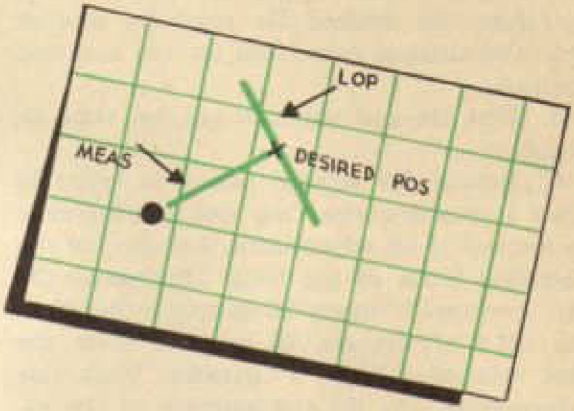
Pre-computation

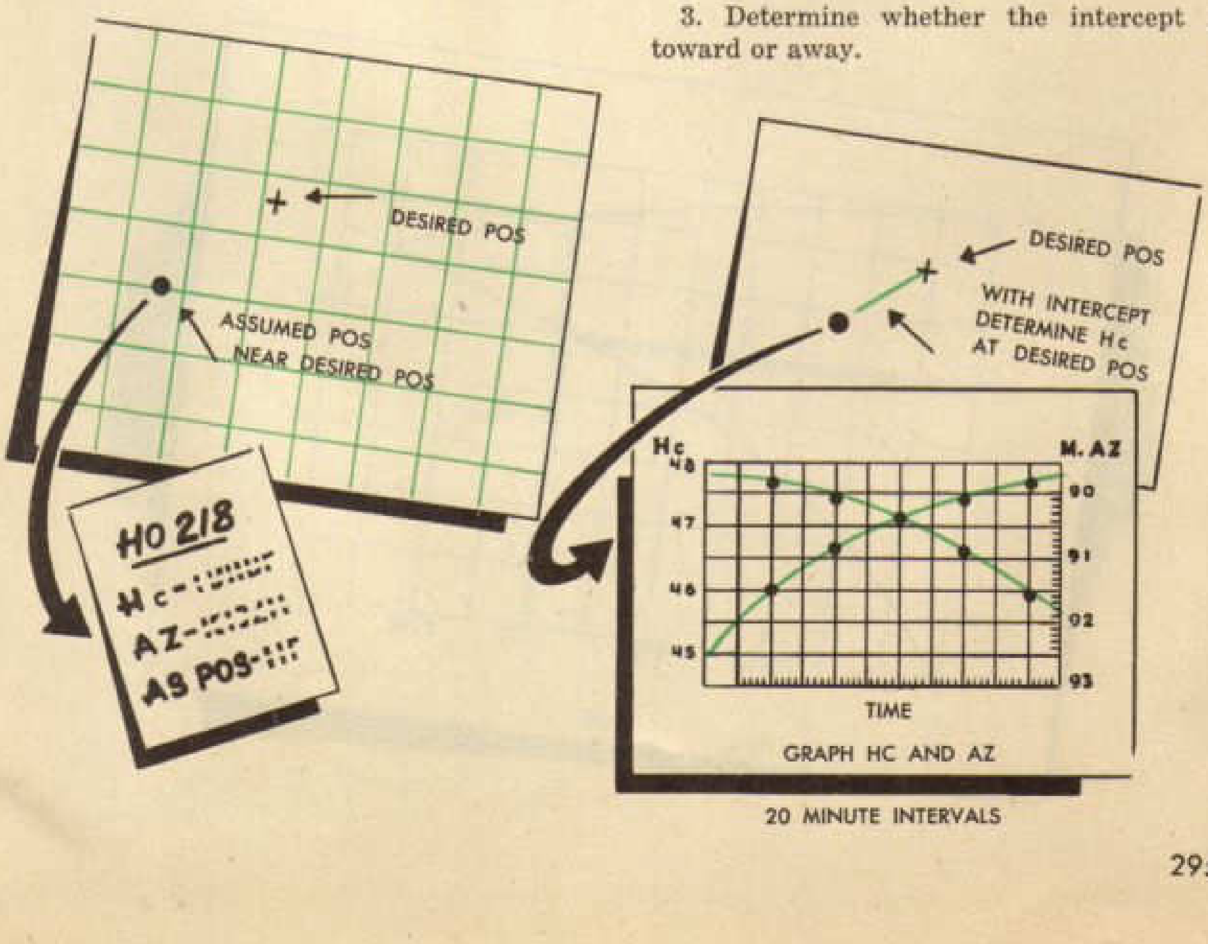
Solution of the astronomical triangle by H.O. 218 provides a quick means of establishing a line of position. The LOP is determined by comparing the difference between the observed altitude and the altiude computed for a convenient position by H. O. 218. Another method, called Dreisenstock, or H. O. 214, can also be used as a shortcut. Ordinarily, however, these two methods fail to provide a calculated altitude for a particular position. When this information is desired, a solution known as Ageton, or H. O. 211, may be employed. Ageton solution for Hc and azimuth of a body is the most accurate that has been found, but it requires much more time to solve the triangle than H. O. 218. For this reason a variation of H. O. 218 has been developed to determine Hc and azimuth for any desired position.

