U.S. HYDROGRAPHIC OFFICE PUBLICATION 249

By P.V. WEEMS (Annapolis).

These tables tabulate the values of hour angle and azimuth for six selected stars for integral degrees of local hour angle of Aries and for integral degrees of latitude from pole to pole. The principal difference between HO 249 and other recent tables is that the former uses the local hour angle of Aries, or local Sideral Time, instead of the meridian angle of the body, and azimuth has replaced the azimuth angle. The arrangement of the tables also differs somewhat due to the fact that the six selected stars change with latitude and hour angle.

Since HO 249 makes no provision for solutions of sun, moon, or planet observations, it is necessary to have at hand another method or methods to make up this deficiency. Also unlike such tables as HO 214, HO 249 must be recomputed every few years to allow for the precession of the equinoxes.

In principle HO 249 provides a short simple solution, but obviously the serious limitation is the fact that only six stars are tabulated for any instance of time and for any given latitude. Furthermore the required corrections due to annual changes in the position of the stars is a serious drawback. There are two wrinkles, however, which may be used to simplify the methods given in HO 249. First, the almanac may be replaced by one sheet giving on one side the daily values for 0 hours G.C.T., the local Hour Angle of Aries, and on the reverse side the G.C.T. correction for hours, minutes, and seconds. The daily tabulation plus the correction gives the local hour angle of Aries for direct entry in the HO 249, and this without reference to the Nautical Almanac or to the Air Almanac. (See Sheet A) Fig. 1.

Second, the "Adjustment of the longitude for the precession of equinoxes" given on the front inside cover page as an annual correction, may be replaced by an annual altitude correction for each star. This correction varies in amount from 0 to about 0'8 a day and the correction might be either plus or minus. Since the correction is given in terms of altitude, it is very easily applied direct to the sextant, when the observation is made. This would be much more simple than applying it to the longitude before plotting and since the changes in star positions are uniform over a period of years, these corrections may be used for ten or twenty years without inaccuracy.

Figure 1 shows a portion of the two pages of corrections which may be used to replace the almanac when using HO 249.

Figure 2 shows a portion of the page from the Star Altitude Curves giving the annual altitude corrections as they are applied when using the Star Altitude Curves. Since the tabutated values of HO 249 are identical with the plotted values of the Star Altitude Curves, the annual altitude correction may be used the same way. In fact it appears desirable to have the annual altitude correction printed directly at the head of the tables in HO 249 for each star.

In fact HO 249 might be considered the tabulated values from points on the Star Altitude Curves, the principal difference being that six instead of three stars are used. While six stars have a certain advantage over three stars, it must be remembered that in either case the method must be considered "a fair weather method" with both HO 249 and the Star Altitude Curves suffering this deficiency and requiring supplementary methods for use with the sun, moon, planets, and stars. A short, compact accurate and universal method, such as the *Line of Position Book* or the *New Line of Position Tables* should be used to supplement HO 249 or the Star Altitude Curves.

As it stands, HO 249 is proving a very popular method and this popularity should be still further increased by providing for each star the correct annual altitude correction, and for some users a separate sheet showing the Hour Angle of Aries would be a convenience.

