8. **Construction of a Plotting Sheet.** Although essential navigational charts and plotting sheets normally will be available, it may become necessary for the navigator to construct an accurate graticule of a particular area for immediate use. The following instructions provide a rapid method of construction utilizing Diagram A. Each parallel of this diagram is projected as if the plane of projection were tangent at that parallel; hence these parallels may be used to establish an accurate small area plotting sheet, resembling the stereographic projection.

Instructions—Draw a straight line to form the central meridian on a suitable sheet of paper and mark intervals of six inches along this line (these will be the points through which the parallels for successive integral degrees of latitude must be drawn); place a piece of tracing paper over Diagram A in the area required, and mark the intersections of the meridians and parallels; transfer the tracing to the construction sheet and superimpose the tracing paper over the central meridian, with each parallel occupying successively the points through which it is desired to draw that parallel and "mark through" sufficient intersections of each parallel with successive meridians. The indicated points can then be connected to establish the parallels, and the meridians can be drawn in as straight lines.

When using the plotting sheet, all azimuths must be measured from the local meridian; the scale will be 10 nautical miles to one inch.

9. **Variation of Altitude with Time.** Inspection of successive altitude differences in the basic tables reveals immediately the change in altitude due to a change of one degree in the declination argument. Frequently navigators desire to ascertain the change with time of the altitude of a celestial body. The difference between the tabular values of the altitude given for the same arguments of latitude and declination, but differing by one degree in LHA, indicates the change of the altitude over a period of four minutes of time. In general the latitude and declination need only be used to the nearest integral degree in order to obtain a good approximation of the rate of change. To determine this approximate rate of change with time, enter the tables with integral degrees of LHA, latitude, and declination, and extract the altitude; turn to the next opening—next value of LHA—and with the same arguments for latitude and declination, extract the corresponding altitude; the difference between the two altitudes divided by four is the rate of change of altitude of the body in one minute of time.

10. **Polar Plotting.** For navigation within a few degrees of the pole it is convenient to adopt the pole as the assumed position and plot from that geographic position or point. At the pole the declination of the observed body, and the calculated altitude, Hc, coincide, and the GHA at the time of observation coincides with the azimuth of the observed body, measured westward from the Greenwich meridian; the intercept is thus the difference between the observed altitude, Ho, and the declination. Thus the position line may be constructed without extracting data from basic sight reduction tables. This method, however, frequently involves the use of long position lines which must be modified if accurate results are required.

The table on page xxiv gives offsets in minutes of arc (nautical miles) for observed altitudes to 70° at distances to 300 minutes of arc along the position line from the intercept; the offset for any altitude and any point along the position line is the distance separating the position line from the position circle; the offsets are to be plotted perpendicular to the position line and toward the observed body. Normally only two offsets, in the vicinity of the DR position, need be plotted and their extremities joined by a straight line, to give a very good approximation to that part of the position circle.

The following example illustrates the calculation and plotting procedure for a typical sight when:

(i) the pole is used as the assumed position;

(ii) an assumed position is chosen in the usual way.

TABLE OF OFFSETS (ALTITUDES 0° TO 70°)

