LAT.	45°		46°		47°		48°		49°		LAT.
H.A.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	H.A.
°	° ′ d	°	° ′ d	°	° ′ d	°	° ′ d	°	° ′ d	°	°
90	18 06+40	71	18 25+41	71	18 44+42	72	19 03+42	72	19 22+42	72	270
91	17 26 40	70	17 46 41	71	18 06 41	71	18 25 42	71	18 44 43	72	269
92	16 46 41	70	17 07 41	70	17 27 42	70	17 47 43	71	18 07 43	71	268
93	16 07 40	69	16 28 41	69	16 49 42	70	17 10 42	70	17 30 43	70	267
94	15 27 41	68	15 49 42	69	16 11 42	69	16 32 43	69	16 53 44	70	266
95	14 48+41	68	15 10+42	68	15 33+42	68	15 55+43	69	16 16+44	69	265
96	14 09 41	67	14 32 42	67	14 55 42	68	15 18 43	68	15 40 44	68	264
97	13 30 41	67	13 54 42	67	14 17 43	67	14 41 43	67	15 04 44	67	263
98	12 51 42	66	13 16 42	66	13 40 43	66	14 04 43	67	14 27 45	67	262
99	12 13 42	65	12 38 42	65	13 03 43	66	13 27 44	66	13 52 44	66	261
100	11 35+42	65	12 00+43	65	12 26+43	65	12 51+44	65	13 16+44	65	260
101	10 57 42	64	11 23 43	64	11 49 43	64	12 15 44	65	12 40 45	65	259
102	10 19+42	63	10 46 43	63	11 12 44	64	11 39 44	64	12 05 45	64	258
103	...		10 09+43	63	10 36 44	63	11 03 45	63	11 30 45	63	257
104	...		...		10 00+44	62	10 28+44	62	10 55 45	63	256
105	...		...		...		...		10 20+46	62	255

In North Latitudes { For argument H.A. on the left, True Azimuth = 360° − Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = Tabulated Azimuth. } See p. 90.

LAT.	45°			46°			47°			48°			49°			LAT.
H.A.	Alt.		Az.	Alt.		Az.	Alt.		Az.	Alt.		Az.	Alt.		Az.	H.A.
°	° , d		°	° , d		°	° , d		°	° , d		°	° , d		°	°
0	19 02	−60	180	18 02	−59	180	17 03	−60	180	16 03	−60	180	15 03	−60	180	360
1	19 02	60	179	18 02	60	179	17 02	60	179	16 03	60	179	15 03	60	179	359
2	19 01	60	178	18 01	60	178	17 01	59	178	16 02	60	178	15 02	60	178	358
3	18 59	60	177	17 59	59	177	17 00	60	177	16 00	60	177	15 00	60	177	357
4	18 57	60	176	17 57	60	176	16 57	59	176	15 58	60	176	14 58	60	176	356
5	18 54	−60	175	17 54	−60	175	16 54	−59	175	15 55	−60	175	14 55	−60	175	355
6	18 50	60	174	17 50	59	174	16 51	60	174	15 51	60	174	14 52	60	174	354
7	18 45	59	173	17 46	60	173	16 46	59	173	15 47	60	173	14 47	59	173	353
8	18 40	60	172	17 41	60	172	16 41	59	173	15 42	60	173	14 43	60	173	352
9	18 34	59	171	17 35	60	172	16 36	60	172	15 36	59	172	14 37	59	172	351
10	18 27	−59	171	17 28	−59	171	16 29	−59	171	15 30	−59	171	14 31	−59	171	350
11	18 20	59	170	17 21	59	170	16 22	59	170	15 24	60	170	14 25	60	170	349
12	18 12	59	169	17 13	59	169	16 15	59	169	15 16	59	169	14 17	59	169	348
13	18 03	59	168	17 05	59	168	16 06	59	168	15 08	59	168	14 10	60	168	347
14	17 54	59	167	16 56	59	167	15 58	59	167	14 59	59	167	14 01	59	167	346
15	17 44	−59	166	16 46	−59	166	15 48	−59	166	14 50	−59	166	13 52	−59	166	345
16	17 33	58	165	16 36	59	165	15 38	59	165	14 40	59	165	13 42	58	165	344
17	17 22	58	164	16 25	59	164	15 27	58	164	14 30	59	164	13 32	59	164	343
18	17 10	58	163	16 13	58	163	15 16	59	163	14 18	58	163	13 21	58	163	342
19	16 58	59	162	16 01	59	162	15 04	59	162	14 07	59	162	13 10	59	163	341
20	16 44	−58	161	15 48	−58	161	14 51	−58	161	13 54	−58	162	12 58	−59	162	340
21	16 30	57	160	15 34	58	160	14 38	58	161	13 41	58	161	12 45	58	161	339
22	16 16	58	159	15 20	58	160	14 24	58	160	13 28	58	160	12 32	58	160	338
23	16 01	58	159	15 05	57	159	14 09	57	159	13 14	58	159	12 18	58	159	337
24	15 45	57	158	14 50	58	158	13 54	57	158	12 59	57	158	12 04	58	158	336
25	15 29	−57	157	14 34	−57	157	13 39	−57	157	12 44	−57	157	11 49	−58	157	335
26	15 12	57	156	14 17	57	156	13 22	56	156	12 28	57	156	11 33	57	156	334
27	14 54	56	155	14 00	57	155	13 06	57	155	12 11	56	155	11 17	57	155	333
28	14 36	56	154	13 42	56	154	12 48	56	154	11 54	56	154	11 01	57	155	332
29	14 17	56	153	13 24	56	153	12 30	56	153	11 37	56	154	10 44	57	154	331
30	13 58	−56	152	13 05	−56	153	12 12	−56	153	11 19	−56	153	10 26	−56	153	330
31	13 38	55	152	12 46	56	152	11 53	56	152	11 00	55	152	10 08	−56	152	329
32	13 18	55	151	12 26	56	151	11 33	55	151	10 41	55	151	...			328
33	12 57	55	150	12 05	55	150	11 13	55	150	10 22	56	150	...			327
34	12 35	54	149	11 44	55	149	10 53	55	149	10 02	−55	149	...			326
35	12 13	−54	148	11 23	−55	148	10 32	−55	148	...			...			325
36	11 51	54	147	11 01	55	147	10 10	−54	148	...			...			324
37	11 28	54	147	10 38	54	147	...			...			...			323
38	11 04	53	146	10 15	−54	146	...			...			...			322
39	10 40	53	145	...			...			...			...			321
40	10 16	−53	144	...			...			...			...			320

In South Latitudes { For argument H.A. on the left, True Azimuth = 180° + Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = 180° − Tabulated Azimuth. } See p. 91.

LAT.	45°			46°			47°			48°			49°			LAT.
H.A.	Alt.	d	Az.	Alt.	d	Az.	Alt.	d	Az.	Alt.	d	Az.	Alt.	d	Az.	H.A.
°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	° ′	′	°	°
0	72 00	+60	180	71 00	+60	180	70 00	+60	180	69 00	+60	180	68 00	+60	180	360
1	71 59	60	177	70 59	60	177	69 59	60	177	68 59	60	178	68 00	59	178	359
2	71 56	60	174	70 56	60	175	69 57	59	175	68 57	60	175	67 57	60	175	358
3	71 51	59	171	70 51	60	172	69 52	60	172	68 53	59	173	67 53	60	173	357
4	71 43	60	169	70 44	60	169	69 46	59	170	68 46	60	170	67 47	60	171	356
5	71 34	+59	166	70 36	+59	166	69 37	+59	167	68 39	+59	168	67 40	+59	168	355
6	71 23	58	163	70 25	58	164	69 27	59	165	68 29	59	165	67 31	59	166	354
7	71 09	58	160	70 13	58	161	69 16	58	162	68 18	59	163	67 21	59	164	353
8	70 54	57	158	69 58	58	159	69 02	58	160	68 06	58	161	67 09	58	161	352
9	70 37	56	155	69 42	57	156	68 47	57	157	67 52	57	158	66 56	58	159	351
10	70 18	+56	153	69 25	+56	154	68 31	+56	155	67 36	+57	156	66 41	+57	157	350
11	69 58	55	150	69 06	55	152	68 13	56	153	67 19	57	154	66 25	57	155	349
12	69 36	54	148	68 45	55	149	67 53	56	151	67 01	56	152	66 08	56	153	348
13	69 13	53	146	68 23	54	147	67 32	55	148	66 41	55	150	65 49	56	151	347
14	68 48	53	143	68 00	53	145	67 10	54	146	66 20	55	148	65 29	55	149	346
15	68 23	+51	141	67 35	+53	143	66 47	+53	144	65 58	+54	146	65 08	+55	147	345
16	67 55	51	139	67 09	52	141	66 23	52	142	65 35	53	144	64 46	54	145	344
17	67 27	50	137	66 43	51	139	65 57	52	140	65 10	53	142	64 23	53	143	343
18	66 58	49	135	66 15	50	137	65 30	52	138	64 45	52	140	63 59	53	141	342
19	66 28	48	133	65 46	49	135	65 03	50	137	64 19	51	138	63 34	52	139	341
20	65 56	+48	132	65 16	+49	133	64 34	+50	135	63 51	+51	136	63 07	+52	138	340
21	65 24	47	130	64 45	48	132	64 05	49	133	63 23	50	135	62 40	52	136	339
22	64 51	47	128	64 13	48	130	63 34	49	131	62 54	50	133	62 13	50	134	338
23	64 18	45	127	63 41	47	128	63 03	48	130	62 24	49	131	61 44	50	133	337
24	63 43	45	125	63 08	46	127	62 32	47	128	61 54	48	130	61 15	49	131	336
25	63 08	+45	124	62 34	+46	125	61 59	+47	127	61 23	+48	128	60 45	+49	130	335
26	62 33	43	122	62 00	45	124	61 26	46	125	60 51	47	127	60 14	49	128	334
27	61 56	44	121	61 25	45	122	60 52	46	124	60 18	47	125	59 43	48	127	333
28	61 20	42	119	60 49	45	121	60 18	45	122	59 45	47	124	59 11	48	125	332
29	60 42	43	118	60 14	43	120	59 43	45	121	59 12	46	123	58 39	47	124	331
30	60 05	+42	117	59 37	+43	118	59 08	+44	120	58 38	+45	121	58 06	+47	123	330
31	59 27	41	116	59 00	43	117	58 32	44	118	58 03	45	120	57 32	47	121	329
32	58 48	41	114	58 23	42	116	57 56	44	117	57 28	45	119	56 59	45	120	328
33	58 09	41	113	57 45	42	115	57 19	44	116	56 53	44	117	56 24	46	119	327
34	57 30	40	112	57 07	42	113	56 43	42	115	56 17	44	116	55 50	45	118	326
35	56 51	+40	111	56 29	+41	112	56 05	+43	114	55 40	+44	115	55 14	+45	116	325
36	56 11	39	110	55 50	41	111	55 28	42	113	55 04	43	114	54 39	44	115	324
37	55 31	39	109	55 11	40	110	54 50	41	111	54 27	43	113	54 03	44	114	323
38	54 51	39	108	54 32	40	109	54 11	42	110	53 50	43	112	53 27	44	113	322
39	54 10	39	107	53 52	40	108	53 33	41	109	53 13	42	111	52 51	43	112	321
40	53 29	+39	106	53 13	+39	107	52 54	+41	108	52 35	+42	110	52 14	+43	111	320
41	52 49	38	105	52 33	39	106	52 15	41	107	51 57	42	109	51 37	43	110	319
42	52 07	38	104	51 52	40	105	51 36	41	106	51 19	41	108	51 00	43	109	318
43	51 26	38	103	51 12	39	104	50 57	40	105	50 40	42	107	50 23	42	108	317
44	50 45	37	102	50 32	38	103	50 17	40	104	50 02	41	106	49 45	42	107	316
45	50 03	+37	101	49 51	+39	102	49 38	+39	103	49 23	+41	105	49 07	+42	106	315

In North Latitudes { For argument H.A. on the left, True Azimuth = 360° − Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = Tabulated Azimuth. } See p. 90