In reality this variation involves in part the working of a H. O. 218 solution backwards. For numerous reasons it is necessary to know the exact altitude and azimuth of a body from a particular position at a definite time.

In general, the method for applying H. O. 218 to this problem is stated below; however particular attention must be paid to the various exceptions to the rule.



1. Work H. O. 218 solution, using an assumed position nearest the desired position. This minimizes error due to change of azimuth between the two positions.
2. Erect an LOP through the desired position from the azimuth, and measure the intercept along the azimuth between this LOP and the assumed position.
3. Determine whether the intercept is toward or away.



20 MINUTE INTERVALS

4. Apply the intercept expressed in minutes to the Hc to determine the Hc at the desired position. If intercept is away, it must be subtracted from the Hc. This means that the desired position is farther away from the subpoint than the assumed position; therefore the desired Hc must be smaller than the altitude calculated for the assumed position.

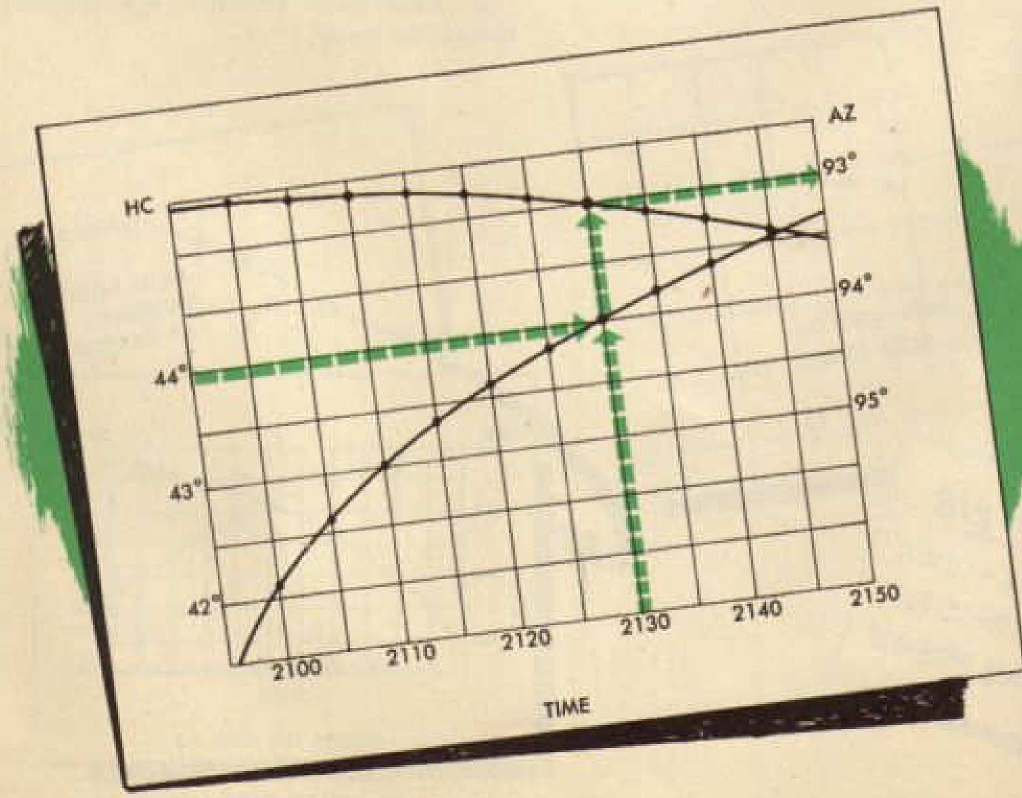
5. Plot Hc and azimuth against time on graph.

6. Repeat for several points in order to draw a smooth curve. Only one solution need be worked if an adjustment is made for the changing GHA of the body. Ordinarily the sun increases 5° every 20 minutes; therefore the LHA of the sun 20 minutes after the first solution will be 5° greater. With this information, the Hc and azimuth of the assumed position can be calculated and plotted and the Hc and azimuth of the desired position determined. Four points usually provide sufficient information from which to draw a curve.