CORRECTION TO BE ADDED TO TABULATED GREENWICH SIDEREAL TIME FOR ELAPSED GREENWICH CIVIL TIME

Min.	0h	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h	12h
	° ′	° ′	° ′	° ′	° ′	°	° ′	° ′	° ′	° ′	° ′	° ′	° ′
0	0 0	15 3	30 5	45 7	60 10	75 12	90 15	105 17	120 20	135 22	150 25	165 27	180 30
1	0 15	15 18	30 20	45 22	60 25	75 27	90 30	105 32	120 35	135 37	150 40	165 42	180 45
2	0 30	15 33	30 35	45 38	60 40	75 42	90 45	105 47	120 50	135 52	150 55	165 57	181 0
3	0 45	15 48	30 50	45 53	60 55	75 57	91 0	106 2	121 5	136 7	151 10	166 12	181 15
4	1 0	16 3	31 5	46 8	61 10	76 13	91 15	106 17	121 20	136 22	151 25	166 27	181 30
5	1 15	16 18	31 20	46 23	61 25	76 28	91 30	106 33	121 35	136 37	151 40	166 42	181 45
6	1 30	16 33	31 35	46 38	61 40	76 43	91 45	106 48	121 50	136 52	151 55	166 57	182 0
7	1 45	16 48	31 50	46 53	61 55	76 58	92 0	107 3	122 5	137 8	152 10	167 12	182 15
8	2 0	17 3	32 5	47 8	62 10	77 13	92 15	107 18	122 20	137 23	152 25	167 27	182 30
9	2 15	17 18	32 20	47 23	62 25	77 28	92 30	107 33	122 35	137 38	152 40	167 43	182 45
10	2 30	17 33	32 35	47 38	62 40	77 43	92 45	107 48	122 50	137 53	152 55	167 58	183 0
11	2 46	17 48	32 50	47 53	62 55	77 58	93 0	108 3	123 5	138 8	153 10	168 13	183 15
12	3 1	18 3	33 5	48 8	63 10	78 13	93 15	108 18	123 20	138 23	153 25	168 28	183 30
13	3 16	18 18	33 21	48 23	63 25	78 28	93 30	108 33	123 35	138 38	153 40	168 43	183 45
14	3 31	18 33	33 36	48 38	63 40	78 43	93 45	108 48	123 50	138 53	153 55	168 58	184 0
15	3 46	18 48	33 51	48 53	63 56	78 58	94 0	109 3	124 5	139 8	154 10	169 13	184 15
16	4 1	19 3	34 6	49 8	64 11	79 13	94 15	109 18	124 20	139 23	154 25	169 28	184 30
17	4 16	19 18	34 21	49 23	64 26	79 28	94 31	109 33	124 35	139 38	154 40	169 43	184 45
18	4 31	19 33	34 36	49 38	64 41	79 43	94 46	109 48	124 50	139 53	154 55	169 58	185 0
19	4 46	19 48	34 51	49 53	64 56	79 58	95 1	110 3	125 6	140 8	155 10	170 13	185 15
20	5 1	20 3	35 6	50 8	65 11	80 13	95 16	110 18	125 21	140 23	155 26	170 28	185 30
21	5 16	20 18	35 21	50 23	65 26	80 28	95 31	110 33	125 36	140 38	155 41	170 43	185 45
22	5 31	20 33	35 36	50 38	65 41	80 43	95 46	110 48	125 51	140 53	155 56	170 58	186 1
23	5 46	20 48	35 51	50 53	65 56	80 58	96 1	111 3	126 6	141 8	156 11	171 13	186 16
24	6 1	21 3	36 6	51 8	66 11	81 13	96 16	111 18	126 21	141 23	156 26	171 28	186 31
25	6 16	21 19	36 21	51 23	66 26	81 28	96 31	111 33	126 36	141 38	156 41	171 43	186 46
26	6 31	21 34	36 36	51 39	66 41	81 43	96 46	111 48	126 51	141 53	156 56	171 58	187 1
27	6 46	21 49	36 51	51 54	66 56	81 58	97 1	112 3	127 6	142 8	157 11	172 13	187 16
28	7 1	22 4	37 6	52 9	67 11	82 14	97 16	112 18	127 21	142 23	157 26	172 28	187 31
29	7 16	22 19	37 21	52 24	67 26	82 29	97 31	112 33	127 36	142 38	157 41	172 43	187 46