LAT.	45°		46°		47°		48°		49°		LAT.
H.A.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	H.A.
°	° , d	°	° , d	°	° , d	°	° , d	°	° , d	°	°
45	50 03+37	101	49 51+39	102	49 38+39	103	49 23+41	105	49 07+42	106	315
46	49 22 37	100	49 10 39	101	48 58 39	103	48 44 41	104	48 29 42	105	314
47	48 40 37	99	48 29 39	101	48 18 39	102	48 05 41	103	47 51 42	104	313
48	47 58 37	99	47 48 38	100	47 38 39	101	47 26 40	102	47 13 41	103	312
49	47 16 37	98	47 07 38	99	46 57 40	100	46 47 40	101	46 35 41	102	311
50	46 34+36	97	46 26+38	98	46 17+39	99	46 07+40	100	45 56+41	101	310
51	45 52 36	96	45 45 37	97	45 37 38	98	45 28 39	99	45 17 41	100	309
52	45 10 36	95	45 03 38	96	44 56 39	97	44 48 40	98	44 39 41	99	308
53	44 27 37	95	44 22 37	96	44 16 38	97	44 08 40	98	44 00 41	99	307
54	43 45 36	94	43 40 38	95	43 35 38	96	43 28 40	97	43 21 41	98	306
55	43 03+36	93	42 59+37	94	42 54+39	95	42 48+40	96	42 42+40	97	305
56	42 20 37	92	42 17 38	93	42 13 39	94	42 08 40	95	42 03 40	96	304
57	41 38 36	92	41 36 37	93	41 33 38	93	41 29 39	94	41 24 40	95	303
58	40 56 36	91	40 54 37	92	40 52 38	93	40 48 40	94	40 44 41	94	302
59	40 13 36	90	40 12 38	91	40 11 38	92	40 08 40	93	40 05 40	94	301
60	39 31+36	90	39 31+37	90	39 30+38	91	39 28+40	92	39 26+40	93	300
61	38 48 37	89	38 49 37	90	38 49 38	90	38 48 40	91	38 46 41	92	299
62	38 06 36	88	38 08 37	89	38 08 39	90	38 08 39	91	38 07 41	91	298
63	37 24 36	87	37 26 37	88	37 27 39	89	37 28 39	90	37 28 40	91	297
64	36 41 37	87	36 44 38	88	36 46 39	88	36 48 39	89	36 48 41	90	296
65	35 59+36	86	36 03+37	87	36 06+38	88	36 08+39	88	36 09+41	89	295
66	35 17 36	85	35 21 38	86	35 25 38	87	35 28 39	88	35 30 40	88	294
67	34 34 37	85	34 40 37	85	34 44 38	86	34 48 39	87	34 51 40	88	293
68	33 52 37	84	33 58 38	85	34 03 39	85	34 08 39	86	34 11 41	87	292
69	33 10 37	83	33 17 37	84	33 22 39	85	33 28 39	85	33 32 40	86	291
70	32 28+37	83	32 35+38	83	32 42+38	84	32 48+39	85	32 53+40	85	290
71	31 46 37	82	31 54 38	83	32 01 39	83	32 08 39	84	32 14 40	85	289
72	31 04 37	82	31 13 37	82	31 20 39	83	31 28 40	83	31 34 41	84	288
73	30 22 37	81	30 31 38	81	30 40 39	82	30 48 40	83	30 55 41	83	287
74	29 40 38	80	29 50 38	81	30 00 39	81	30 08 40	82	30 16 41	83	286
75	28 59+37	80	29 09+38	80	29 19+39	81	29 29+40	81	29 37+41	82	285
76	28 17 37	79	28 28 39	80	28 39 39	80	28 49 40	81	28 58 41	81	284
77	27 35 38	78	27 47 39	79	27 59 39	79	28 09 41	80	28 20 41	80	283
78	26 54 38	78	27 06 39	78	27 18 40	79	27 30 40	79	27 41 41	80	282
79	26 13 37	77	26 26 38	78	26 38 40	78	26 51 40	79	27 02 42	79	281
80	25 31+38	76	25 45+39	77	25 59+39	77	26 11+41	78	26 24+41	78	280
81	24 50 38	76	25 05 39	76	25 19 40	77	25 32 41	77	25 45 42	78	279
82	24 09 39	75	24 24 39	76	24 39 40	76	24 53 41	77	25 07 42	77	278
83	23 28 39	75	23 44 39	75	23 59 40	75	24 14 41	76	24 29 41	76	277
84	22 48 38	74	23 04 39	74	23 20 40	75	23 35 42	75	23 51 41	76	276
85	22 07+39	73	22 24+40	74	22 41+40	74	22 57+41	75	23 13+42	75	275
86	21 26 39	73	21 44 40	73	22 01 41	73	22 18 42	74	22 35 42	74	274
87	20 46 39	72	21 04 40	72	21 22 41	73	21 40 41	73	21 57 42	74	273
88	20 06 39	71	20 25 40	72	20 43 41	72	21 01 42	73	21 19 43	73	272
89	19 26 39	71	19 45 41	71	20 04 42	71	20 23 42	72	20 42 42	72	271
90	18 46+40	70	19 06+41	71	19 26+41	71	19 45+42	71	20 04+43	72	270

In South Latitudes { For argument H.A. on the left, True Azimuth = 180° + Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = 180° − Tabulated Azimuth. } See p. 91.

LAT.	45°		46°		47°		48°		49°		LAT.
H.A.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	H.A.
°	° , d	°	° , d	°	° , d	°	° , d	°	° , d	°	°
90	18 46+40	70	19 06+41	71	19 26+41	71	19 45+42	71	20 04+43	72	270
91	18 06 40	70	18 27 41	70	18 47 42	70	19 07 43	71	19 27 43	71	269
92	17 27 40	69	17 48 41	69	18 09 42	70	18 30 42	70	18 50 43	70	268
93	16 47 40	68	17 09 41	69	17 31 42	69	17 52 43	69	18 13 44	69	267
94	16 08 40	68	16 31 41	68	16 53 42	68	17 15 43	69	17 37 43	69	266
95	15 29+41	67	15 52+42	67	16 15+42	68	16 38+43	68	17 00+44	68	265
96	14 50 41	66	15 14 42	67	15 37 43	67	16 01 43	67	16 24 44	67	264
97	14 11 42	66	14 36 42	66	15 00 43	66	15 24 43	67	15 48 44	67	263
98	13 33 41	65	13 58 42	65	14 23 43	66	14 47 44	66	15 12 44	66	262
99	12 55 41	65	13 20 43	65	13 46 43	65	14 11 44	65	14 36 44	65	261
100	12 17+42	64	12 43+42	64	13 09+43	64	13 35+44	64	14 00+45	65	260
101	11 39 42	63	12 06 43	63	12 32 44	64	12 59 44	64	13 25 45	64	259
102	11 01 43	63	11 29 43	63	11 56 44	63	12 23 44	63	12 50 45	63	258
103	10 24+43	62	10 52 43	62	11 20 44	62	11 48 44	62	12 15 45	63	257
104	...		10 16+43	61	10 44 44	62	11 12 45	62	11 40 46	62	256
105	...		...		10 08+45	61	10 37+45	61	11 06+46	61	255
106	...		...		...		10 02+46	60	10 32+46	61	254
107	...		...		...		...		...		253
108	...		...		...		...		...		252
109	...		...		...		...		...		251
110	...		...		...		...		...		250

In North Latitudes { For argument H.A. on the left, True Azimuth = 360° − Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = Tabulated Azimuth. } See p. 90.

LAT.	45°			46°			47°			48°			49°			LAT.
H.A.	Alt.		Az.	Alt.		Az.	Alt.		Az.	Alt.		Az.	Alt.		Az.	H.A.
°	° ′	d	°	° ′	d	°	° ′	d	°	° ′	d	°	° ′	d	°	°
0	18 02	−59	180	17 03	−60	180	16 03	−60	180	15 03	−60	180	14 03	−59	180	360
1	18 02	60	179	17 02	60	179	16 02	59	179	15 03	60	179	14 03	60	179	359
2	18 01	60	178	17 01	60	178	16 02	60	178	15 02	60	178	14 02	60	178	358
3	17 59	59	177	17 00	60	177	16 00	60	177	15 00	60	177	14 00	59	177	357
4	17 57	60	176	16 57	59	176	15 58	60	176	14 58	60	176	13 58	59	176	356
5	17 54	−60	175	16 54	−59	175	15 55	−60	175	14 55	−60	175	13 55	−59	175	355
6	17 50	60	174	16 51	60	174	15 51	60	174	14 51	59	174	13 52	60	175	354
7	17 46	60	173	16 46	59	173	15 47	60	174	14 47	59	174	13 48	60	174	353
8	17 40	59	173	16 41	59	173	15 42	60	173	14 42	59	173	13 43	59	173	352
9	17 35	60	172	16 35	59	172	15 36	59	172	14 37	59	172	13 38	60	172	351
10	17 28	−59	171	16 29	−59	171	15 30	−59	171	14 31	−59	171	13 32	−59	171	350
11	17 21	59	170	16 22	59	170	15 23	59	170	14 24	59	170	13 25	59	170	349
12	17 13	59	169	16 14	59	169	15 16	60	169	14 17	59	169	13 18	59	169	348
13	17 04	59	168	16 06	59	168	15 07	59	168	14 09	59	168	13 10	59	168	347
14	16 55	59	167	15 57	59	167	14 59	59	167	14 00	59	167	13 02	59	167	346
15	16 45	−58	166	15 47	−58	166	14 49	−59	166	13 51	−59	166	12 53	−59	166	345
16	16 35	59	165	15 37	59	165	14 39	58	165	13 41	58	165	12 44	59	165	344
17	16 24	59	164	15 26	58	164	14 29	59	164	13 31	59	164	12 33	58	165	343
18	16 12	58	163	15 15	59	163	14 17	58	164	13 20	58	164	12 23	59	164	342
19	15 59	58	162	15 02	58	163	14 05	58	163	13 08	58	163	12 11	58	163	341
20	15 46	−58	162	14 50	−58	162	13 53	−58	162	12 56	−58	162	11 59	−58	162	340
21	15 33	58	161	14 36	58	161	13 40	58	161	12 43	57	161	11 47	58	161	339
22	15 18	57	160	14 22	57	160	13 26	57	160	12 30	58	160	11 34	58	160	338
23	15 03	57	159	14 08	58	159	13 12	58	159	12 16	57	159	11 20	57	159	337
24	14 48	57	158	13 52	57	158	12 57	57	158	12 02	58	158	11 06	57	158	336
25	14 32	−57	157	13 37	−57	157	12 42	−57	157	11 47	−58	157	10 51	−57	157	335
26	14 15	57	156	13 20	56	156	12 26	57	156	11 31	57	157	10 36	57	157	334
27	13 58	57	155	13 03	56	155	12 09	57	156	11 15	57	156	10 20	56	156	333
28	13 40	56	155	12 46	56	155	11 52	56	155	10 58	56	155	10 04	−56	155	332
29	13 21	56	154	12 28	56	154	11 34	56	154	10 41	57	154		...		331
30	13 02	−55	153	12 09	−56	153	11 16	−56	153	10 23	−56	153		...		330
31	12 43	56	152	11 50	56	152	10 57	55	152	10 05	−56	152		...		329
32	12 23	56	151	11 30	55	151	10 38	55	151		...			...		328
33	12 02	55	150	11 10	55	150	10 18	−55	150		...			...		327
34	11 41	55	149	10 49	54	150		...			...			...		326
35	11 19	−54	149	10 28	−54	149		...			...			...		325
36	10 57	54	148	10 06	−54	148		...			...			...		324
37	10 34	54	147		...			...			...			...		323
38	10 11	−54	146		...			...			...			...		322
39		...			...			...			...			...		321
40		...			...			...			...			...		320

In South Latitudes { For argument H.A. on the left, True Azimuth = 180° + Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = 180° − Tabulated Azimuth. } See p. 91.

LAT.	45°			46°			47°			48°			49°			LAT.
H.A.	Alt.		Az.	Alt.		Az.	Alt.		Az.	Alt.		Az.	Alt.		Az.	H.A.
	° ′	d	°	° ′	d	°	° ′	d	°	° ′	d	°	° ′	d	°	°
0	73 00	+60	180	72 00	+60	180	71 00	+60	180	70 00	+60	180	69 00	+60	180	360
1	72 59	60	177	71 59	60	177	70 59	60	177	69 59	60	177	68 59	60	178	359
2	72 56	60	174	71 56	60	174	70 56	60	175	69 57	60	175	68 57	60	175	358
3	72 50	60	171	71 51	60	171	70 52	59	172	69 52	60	172	68 53	59	173	357
4	72 43	59	168	71 44	59	169	70 45	59	169	69 46	59	170	68 47	59	170	356
5	72 33	+58	165	71 35	+58	166	70 36	+59	167	69 38	+59	167	68 39	+60	168	355
6	72 21	58	162	71 23	59	163	70 26	58	164	69 28	59	165	68 30	59	165	354
7	72 07	57	160	71 11	57	161	70 14	58	161	69 17	58	162	68 20	58	163	353
8	71 51	57	157	70 56	57	158	70 00	57	159	69 04	58	160	68 07	58	161	352
9	71 33	56	154	70 39	57	155	69 44	57	156	68 49	58	158	67 54	57	158	351
10	71 14	+55	152	70 21	+56	153	69 27	+57	154	68 33	+57	155	67 38	+58	156	350
11	70 53	54	149	70 01	55	150	69 09	55	152	68 16	56	153	67 22	56	154	349
12	70 30	54	147	69 40	54	148	68 49	55	149	67 57	55	151	67 04	56	152	348
13	70 06	53	144	69 17	54	146	68 27	54	147	67 36	55	149	66 45	55	150	347
14	69 41	52	142	68 53	53	144	68 04	54	145	67 15	54	146	66 24	55	148	346
15	69 14	+51	140	68 28	+52	142	67 40	+53	143	66 52	+54	144	66 03	+54	146	345
16	68 46	51	138	68 01	52	139	67 15	52	141	66 28	53	142	65 40	54	144	344
17	68 17	50	136	67 34	50	137	66 49	51	139	66 03	52	141	65 16	53	142	343
18	67 47	49	134	67 05	50	136	66 22	50	137	65 37	52	139	64 52	52	140	342
19	67 16	48	132	66 35	49	134	65 53	50	135	65 10	51	137	64 26	52	138	341
20	66 44	+47	130	66 05	+48	132	65 24	+49	134	64 42	+51	135	63 59	+51	137	340
21	66 11	47	128	65 33	48	130	64 54	49	132	64 13	50	133	63 32	50	135	339
22	65 38	45	127	65 01	47	128	64 23	48	130	63 44	49	132	63 03	50	133	338
23	65 03	45	125	64 28	46	127	63 51	48	128	63 13	49	130	62 34	50	132	337
24	64 28	45	124	63 54	46	125	63 19	47	127	62 42	48	128	62 04	49	130	336
25	63 53	+43	122	63 20	+45	124	62 46	+46	125	62 11	+47	127	61 34	+48	128	335
26	63 16	43	121	62 45	44	122	62 12	46	124	61 38	47	125	61 03	48	127	334
27	62 40	42	119	62 10	43	121	61 38	45	122	61 05	47	124	60 31	47	125	333
28	62 02	42	118	61 34	43	120	61 03	45	121	60 32	46	123	59 59	47	124	332
29	61 25	41	117	60 57	43	118	60 28	44	120	59 58	45	121	59 26	46	123	331
30	60 47	+40	115	60 20	+42	117	59 52	+44	118	59 23	+45	120	58 53	+46	121	330
31	60 08	40	114	59 43	42	116	59 16	43	117	58 48	45	119	58 19	45	120	329
32	59 29	40	113	59 05	41	114	58 40	42	116	58 13	44	117	57 44	46	119	328
33	58 50	40	112	58 27	41	113	58 03	42	115	57 37	43	116	57 10	45	118	327
34	58 10	40	111	57 49	40	112	57 25	42	114	57 01	43	115	56 35	44	116	326
35	57 31	+38	110	57 10	+40	111	56 48	+41	112	56 24	+43	114	55 59	+44	115	325
36	56 50	39	108	56 31	40	110	56 10	41	111	55 47	43	113	55 23	44	114	324
37	56 10	38	107	55 51	40	109	55 31	41	110	55 10	42	112	54 47	44	113	323
38	55 30	37	106	55 12	39	108	54 53	40	109	54 33	41	110	54 11	43	112	322
39	54 49	37	105	54 32	39	107	54 14	40	108	53 55	41	109	53 34	43	111	321
40	54 08	+37	104	53 52	+39	106	53 35	+40	107	53 17	+41	108	52 57	+43	110	320
41	53 27	37	104	53 12	38	105	52 56	40	106	52 39	41	107	52 20	42	109	319
42	52 45	37	103	52 32	38	104	52 17	39	105	52 00	41	106	51 43	42	108	318
43	52 04	37	102	51 51	38	103	51 37	39	104	51 22	40	105	51 05	42	107	317
44	51 22	37	101	51 10	38	102	50 57	39	103	50 43	40	104	50 27	42	106	316
45	50 40	+37	100	50 30	+37	101	50 17	+39	102	50 04	+40	103	49 49	+42	105	315