ALT.	DISTANCE ALONG POSITION LINE FROM INTERCEPT														ALT.
	20′	40′	60′	80′	100′	120′	140′	160′	180′	200′	220′	240′	260′	280′	300′	
	OFFSETS															
0°	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0′.0	0°
5	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.1	5
10	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.7	0.8	1.0	1.2	1.5	1.7	2.0	2.3	10
15	0.0	0.1	0.1	0.2	0.4	0.6	0.8	1.0	1.3	1.6	1.9	2.2	2.6	3.1	3.5	15
20	0.0	0.1	0.2	0.3	0.5	0.8	1.0	1.4	1.7	2.1	2.6	3.1	3.6	4.2	4.8	20
25	0.0	0.1	0.2	0.4	0.7	1.0	1.3	1.7	2.2	2.7	3.3	3.9	4.6	5.3	6.1	25
30	0.0	0.1	0.3	0.5	0.8	1.2	1.6	2.1	2.7	3.4	4.1	4.8	5.7	6.6	7.6	30
35	0.0	0.2	0.4	0.7	1.0	1.5	2.0	2.6	3.3	4.1	4.9	5.9	6.9	8.0	9.2	35
40	0.0	0.2	0.4	0.8	1.2	1.8	2.4	3.2	4.0	4.9	6.0	7.1	8.4	9.7	11.1	40
45	0.1	0.2	0.5	0.9	1.5	2.1	2.9	3.7	4.7	5.8	7.0	8.4	9.8	11.4	13.1	45
50	0.1	0.3	0.6	1.1	1.7	2.5	3.4	4.4	5.6	6.9	8.4	10.0	11.7	13.6	15.6	50
52	0.1	0.3	0.7	1.2	1.9	2.7	3.7	4.8	6.0	7.5	9.0	10.7	12.6	14.6	16.8	52
54	0.1	0.3	0.7	1.3	2.0	2.9	3.9	5.1	6.5	8.0	9.6	11.6	13.6	15.7	18.1	54
56	0.1	0.3	0.8	1.4	2.2	3.1	4.2	5.5	7.0	8.6	10.5	12.5	14.6	17.0	19.5	56
58	0.1	0.4	0.8	1.5	2.3	3.4	4.6	6.0	7.6	9.3	11.3	13.5	15.8	18.3	21.1	58
60	0.1	0.4	0.9	1.6	2.5	3.6	4.9	6.5	8.2	10.1	12.2	14.6	17.1	19.8	22.8	60
61	0.1	0.4	0.9	1.7	2.6	3.8	5.1	6.7	8.5	10.5	12.7	15.2	17.8	20.7	23.8	61
62	0.1	0.4	1.0	1.8	2.7	3.9	5.4	7.0	8.9	11.0	13.3	15.8	18.6	21.6	24.8	62
63	0.1	0.5	1.0	1.8	2.9	4.1	5.6	7.3	9.3	11.5	13.9	16.5	19.4	22.5	25.9	63
64	0.1	0.5	1.1	1.9	3.0	4.3	5.9	7.7	9.7	12.0	14.5	17.3	20.3	23.5	27.1	64
65	0.1	0.5	1.1	2.0	3.1	4.5	6.1	8.0	10.1	12.5	15.2	18.1	21.2	24.6	28.3	65
66	0.1	0.5	1.2	2.1	3.3	4.7	6.4	8.4	10.6	13.1	15.9	18.9	22.2	25.8	29.7	66
67	0.1	0.5	1.2	2.2	3.4	4.9	6.7	8.8	11.1	13.8	16.7	19.9	23.4	27.1	31.2	67
68	0.1	0.6	1.3	2.3	3.6	5.2	7.1	9.2	11.7	14.5	17.5	20.9	24.6	28.5	32.8	68
69	0.2	0.6	1.4	2.4	3.8	5.5	7.4	9.7	12.3	15.2	18.5	22.0	25.9	30.0	34.5	69
70	0.2	0.6	1.4	2.6	4.0	5.8	7.9	10.3	13.0	16.1	19.5	23.2	27.3	31.7	36.5	70

The distance is measured along the position line from the intercept. The offsets are to be drawn at right angles t the position line in the direction of the observed body. Join the extremities of the offsets to obtain the position circl

Example—On a certain date in DR position 88°20′ S, 66°40′ E, the following observations of tw stars were made. At GMT $12^h42^m34^s$ the observed altitude of *Canopus* was 51°15′.6; at $12^h47^m49^s$ th observed altitude of *Achernar* was 56°06′.1.

		Canopus			*Achernar*	
GHA ♈	12^h	165° 38′.4		12^h	165° 38′.4	
Inc.	42^m34^s	10 40.2		47^m49^s	11 59.2	
SHA, Dec.		264 11.4	52° 40′.2 S		335 51.1	57° 23′.4 S
GHA ☆	$12^h42^m34^s$	80 30.0		$12^h47^m49^s$	153 28.7	

(i) For the South Pole as the assumed position.

GHA	(Long. W)	80° 30′.0		(Long. W)	153° 28′.7
Dec.		52 40.2 S			57 23.4 S
Ho		51 15.6			56 06.1
Intercept		1 24.6 A			1 17.3 A

(ii) For the normal method, assumed latitude = 88° S

GHA☆		80° 30′.0				153° 28′.7	
aλ		66 30.0 E				66 31.3 E	
LHA		147				220	
	Hc	d	Z		Hc	d	Z
From page 251	50° 18′.6	(+)60′.0	31°.7†	page 265	55° 26′.8	(+)60′.0	38°.1†
Alt. Corr.	(+)40.2*				(+)23.4*		
Hc	50 58.8				55 50.2		
Ho	51 15.6				56 06.1		
Intercept	16.8 T	Zn	211.7		15.9 T	Zn	141.9

*When d=60′.0 the use of the Interpolation Table is not required, for the change in altitude is equal to the change in declination, hence the altitude correction is equal to the declination increment. †Interpolated value.