30	7 31	22 34	37 36	52 39	67 41	82 44	97 46	112 49	127 51	142 53	157 56	172 58	188 1
31	7 46	22 49	37 51	52 54	67 56	82 59	98 1	113 4	128 6	143 8	158 11	173 13	188 16
32	8 1	23 4	38 6	53 9	68 11	83 14	98 16	113 19	128 21	143 24	158 26	173 28	188 31
33	8 16	23 19	38 21	53 24	68 26	83 29	98 31	113 34	128 36	143 39	158 41	173 44	188 46
34	8 31	23 34	38 36	53 39	68 41	83 44	98 46	113 49	128 51	143 54	158 56	173 59	189 1
35	8 46	23 49	38 51	53 54	68 56	83 59	99 1	114 4	129 6	144 9	159 11	174 14	189 16
36	9 2	24 4	39 6	54 9	69 11	84 14	99 16	114 19	129 21	144 24	159 26	174 29	189 31
37	9 17	24 19	39 21	54 24	69 26	84 29	99 31	114 34	129 36	144 39	159 41	174 44	189 46
38	9 32	24 34	39 37	54 39	69 41	84 44	99 46	114 49	129 51	144 54	159 56	174 59	190 1
39	9 47	24 49	39 52	54 54	69 57	84 59	100 1	115 4	130 6	145 9	160 11	175 14	190 16
40	10 2	25 4	40 7	55 9	70 12	85 14	100 16	115 19	130 21	145 24	160 26	175 29	190 31
41	10 17	25 19	40 22	55 24	70 27	85 29	100 32	115 34	130 36	145 39	160 41	175 44	190 46
42	10 32	25 34	40 37	55 39	70 42	85 44	100 47	115 49	130 51	145 54	160 56	175 59	191 1
43	10 47	25 49	40 52	55 54	70 57	85 59	101 2	116 4	131 7	146 9	161 11	176 14	191 16
44	11 2	26 4	41 7	56 9	71 12	86 14	101 17	116 19	131 22	146 24	161 26	176 29	191 31
45	11 17	26 19	41 22	56 24	71 27	86 29	101 32	116 34	131 37	146 39	161 42	176 44	191 46
46	11 32	26 34	41 37	56 39	71 42	86 44	101 47	116 49	131 52	146 54	161 57	176 59	192 2
47	11 47	26 49	41 52	56 54	71 57	86 59	102 2	117 4	132 7	147 9	162 12	177 14	192 17
48	12 2	27 4	42 7	57 9	72 12	87 14	102 17	117 19	132 22	147 24	162 27	177 29	192 32
49	12 17	27 20	42 22	57 24	72 27	87 29	102 32	117 34	132 37	147 39	162 42	177 44	192 47
50	12 32	27 35	42 37	57 39	72 42	87 44	102 47	117 49	132 52	147 54	162 57	177 59	193 2
51	12 47	27 50	42 52	57 55	72 57	87 59	103 2	118 4	133 7	148 9	163 12	178 14	193 17
52	13 2	28 5	43 7	58 10	73 12	88 15	103 17	118 19	133 22	148 24	163 27	178 29	193 32
53	13 17	28 20	43 22	58 25	73 27	88 30	103 32	118 34	133 37	148 39	163 42	178 44	193 47
54	13 32	28 35	43 37	58 40	73 42	88 45	103 47	118 50	133 52	148 54	163 57	178 59	194 2
55	13 47	28 50	43 52	58 55	73 57	89 0	104 2	119 5	134 7	149 9	164 12	179 14	194 17
56	14 2	29 5	44 7	59 10	74 12	89 15	104 17	119 20	134 22	149 25	164 27	179 29	194 32
57	14 17	29 20	44 22	59 25	74 27	89 30	104 32	119 35	134 37	149 40	164 42	179 44	194 47
58	14 32	29 35	44 37	59 40	74 42	89 45	104 47	119 50	134 52	149 55	164 57	180 0	195 2
59	14 47	29 50	44 52	59 55	74 57	90 0	105 2	120 5	135 7	150 10	165 12	180 15	195 17
60	15 3	30 5	45 7	60 10	75 12	90 15	105 17	120 20	135 22	150 25	165 27	180 30	195 32