In North Latitudes { For argument H.A. on the left, True Azimuth = 360° − Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = Tabulated Azimuth. } See p. 90.

LAT.	45°			46°			47°			48°			49°			LAT.
H.A.	Alt.	d	Az.	Alt.	d	Az.	Alt.	d	Az.	Alt.	d	Az.	Alt.	d	Az.	H.A.
°	° ′		°	° ′		°	° ′		°	° ′		°	° ′		°	°
45	50 40	+37	100	50 30	+37	101	50 17	+39	102	50 04	+40	103	49 49	+42	105	315
46	49 59	36	99	49 49	37	100	49 37	39	101	49 25	40	103	49 11	41	104	314
47	49 17	36	98	49 08	37	99	48 57	39	101	48 46	39	102	48 33	41	103	313
48	48 35	36	97	48 26	38	99	48 17	38	100	48 06	40	101	47 54	41	102	312
49	47 53	36	97	47 45	37	98	47 37	38	99	47 27	39	100	47 16	41	101	311
50	47 10	+36	96	47 04	+37	97	46 56	+38	98	46 47	+40	99	46 37	+41	100	310
51	46 28	36	95	46 22	37	96	46 15	39	97	46 07	40	98	45 58	41	99	309
52	45 46	36	94	45 41	37	95	45 35	38	96	45 28	39	97	45 20	40	98	308
53	45 04	35	94	44 59	37	95	44 54	38	96	44 48	39	97	44 41	40	98	307
54	44 21	36	93	44 18	37	94	44 13	38	95	44 08	39	96	44 02	40	97	306
55	43 39	+36	92	43 36	+37	93	43 33	+38	94	43 28	+39	95	43 22	+41	96	305
56	42 57	35	91	42 55	36	92	42 52	38	93	42 48	39	94	42 43	40	95	304
57	42 14	36	91	42 13	37	92	42 11	38	92	42 08	39	93	42 04	40	94	303
58	41 32	35	90	41 31	37	91	41 30	38	92	41 28	39	93	41 25	40	93	302
59	40 49	36	89	40 50	37	90	40 49	38	91	40 48	39	92	40 45	40	93	301
60	40 07	+36	89	40 08	+37	89	40 08	+38	90	40 08	+39	91	40 06	+40	92	300
61	39 25	35	88	39 26	37	89	39 27	38	89	39 28	38	90	39 27	40	91	299
62	38 42	36	87	38 45	37	88	38 47	37	89	38 47	39	90	38 48	39	90	298
63	38 00	36	86	38 03	37	87	38 06	38	88	38 07	39	89	38 08	40	90	297
64	37 18	35	86	37 22	37	87	37 25	38	87	37 27	39	88	37 29	40	89	296
65	36 35	+36	85	36 40	+37	86	36 44	+38	87	36 47	+39	87	36 50	+39	88	295
66	35 53	36	84	35 59	37	85	36 03	38	86	36 07	39	87	36 10	40	87	294
67	35 11	36	84	35 17	37	85	35 22	38	85	35 27	39	86	35 31	40	87	293
68	34 29	36	83	34 36	37	84	34 42	38	85	34 47	39	85	34 52	40	86	292
69	33 47	36	83	33 54	37	83	34 01	38	84	34 07	39	85	34 12	41	85	291
70	33 05	+36	82	33 13	+37	83	33 20	+39	83	33 27	+39	84	33 33	+40	84	290
71	32 23	36	81	32 32	37	82	32 40	38	82	32 47	40	83	32 54	40	84	289
72	31 41	37	81	31 50	38	81	31 59	39	82	32 08	39	82	32 15	40	83	288
73	30 59	37	80	31 09	38	81	31 19	38	81	31 28	39	82	31 36	40	82	287
74	30 18	36	79	30 28	38	80	30 39	38	80	30 48	40	81	30 57	41	82	286
75	29 36	+37	79	29 47	+38	79	29 58	+39	80	30 09	+39	80	30 18	+41	81	285
76	28 54	37	78	29 07	37	79	29 18	39	79	29 29	40	80	29 39	41	80	284
77	28 13	37	77	28 26	38	78	28 38	39	79	28 50	40	79	29 01	40	80	283
78	27 32	37	77	27 45	38	77	27 58	39	78	28 10	40	78	28 22	41	79	282
79	26 50	38	76	27 04	39	77	27 18	39	77	27 31	40	78	27 44	41	78	281
80	26 09	+38	76	26 24	+39	76	26 38	+40	77	26 52	+40	77	27 05	+41	78	280
81	25 28	38	75	25 44	38	75	25 59	39	76	26 13	40	76	26 27	41	77	279
82	24 48	38	74	25 03	39	75	25 19	40	75	25 34	41	76	25 49	41	76	278
83	24 07	38	74	24 23	39	74	24 39	40	75	24 55	41	75	25 10	42	75	277
84	23 26	39	73	23 43	40	74	24 00	40	74	24 17	40	74	24 32	42	75	276
85	22 46	+38	72	23 04	+39	73	23 21	+40	73	23 38	+41	74	23 55	+41	74	275
86	22 05	39	72	22 24	39	72	22 42	40	73	23 00	41	73	23 17	42	73	274
87	21 25	39	71	21 44	40	72	22 03	40	72	22 21	42	72	22 39	42	73	273
88	20 45	39	71	21 05	40	71	21 24	41	71	21 43	42	72	22 02	42	72	272
89	20 05	40	70	20 26	40	70	20 46	40	71	21 05	42	71	21 24	43	71	271
90	19 26	+39	69	19 47	+40	70	20 07	+41	70	20 27	+42	70	20 47	+43	71	270

In South Latitudes { For argument H.A. on the left, True Azimuth = 180° + Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = 180° − Tabulated Azimuth. } See p. 91.

LAT.	45°		46°		47°		48°		49°		LAT.
H.A.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	H.A.
°	° ′ d	°	° ′ d	°	° ′ d	°	° ′ d	°	° ′ d	°	°
90	19 26+39	69	19 47+40	70	20 07+41	70	20 27+42	70	20 47+43	71	270
91	18 46 40	69	19 08 40	69	19 29 41	69	19 50 42	70	20 10 43	70	269
92	18 07 40	68	18 29 41	68	18 51 41	69	19 12 42	69	19 33 43	69	268
93	17 27 41	68	17 50 41	68	18 13 41	68	18 35 42	68	18 57 43	69	267
94	16 48 41	67	17 12 41	67	17 35 42	67	17 58 42	68	18 20 43	68	266
95	16 10+40	66	16 34+41	67	16 57+42	67	17 21+42	67	17 44+43	67	265
96	15 31 41	66	15 56 41	66	16 20 42	66	16 44 43	66	17 08 43	67	264
97	14 53 41	65	15 18 41	65	15 43 42	66	16 07 43	66	16 32 44	66	263
98	14 14 42	64	14 40 42	65	15 06 42	65	15 31 43	65	15 56 44	65	262
99	13 36 42	64	14 03 42	64	14 29 43	64	14 55 43	64	15 20 45	65	261
100	12 59+41	63	13 25+43	63	13 52+43	64	14 19+43	64	14 45+44	64	260
101	12 21 42	63	12 49 42	63	13 16 43	63	13 43 44	63	14 10 44	63	259
102	11 44 42	62	12 12 43	62	12 40 43	62	13 07 45	62	13 35 45	63	258
103	11 07 42	61	11 35 43	61	12 04 43	62	12 32 44	62	13 00 45	62	257
104	10 30+42	61	10 59 43	61	11 28 44	61	11 57 45	61	12 26 45	61	256
105	...		10 23+44	60	10 53+44	60	11 22+45	60	11 52+45	61	255
106	...		...		10 17+45	60	10 48 45	60	11 18 45	60	254
107	...		...		...		10 13+45	59	10 44 46	59	253
108	...		...		...		...		10 10+46	59	252
109	...		...		...		...		...		251
110	...		...		...		...		...		250

In North Latitudes { For argument H.A. on the left, True Azimuth = 360° − Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = Tabulated Azimuth. } See p. 90.

LAT.	45°		46°		47°		48°		49°		LAT.
H.A.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	Alt.	Az.	H.A.
°	° ′ d	°	° ′ d	°	° ′ d	°	° ′ d	°	° ′ d	°	°
0	17 03−60	180	16 03−60	180	15 03−60	180	14 03−59	180	13 04−60	180	360
1	17 02 60	179	16 02 59	179	15 03 60	179	14 03 60	179	13 03 59	179	359
2	17 01 60	178	16 01 59	178	15 02 60	178	14 02 60	178	13 02 59	178	358
3	17 00 60	177	16 00 60	177	15 00 60	177	14 00 59	177	13 01 60	177	357
4	16 57 60	176	15 58 60	176	14 58 60	176	13 58 59	176	12 59 60	176	356
5	16 54−60	175	15 55−60	175	14 55−60	175	13 55−59	175	12 56−60	175	355
6	16 50 59	174	15 51 60	175	14 51 59	175	13 52 60	175	12 52 59	175	354
7	16 46 60	174	15 47 60	174	14 47 59	174	13 48 60	174	12 48 59	174	353
8	16 41 60	173	15 42 60	173	14 42 59	173	13 43 59	173	12 44 60	173	352
9	16 35 59	172	15 36 59	172	14 37 60	172	13 38 60	172	12 38 59	172	351
10	16 29−60	171	15 30−60	171	14 31−60	171	13 32−60	171	12 33−60	171	350
11	16 22 60	170	15 23 59	170	14 24 59	170	13 25 59	170	12 26 59	170	349
12	16 14 59	169	15 15 59	169	14 16 59	169	13 18 59	169	12 19 59	169	348
13	16 05 59	168	15 07 59	168	14 08 59	168	13 10 59	168	12 11 58	168	347
14	15 56 58	167	14 58 59	167	14 00 59	167	13 01 58	167	12 03 59	167	346
15	15 47−59	166	14 49−59	166	13 50−58	166	12 52−58	166	11 54−58	167	345
16	15 36 58	165	14 38 58	165	13 41 59	166	12 43 59	166	11 45 59	166	344
17	15 25 58	164	14 28 59	165	13 30 58	165	12 32 58	165	11 35 59	165	343
18	15 14 59	164	14 16 58	164	13 19 58	164	12 22 59	164	11 24 58	164	342
19	15 01 58	163	14 04 58	163	13 07 58	163	12 10 58	163	11 13 58	163	341
20	14 48−57	162	13 52−58	162	12 55−58	162	11 58−58	162	11 01−58	162	340
21	14 35 58	161	13 38 57	161	12 42 58	161	11 46 58	161	10 49 58	161	339
22	14 21 58	160	13 25 58	160	12 29 58	160	11 32 57	160	10 36 57	160	338
23	14 06 57	159	13 10 57	159	12 14 57	159	11 19 58	159	10 23 58	159	337
24	13 51 57	158	12 55 57	158	12 00 57	158	11 04 57	159	10 09−57	159	336
25	13 35−57	157	12 40−57	158	11 45−57	158	10 49−57	158	...		335
26	13 18 56	157	12 24 57	157	11 29 57	157	10 34 57	157	...		334
27	13 01 56	156	12 07 57	156	11 12 56	156	10 18 57	156	...		333
28	12 44 56	155	11 50 57	155	10 56 57	155	10 02−57	155	...		332
29	12 25 55	154	11 32 56	154	10 38 56	154	...		...		331
30	12 07−56	153	11 13−55	153	10 20−56	153	...		...		330
31	11 47 55	152	10 54 55	152	10 02−56	153	...		...		329
32	11 27 55	152	10 35 55	152	...		...		...		328
33	11 07 55	151	10 15−55	151	...		...		...		327
34	10 46 54	150	...		...		...		...		326
35	10 25−55	149	...		...		...		...		325
36	10 03−54	148	...		...		...		...		324
37	...		...		...		...		...		323
38	...		...		...		...		...		322
39	...		...		...		...		...		321
40	...		...		...		...		...		320

In South Latitudes { For argument H.A. on the left, True Azimuth = 180° + Tabulated Azimuth. / For argument H.A. on the right, True Azimuth = 180° − Tabulated Azimuth. } See p. 91.

