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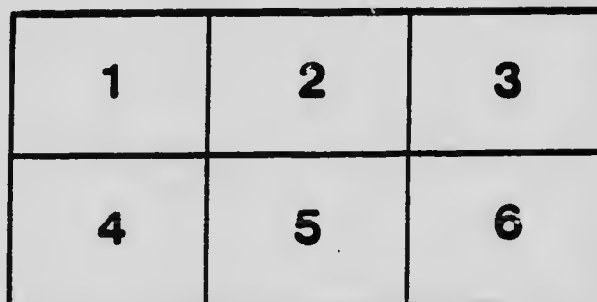
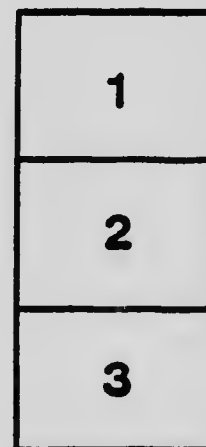
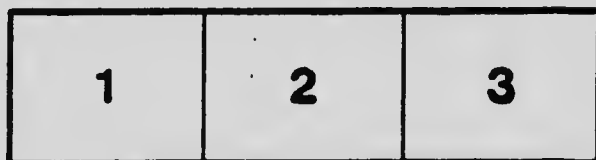
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NEW AND ENLARGED EDITION

AZIMUTHS
OF
THE NORTH POLE STAR

LAT. 38' N. TO LAT. 55' N.

FOR USE UNTIL THE YEAR 1915.

By SYDNEY A. ROBERTS,
DOMINION AND PROVINCIAL LAND SURVEYOR.

APRIL
1902.

Room 45, Five Sisters' Block,
VICTORIA, BRITISH COLUMBIA.

PRICE, \$2.00

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AZIMUTHS OF THE NORTH POLE STAR.

For Use Until the Year 1815.

With these tables the Azimuths of Polaris is known at any instant.

An observation can be made whenever the star is visible, practically at any moment from sunset to sunrise; the most favourable times being in the twilight of evening and morning, for the work can always be done more quickly and accurately by daylight, than in the dark.

The Azimuth of the Star being known, the direction of a true meridian, or any other line, at the point of observation, can be at once determined.

EXPLANATION OF THE TABLES.

The Azimuths are calculated for a Fixed Polar Distance of $1^{\circ} 11' 40''$, and are tabulated to the nearest tenth part of a minute; for each degree of Latitude, from 38° N to 55° N. The Star's Hour Angles are in Mean Time, ten minutes apart:—excepting at 3h 0m, 8h 40m, 14h 58m, 20h 47m, where nine minutes intervene.

As the Star's Polar Distance is constantly changing, it is necessary to apply a correction, in order to obtain the True Azimuth.

The Correction is furnished, to the nearest tenth part of a minute, by means of two tables. The first gives the amount at 5 h 59 m. The second, depending on the first, gives the correction for any Hour Angle.

In the first, the amounts at 5h 59 m are given for each degree of Latitude, and for changes from 0' to 3' in the Polar Distance.

In the second table, the Hour Angles are at the side, the amounts at 5h 59m on the centre line of the page; and the Corrections to the Azimuths are above, and below. They are to be added to the tabulated Azimuth, when the Star's Apparent Polar Distance is greater than $1^{\circ} 11' 40''$, and subtracted therefrom, when it is less.

TIME.

Local Mean Time (L. M. T.) must always be used for finding Star's Hour Angle, and care taken to remember this in places where Standard time is usually kept.

Standard Time is faster than Local Mean Time when the Standard Meridian lies to the Eastward; and slower when it lies to the Westward of a place; the amount being the difference of Longitude (in time) between the two points.

Ex: In Long. 3h 26m W, where Stand. Time of a Meridian 3h W is kept. Find L. M. T. when a watch 3m 2s fast on Stand. Time shows 8h 0m P.M.

	h	m		h	m	s
Long. Stand. Mer.	3	0	W	Watch	8	0
Long. of place	3	26	W	do. fast	3	2
Stand. T. fast.	0	26		Stand. T.	7	58
				do. fast	26	0
				L. M. T.	7	30
					58	P.M.

INTERPOLATIONS FOR SMALL INTERVALS OF TIME.

One tenth of the difference between two consecutive Azimuths will give the change in Azimuth for 1m of time; two tenths for 2m, etc., excepting at 3h 0m, 8h 40m, 14h 58m, 20h 47m, where one ninth, etc., must be used.