Min.	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
0	195 32	210 35	225 37	240 39	255 42	270 44	285 47	300 49	315 52	330 54	345 57
1	195 47	210 50	225 52	240 55	255 57	270 59	286 2	301 4	316 7	331 9	346 12
2	196 2	211 5	226 7	241 10	256 12	271 14	286 17	301 19	316 22	331 24	346 27
3	196 17	211 20	226 22	241 25	256 27	271 30	286 32	301 34	316 37	331 39	346 42
4	196 32	211 35	226 37	241 40	256 42	271 45	286 47	301 49	316 52	331 54	346 57
5	196 47	211 50	226 52	241 55	256 57	272 0	287 2	302 5	317 7	332 9	347 12
6	197 2	212 5	227 7	242 10	257 12	272 15	287 17	302 20	317 22	332 25	347 27
7	197 17	212 20	227 22	242 25	257 27	272 30	287 32	302 35	317 37	332 40	347 42
8	197 32	212 35	227 37	242 40	257 42	272 45	287 47	302 50	317 52	332 55	347 57
9	197 47	212 50	227 52	242 55	257 57	273 0	288 2	303 5	318 7	333 10	348 12
10	198 2	213 5	228 7	243 10	258 12	273 15	288 17	303 20	318 22	333 25	348 27
11	198 18	213 20	228 22	243 25	258 27	273 30	288 32	303 35	318 37	333 40	348 42
12	198 33	213 35	228 38	243 40	258 42	273 45	288 47	303 50	318 52	333 55	348 57
13	198 48	213 50	228 53	243 55	258 57	274 0	289 2	304 5	319 7	334 10	349 12
14	199 3	214 5	229 8	244 10	259 13	274 15	289 17	304 20	319 22	334 25	349 27
15	199 18	214 20	229 23	244 25	259 28	274 30	289 32	304 35	319 37	334 40	349 42
16	199 33	214 35	229 38	244 40	259 43	274 45	289 48	304 50	319 52	334 55	349 57
17	199 48	214 50	229 53	244 55	259 58	275 0	290 3	305 5	320 7	335 10	350 12
18	200 3	215 5	230 8	245 10	260 13	275 15	290 18	305 20	320 23	335 25	350 27
19	200 18	215 20	230 23	245 25	260 28	275 30	290 33	305 35	320 38	335 40	350 43
20	200 33	215 35	230 38	245 40	260 43	275 45	290 48	305 50	320 53	335 55	350 58
21	200 48	215 50	230 53	245 55	260 58	276 0	291 3	306 5	321 8	336 10	351 13
22	201 3	216 5	231 8	246 10	261 13	276 15	291 18	306 20	321 23	336 25	351 28
23	201 18	216 20	231 23	246 25	261 28	276 30	291 33	306 35	321 38	336 40	351 43
24	201 33	216 36	231 38	246 40	261 43	276 45	291 48	306 50	321 53	336 55	351 58
25	201 48	216 51	231 53	246 55	261 58	277 0	292 3	307 5	322 8	337 10	352 13
26	202 3	217 6	232 8	247 11	262 13	277 15	292 18	307 20	322 23	337 25	352 28
27	202 18	217 21	232 23	247 26	262 28	277 31	292 33	307 35	322 38	337 40	352 43
28	202 33	217 36	232 38	247 41	262 43	277 46	292 48	307 50	322 53	337 55	352 58
29	202 48	217 51	232 53	247 56	262 58	278 1	293 3	308 6	323 8	338 10	353 13