EXPLANATION

By agreement with the Admiralty, the *Astronomical Navigation Tables* are produced by H.M. Nautical Almanac Office to the general requirements of the Air Ministry.

These tables are designed to give, in a simple and direct manner, the solution of the astronomical spherical triangle that occurs in navigational practice. They have been planned for use with the *Air Almanac* (Air Publication 1602) and are consequently designed primarily to meet the requirements of modern air navigation: their use can however be extended to surface navigation, as in the case of the *Air Almanac*, within the limitations of the precision of the tabulated altitude and azimuth.

The general object of the *Astronomical Navigation Tables* is to facilitate the calculation of the Altitude and Azimuth of an observed heavenly body, as seen from some position close to that of the observer. This information, together with the observed altitude, allows to be plotted on the chart a position line upon which the observer must lie; two such position lines serve in general to determine the position of the observer. The tables have been arranged with special relation to the determination of the altitude and azimuth when an assumed position is adopted such that the latitude and hour angle are both integral degrees; interpolation in this case is consequently restricted to interpolation to the declination of the body observed, and provision has been made for this to be done in a simple manner. The precision of the tabulated data is consistent with that adopted for the *Air Almanac*, namely that the altitudes are given to the nearest minute of arc, and so are correct to within 0'·5; this standard of precision is sufficient for all purposes of air navigation and, in fact, is at present (1938) considerably greater than the precision obtainable in an altitude observed with a bubble sextant. Although these tables have been prepared in conjunction with the *Air Almanac*, they are equally applicable for use with any other almanac from which the Greenwich Hour Angle and Declination of the body observed can be found for the time of observation; it is intended, however, that the two publications should provide, in the most convenient form, all the material for a rapid solution of the navigator's problem, for all practical observations.

The *Astronomical Navigation Tables* consist of main tables and auxiliary tables. The main tables give the Tabulated Altitude, to the nearest minute of arc, and the Tabulated Azimuth, to the nearest degree, with the three arguments:—

Latitude —each integral degree from S.69° to N.69°.

Declination—for 22 selected stars for the epoch 1940 and each integral degree from S.28° to N.28°.

Hour Angle—each integral degree for which the altitude is greater than 10°* and less than 80°.

Thus for every combination of an integral degree of latitude, declination and hour angle in the above ranges, the tables give immediately the quantities required.

* The limit is decreased for declinations appropriate to the Sun (0°–23°) in latitudes above 55°, where the Sun may be at low altitudes for long periods of each day, and in latitudes below 30°, where the Sun rises rapidly, and the azimuth at low altitudes is required for checking compasses.

EXPLANATION

In the case of the separate tabulations for the 22 stars, the values of the declinations used in the tables are those of the stars themselves at the middle of 1940; the declinations of the stars change slowly owing to precession and to other causes, but the effect of these changes can be allowed for by means of a simple correcting term, which although smaller, is catered for in a similar way to the interpolation for the declination of other bodies. The stars have been selected for their brightness and their distribution in the sky, and are the same in both name and number as stars Nos. 1-22 in the *Air Almanac*. The tables for integral degrees of declination are applicable to observations of the Sun, Moon and planets, as well as for all stars with declinations between S.29° and N.29°; a list of 13 such stars is given in the *Air Almanac* (Nos. 23-35). It is only for stars outside these limits of declination, in particular stars Nos. 36-50 in the *Air Almanac*, that these tables are not applicable; some other method of obtaining the altitude and azimuth must then be employed. The 22 stars catered for separately may however be regarded as generally sufficient for all practical purposes of air navigation; with the 13 additional stars to be used in exceptional circumstances, reference to other methods should be unnecessary.

The interpolation of tables with three arguments is both laborious and difficult, and should be avoided wherever possible; no provision has therefore been made for interpolation other than for declination, and the navigator should not interpolate for latitude and hour angle, but should use an assumed position so that this may be avoided. The arrangement of the tables, however, allows for interpolation for latitude and hour angle without, in general, the necessity for the comparison of figures on different pages, and the tables may therefore be interpolated for these arguments for the solution of special problems.

The tabulated altitude includes the effect of atmospheric refraction, and is thus directly comparable with the corrected sextant reading; it is in fact the altitude of the body as would be measured by an observer. The refraction included is based on the mean value of the refraction at a height of 5,000 feet in normal conditions, and it is unlikely that at heights in that neighbourhood the refraction will differ by more than 0'·5 from that used. Table VI on page 222 gives the adjustment necessary at heights that differ materially from the basic height adopted; the values in this table should only be applied in extreme cases, and where great accuracy is necessary.

The tabulated azimuth is measured from the elevated pole either to the east or to the west. This can be converted to true azimuth, measured always from the north through east, either by the rules given at the foot of each page, or by the use of Table III on pages 90 and 91.

For the greater convenience of the user, the tables are issued in fourteen volumes, each of which caters for a belt of latitude, 5° in width, in both the northern and southern hemispheres. In each volume tabulations are given for five integral degrees of latitude; working from an assumed position, whose latitude is taken to be the nearest integral degree to that of the D.R. (or estimated) position of the observer, each tabular latitude suffices to cover observations from positions within 0° 30' of the integral degree used. The Explanation and auxiliary tables are reprinted in each volume.

Each volume consists of two main parts, pages 2–89 giving the tabulations for the selected 22 stars and pages 94–209 those for declinations 0°–28°. Each part is

divided into sections of four pages, covering one star or one whole degree of declination; separate indexes on the margin enable immediate reference to be made to the first opening of each section. Throughout, the arrangement of the tabulations in each section is generally the same; the five values of latitude (LAT.) are given across the page and the values of the hour angle (H.A.) down the page. For the stars, the tabulations for NORTH latitudes precede those for SOUTH latitudes, and for the integral degrees of declination, those for the SAME name as the latitude precede those for CONTRARY name. The amount of tabulation varies in each case with different stars and declinations, and in some cases there are no tabulations either in north or in south latitudes, as the star or a body of the given declination does not reach an altitude which makes it suitable for observation in those latitudes; occasionally it has been necessary to continue the tabulation from one page on to the previous page, and for one or two stars, in south latitudes, on to two pages before.

For the stars, each column refers to a given latitude, and contains for all applicable values of the hour angle, the altitude (Alt.), its variation with time (t) and the azimuth (Az.). For the degrees of declination, the variation t is replaced by the difference (d) between the altitude given and that for the following degree. The procedure of entering and interpolating the tables is not appreciably different in the two cases.

An assumed position is taken close to the D.R. position so that the latitude is an integral degree, while the longitude is chosen so that the hour angle, formed by the combination of longitude (*added* if *east*, *subtracted* if *west*) with the G.H.A., taken from the *Air Almanac*, is also an integral degree. The appropriate part (star or degree of declination) is chosen, and the correct section obtained by the marginal index, using the star number, or the integral degree numerically *less* than the declination of the observed body as found from the *Air Almanac*. In this section, the column is chosen corresponding to the assumed latitude, care being taken to select the correct hemisphere. In this column, the values of Alt., t, and Az. can be read off for the stars, corresponding to the particular integral hour angle; for a degree of declination, the values of Alt., d and Az. are similarly found.

The tabulated altitude must now be corrected, in the case of the 22 stars, for the effect of precession, and for other bodies, interpolated to the true declination. Table I on the inside front cover gives the correction to be applied to the altitude of the stars for all years to 2000 for values of t; this correction must be added or subtracted according to the sign prefixed to t. For each star a limiting year is given before which this correction cannot exceed 1′, and there is therefore no need to apply it until after that date. Similarly, the inside back cover and its facing page contain Table XV, with arguments d and the minutes of the declination of the body, giving the correction to be applied to the tabulated altitude taken out for an integral degree; this correction is to be applied to the tabulated altitude with the same sign as that of d.

It is unnecessary to correct the tabulated azimuth in any way, but it must of course be converted to true azimuth before being used to plot a position line.

Having thus obtained the corrected tabulated altitude and the true azimuth, the position line is drawn in the usual manner. The intercept is obtained from the difference between the corrected sextant reading and the corrected tabulated altitude, and is set off from the assumed position either *towards* the direction given

by the true azimuth or in the opposite direction (*away* from), according to the following rules:

Corr. Tab. Alt. *less* than Corr. Sext. Rdg., intercept *towards*;
Corr. Tab. Alt. *greater* than Corr. Sext. Rdg., intercept *away*.

The position line is then drawn at right angles to the intercept through the point so obtained. The expression corrected sextant reading is used conveniently for the observed altitude to emphasize that this quantity is the altitude as measured by the sextant, corrected only for sextant errors and for dome refraction if applicable. As the atmospheric refraction is catered for in the tabulated altitude, no correction for this should be applied to the sextant reading.

If the assumed position is close to the true position, a slight inaccuracy in plotting the tabulated azimuth is unimportant; when the tabulated azimuth is near 0° or 180° advantage may be taken of this to draw the position line simply as part of a parallel of latitude. A double border rule, given when the azimuth is within a few degrees of the meridian, indicates the portions of the tables where this can be done without great error; the limit of azimuth has been varied slightly in different volumes, according to the latitude, so as to reduce the error due to this simplified procedure. The accuracy of this method depends upon the error in the assumed longitude; for an error of 20 miles in the D.R. longitude, the maximum error introduced into the deduced latitude is about 2 miles, while the remaining error (due to the use of an assumed position) may reach a maximum of 2 miles in the worst case. This method should therefore only be adopted either when errors up to about 4 miles can be tolerated, or when the D.R. longitude is known to be fairly accurate; if the D.R. position is liable to much greater error than 20 miles, this method should not be used. An assumed position is taken and the tables entered in exactly the same way (whether for stars or other bodies) as for an ordinary observation, but there is now no necessity to take out the azimuth or to convert to true azimuth. The tabulated altitude is corrected by Table I or Table XV as necessary, and the intercept formed by the usual rules. The intercept is then set off from the assumed position *towards* or *away* from the direction of the object observed, this direction being taken as true north or true south; the position line is thus drawn in as a parallel of latitude. Although the procedure of entering the tables is exactly the same, this method saves a considerable amount of work in the plotting of the position line.

A list of the auxiliary tables is given in the list of contents; in general the titles of these tables are self-explanatory and their use either self-evident or explained on the page concerned.

Tables VII, VIII, IX, X, XI and XIII are arranged as critical tables, so that the result is obtained immediately without interpolation. The argument is divided into intervals, successive intervals corresponding to successive values of the result; for any values of the argument, inside one of these intervals, the corresponding result is the quantity opposite that interval and has in general a maximum error of less than half a unit in the last figure given; when successive values of the result are not consecutive integers, this error can rise to half the difference between successive values. The tabulated values of the argument correspond to half-way values of the result, and these are always chosen so that when the argument is exactly equal to one of the tabulated values, the nearest value of the result is the one corresponding to the previous interval. Thus the rule to be followed is:

When the argument is an exact tabulated value, the *upper* of the two possible values of the result should be taken.

ILLUSTRATIONS

Example 1.—On 1939 February 28, local date, about two hours after sunset, in dead reckoning position latitude 48° 17′ N., longitude 125° 20′ W., star number 3 (Aldebaran) was observed to obtain a position line. Corrected sextant reading 52° 20′; G.M.T. of observation $03^h\ 58^m\ 14^s$.

From Table IV, page 92:

Long. 120° W. (approx.)

	Hrs.	Date
Approx. L.M.T.	2000	Feb. 28
G.M.T.	0400	Mar. 1

From *Air Almanac*, 1939 Mar. 1:

G.H.A. ♈	($03^h\ 50^m$)	215° 34′
Increment	($8^m\ 14^s$)	2 ·04
S.H.A.	(No. 3)	291 53
G.H.A. of star		509 31
Long. of ass. position		−125 31
		384 00
		−360

From page 10:

Lat. of ass. position 48° NORTH

Star No. 3 — H.A. 24°

Tab. Alt.	52° 46′
Correction	—
Corr. Tab. Alt.	52 46
Corr. Sext. Rdg.	52 20
Intercept	26′ *away*

No correction for date is necessary in 1939.