ERRORS IN AZIMUTH CAUSED BY ERRORS IN TIME.

These will be greatest when the star is crossing the meridian, for then it is moving most rapidly in Azimuth. To find the amount: Multiply the change in Azimuth for 1m at the given Hour Angle, by the error in time reduced to minutes and tenths. The result will be the corresponding error in Azimuth.

Ex: Two observations were made in Lat. 49° N. In each case, it was afterwards found that there had been an error of 2m 56s in the time used. What were the errors in Azimuth?

1st Obs'n.	2nd Obs'n.
Hour Angle 0h 7m.	Hour Angle 16h 38 m.
Change in Az. for 1m ... 0.49	Change in Az. for 1m ... 0.16
Error in Time 2m 56s. ... 2.94 ×	Error in Time 2m 56s. 2.94 ×
Error in Az. 1.421	Error in Az. 0.464

NOTE—At 1000 feet, a deflection of 1' gives an offset of 3.19 inches.

TO FIND POLARIS WITH THE TELESCOPE.

Should the light be rather strong and the star not easily detected, it may be found as follows:—

After levelling, turn the instrument until, by deflection from the magnetic meridian, the telescope points true North, then deflect it East or West for the Star's known Azimuth. Lastly, direct the telescope upwards, at an angle equal to the Latitude of the place, + or - the Star's distance above or below the pole, as given in the following table:—

Star's Hour Angle.	Approx. Alt. Polaris
h. h.	° '
1 or 23	Lat. +1 40
2 22	" +1 0
3 21	" +0 50
4 20	" +0 35
5 19	" +0 20
6 18	" 0 0
7 17	Lat. -0 20
8 16	" -0 35
9 15	" -0 50
10 14	" -1 0
11 13	" -1 40

TO FIND LOCAL MEAN TIME OF CULMINATION OF POLARIS

Sidereal Time at preceding Mean Noon at Greenwich is to be decreased if the place is in Long. E., and increased if in Long. W., at the rate of 0.8536 secs. for each hour of Long. in order to obtain the Sidereal Time at preceding Mean Noon at the place. Subtract this from the Star's Apparent Right Ascension adding 24 hours to the latter if necessary. Convert the remainder into its Mean Time equivalent, and it will be the required Local Mean Time of Culmination.

Ex: In Lat. 40° Long. 3h 24m W. of Greenwich on 3rd May, 1902.

	h.	m.	s.
Sid. Time Mean Noon Greenwich	2	44	48.00
Corr'n for Long. W.		+	33.84
Sid. Time Mean Noon at place	2	42	24.84
App. R. A. Polaris + 24h.	25	23	3.28
Remainder	22	40	44.35
Conversion	-	3	42.30
Local Mean Time of Culm'n.	22	36	58.44
or Civil Time on 4th.	10	36	58.44 A.M.

RULE FOR FINDING THE AZIMUTH.

Find the Mean Time interval between the preceding culmination of Polaris, and the Local Mean Time at which the observation is to be made. This is the Star's Hour Angle.

Enter the Azimuth Table, with Star's Hour Angle at the side, and, under the Latitude, note the tabulated Azimuth.

Take the difference between 1° 11' 40" and the Star's Apparent Polar Distance. Enter the Table of Corrections at 5h 59m, with this difference (to the nearest tenth part of a minute) at the side, and, under the Latitude, note the amount.

Then enter the Table of Corrections to Azimuth, with the amount at 5h 59m, on the centre line of the page. Above or below it, in the same column, and opposite the Star's Hour Angle, will be found the Correction, which is to be added to, or subtracted from the tabulated Azimuth, according as the Star's Apparent Polar Distance is greater or less than 1° 11' 40".

The result will be the True Azimuth of Polaris at the instant of observation. The Star will be East of the Meridian when its Hour Angle is greater than 11h 58m, and West, when it is less.

Ex: On 4th May, 1902, in Lat. 40° N. Long. 3h 24m W. Required the Azimuth of Polaris at 7h 30m 58s P.M. Local Mean Time.

	h.	m.	s.		°	'
Preced'g Culm'n.	10	36	58 A.M.	Tab. Az.	1	17.4
L.M.T. of Obs'n.	7	30	58 P.M.	Corr'n to Az.	+	1.4
Hour Angle	8	54	0	True Az.	N 1	18.8 W
Fixed Pol. Dist.	1	11	40			
Star's App. Pol. Dist.	1	12	57			
Diff.	1	17				
Corr'n at 5h 59m.	2.0					

STAR'S
 HOUR ANGLE.
 Local
 Mean Time.

