passage at equal altitudes.

$$GMT_{Merpass} = \frac{T_1 + T_2}{2}$$



Meridian Passage

2. From the Nautical Almanac, obtain the equation of time (EoT) by interpolation

   The Equation of Time table is located in the lower right corner on the daily pages of the Nautical Almanac, with the date in the left column and the other columns under the sun, which are 00^h, 12^h, Mer. Pass. The Mer. Pass. column gives the time when the sun is at noon on the Greenwich meridian. The 00^h gives the difference in time between Greenwich midnight and where the sun will be in relation to the International Date Line. The 12^h column gives the difference in time between Greenwich noon and the actual position of sun in relation to Greenwich meridian. It depends on

the GMT when the observer is at Local Apparent Noon (LAN), at which time the correction can be interpolated between 00^h and 12^h.

3. Determine GAT by using a formula

$$GAT = UT \pm EoT$$

The correction is applied to UT to obtain GAT. If the Mer. Pass is 12^h00^m or later, then the correction is added to UT, indicated by a grey box. Otherwise, subtract the correction to obtain the GAT.

4. Use GAT and LAT to determine the longitude, where LAT always equals 1200.

$$\text{Longitude} = 15(LAT - GAT)$$

Example 1 At the moment before local noon on 20th April 2008, in DR position 16° N 129° W, the times at equal altitude of the sun were taken before and after the LAN at $3^h22^m10^s$ and $3^h29^m12^s$, no chronometer error. Find the longitude of the observer:

$$GMT_{Merpass} = \frac{3^h22^m10^s + 3^h29^m12^s}{2} = 3^h25^m41^s$$

$$\text{Equation of Time} = 1^m06^s \quad \text{(Interpolation from Nautical Almanac)}$$

$$GAT = GMT \pm EoT = 3^h25^m41^s - 1^m06^s = 3^h24^m35^s$$

$$\text{Longitude} = 15(LAT - GAT) = 15(12^h00^m00^s - 3^h24^m35^s)$$
$$= 15 \times 8^h35^m25^s = 128°51.3'W$$