Tab. Az. 140°

Assumed position: Lat. 48° N., Long. 125° 31′ W.

From Table III, page 90: True Az. 220° T.

Example 2.—On 1950 August 17, Greenwich date, in dead reckoning position latitude 45° 52′ S., longitude 26° 29′ E., star number 13 (Fomalhaut) was observed to obtain a position line. From the *Almanac* of that date it was found that the G.H.A. of the star corresponding to the G.M.T. of observation was 15° 14′. Corrected sextant reading 53° 54′.

G.H.A. of star	15° 14′
Long. of ass. position	+ 26 46

From page 51:

Lat. of ass. position 46° SOUTH

Star No. 13 — H.A. 42°

Tab. Alt.	53° 45′
Correction (Table I)	− 2
Corr. Tab. Alt.	53 43
Corr. Sext. Rdg.	53 54
Intercept	11′ *towards*

t . . −12

Year . . 1950

Tab. Az. 101°

Assumed position: Lat. 46° S., Long. 26° 46′ E.

From Table III, page 91: True Az. 281° T.

Example 3.—On 1939 March 1, local date, at approximate local noon, in dead reckoning position latitude 48° 40′ S., longitude 46° 47′ W., the Sun was observed to obtain a position line. Corrected sextant reading 49° 03′: G.M.T. of observation $15^h\ 11^m\ 27^s$.

From Table IV, page 92:

Long. 45° W. (approx.)

Approx.	Hrs.	Date
L.M.T.	1200	Mar. 1
G.M.T.	1500	Mar. 1

From *Air Almanac*, 1939 Mar. 1:

		°	′
G.H.A.	($15^h\ 10^m$)	44	21
Increment	($1^m\ 27^s$)		22
G.H.A. of Sun		44	43
Long. of ass. position		− 46	43
		− 2	00
		+360	

From page 122:

Lat. of ass. position 49° S. Dec. 7° 46′ S. SAME name H.A. 358°

Tab. Alt.	47°	59′	*d*	+60	Tab. Az. 177°
Correction (Table XV)	+	46	Minutes of dec.	46	
Corr. Tab. Alt.	48	45			
Corr. Sext. Rdg.	49	03			
Intercept	18′ *towards*				

Assumed position: Lat. 49° S. Long. 46° 43′ W.

From Table III, page 91: True Az. 003° T.

Since there is a donble border rule opposite the entry on page 122, this observation may be reduced by the method described on page 213. In this case the intercept is set off from the assumed position *towards* the Sun (i.e. northwards), and the position line drawn as a parallel of latitude. There is then no necessity to take out the tabulated azimuth.

Example 4.—On 1939 March 2, local date, shortly before sunrise, in dead reckoning position latitude 44° 38′ N., longitude 147° 08′ E., Mars was observed to obtain a position line. Corrected sextant reading 20° 22′; G.M.T. of observation $19^h\ 38^m\ 17^s$

From Table IV, page 93:

Long. 150° E. (approx.)

Approx.	Hrs.	Date
L.M.T.	0600	Mar. 2
G.M.T.	2000	*Mar.* 1

From *Air Almanac*, 1939 Mar. 1:

		°	′
G.H.A.	(19^h)	185	50
Increment	($38^m\ 17^s$)	9	36
G.H.A. of Mars		195	26
Long. of ass. position		+ 147	34

From page 185:

Lat. of ass. position 45° N. Dec. 22° 39′ S. CONTRARY name H.A. 343°

Tab. Alt.	21°	16′	*d*	−59	Tab. Az. 163°
Correction (Table XV)	−	38	Minutes of dec.	39	
Corr. Tab. Alt.	20	38			
Corr. Sext. Rdg.	20	22			
Intercept	16′ *away*				

Assumed position: Lat. 45° N. Long. 147° 34′ E.

From Table III, page 90: True Az. 163° T.

IVa.—CHANGE OF SEXTANT READING WITH TIME

Due to motion of body observed

True Azimuth of body	Latitude 45°	47°	49°	True Azimuth of body
°	′	′	′	°
090	+32	+31	+30	090
095	32	31	29	085
100	31	30	29	080
105	31	30	29	075
110	30	29	28	070
115	29	28	27	065
120	+28	+27	+26	060
125	26	25	24	055
130	24	24	23	050
135	22	22	21	045
140	20	20	19	040
145	18	18	17	035
150	+16	+15	+15	030
155	13	13	12	025
160	11	10	10	020
165	8	8	8	015
170	6	5	5	010
175	+3	+3	+3	005
180	0	0	0	000
185	−3	−3	-3	355
190	6	5	5	350
195	8	8	8	345
200	11	10	10	340
205	13	13	12	335
210	−16	−15	−15	330
215	18	18	17	325
220	20	20	19	320
225	22	22	21	315
230	24	24	23	310
235	26	25	24	305
240	−28	−27	−26	300
245	29	28	27	295
250	30	29	28	290
255	31	30	29	285
260	31	30	29	280
265	32	31	29	275
270	−32	−31	−30	270

Due to motion of observer

Difference between True Az. of body and Track	Ground speed in m.p.h. 100	130	160	190	220	250	280	310	340	Difference between True Az. of body and Track
°	′	′	′	′	′	′	′	′	′	°
000	+4	+6	+7	+8	+10	+11	+12	+13	+15	360
005	4	6	7	8	10	11	12	13	15	355
010	4	6	7	8	9	11	12	13	15	350
015	4	5	7	8	9	10	12	13	14	345
020	4	5	7	8	9	10	11	13	14	340
025	4	5	6	7	9	10	11	12	13	335
030	+4	+5	+6	+7	+8	+9	+11	+12	+13	330
035	4	5	6	7	8	9	10	11	12	325
040	3	4	5	6	7	8	9	10	11	320
045	3	4	5	6	7	8	9	10	10	315
050	3	4	4	5	6	7	8	9	9	310
055	2	3	4	5	5	6	7	8	8	305
060	+2	+3	+3	+4	+5	+5	+6	+7	+7	300
065	2	2	3	3	4	5	5	6	6	295
070	1	2	2	3	3	4	4	5	5	290
075	1	1	2	2	2	3	3	3	4	285
080	+1	+1	1	1	2	2	2	2	3	280
085	0	0	+1	+1	+1	+1	+1	+1	+1	275
090	0	0	0	0	0	0	0	0	0	270
095	0	0	−1	−1	−1	−1	−1	−1	−1	265
100	−1	−1	1	1	2	2	2	2	3	260
105	1	1	2	2	2	3	3	3	4	255
110	1	2	2	3	3	4	4	5	5	250
115	2	2	3	3	4	5	5	6	6	245
120	−2	−3	−3	−4	−5	−5	−6	−7	−7	240
125	2	3	4	5	5	6	7	8	8	235
130	3	4	4	5	6	7	8	9	9	230
135	3	4	5	6	7	8	9	10	10	225
140	3	4	5	6	7	8	9	10	11	220
145	4	5	6	7	8	9	10	11	12	215
150	−4	−5	−6	−7	−8	−9	−11	−12	−13	210
155	4	5	6	7	9	10	11	12	13	205
160	4	5	7	8	9	10	11	13	14	200
165	4	5	7	8	9	10	12	13	14	195
170	4	6	7	8	9	11	12	13	15	190
175	4	6	7	8	10	11	12	13	15	185
180	−4	−6	−7	−8	−10	−11	−12	−13	−15	180

The theoretical change of sextant reading in any interval of time depends partly on the motion of the body observed across the sky and partly on the motion of the observer over the Earth's surface.

The two tables above give this change, in an interval of three minutes of time, due to each of these causes; a + sign denotes that the sextant reading is increasing, and a − sign that it is decreasing. The theoretical change of sextant reading in three minutes of time is obtained by combining the appropriate entries from each table.

IVb.—CHANGE OF SEXTANT READING WITH TIME

Interval of time	Change in 3m (from Table IVa)																									Interval of time
	0′	3′	6′	9′	12′	15′	18′	21′	24′	27′	30′	33′	36′	39′	42′	45′	48′	51′	54′	57′	60′	
m s	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	m s
0 00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 00
05	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	05
10	0	0	0	0	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	10
15	0	0	0	1	1	1	2	2	2	2	2	3	3	3	4	4	4	4	4	5	5	15
20	0	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	20
25	0	0	1	1	2	2	2	3	3	4	4	5	5	5	6	6	7	7	8	8	8	25
0 30	0	0	1	2	2	2	3	4	4	4	5	6	6	6	7	8	8	8	9	10	10	0 30
35	0	1	1	2	2	3	4	4	5	5	6	6	7	8	8	9	9	10	10	11	12	35
40	0	1	1	2	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12	13	13	40
45	0	1	2	2	3	4	4	5	6	7	8	8	9	10	10	11	12	13	14	14	15	45
50	0	1	2	2	3	4	5	6	7	8	8	9	10	11	12	12	13	14	15	16	17	50
0 55	0	1	2	3	4	5	6	6	7	8	9	10	11	12	13	14	15	16	16	17	18	0 55
1 00	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1 00
05	0	1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	20	21	22	05
10	0	1	2	4	5	6	7	8	9	10	12	13	14	15	16	18	19	20	21	22	23	10
15	0	1	2	4	5	6	8	9	10	11	12	14	15	16	18	19	20	21	22	24	25	15
20	0	1	3	4	5	7	8	9	11	12	13	15	16	17	19	20	21	23	24	25	27	20
25	0	1	3	4	6	7	8	10	11	13	14	16	17	18	20	21	23	24	26	27	28	25
1 30	0	2	3	4	6	8	9	10	12	14	15	16	18	20	21	22	24	26	27	28	30	1 30
35	0	2	3	5	6	8	10	11	13	14	16	17	19	21	22	24	25	27	28	30	32	35
40	0	2	3	5	7	8	10	12	13	15	17	18	20	22	23	25	27	28	30	32	33	40
45	0	2	4	5	7	9	10	12	14	16	18	19	21	23	24	26	28	30	32	33	35	45
50	0	2	4	6	7	9	11	13	15	16	18	20	22	24	26	28	29	31	33	35	37	50
1 55	0	2	4	6	8	10	12	13	15	17	19	21	23	25	27	29	31	33	34	36	38	1 55
2 00	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	2 00
05	0	2	4	6	8	10	12	15	17	19	21	23	25	27	29	31	33	35	38	40	42	05
10	0	2	4	6	9	11	13	15	17	20	22	24	26	28	30	32	35	37	39	41	43	10
15	0	2	4	7	9	11	14	16	18	20	22	25	27	29	32	34	36	38	40	43	45	15
20	0	2	5	7	9	12	14	16	19	21	23	26	28	30	33	35	37	40	42	44	47	20
25	0	2	5	7	10	12	14	17	19	22	24	27	29	31	34	36	39	41	44	46	48	25
2 30	0	2	5	8	10	12	15	18	20	22	25	28	30	32	35	38	40	42	45	48	50	2 30
35	0	3	5	8	10	13	16	18	21	23	26	28	31	34	36	39	41	44	46	49	52	35
40	0	3	5	8	11	13	16	19	21	24	27	29	32	35	37	40	43	45	48	51	53	40
45	0	3	6	8	11	14	16	19	22	25	28	30	33	36	38	41	44	47	50	52	55	45
50	0	3	6	8	11	14	17	20	23	26	28	31	34	37	40	42	45	48	51	54	57	50
2 55	0	3	6	9	12	15	18	20	23	26	29	32	35	38	41	44	47	50	52	55	58	2 55
3 00	0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	3 00

This table gives the theoretical change of sextant reading in any interval of time up to 3m, in terms of the change in 3m obtained from the tables on the opposite page. If the interval is greater than 3m, it may be split into multiples of 3m and a residue, and the corresponding entries from the table added together.

A knowledge of this change enables sights on different objects taken at slightly different times to be adjusted to a specified exact time, which may be either the exact time of one of them or a moment when a fix is required for a particular reason.