The plotting sheet portraying these data was constructed using Diagram A, then reduced to scale.

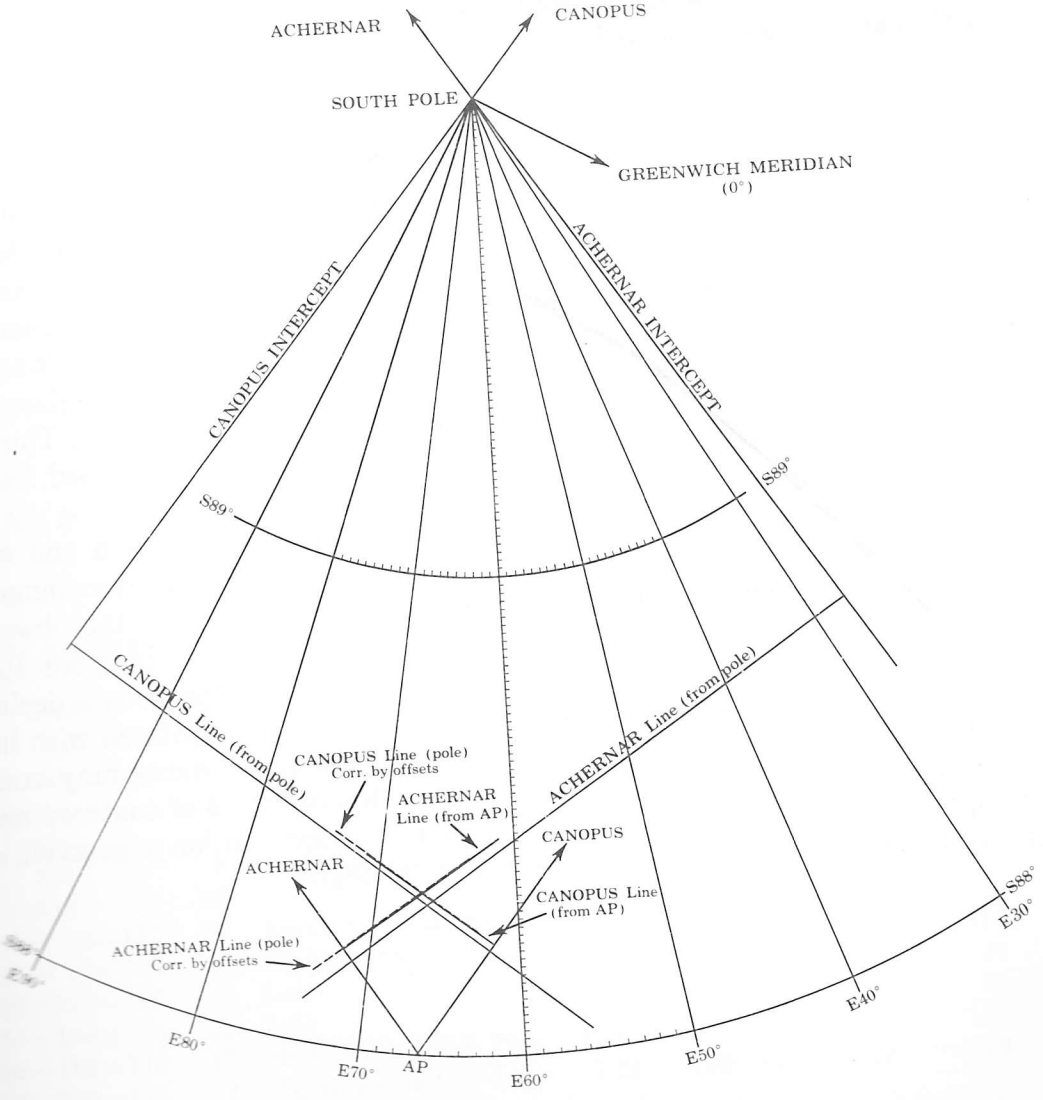

Fig. 6—Plot from pole using offsets gives same fix as normal plot.