Reference to the Air Almanac reveals that the GHA of the sun does not always change 5° every 20 minutes, but it sometimes changes 5° 01′ during a 20 minute period. This necessitates the movement of the assumed position one minute to the west after the change occurs. This does not affect the accuracy of the curve. In many cases the GHA follows a constant rate of change for several hours; therefore, in reality very few movements of the assumed position is necessary.

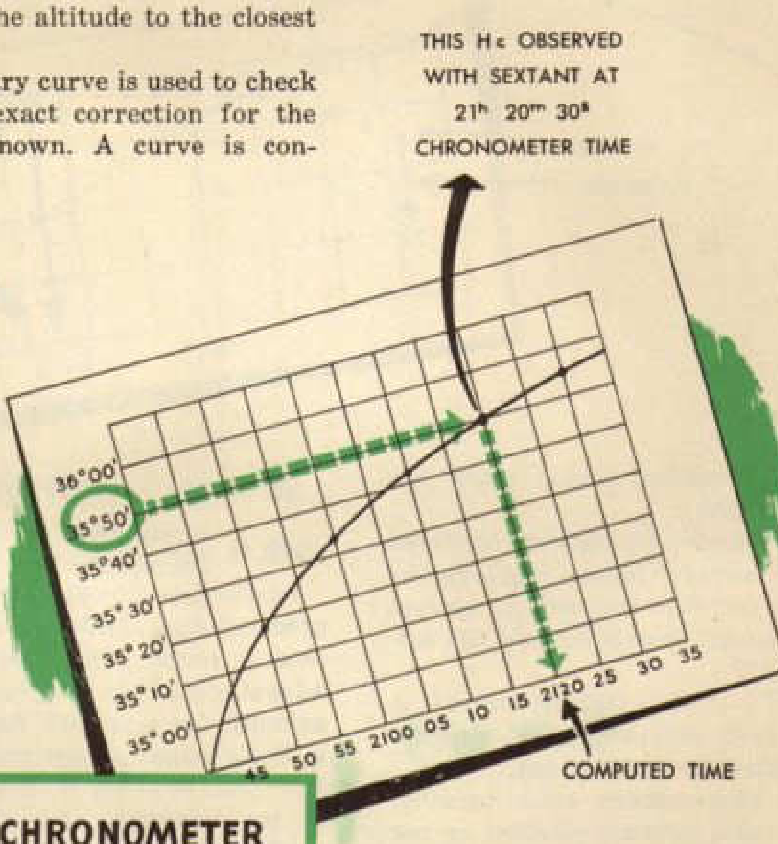
If a star is to be used, the same method may be followed; however the rate of change of the GHA ♈ is usually 5°01′ for each 20 minutes of time. Therefore, the assumed position must be moved one minute westward for each 20 minutes of time. This movement need not be made when the GHA ♈ changes only 5°, as it sometimes does.

If the Hc and azimuth of a body from a definite position have been calculated for intervals of twenty minutes over a period of an hour or so, it is possible to plot them against time and obtain a curve which represents all possible altitudes within the specified time. This type of curve, called *stationary* curve because the Hc and azimuth



are calculated on one position, may be used to check chronometers and sextants, as well as to fly landfalls. It is a graphical representation of the change in altitude and azimuth of a celestial body over a given period of time, as seen from the definite position. The diagram shows that the Hc for 2130 is about 44°. The azimuth is about 93°. If the scale were sufficiently large, it would be possible to determine the altitude to the closest minute.

When the stationary curve is used to check chronometers, the exact correction for the sextant must be known. A curve is constructed including the time over which the check is to be made. Fifty to a hundred observations are made from the known position with the sextant and plotted on the graph. The curve is entered with the sextant observation, and the time that the body actually had that altitude is determined from the time scale. These times are then compared with the time of the sextant observations and the differences noted. If the chronometer time of the sextant observation is greater than the time obtained from the graph, the sign of the difference is minus. These differences are added algebraically and divided by the number of observations. The correction thus obtained is applied to the chronometer time as the sign indicates.