V.—DIFFERENCE BETWEEN RHUMB LINE AND GREAT CIRCLE DISTANCES

N. 45°-49° **S. 45°-49°**

Latitude of Destination	Change of Longitude																		Latitude of Destination
	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	
°																			°
N. 60	0	1	2	3	6	10	15	22	30	41	53	69	87	109	134	162	195	232	S. 60
55	0	0	1	3	5	9	13	20	28	38	51	66	84	105	130	159	192	229	55
50	0	0	1	2	5	8	13	19	27	37	49	64	82	103	127	156	188	226	50
45	0	0	1	2	4	8	12	18	26	35	47	62	79	100	124	152	184	221	45
40	0	0	1	2	4	8	12	18	25	35	46	60	77	97	121	148	179	215	40
N. 35	0	0	1	3	5	8	12	18	25	34	45	59	75	94	117	143	173	208	S. 35
30	0	1	1	3	5	8	12	17	24	33	44	57	72	91	112	137	167	200	30
25	0	1	2	3	5	8	12	17	24	32	42	55	69	87	107	131	159	191	25
20	0	1	2	3	5	8	12	17	23	31	40	52	66	82	101	124	150	180	20
15	0	1	2	3	5	8	12	16	22	30	39	49	62	77	95	116	140	168	15
N. 10	0	1	2	3	5	8	11	16	21	28	36	46	58	72	88	108	130	156	S. 10
N. 5	0	1	2	3	5	7	11	15	20	26	34	43	53	66	81	99	119	142	S. 5
0	0	1	2	3	5	7	10	14	18	24	31	39	49	60	73	89	107	128	0
S. 5	0	1	1	3	4	6	9	13	17	22	28	35	43	54	65	79	95	114	N. 5
10	0	1	1	2	4	6	8	11	15	19	25	31	38	47	57	69	83	99	10
S. 15	0	1	1	2	3	5	7	10	13	17	21	27	33	41	49	59	71	85	N. 15
20	0	0	1	2	3	4	6	9	11	14	18	23	28	34	42	50	60	71	20
25	0	0	1	2	3	4	5	7	10	12	16	19	24	29	35	42	49	58	25
30	0	0	1	1	2	3	5	6	8	10	13	16	20	24	29	34	41	48	30
35	0	0	1	1	2	3	4	6	7	9	11	14	17	21	24	29	34	40	35
S. 40	0	0	1	1	2	3	4	5	7	8	10	13	16	19	22	26	30	35	N. 40
45	0	0	1	1	2	3	4	5	7	9	11	13	16	19	22	26	30	35	45
50	0	0	1	2	2	3	5	6	8	10	13	16	19	22	26	30	35	41	50
55	0	0	1	2	3	5	6	8	11	13	17	20	24	29	34	40	46	53	55
S. 60	0	1	2	3	4	6	8	11	15	18	23	28	33	40	47	55	63	73	N. 60

This table gives the difference, in nautical miles, between the distance from one place to another by the Rhumb Line track and the distance by the Great Circle track. It is based on a *Latitude of Departure* of 47°, but may be used for any place of departure between latitudes 45° and 49°. Of the two argument columns headed *Latitude of Destination*, the one on the left is to be used when the place of departure lies between N. 45° and N. 49°, and the one on the right when the place of departure lies between S. 45° and S. 49°.

The table is intended to give only the approximate difference of distance between the two tracks. For intermediate values of the arguments *Latitude of Destination* and *Change of Longitude*, the figures in the table should be interpolated by inspection. If the *Latitude of Departure* differs by the maximum of 2½° from that on which the table is based, the error in the result will not exceed 3 miles up to a *Change of Longitude* of 50°, but may reach 7 miles for a change of 70°, and 13 miles for a change of 90°.

Example.—Required the difference in distance between the Rhumb Line track and the Great Circle track from Quebec (Lat. 46° 48′ N., Long. 71° 13′ W.) to London (Lat. 51° 32′ N., Long 0° 05′ W.).

Entering the argument column on the left with the *Latitude of Destination* of 51° 32′ N., and interpolating by inspection for the *Change of Longitude* of 71° 08′, it will be seen that the difference in distance is about 110 nautical miles.

VI.—ADJUSTMENT TO REFRACTION IN SPECIAL CONDITIONS

Height in feet	Observed Altitude						Height in metres
	10°	15°	20°	30°	45°	60°	
	′	′	′	′	′	′	
0	−1	0	0	0	0	0	0
5000	0	0	0	0	0	0	1500
10000	+1	0	0	0	0	0	3000
15000	1	+1	+1	0	0	0	4600
20000	2	1	1	+1	0	0	6100
25000	2	1	1	1	0	0	7600
30000	3	2	1	1	0	0	9100
35000	3	2	1	1	+1	0	10700
40000	+3	+2	+2	+1	+1	0	12200

This table gives the additional correction for refraction to be applied to the *observed* altitude beyond that already included in the altitude tabulated in the main tables. It is only intended for use by an observer at great heights when special accuracy is required.

VII.—TRUE AZIMUTH OF THE POLE STAR

1940–1960		1960–1980		1980–2000	
L.H.A. ♈	True Azimuth	L.H.A. ♈	True Azimuth	L.H.A. ♈	True Azimuth
°	°	°	°	°	°
0	001	0	001	0	001
6	000	7	000	9	000
47	359	53	359	61	359
186	000	187	000	189	000
227	001	233	001	241	001
360		360		360	

These tables give the True Azimuth of the Pole Star, over various periods of time, for an observer between latitudes N. 45° and N. 49°. The argument L.H.A.♈ is obtained from G.H.A.♈ by *subtracting west* longitude or *adding east* longitude.

VIII.—DIP OF THE SEA HORIZON

Height in feet	Dip	Height in metres	Height in feet	Dip	Height in metres	Height in feet	Dip	Height in metres	Height in feet	Dip	Height in metres	Height in feet	Dip	Height in metres
	′			′			′			′			′	
0	1	0	437	21	133	1700	41	520	3810	61	1160	6740	81	2050
2	2		481	22	146	1790	42	546	3930	62	1200	6910	82	2100
6	3	1	527	23	160	1880	43	573	4060	63	1230	7080	83	2160
12	4	3	575	24	175	1970	44	600	4190	64	1270	7250	84	2210
21	5	6	625	25	190	2060	45	628	4330	65	1320	7430	85	2260
31	6	9	677	26	206	2150	46	657	4460	66	1360	7610	86	2320
43	7	13	731	27	222	2250	47	686	4600	67	1400	7790	87	2370
58	8	17	787	28	240	2340	48	716	4740	68	1440	7970	88	2420
75	9	22	845	29	257	2440	49	746	4880	69	1480	8150	89	2480
93	10	28	906	30	276	2550	50	777	5020	70	1530	8340	90	2540
114	11	34	968	31	295	2650	51	809	5170	71	1570	8520	91	2590
137	12	41	1030	32	314	2760	52	841	5320	72	1620	8710	92	2650
162	13	49	1090	33	335	2860	53	874	5470	73	1660	8900	93	2710
189	14	57	1160	34	356	2980	54	908	5620	74	1710	9100	94	2770
218	15	66	1230	35	377	3090	55	942	5770	75	1760	9290	95	2830
250	16	76	1310	36	399	3200	56	977	5930	76	1800	9490	96	2890
283	17	86	1380	37	422	3320	57	1010	6090	77	1850	9690	97	2950
318	18	97	1460	38	446	3440	58	1040	6250	78	1900	9890	98	3010
356	19	108	1540	39	470	3560	59	1080	6410	79	1950	10100	99	3070
395	20	120	1620	40	495	3680	60	1120	6580	80	2000	10300	100	3140
437		133	1700		520	3810		1160	6740		2050	10500		3200

This table gives the dip of the sea horizon, in minutes of arc, with argument height of eye of the observer in feet or in metres. It is only required when the altitude is measured from the sea horizon. The dip is to be *subtracted* from the observed altitude.

IX.—DISTANCE TO THE SEA HORIZON IN NAUTICAL MILES

Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres
0	1	0	287	20	87	1120	39	341	2500	58	762	4420	77	1340	6890	96	2100
1	2		317	21	96	1170	40	359	2580	59	788	4540	78	1380	7040	97	2140
4	3	1	349	22	106	1240	41	378	2670	60	815	4650	79	1420	7180	98	2190
9	4	2	382	23	116	1300	42	396	2760	61	843	4770	80	1450	7330	99	2230
15	5	4	417	24	127	1360	43	416	2850	62	871	4900	81	1490	7480	100	2280
22	6	6	453	25	138	1430	44	436	2950	63	900	5020	82	1530	7630	101	2320
31	7	9	491	26	149	1490	45	456	3040	64	929	5140	83	1560	7780	102	2370
42	8	12	531	27	161	1560	46	477	3140	65	958	5270	84	1600	7940	103	2420
54	9	16	571	28	174	1630	47	498	3240	66	988	5390	85	1640	8100	104	2460
68	10	20	614	29	187	1700	48	520	3340	67	1010	5520	86	1680	8250	105	2510
83	11	25	658	30	200	1770	49	542	3440	68	1050	5650	87	1720	8410	106	2560
100	12	30	703	31	214	1850	50	564	3540	69	1080	5780	88	1760	8570	107	2610
118	13	36	750	32	228	1920	51	587	3650	70	1110	5920	89	1800	8730	108	2660
137	14	42	798	33	243	2000	52	611	3750	71	1140	6050	90	1840	8900	109	2710
158	15	48	848	34	258	2080	53	635	3860	72	1170	6190	91	1880	9060	110	2760
181	16	55	900	35	274	2160	54	659	3970	73	1210	6330	92	1920	9230	111	2810
205	17	62	953	36	290	2240	55	684	4080	74	1240	6460	93	1970	9400	112	2860
231	18	70	1000	37	307	2320	56	709	4190	75	1270	6610	94	2010	9560	113	2910
258	19	78	1060	38	324	2410	57	735	4310	76	1310	6750	95	2050	9740	114	2960
287		87	1120		341	2500		762	4420		1340	6890		2100	9910		3020

IX.—DISTANCE TO THE SEA HORIZON IN STATUTE MILES

Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres	Height in feet	Dist.	Height in metres
0	1	0	288	23	87	1120	45	344	2520	67	768	4460	89	1360	6960	111	2120
1	2		314	24	95	1180	46	359	2590	68	791	4560	90	1390	7080	112	2160
3	3	1	342	25	104	1230	47	375	2670	69	815	4670	91	1420	7210	113	2190
6	4	2	370	26	113	1280	48	392	2750	70	839	4770	92	1450	7340	114	2230
11	5	3	400	27	122	1340	49	408	2830	71	863	4870	93	1480	7470	115	2270
17	6	5	431	28	131	1390	50	425	2910	72	888	4980	94	1510	7600	116	2310
24	7	7	463	29	141	1450	51	443	2990	73	913	5090	95	1550	7730	117	2350
32	8	9	496	30	151	1510	52	460	3080	74	938	5200	96	1580	7870	118	2390
41	9	12	530	31	161	1570	53	479	3160	75	964	5310	97	1610	8000	119	2440
51	10	15	565	32	172	1630	54	497	3250	76	990	5420	98	1650	8140	120	2480
62	11	19	602	33	183	1690	55	516	3330	77	1010	5530	99	1680	8280	121	2520
75	12	22	639	34	195	1750	56	535	3420	78	1040	5640	100	1720	8410	122	2560
89	13	27	678	35	206	1820	57	554	3510	79	1070	5750	101	1750	8550	123	2600
103	14	31	718	36	219	1880	58	574	3600	80	1090	5870	102	1790	8690	124	2650
119	15	36	759	37	231	1950	59	594	3690	81	1120	5990	103	1820	8830	125	2690
137	16	41	801	38	244	2010	60	615	3780	82	1150	6100	104	1860	8980	126	2730
155	17	47	845	39	257	2080	61	636	3880	83	1180	6220	105	1890	9120	127	2780
174	18	53	889	40	271	2150	62	657	3970	84	1210	6340	106	1930	9270	128	2820
195	19	59	935	41	285	2220	63	678	4070	85	1240	6460	107	1970	9410	129	2870
216	20	66	982	42	299	2290	64	700	4160	86	1270	6580	108	2000	9560	130	2910
239	21	73	1030	43	313	2370	65	723	4260	87	1300	6710	109	2040	9710	131	2960
263	22	80	1070	44	328	2440	66	745	4360	88	1330	6830	110	2080	9860	132	3000
288		87	1120		344	2520		768	4460		1360	6960		2120	10000		3050

These tables give the distance to the sea horizon, in nautical miles and in statute miles, with argument height of eye of the observer in feet or in metres.

At the moment when an object of known height is just appearing or disappearing over the sea horizon, its distance may be found by adding the distance corresponding to its height to the distance corresponding to the height of eye of the observer.

X.—TABLE OF RANGES IN NAUTICAL MILES

The tables below and on the opposite page give the distance, to the nearest 5 nautical miles, of an object, whose height is known and is *greater* than the height of the observer. The arguments of the table are the observed *angle of elevation* to the object, and the *difference in height* between the object and the observer, expressed in feet or in metres.

Example.—An observer, whose height is 1,500 feet, finds that the angle of elevation to the summit of a mountain, whose height is known to be 7,000 feet, is 0° 48′. Required the distance away of the mountain.

The difference in height between the mountain and the observer is 7,000 − 1,500 = 5,500 feet. Entering on the opposite page the column headed 0° 50′ (the nearest tabulated value to 0° 48′), and choosing the left-hand of the two argument columns since the height is measured in feet, it is seen that 5,500 lies in the interval between 5,130 and 5,910, so that the distance of the mountain, to the nearest 5 miles, is 45 nautical miles.

The tables on pages 226 to 228 give the distance of an object, whose height is known, and is *less* than the height of the observer. The arguments of the table are the observed *angle of depression* to the object, and the *difference in height* between the observer and the object, expressed in feet or in metres. The distance is given to the nearest mile up to 10 nautical miles, and to the nearest 5 miles from 10 to 60 nautical miles.

Example.—An observer, whose height is 1,500 metres, finds that the angle of depression to a ship is 5° 37′. Required the distance away of the ship.

Entering on page 228 the column headed 5° 30′, and choosing the right-hand of the two argument columns, it is seen that 1,500 is an exact tabulated value, so that the distance away of the ship is 8 nautical miles.

On page 226, figures in *italics* represent the difference in height, *when the object observed is beyond the sea horizon.* If it is uncertain whether the object is beyond the horizon or not, and the two parts of the table give widely different results, there should be no doubt which is the correct one, while in doubtful cases the error will not be serious.

These tables are intended to give only the approximate range. They should prove a more reliable guide for large angles of elevation and depression than for small ones.