30	203 3	218 6	233 8	248 11	263 13	278 16	293 18	308 21	323 23	338 25	353 28
31	203 18	218 21	233 23	248 26	263 28	278 31	293 33	308 36	323 38	338 41	353 43
32	203 33	218 36	233 38	248 41	263 43	278 46	293 48	308 51	323 53	338 56	353 58
33	203 48	218 51	233 53	248 56	263 58	279 1	294 3	309 6	324 8	339 11	354 13
34	204 3	219 6	234 8	249 11	264 13	279 16	294 18	309 21	324 23	339 26	354 28
35	204 19	219 21	234 23	249 26	264 28	279 31	294 33	309 36	324 38	339 41	354 43
36	204 34	219 36	234 38	249 41	264 43	279 46	294 48	309 51	324 53	339 56	354 58
37	204 49	219 51	234 54	249 56	264 58	280 1	295 3	310 6	325 8	340 11	355 13
38	205 4	220 6	235 9	250 11	265 13	280 16	295 18	310 21	325 23	340 26	355 28
39	205 19	220 21	235 24	250 26	265 29	280 31	295 33	310 36	325 38	340 41	355 43
40	205 34	220 36	235 39	250 41	265 44	280 46	295 49	310 51	325 53	340 56	355 58
41	205 49	220 51	235 54	250 56	265 59	281 1	296 4	311 6	326 8	341 11	356 13
42	206 4	221 6	236 9	251 11	266 14	281 16	296 19	311 21	326 24	341 26	356 28
43	206 19	221 21	236 24	251 26	266 29	281 31	296 34	311 36	326 39	341 41	356 43
44	206 34	221 36	236 39	251 41	266 44	281 46	296 49	311 51	326 54	341 56	356 59
45	206 49	221 51	236 54	251 56	266 59	282 1	297 4	312 6	327 9	342 11	357 14
46	207 4	222 6	237 9	252 11	267 14	282 16	297 19	312 21	327 24	342 26	357 29
47	207 19	222 21	237 24	252 26	267 29	282 31	297 34	312 36	327 39	342 41	357 44
48	207 34	222 37	237 39	252 41	267 44	282 46	297 49	312 51	327 54	342 56	357 59
49	207 49	222 52	237 54	252 56	267 59	283 1	298 4	313 6	328 9	343 11	358 14
50	208 4	223 7	238 9	253 12	268 14	283 16	298 19	313 21	328 24	343 26	358 29
51	208 19	223 22	238 24	253 27	268 29	283 31	298 34	313 36	328 39	343 41	358 44
52	208 34	223 37	238 39	253 42	268 44	283 47	298 49	313 51	328 54	343 56	358 59
53	208 49	223 52	238 54	253 57	268 59	284 2	299 4	314 7	329 9	344 11	359 14
54	209 4	224 7	239 9	254 12	269 14	284 17	299 19	314 22	329 24	344 26	359 29
55	209 19	224 22	239 24	254 27	269 29	284 32	299 34	314 37	329 39	344 42	359 44
56	209 34	224 37	239 39	254 42	269 44	284 47	299 49	314 52	329 54	344 57	359 59
57	209 49	224 52	239 54	254 57	269 59	285 2	300 4	315 7	330 9	345 12	0 14
58	210 4	225 7	240 9	255 12	270 14	285 17	300 19	315 22	330 24	345 27	0 29
59	210 20	225 22	240 24	255 27	270 29	285 32	300 34	315 37	330 39	345 42	0 44
60	210 35	225 37	240 39	255 42	270 44	285 47	300 49	315 52	330 54	345 57	0 59