CORRECTIONS TO AZIMUTHS.

→ If Appt. Pol. Dist. is greater than 1° 40' ← If Appt. Pol. Dist. is less than 1° 40'

STAR'S
 HOUR ANGLE.
 Local
 Mean Time.

H	M	S													H	M	S	
0	0	0														0	0	0
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
1	0		0.0													21	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
2	0		0.0													22	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
3	0		0.0													23	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
4	0		0.0													24	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
5	0		0.0													25	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
6	0		0.0													26	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
7	0		0.0													27	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
8	0		0.0													28	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
9	0		0.0													29	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
10	0		0.0													30	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
11	0		0.0													31	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	
12	0		0.0													32	0	
	10																10	
	20																20	
	30																30	
	40																40	
	50																50	

STAR'S HOUR ANGLE Local Mean Time.				CORRECTIONS TO AZIMUTHS.												STAR'S HOUR ANGLE Local Mean Time.			
				+ (P Pol Dist. is greater than 10° 40')						- (P Pol Dist. is less than 10° 40')									
H	M	S		0.0	0.1	0.2	0.3	0.4	0.5	0.0	0.1	0.2	0.3	0.4	0.5	H	M	S	
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	0.0
0	10	0	0.1	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	10	0	0.1
0	20	0	0.2	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	20	0	0.2
0	30	0	0.3	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	30	0	0.3
0	40	0	0.4	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	40	0	0.4
0	50	0	0.5	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	50	0	0.5
1	0	0	1.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	0	0	1.0
1	10	0	1.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	10	0	1.1
1	20	0	1.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	20	0	1.2
1	30	0	1.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	30	0	1.3
1	40	0	1.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	40	0	1.4
1	50	0	1.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1	50	0	1.5
2	0	0	2.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2	0	0	2.0
2	10	0	2.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2	10	0	2.1
2	20	0	2.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2	20	0	2.2
2	30	0	2.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2	30	0	2.3
2	40	0	2.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2	40	0	2.4
2	50	0	2.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2	50	0	2.5
3	0	0	3.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3	0	0	3.0
3	10	0	3.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3	10	0	3.1
3	20	0	3.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3	20	0	3.2
3	30	0	3.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3	30	0	3.3
3	40	0	3.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3	40	0	3.4
3	50	0	3.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	3	50	0	3.5
4	0	0	4.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4	0	0	4.0
4	10	0	4.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4	10	0	4.1
4	20	0	4.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4	20	0	4.2
4	30	0	4.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4	30	0	4.3
4	40	0	4.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4	40	0	4.4
4	50	0	4.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	4	50	0	4.5
5	0	0	5.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5	0	0	5.0
5	10	0	5.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5	10	0	5.1
5	20	0	5.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5	20	0	5.2
5	30	0	5.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5	30	0	5.3
5	40	0	5.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5	40	0	5.4
5	50	0	5.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5	50	0	5.5
6	0	0	6.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	6	0	0	6.0
6	10	0	6.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	6	10	0	6.1
6	20	0	6.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	6	20	0	6.2
6	30	0	6.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	6	30	0	6.3
6	40	0	6.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	6	40	0	6.4
6	50	0	6.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	6	50	0	6.5
7	0	0	7.0	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	7	0	0	7.0
7	10	0	7.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	7	10	0	7.1
7	20	0	7.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	7	20	0	7.2
7	30	0	7.3	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	7	30	0	7.3
7	40	0	7.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	7	40	0	7.4
7	50	0	7.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	7	50	0	7.5
8	0	0	8.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	8	0	0	8.0
8	10	0	8.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	8	10	0	8.1
8	20	0	8.2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	8	20	0	8.2
8	30	0	8.3	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	8	30	0	8.3
8	40	0	8.4	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	8	40	0	8.4
8	50	0	8.5	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	8	50	0	8.5
9	0	0	9.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	9	0	0	9.0
9	10	0	9.1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	9	10	0	9.1
9	20	0	9.2	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	9	20	0	9.2
9	30	0	9.3	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	9	30	0	9.3
9	40	0	9.4	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	9	40	0	9.4
9	50	0	9.5	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	9	50	0	9.5
10	0	0	10.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10	0	0	10.0
10	10	0	10.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10	10	0	10.1
10	20	0	10.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10	20	0	10.2
10	30	0	10.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10	30	0	10.3
10	40	0	10.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10	40	0	10.4
10	50	0	10.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10	50	0	10.5
11	0	0	11.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	11	0	0	11.0
11	10	0	11.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	11	10	0	11.1
11	20	0	11.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	11	20	0	11.2
11	30	0	11.3	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	11	30	0	11.3
11	40	0	11.4	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	11	40	0	11.4
11	50	0	11.5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	11	50	0	11.5