Height of object *greater* than height of observer

Angle of elevation												
4° 00′			3° 40′			3° 20′			3° 00′			2° 40′			2° 20′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0		0	0		0	0		0	0		0	0		0	0		0
1060	0	325	978	0	298	890	0	271	801	0	244	712	0	217	624	0	190
3230	5	985	2960	5	904	2690	5	822	2430	5	741	2160	5	660	1900	5	579
5430	10	1650	4990	10	1520	4540	10	1380	4100	10	1250	3650	10	1110	3210	10	980
7670	15	2330	7050	15	2140	6430	15	1960	5810	15	1770	5190	15	1580	4570	15	1390
9950	20	3030	9150	20	2790	8350	20	2540	7550	20	2300	6750	20	2050	5960	20	1810
12200	25	3740	11200	25	3440	10300	25	3140	9340	25	2840	8360	25	2540	7390	25	2250
14600	30	4450	13400	30	4100	12300	30	3750	11100	30	3400	10000	30	3050	8850	30	2690
17000	35	5180	15600	35	4780	14300	35	4370	13000	35	3960	11600	35	3560	10300	35	3150
19400	40	5920	17900	40	5460	16400	40	5000	14900	40	4540	13400	40	4080	11900	40	3620
21900	45	6680	20200	45	6160	18500	45	5650	16800	45	5130	15100	45	4620	13400	45	4110
24400	50	7440	22500	50	6870	20600	50	6300	18800	50	5730	16900	50	5170	15100	50	4600
26900	55	8210	24900	55	7590	22800	55	6970	20800	55	6350	18800	55	5730	16700	55	5100
29500	60	9000	27300	60	8320	25100	60	7650	22800	60	6970	20600	60	6300	18400	60	5620

X.—TABLE OF RANGES IN NAUTICAL MILES

Height of object *greater* than height of observer

Angle of elevation

2° 00′			1° 50′			1° 40′			1° 30′			1° 20′			1° 10′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0		0	0		0	0		0	0		0	0		0	0		0
535	0	163	491	0	149	447	0	136	402	0	122	358	0	109	314	0	95
1630	5	498	1500	5	458	1370	5	417	1230	5	377	1100	5	336	971	5	296
2770	10	845	2550	10	777	2330	10	710	2100	10	643	1880	10	575	1660	10	508
3940	15	1200	3630	15	1100	3320	15	1010	3020	15	920	2710	15	826	2400	15	731
5160	20	1570	4760	20	1450	4360	20	1330	3960	20	1200	3570	20	1080	3170	20	966
6410	25	1950	5920	25	1800	5440	25	1650	4950	25	1510	4460	25	1360	3980	25	1210
7700	30	2340	7130	30	2170	6550	30	1990	5970	30	1820	5400	30	1640	4820	30	1470
9030	35	2750	8360	35	2550	7700	35	2340	7040	35	2140	6370	35	1940	5710	35	1740
10400	40	3160	9640	40	2940	8890	40	2710	8140	40	2480	7390	40	2250	6630	40	2020
11800	45	3590	10900	45	3340	10100	45	3080	9280	45	2820	8440	45	2570	7590	45	2310
13200	50	4030	12300	50	3750	11300	50	3470	10400	50	3180	9520	50	2900	8590	50	2620
14700	55	4480	13700	55	4170	12600	55	3860	11600	55	3550	10600	55	3240	9630	55	2930
16200	60	4950	15100	60	4610	14000	60	4270	12900	60	3930	11800	60	3600	10700	60	3260

Angle of elevation

1° 00′			0° 55′			0° 50′			0° 45′			0° 40′			0° 35′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0		0	0		0	0		0	0		0	0		0	0		0
270	0	82	247	0	75	225	0	68	203	0	62	181	0	55	159	0	48
839	5	255	772	5	235	706	5	215	640	5	195	573	5	174	507	5	154
1440	10	440	1330	10	406	1220	10	373	1110	10	339	1000	10	305	893	10	272
2090	15	637	1930	15	590	1780	15	542	1620	15	495	1470	15	448	1310	15	401
2770	20	845	2570	20	784	2370	20	724	2170	20	663	1970	20	602	1770	20	542
3490	25	1060	3250	25	991	3000	25	916	2760	25	842	2520	25	768	2270	25	694
4250	30	1290	3960	30	1200	3670	30	1120	3390	30	1030	3100	30	945	2810	30	858
5050	35	1530	4710	35	1430	4380	35	1330	4050	35	1230	3720	35	1130	3390	35	1030
5880	40	1790	5500	40	1670	5130	40	1560	4750	40	1450	4380	40	1330	4000	40	1220
6750	45	2060	6330	45	1930	5910	45	1800	5490	45	1670	5070	45	1540	4650	45	1410
7670	50	2330	7200	50	2190	6740	50	2050	6270	50	1910	5810	50	1770	5340	50	1620
8610	55	2620	8100	55	2470	7600	55	2310	7090	55	2160	6580	55	2000	6070	55	1850
9600	60	2920	9050	60	2750	8500	60	2590	7940	60	2420	7390	60	2250	6840	60	2080

Angle of elevation

0° 30′			0° 25′			0° 20′			0° 15′			0° 10′			0° 05′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0		0	0		0	0		0	0		0	0		0	0		0
137	0	41	115	0	35	93	0	28	71	0	21	48	0	14	26	0	8
440	5	134	374	5	114	308	5	93	241	5	73	175	5	53	109	5	33
782	10	238	671	10	204	561	10	171	450	10	137	339	10	103	229	10	69
1160	15	354	1000	15	306	852	15	259	697	15	212	542	15	165	387	15	118
1570	20	481	1380	20	420	1180	20	360	982	20	299	783	20	238	584	20	178
2030	25	620	1790	25	546	1540	25	471	1300	25	397	1060	25	323	818	25	249
2520	30	770	2240	30	683	1950	30	595	1660	30	507	1370	30	420	1090	30	332
3060	35	932	2720	35	831	2390	35	730	2060	35	629	1730	35	528	1400	35	427
3620	40	1100	3250	40	991	2870	40	877	2500	40	762	2120	40	648	1750	40	533
4230	45	1290	3810	45	1160	3390	45	1030	2970	45	907	2550	45	779	2130	45	651
4880	50	1480	4410	50	1340	3950	50	1200	3480	50	1060	3020	50	922	2560	50	780
5560	55	1690	5050	55	1540	4540	55	1380	4040	55	1230	3530	55	1070	3020	55	921
6280	60	1910	5730	60	1740	5180	60	1570	4620	60	1410	4070	60	1240	3520	60	1070

X.—TABLE OF RANGES IN NAUTICAL MILES

Height of object *less* than height of observer

Angle of depression

0° 05′			0° 10′			0° 15′			0° 20′			0° 25′			0° 30′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4		1	9		2	13		4	17		5	21		6	26		8
11	1	3	24	1	7	38	1	11	51	1	15	64	1	19	77	1	23
17	2	5	39	2	12	61	2	18	83	2	25	106	2	32	127	2	39
21	3	6	52	3	15	83	3	25	114	3	34	145	3	44	176	3	53
24	4	7	64	4	19	103	4	31	143	4	43	183	4	55	223	4	68
25	5		74	5	22	122	5	37	171	5	52	220	5	67	268	5	81
26	6	*8*	82	6	25	140	6	42	197	6	60	255	6	77	312	6	95
24	7		89	7	27	156	7	47	222	7	67	288	7	88	355	7	108
21	8	*7*	95	8	29	170	8	52	245	8	74	320	8	97	396	8	120
16	9	*5*	99	9	30	183	9	55	267	9	81	351	9	107	435	9	132
0	10	*0*	*103*	10	*32*	212	10	64	323	10	98	434	10	132	544	10	166
			77	15	*24*	231	15	70	386	15	117	541	15	164	695	15	212
			13	20	*4*	*213*	20	*65*	411	20	125	609	20	185	808	20	246
			0	25	0	*155*	25	*48*	*398*	25	*122*	640	25	195	884	25	269
						59	30	*18*	*346*	30	*106*	*634*	30	*194*	921	30	280
						0	35	0	*258*	35	79	*590*	35	*180*	*921*	35	*281*
									130	40	40	*506*	40	*155*	*882*	40	*269*
									0	45	0	*385*	45	*118*	*805*	45	*246*
												226	50	69	690	50	*211*
												28	55	9	*537*	55	*164*
												0	60	0	*346*	60	*106*

Angle of depression

0° 35′			0° 40′			0° 45′			0° 50′			0° 55′			1° 00′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30		9	35		10	39		12	44		13	48		14	52		16
91	1	27	104	1	31	117	1	35	130	1	39	144	1	43	157	1	47
150	2	45	172	2	52	194	2	59	216	2	65	238	2	72	260	2	79
207	3	63	238	3	72	269	3	82	300	3	91	331	3	100	362	3	110
263	4	80	302	4	92	342	4	104	382	4	116	422	4	128	462	4	140
317	5	96	366	5	111	414	5	126	463	5	141	512	5	156	560	5	170
370	6	112	427	6	130	485	6	147	542	6	165	600	6	182	657	6	200
421	7	128	488	7	148	554	7	168	620	7	189	687	7	209	753	7	229
471	8	143	546	8	166	621	8	189	696	8	212	772	8	235	847	8	258
519	9	158	603	9	183	687	9	209	771	9	235	855	9	260	939	9	286
655	10	199	765	10	233	876	10	267	986	10	300	1090	10	334	1200	10	368
850	15	259	1000	15	306	1160	15	353	1310	15	400	1470	15	448	1620	15	495
1000	20	307	1200	20	367	1400	20	428	1600	20	489	1800	20	549	2000	20	610
1120	25	343	1370	25	417	1610	25	491	1850	25	566	2100	25	640	2340	25	714
1200	30	368	1490	30	456	1780	30	543	2070	30	631	2350	30	719	2640	30	806
1250	35	381	1580	35	482	1910	35	583	2240	35	685	2570	35	786	2910	35	887
1260	40	*384*	1630	40	497	2000	40	612	2380	40	727	2760	40	841	3130	40	956
1230	45	*374*	*1650*	45	*502*	2060	45	629	2480	45	757	2900	45	885	3320	45	1010
1160	50	*352*	*1620*	50	*494*	2080	50	634	2540	50	776	3010	50	918	3470	50	1050
1050	55	*319*	*1560*	55	*474*	*2070*	55	*629*	2570	55	783	3080	55	938	3580	55	1090
899	60	*274*	*1460*	60	*443*	*2010*	60	*611*	*2560*	60	*780*	3110	60	947	3660	60	1110

For explanation, see page 224.

X.—TABLE OF RANGES IN NAUTICAL MILES

Height of object *less* than height of observer

Angle of depression												
1° 10′			1° 20′			1° 30′			1° 40′			1° 50′			2° 00′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0		0	0		0	0		0	0		0	0		0	0		0
61	0	18	70	0	21	79	0	24	88	0	26	97	0	29	106	0	32
183	1	56	210	1	64	237	1	72	263	1	80	290	1	88	316	1	96
305	2	92	349	2	106	393	2	119	437	2	133	481	2	146	526	2	160
424	3	129	486	3	148	548	3	167	610	3	185	672	3	204	734	3	223
541	4	165	621	4	189	701	4	213	780	4	238	860	4	262	940	4	286
658	5	200	755	5	230	852	5	259	950	5	289	1040	5	319	1140	5	349
772	6	235	887	6	270	1000	6	305	1110	6	340	1230	6	375	1340	6	410
886	7	270	1010	7	310	1150	7	351	1280	7	391	1410	7	432	1550	7	472
997	8	304	1140	8	350	1290	8	395	1440	8	441	1590	8	487	1750	8	533
1100	9	337	1270	9	388	1440	9	440	1610	9	491	1780	9	542	1940	9	594
1430	10	435	1650	10	503	1870	10	570	2090	10	638	2310	10	705	2530	10	772
1930	15	589	2240	15	684	2550	15	778	2860	15	872	3170	15	967	3480	15	1060
2400	20	732	2790	20	853	3190	20	974	3590	20	1090	3990	20	1210	4390	20	1330
2830	25	862	3310	25	1010	3800	25	1150	4290	25	1300	4770	25	1450	5260	25	1600
3220	30	982	3790	30	1150	4370	30	1330	4940	30	1500	5520	30	1680	6090	30	1850
3570	35	1080	4230	35	1290	4900	35	1490	5560	35	1690	6230	35	1890	6890	35	2100
3880	40	1180	4640	40	1410	5390	40	1640	6140	40	1870	6890	40	2100	7650	40	2330
4160	45	1270	5000	45	1520	5840	45	1780	6680	45	2030	7530	45	2290	8370	45	2550
4400	50	1340	5330	50	1620	6260	50	1900	7190	50	2190	8120	50	2470	9050	50	2750
4600	55	1400	5620	55	1710	6640	55	2020	7660	55	2330	8670	55	2640	9690	55	2950
4760	60	1450	5870	60	1790	6980	60	2120	8080	60	2460	9190	60	2800	10300	60	3140