Sec.	Corr.
	′
0	0
1	0
2	1
3	1
4	1
5	1
6	2
7	2
8	2
9	2
10	3
11	3
12	3
13	3
14	4
15	4
16	4
17	4
18	5
19	5
20	5
21	5
22	6
23	6
24	6
25	6
26	7
27	7
28	7
29	7
30	8
31	8
32	8
33	8
34	9
35	9
36	9
37	9
38	10
39	10
40	10
41	10
42	11
43	11
44	11
45	11
46	12
47	12
48	12
49	12
50	13
51	13
52	13
53	13
54	14
55	14
56	14
57	14
58	15
59	15
60	15

FIG. 1 — SHEET B.

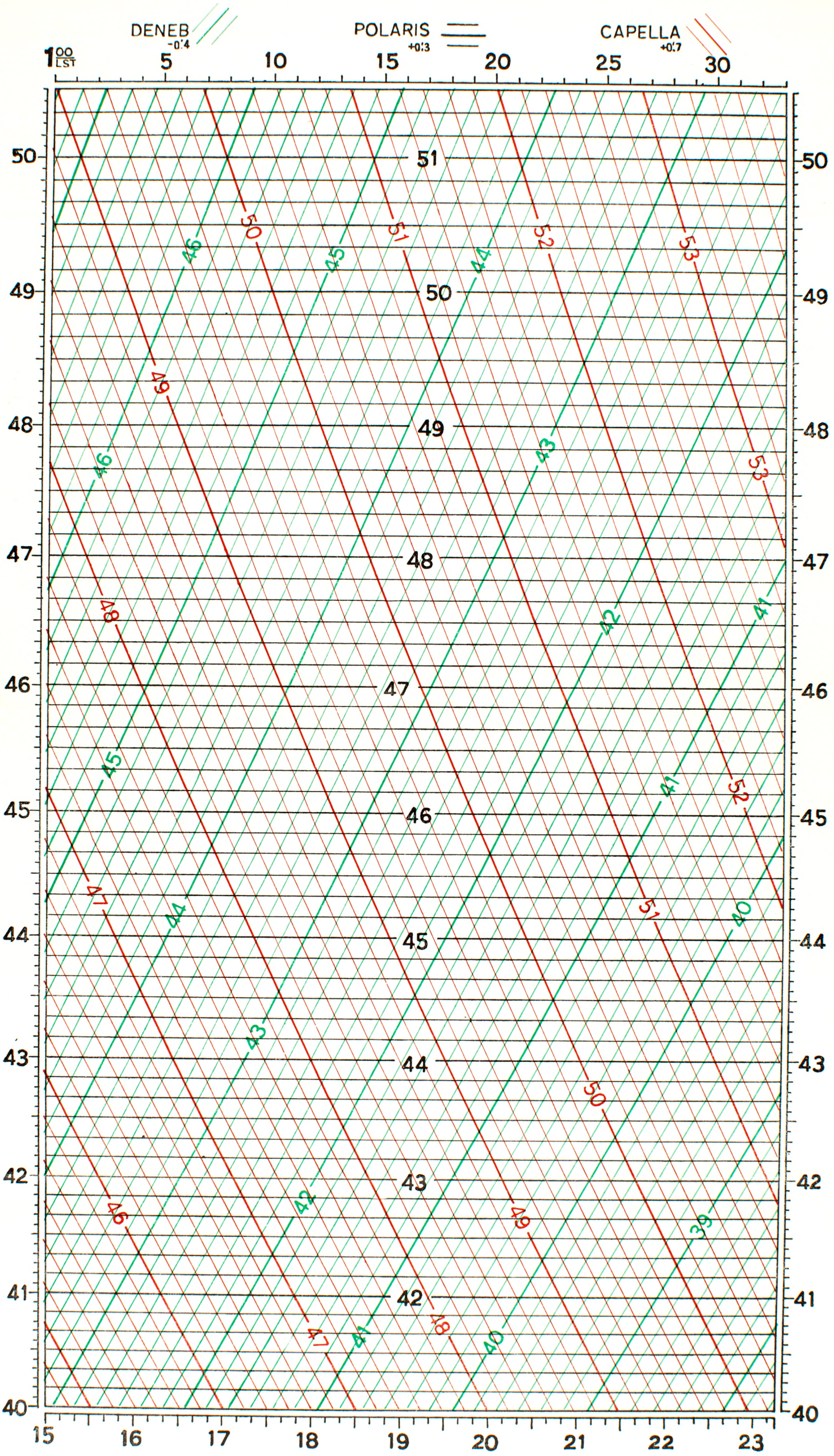
DENEB
-0.4
POLARIS
+0.3
CAPELLA
+0.7
100 LST
5
10
15
20
25
30
50
51
49
50
48
49
47
48
46
47
45
46
44
45
43
44
42
43
41
42
40
41
15
16
17
18
19
20
21
22
23
46
47
48
49
50
51
52
53
45
44
43
42
41
40
39

FIG 2