STAR'S
HOUR ANGLE.

CORRECTIONS TO AZIMUTHS.

STAR'S
HOUR ANGLE.

Local
Mean Time.

+ If Appt. Pot. Dist. is greater than 1 0' 40".

- If Appt. Pot. Dist. is less than 1 0' 40".

Local
Mean Time.

H.	M.	S.	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	H.	M.	S.	
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	0.0	23	56	4	
	10		.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2		40		
	20		.3	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4		36		
	30		.5	.5	.5	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6		20		
	40		.7	.7	.7	.7	.8	.8	.8	.8	.8	.8	.8	.8	.8	.8	.8		16		
	50		.9	.9	.9	.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	23	6		
1	0		1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2		50		
	10		1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5		46		
	20		1.4	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7		36		
	30		2.4	2.5	2.6	2.6	2.7	2.7	2.8	2.8	2.8	2.8	2.9	2.9	2.9	2.9	2.9		26		
	40		1.7	1.7	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1	2.2	2.2	2.2		16		
	50		1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.3	2.3	2.3	22	6		
2	0		2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.3	2.4	2.4	2.5	2.5	2.5	2.6	2.6	21	56		
	10		2.1	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.7	2.8	2.8		46		
	20		2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.8	2.8	2.9	2.9	2.9	3.0	3.0		36		
	30		4	2.5	2.6	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.0	3.0	3.1	3.2	3.2	23	16		
	40		2.6	2.6	2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.3	21	6		
	50		2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.2	3.2	3.3	3.3	3.4	3.4	3.5	3.5	20	56	4	
3	0	0	2.8	2.9	3.0	3.0	3.1	3.2	3.2	3.3	3.3	3.4	3.5	3.5	3.6	3.6	3.7	20	56	4	
	10	1	2.9	3.0	3.1	3.2	3.2	3.3	3.3	3.4	3.5	3.5	3.6	3.7	3.8	3.8	3.8		47	3	
	20		3.1	3.1	3.2	3.3	3.3	3.4	3.5	3.6	3.7	3.7	3.8	3.9	4.0	4.0	4.0		37		
	30		3.2	3.3	3.3	3.4	3.5	3.6	3.6	3.7	3.8	3.9	4.0	4.0	4.1	4.1	4.1		27		
	40		3.3	3.4	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.0	4.1	4.2	4.3	4.3	4.3	20	7		
	50		3.4	3.5	3.5	3.6	3.7	3.8	3.9	4.0	4.0	4.1	4.2	4.3	4.4	4.4	4.4	19	57		
3	59		3.5	3.6	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.2	4.3	4.4	4.5	4.5	4.5		47		
4	0		3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.3	4.4	4.5	4.6	4.6	4.6		37		
	10		3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.4	4.5	4.6	4.7	4.7	4.7		27		
	20		3.7	3.8	3.9	4.0	4.1	4.2	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.8	4.8		17		
	30		3.8	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.0	19	7		
	40		3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.0	5.0	18	57		
4	59		3.9	4.0	4.1	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.1		47		
5	0		3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.2		37		
	10		3.8	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1		27		
	20		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.2	5.2		17		
	30		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.2	5.2	18	7		
	40		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.2	5.2				
5	50	1	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.2	5.2	17	57	3	
6	0		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.2	5.2		47		
	10		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.2	5.2		37		
	20		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.1	5.1	5.1		27		
	30		3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.1	5.1		17		
	40		3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.1	5.1	17	7		
	50		3.9	4.0	4.1	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.0	5.0	16	57		
6	59		3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.1		47		
7	0		3.8	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.0		37		
	10		3.8	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.0		27		
	20		3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.0		17		
	30		3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.9	16	7		
	40		3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.8		17		
	50		3.5	3.6	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.2	4.3	4.4	4.5	4.5	4.5	15	57		
7	59		3.1	3.5	3.5	3.6	3.7	3.8	3.9	4.0	4.0	4.1	4.2	4.3	4.4	4.5	4.5		47		
8	0		3.1	3.5	3.5	3.6	3.7	3.8	3.9	4.0	4.0	4.1	4.2	4.3	4.4	4.4	4.4		37		
	10		3.3	3.4	3.4	3.5	3.6	3.7	3.8	3.9	3.9	4.0	4.1	4.2	4.3	4.3	4.3		27		
	20		3.2	3.3	3.3	3.4	3.5	3.6	3.6	3.7	3.8	3.9	4.0	4.0	4.1	4.1	4.1		17		
	30		3.1	3.1	3.2	3.3	3.4	3.4	3.5	3.6	3.7	3.7	3.8	3.9	4.0	4.0	4.0		7		
	40		2.9	3.0	3.1	3.2	3.2	3.3	3.4	3.5	3.5	3.6	3.7	3.8	3.8	3.8	3.8	15	7	3	
	50	1	2.8	2.9	3.0	3.0	3.1	3.2	3.3	3.3	3.4	3.5	3.6	3.7	3.8	3.8	3.8		14	58	2
8	58		2.8	2.9	3.0	3.0	3.1	3.2	3.3	3.3	3.4	3.5	3.6	3.7	3.8	3.8	3.8		38		
	8		2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.2	3.2	3.3	3.4	3.4	3.5	3.5	3.5		28		
	18		2.6	2.6	2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.1	3.2	3.3	3.3	3.3	3.3		18		
	28		2.4	2.5	2.6	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.0	3.1	3.2	3.3	3.3		8		
	38		2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.8	2.8	2.9	2.9	3.0	3.0	3.0		14	8	
	48		2.1	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.7	2.7	2.8	2.8	2.8	14	8		
	58		2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.6	13	58		
9	58		1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.4	2.4	2.4	2.4		48		
10	18		1.7	1.7	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1	2.2	2.2	2.2		38		
	28		1.5	1.6	1.6	1.6	1.7	1.7	1.8	1.8	1.8</										