21 20 30	CHRONOMETER
21 20 00	COMPUTED
−00 00 30	CORRECTION

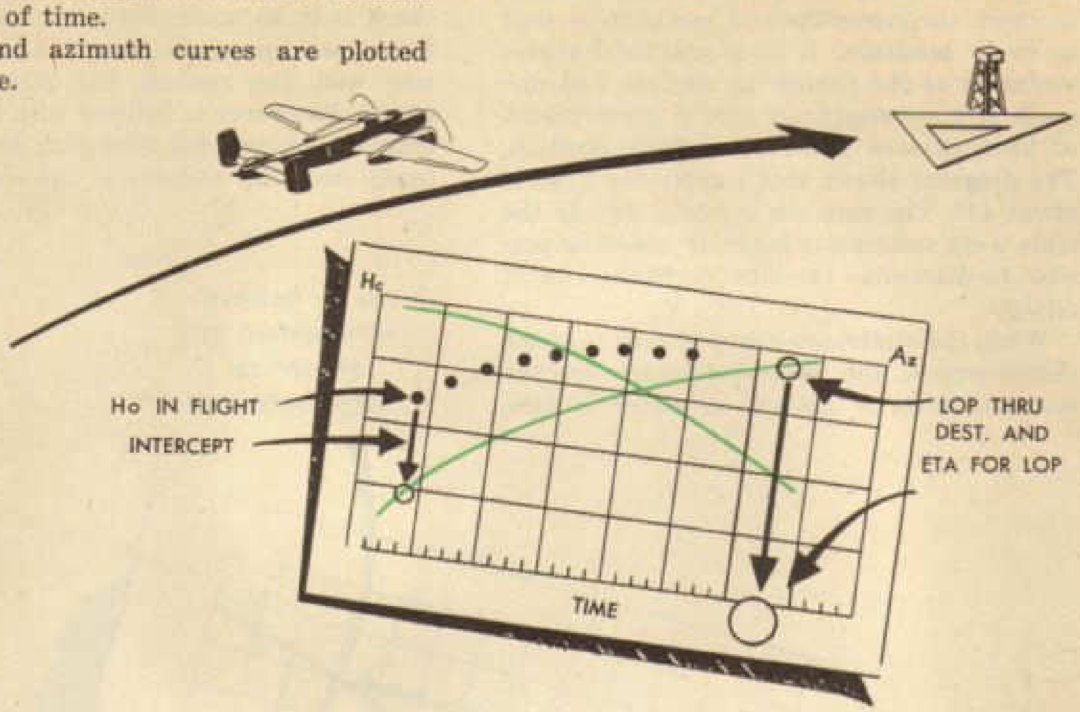
TO BE APPLIED TO CHRONOMETER

When using the stationary curve as an aid in performing a landfall, the following procedure is followed:

1. Destination is taken as the position for which the solutions are worked.
2. The time of the curve is determined by the ETA plus at least 30 minutes or an hour.

3. Hc and azimuth are calculated for each 20 minutes of time.

4. Hc and azimuth curves are plotted against time.



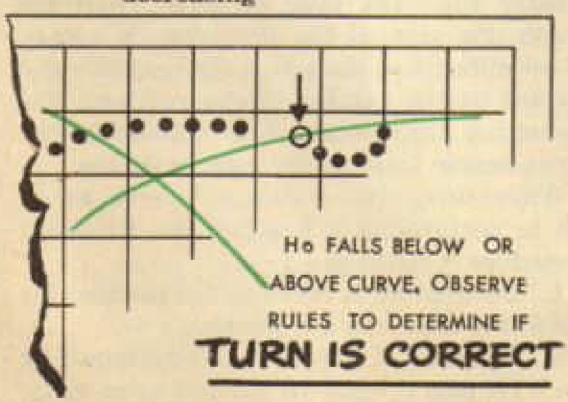
5. Altitudes observed during flight are plotted on the graph.

6. A curve is drawn through the observed altitudes a few minutes before reaching the Hc curve. This provides the time of arrival at the LOP through desination and the azimuth of that LOP.

7. At the ETA to the LOP, the aircraft is turned on the LOP (azimuth $\pm 90^\circ$, depending on the direction to destination).

8. Continue observations after turning. The following rules indicate whether or not the correct turn has been made.

$90^\circ + Az =$ curve falls $\frac{\text{below}}{\text{above}}$ when azimuth is $\frac{\text{increasing}}{\text{decreasing}}$



$90^\circ - Az =$ curve falls $\frac{\text{above}}{\text{below}}$ when azimuth is $\frac{\text{increasing}}{\text{decreasing}}$

Stationary curves are merely a means of precomputing altitudes and azimuths. Obviously, under certain conditions it becomes advantageous to precompute an Hc and azimuth for a specific future time. Normally these computations are used at the specified time; however if they should not be used at the intended time, the precomputation work need not be wasted. The A.N.T. book includes two tables with directions for use when adjusting for time.

This series of H. O. 218 books and the American Air Almanac include other tables which the navigator may need to use at various times. Complete directions accompany sunrise and sunset, moonrise and moonset, dip, and coriolis force tables.