STAR'S
HOUR ANGLE.
Local
Mean Time

AZIMUTHS OF THE NORTH POLE STAR.
POLAR DISTANCE 1° 11' 40".

STAR'S
HOUR ANGLE.
Local
Mean Time.

			LAT. 38° N.	39	40	41	42	43	44	45	LAT. 46° N			
H.	M.	S.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	H.	M.	S.
0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23	56	4
	10		4.0	4.1	4.2	4.2	4.3	4.4	4.4	4.5	4.6		46	
	20		8.1	8.2	8.3	8.4	8.6	8.7	8.9	9.0	9.2		36	
	30		12.1	12.3	12.5	12.7	12.9	13.1	13.3	13.5	13.8		26	
	40		16.1	16.3	16.6	16.8	17.1	17.4	17.7	18.0	18.4		16	
0	50		20.1	20.3	20.7	21.0	21.3	21.7	22.1	22.5	22.9	23	6	
1	0		24.0	24.3	24.7	25.1	25.5	25.9	26.4	26.9	27.4	22	56	
	10		27.9	28.3	28.7	29.1	29.6	30.1	30.6	31.2	31.8		46	
	20		31.7	32.1	32.6	33.1	33.7	34.2	34.8	35.5	36.1		36	
	30		35.4	35.9	36.5	37.1	37.7	38.3	39.0	39.7	40.4		26	
	40		39.1	39.7	40.3	40.9	41.6	42.3	43.0	43.8	44.6		16	
1	50		42.7	43.3	44.0	44.7	45.4	46.2	47.0	47.8	48.7	22	6	
2	0		46.2	46.9	47.6	48.4	49.1	50.0	50.8	51.7	52.7	21	56	
	10		49.7	50.4	51.1	51.9	52.8	53.7	54.6	55.6	56.6		46	
	20		53.0	53.8	54.6	55.4	56.3	57.2	58.2	59.3	60.4		36	
	30		56.2	57.0	57.9	58.8	59.7	60.7	61.8	62.9	64.1		26	
	40		59.3	60.2	61.1	62.0	63.0	64.1	65.2	66.1	67.6		16	
2	50		62.3	63.2	64.2	65.2	66.2	67.3	68.5	69.7	71.0	21	6	
3	0	0	65.2	66.1	67.1	68.2	69.3	70.4	71.6	72.9	74.2	20	56	4
	10	1	67.7	68.6	69.7	70.8	71.9	73.1	74.3	75.6	77.0		47	3
	20		70.3	71.3	72.4	73.5	74.7	75.9	77.2	78.6	80.0		37	
	30		72.8	73.8	74.9	76.1	77.3	78.6	80.0	81.3	82.8		27	
	40		75.1	76.2	77.3	78.5	79.8	81.1	82.5	83.9	85.5		17	
3	50		77.3	78.4	79.6	80.8	82.1	83.4	84.9	86.4	87.9	20	7	
4	0		79.3	80.5	81.7	82.9	84.2	85.6	87.1	88.6	90.2	19	57	
	10		81.2	82.4	83.6	84.9	86.2	87.6	89.1	90.7	92.4		47	
	20		82.9	84.1	85.4	86.7	88.0	89.5	91.0	92.6	94.3		37	
	30		84.5	85.7	87.0	88.3	89.7	91.2	92.7	94.3	96.1		27	
	40		86.0	87.2	88.5	89.8	91.2	92.7	94.3	95.9	97.6		17	
1	50		87.4	88.6	89.9	91.2	92.6	94.1	95.6	97.2	98.9	19	7	
2	0		88.7	89.9	91.2	92.5	93.9	95.4	96.9	98.5	100.2	18	57	
	10		89.9	91.1	92.4	93.7	95.1	96.6	98.1	99.7	101.4		47	
	20		91.0	92.2	93.5	94.8	96.2	97.7	99.2	100.8	102.5		37	
	30		92.0	93.2	94.5	95.8	97.2	98.7	100.2	101.8	103.5		27	
	40		92.9	94.1	95.4	96.7	98.1	99.6	101.1	102.7	104.4	18	7	
5	50	1	300	322	335	348	361	374	386	413	432	17	57	3
6	0		308	320	334	348	363	378	391	411	430		47	
	10		305	317	330	344	359	374	391	408	426		37	
	20		300	312	325	339	354	369	385	402	420		27	
	30		293	305	318	332	346	362	378	394	412		17	
	40		285	297	310	323	337	352	368	385	402		7	
6	50		275	287	299	313	327	341	357	373	391	16	57	
7	0		263	275	287	300	314	329	344	360	377	16	47	
	10		250	261	274	286	300	314	329	345	362		37	
	20		235	246	258	271	284	298	313	328	345		27	
	30		218	229	241	254	267	280	295	310	326		17	
	40		200	211	223	235	247	261	275	290	305	16	7	
7	50		181	191	202	214	227	240	253	268	283	15	57	
8	0		160	170	181	192	204	217	230	245	259		47	
	10		137	147	158	169	181	193	206	219	234		37	
	20		113	123	133	144	155	167	180	193	207		27	
	30		88	98	108	118	129	140	152	165	178		17	
	40		62	71	80	90	101	112	123	135	148	15	7	
8	50	1	37	46	55	64	75	85	96	108	120	14	58	2
9	0	0	0.9	1.7	2.5	3.3	4.1	5.1	6.5	7.6	8.8	13	38	
	10		57.9	58.7	59.5	60.3	61.3	62.2	63.2	64.3	65.4		28	
	20		54.8	55.5	56.3	57.1	58.0	58.9	59.8	60.8	61.9		18	
	30		51.6	52.3	53.0	53.8	54.6	55.5	56.4	57.3	58.3		8	
	40		48.3	49.0	49.7	50.4	51.1	51.9	52.8	53.7	54.6	14	8	
9	50		45.0	45.6	46.2	46.9	47.6	48.3	49.1	49.9	50.8	13	58	
10	0		41.5	42.1	42.7	43.3	43.9	44.6	45.3	46.1	46.9		48	
	10		38.0	38.5	39.0	39.6	40.2	40.8	41.5	42.2	42.9		38	
	20		34.4	34.8	35.3	35.8	36.4	36.9	37.5	38.2	38.8		28	
	30		30.7	31.1	31.6	32.0	32.5	33.0	33.5	34.1	34.7		18	
	40		27.0	27.4	27.8	28.2	28.6	29.0	29.5	30.0	30.5	13	8	
10	50		23.2	23.6	23.9	24.2	24.6	25.0	25.4	25.8	26.2	12	58	
11	0		19.4	19.7	20.0	20.2	20.6	20.9	21.2	21.6	21.9		48	
	10		15.6	15.8	16.0	16.2	16.5	16.7	17.0	17.3	17.6		38	
	20		11.7	11.9	12.0	12.2	12.4	12.6	12.8	13.0	13.2		28	
	30		7.8	7.9	8.0	8.1	8.3	8.4	8.5	8.7	8.8		18	
	40		3.9	4.0	4.0	4.1	4.1	4.2	4.3	4.3	4.4	12	8	
11	58	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11	58	2

STAR'S HOUR ANGLE.			AZIMUTHS OF THE NORTH POLE STAR. POLAR DISTANCE, 1° 11' 40".												STAR'S HOUR ANGLE.								
Local Mean Time			LAT. 47° N.	48°	49°	50°	51°	52°	53°	54°	LAT. 55° N.	Local Mean Time.											
H.	M.	S.										H.	M.	S.									
0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	23	56	4								
10			4.7	4.8	4.9	5.0	5.1	5.2	5.4	5.5	5.6			46									
20			9.4	9.6	9.8	10.0	10.2	10.4	10.7	11.0	11.2			36									
30			14.1	14.3	14.6	15.0	15.3	15.6	16.0	16.4	16.8			26									
40			18.7	19.1	19.5	19.9	20.4	20.8	21.3	21.9	22.4			16									
0	50		23.3	23.8	24.3	24.8	25.4	25.9	26.6	27.2	27.9	22	6										
1	0		27.9	28.4	29.0	29.6	30.3	31.0	31.8	32.5	33.4	22	56										
10			32.4	33.0	33.7	34.4	35.2	36.0	36.9	37.8	38.8			46									
20			36.8	37.6	38.3	39.2	40.0	40.9	41.9	43.0	44.1			36									
30			41.2	42.0	42.9	43.8	44.8	45.8	46.9	48.1	49.3			26									
40			45.5	46.4	47.3	48.3	49.4	50.5	51.8	53.0	54.4			16									
1	50		49.6	50.6	51.7	52.8	54.0	55.2	0	56.5	0	59.4	22	6									
2	0		53.7	54.8	0	55.9	0	57.1	0	58.4	0	59.7	1	4.3									
10			57.7	0	58.8	1	0.1	1	1.3	1	2.7	1	4.1	21									
20			1	1.6	1	2.8	4.1	5.4	6.9	8.4	10.1	11.8		46									
30			5.3	6.6	7.9	9.4	10.9	12.6	14.3	16.1	18.1	19.6		36									
40			8.9	10.2	11.7	13.2	14.8	16.6	18.4	20.3	22.4	24.4		26									
2	50		12.3	13.8	15.3	16.9	18.6	20.4	22.3	24.3	26.5	28.6	21	6									
3	0	0	15.7	17.2	18.8	20.4	22.2	24.1	26.1	28.2	30.4	32.6	20	56									
9	1		18.5	20.1	21.7	23.4	25.3	27.2	29.3	31.5	33.8	36.1	47	3									
19			21.5	23.1	24.8	26.7	28.6	30.6	32.7	35.0	37.4	40.8		27									
29			24.4	26.1	27.8	29.7	31.7	33.7	35.9	38.3	40.8	44.0		17									
39			27.1	28.8	30.6	32.5	34.0	36.7	39.0	41.4	44.0	47.0	20	7									
49			29.6	31.4	33.2	35.2	37.3	39.5	41.8	44.3	47.0	49.7	10	57									
3	59		31.9	33.8	35.7	37.7	39.8	42.1	44.5	47.0	49.5	52.3		47									
4	0		34.1	36.0	37.9	40.0	42.2	44.5	46.9	49.5	51.8	54.6		37									
10			36.1	38.0	39.9	42.0	44.3	46.6	49.1	51.8	54.6	57.7		27									
20			37.9	39.8	41.8	43.9	46.2	48.6	51.3	53.8	56.6	1	58.6	17									
30			39.5	41.4	43.5	45.6	47.9	50.3	52.9	55.6	1	58.6	10	7									
40			40.9	42.8	44.9	47.1	49.4	51.9	54.5	57.2	2	0.2	18	57									
4	50		42.1	44.0	46.1	48.3	50.7	53.2	55.8	58.6	1	1.6	18	57									
5	9		43.1	45.1	47.2	49.4	51.8	54.3	56.9	1	59.7	2.7		47									
19			43.9	45.9	48.0	50.2	52.6	55.1	57.8	2	0.6	3.6		37									
29			44.5	46.5	48.6	50.9	53.3	55.8	58.5	1.3	4.3			27									
39			44.9	46.9	49.0	51.3	53.7	56.2	58.9	1.7	4.8			17									
49			45.1	47.1	49.2	51.5	53.9	56.4	59.1	1.9	5.0	18		7									
5	59	1	1	45.1	1	47.1	1	49.2	1	51.5	1	53.9	1	56.4	1	59.1	2	1.9	2	4.9	17	57	3
6	0		44.9	46.9	49.0	51.2	53.6	56.1	58.8	1.6	4.6			47									
19			44.5	46.5	48.6	50.8	53.2	55.7	58.3	1.1	4.1			37									
29			43.9	45.8	47.9	50.2	52.5	55.0	57.6	2	0.4	3.4		27									
39			43.1	45.0	47.1	49.3	51.6	54.1	56.7	1	59.4	2.4		17									
49			42.1	44.0	46.1	48.2	50.5	53.0	55.5	58.3	2	1.2	17	7									
6	59		40.9	42.8	44.8	47.0	49.2	51.6	54.2	56.9	1	59.7	16	57									
7	0		39.5	41.4	43.4	45.5	47.7	50.1	52.6	55.2	58.0			47									
19			37.9	39.8	41.8	43.8	46.0	48.3	50.8	53.4	56.2			37									
29			36.2	38.0	39.9	42.0	44.1	46.4	48.8	51.3	54.1			27									
39			34.3	36.1	37.9	39.9	42.0	44.2	46.6	49.1	51.7			17									
49			32.2	33.9	35.8	37.7	39.7	41.9	44.2	46.6	49.2	16		7									
7	50		29.9	31.6	33.4	35.3	37.3	39.4	41.6	44.0	46.5	15		57									
8	9		27.5	29.1	30.9	32.7	34.6	36.7	38.8	41.2	43.6			47									
19			24.9	26.5	28.2	29.9	31.8	33.8	35.9	38.1	40.5			37									
29			22.1	23.7	25.3	27.0	28.8	30.7	32.8	34.9	37.2			27									
39			19.2	20.7	22.3	23.9	25.7	27.5	29.5	31.5	33.8			17									
49			16.2	17.6	19.1	20.7	22.4	24.1	26.0	28.0	30.1	15		7									
5	8	2	13.3	14.7	16.1	17.6	19.3	21.0	22.8	24.7	26.7	14		58									
9	8		10.4	11.5	12.7	14.1	15.7	17.3	19.0	20.8	22.8			48									
18			6.6	7.8	9.1	10.5	12.0	13.5	15.1	16.9	18.7			38									
28			3.0	4.2	5.4	6.7	8.1	9.6	11.1	12.7	14.5			28									
38			0	59.3	1	0.1	1	1.6	1	2.8	4.1			18									
48			55.6	0	56.6	0	57.7	0	58.8	1	0.0	1	1.3	1	2.7	14	8						
9	58		51.7	52.6	53.6	54.7	0	55.8	0	57.0	0	58.3	1	1.1	13	58							
10	8		47.7	48.6	49.5	50.5	51.5	52.6	53.8	55.0	0	56.4			48								
18			43.6	44.4	45.3	46.2	47.2	48.2	49.2	50.4	51.6			38									
28			39.5	40.2	41.0	41.8	42.7	43.6	44.6	45.6	46.7			28									
38			35.3	36.0	36.6	37.4	38.1	38.9	39.8	40.7	41.7			18									
48			31.0	31.6	32.2	32.8	33.5	34.2	35.0	35.8	36.6	13		8									
10	58		26.7	27.2	27.7	28.3	28.8	29.4	30.1	30.8	31.5	12		58									
11	8		22.3	22.7	23.2	23.6	24.1	24.6	25.2	25.7	26.3			48									
18			17.9	18.2	18.6	18.9	19.3	19.8	20.2	20.6	21.1			38									
28			13.5	13.7	14.0	14.2	14.5	14.9	15.2	15.5	15.9			28									
38			9.0	9.2	9.3	9.7	9.7	9.9	10.1	10.4	10.6			18									
48			4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	12		8									
11	58	2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	11	58	2								