Angle of depression												
2° 20′			2° 40′			3° 00′			3° 20′			3° 40′			4° 00′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0		0	0		0	0		0	0		0	0		0	0		0
123	0	37	141	0	43	159	0	48	176	0	53	194	0	59	212	0	64
369	1	112	422	1	128	476	1	145	529	1	161	582	1	177	636	1	193
614	2	187	703	2	214	792	2	241	880	2	268	969	2	295	1050	2	322
858	3	261	982	3	299	1100	3	337	1230	3	375	1350	3	412	1470	3	450
1090	4	335	1250	4	383	1410	4	432	1570	4	481	1730	4	529	1890	4	578
1340	5	408	1530	5	467	1730	5	527	1920	5	586	2120	5	646	2310	5	706
1570	6	481	1800	6	551	2040	6	621	2270	6	692	2500	6	762	2730	6	832
1810	7	553	2080	7	634	2340	7	715	2610	7	796	2880	7	877	3140	7	959
2050	8	625	2350	8	717	2650	8	809	2950	8	901	3250	8	993	3560	8	1080
2280	9	696	2620	9	799	2950	9	902	3290	9	1000	3630	9	1100	3970	9	1210
2970	10	908	3420	10	1040	3860	10	1170	4300	10	1310	4750	10	1440	5190	10	1580
4100	15	1250	4720	15	1430	5340	15	1620	5960	15	1810	6580	15	2000	7200	15	2190
5190	20	1580	5980	20	1820	6780	20	2060	7580	20	2310	8380	20	2550	9180	20	2790
6230	25	1900	7210	25	2190	8180	25	2490	9160	25	2790	10100	25	3090	11100	25	3380
7250	30	2210	8400	30	2560	9550	30	2910	10700	30	3260	11800	30	3610	13000	30	3960
8220	35	2500	9550	35	2910	10800	35	3310	12200	35	3720	13500	35	4120	14800	35	4530
9150	40	2790	10600	40	3250	12100	40	3710	13600	40	4170	15100	40	4620	16700	40	5090
10000	45	3060	11700	45	3570	13400	45	4090	15100	45	4600	16700	45	5120	18400	45	5630
10900	50	3320	12700	50	3890	14600	50	4460	16400	50	5020	18300	50	5590	20200	50	6160
11700	55	3570	13700	55	4190	15800	55	4810	17800	55	5440	19900	55	6060	21900	55	6680
12500	60	3810	14700	60	4490	16900	60	5160	19100	60	5840	21300	60	6510	23600	60	7190

For explanation, see page 224.

X.—TABLE OF RANGES IN NAUTICAL MILES

Height of object *less* than height of observer

Angle of depression

4° 30′			5° 00′			5° 30′			6° 00′			6° 30′			7° 00′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
238	1	72	265	1	81	292	1	89	319	1	97	346	1	105	373	1	113
716	2	218	796	2	242	876	2	267	956	2	291	1030	2	316	1110	2	340
1190	3	363	1320	3	404	1450	3	444	1590	3	485	1720	3	526	1860	3	567
1660	4	507	1850	4	564	2040	4	621	2220	4	679	2410	4	736	2600	4	793
2130	5	651	2370	5	725	2610	5	798	2860	5	872	3100	5	945	3340	5	1010
2600	6	795	2900	6	885	3190	6	974	3490	6	1060	3780	6	1150	4080	6	1240
3070	7	938	3420	7	1040	3770	7	1150	4120	7	1250	4470	7	1360	4820	7	1460
3540	8	1080	3940	8	1200	4340	8	1320	4750	8	1440	5150	8	1570	5550	8	1690
4010	9	1220	4460	9	1360	4920	9	1500	5370	9	1630	5830	9	1770	6290	9	1910
4470	10	1360	4980	10	1510	5490	10	1670	6000	10	1830	6510	10	1980	7020	10	2140
5860	15	1780	6530	15	1990	7200	15	2190	7870	15	2390	8540	15	2600	9210	15	2800
8140	20	2480	9070	20	2760	10000	20	3050	10900	20	3330	11800	20	3620	12800	20	3910
10300	25	3160	11500	25	3530	12700	25	3890	14000	25	4260	15200	25	4630	16400	25	5000
12500	30	3830	14000	30	4280	15500	30	4730	16900	30	5180	18400	30	5630	19900	30	6080
14700	35	4490	16400	35	5020	18200	35	5550	19900	35	6080	21700	35	6620	23400	35	7150
16800	40	5140	18800	40	5750	20800	40	6360	22800	40	6980	24900	40	7590	26900	40	8210
18900	45	5780	21200	45	6470	23500	45	7160	25800	45	7860	28000	45	8550	30300	45	9250
21000	50	6400	23500	50	7180	26000	50	7950	28600	50	8730	31100	50	9510	33700	50	10200
23000	55	7020	25800	55	7870	28600	55	8730	31400	55	9590	34200	55	10400	37100	55	11300
25000	60	7620	28000	60	8550	31100	60	9490	34200	60	10400	37300	60	11300	40400	60	12300
26900		8210	30200		9230	33600		10200	36900		11200	40300		12200	43600		13300

Angle of depression

7° 30′			8° 00′			8° 30′			9° 00′			9° 30′			10° 00′		
Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres	Height in feet	Range	Height in metres
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
399	1	121	427	1	130	454	1	138	481	1	146	508	1	154	535	1	163
1190	2	365	1270	2	390	1360	2	415	1440	2	439	1520	2	464	1600	2	489
1990	3	608	2130	3	649	2260	3	691	2400	3	732	2540	3	774	2670	3	815
2790	4	851	2980	4	909	3170	4	966	3360	4	1020	3550	4	1080	3740	4	1140
3580	5	1090	3830	5	1160	4070	5	1240	4310	5	1310	4560	5	1390	4810	5	1460
4380	6	1330	4670	6	1420	4970	6	1510	5270	6	1600	5570	6	1690	5870	6	1790
5170	7	1570	5520	7	1680	5870	7	1790	6220	7	1890	6580	7	2000	6930	7	2110
5960	8	1810	6360	8	1940	6770	8	2060	7180	8	2180	7580	8	2310	8000	8	2430
6750	9	2050	7210	9	2190	7670	9	2330	8130	9	2470	8590	9	2610	9060	9	2760
7530	10	2290	8050	10	2450	8560	10	2610	9080	10	2760	9600	10	2920	10100	10	3080
9880	15	3010	10500	15	3220	11200	15	3420	11900	15	3630	12600	15	3840	13200	15	4050
13700	20	4200	14700	20	4480	15600	20	4770	16600	20	5060	17500	20	5350	18500	20	5640
17600	25	5370	18800	25	5740	20000	25	6110	21200	25	6480	22500	25	6860	23700	25	7230
21400	30	6530	22900	30	6980	24400	30	7440	25900	30	7890	27400	30	8350	28900	30	8810
25200	35	7680	26900	35	8220	28700	35	8760	30500	35	9290	32200	35	9830	34000	35	10300
28900	40	8820	30900	40	9440	33000	40	10000	35000	40	10600	37000	40	11300	39100	40	11900
32600	45	9950	34900	45	10600	37200	45	11300	39500	45	12000	41800	45	12700	44200	45	13400
36300	50	11000	38800	50	11800	41400	50	12600	44000	50	13400	46600	50	14200	49200	50	15000
39900	55	12100	42700	55	13000	45600	55	13900	48400	55	14700	51300	55	15600	54200	55	16500
43500	60	13200	46600	60	14200	49700	60	15100	52800	60	16100	56000	60	17000	59100	60	18000
47000		14300	50400		15300	53800		16400	57200		17400	60600		18400	64000		19500

For explanation, see page 224.

XI.—TEMPERATURE CONVERSION
FAHRENHEIT AND CENTIGRADE

°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
−52		−14		+23		+61		+99		+137		+175	
50	−46	13	−25	25	−4	63	+17	101	+38	139	+59	176	+80
49	45	11	24	27	3	65	18	103	39	140	60	178	81
47	44	9	23	29	2	67	19	104	40	142	61	180	82
45	43	7	22	31	−1	68	20	106	41	144	62	182	83
43	42	5	21	32	0	70	21	108	42	146	63	184	84
41	41	4	20	34	+1	72	22	110	43	148	64	185	85
40	40	−2	19	36	2	74	23	112	44	149	65	187	86
38	39	0	18	38	3	76	24	113	45	151	66	189	87
36	38	+2	17	40	4	77	25	115	46	153	67	191	88
34	37	4	16	41	5	79	26	117	47	155	68	193	89
32	36	5	15	43	6	81	27	119	48	157	69	194	90
31	35	7	14	45	7	83	28	121	49	158	70	196	91
29	34	9	13	47	8	85	29	122	50	160	71	198	92
27	33	11	12	49	9	86	30	124	51	162	72	200	93
25	32	13	11	50	10	88	31	126	52	164	73	202	94
23	31	14	10	52	11	90	32	128	53	166	74	203	95
22	30	16	9	54	12	92	33	130	54	167	75	205	96
20	29	18	8	56	13	94	34	131	55	169	76	207	97
18	28	20	7	58	14	95	35	133	56	171	77	209	98
16	27	22	6	59	15	97	36	135	57	173	78	211	99
−14	−26	+23	−5	+61	+16	+99	+37	+137	+58	+175	+79	+212	+100

XII.—CONVERSION FACTORS

Conversion	Ratio	Factor	Reciprocal
DISTANCE			
Statute Miles to Nautical Miles ...	66 to 76	0·8684	1·1515
Statute Miles „ Kilometres	66 „ 41	1·6093	0·6214
Nautical Miles „ Kilometres	76 „ 41	1·8531	0·5396
Feet „ Metres	25 „ 82	0·3048	3·2808
Yards „ Metres	32 „ 35	0·9144	1·0936
Fathoms „ Feet	6 „ 1	6·0	0·1667
SPEED			
Miles per hour to Knots	66 to 76	0·8684	1·1515
Miles per hour „ Metres per second ...	38 „ 85	0·4470	2·2369
Knots „ Metres per second ...	35 „ 68	0·5148	1·9426
Miles per hour „ Feet per second ...	22 „ 15	1·4667	0·6818
LIQUID MEASURE			
Gallons to Litres	50 to 11	4·5460	0·2200
WEIGHT			
Pounds to Kilograms	44 to 97	0·4536	2·2046
PRESSURE			
Inches of Mercury to Millibars ...	2100 to 62	33·87	0·02953

XIII.—CONVERSION OF TIME TO ARC

For Intervals of 10m

h m	° ′	h m	° ′	h m	° ′
00 00	0 00	08 00	120 00	16 00	240 00
10	2 30	10	122 30	10	242 30
20	5 00	20	125 00	20	245 00
30	7 30	30	127 30	30	247 30
40	10 00	40	130 00	40	250 00
50	12 30	50	132 30	50	252 30
01 00	15 00	09 00	135 00	17 00	255 00
10	17 30	10	137 30	10	257 30
20	20 00	20	140 00	20	260 00
30	22 30	30	142 30	30	262 30
40	25 00	40	145 00	40	265 00
50	27 30	50	147 30	50	267 30
02 00	30 00	10 00	150 00	18 00	270 00
10	32 30	10	152 30	10	272 30
20	35 00	20	155 00	20	275 00
30	37 30	30	157 30	30	277 30
40	40 00	40	160 00	40	280 00
50	42 30	50	162 30	50	282 30
03 00	45 00	11 00	165 00	19 00	285 00
10	47 30	10	167 30	10	287 30
20	50 00	20	170 00	20	290 00
30	52 30	30	172 30	30	292 30
40	55 00	40	175 00	40	295 00
50	57 30	50	177 30	50	297 30
04 00	60 00	12 00	180 00	20 00	300 00
10	62 30	10	182 30	10	302 30
20	65 00	20	185 00	20	305 00
30	67 30	30	187 30	30	307 30
40	70 00	40	190 00	40	310 00
50	72 30	50	192 30	50	312 30
05 00	75 00	13 00	195 00	21 00	315 00
10	77 30	10	197 30	10	317 30
20	80 00	20	200 00	20	320 00
30	82 30	30	202 30	30	322 30
40	85 00	40	205 00	40	325 00
50	87 30	50	207 30	50	327 30
06 00	90 00	14 00	210 00	22 00	330 00
10	92 30	10	212 30	10	332 30
20	95 00	20	215 00	20	335 00
30	97 30	30	217 30	30	337 30
40	100 00	40	220 00	40	340 00
50	102 30	50	222 30	50	342 30
07 00	105 00	15 00	225 00	23 00	345 00
10	107 30	10	227 30	10	347 30
20	110 00	20	230 00	20	350 00
30	112 30	30	232 30	30	352 30
40	115 00	40	235 00	40	355 00
50	117 30	50	237 30	50	357 30

Interpolation Table

m s	° ′
00 00	0 00
02	0 01
05	0 02
10	0 03
13	0 04
18	0 05
21	0 06
26	0 07
29	0 08
34	0 09
37	0 10
42	0 11
45	0 12
50	0 13
53	0 14
00 58	0 15
01 01	0 16
06	0 17
09	0 18
14	0 19
17	0 20
22	0 21
25	0 22
30	0 23
33	0 24
38	0 25
41	0 26
46	0 27
49	0 28
54	0 29
01 57	0 30
02 02	0 31
05	0 32
10	0 33
13	0 34
18	0 35
21	0 36
26	0 37
29	0 38
34	0 39
37	0 40
42	0 41
45	0 42
50	0 43
53	0 44
02 58	0 45
03 01	0 46
06	0 47
09	0 48
14	0 49
17	0 50
03 22	0 51
25	0 52
30	0 53
33	0 54
38	0 55
41	0 56
46	0 57
49	0 58
54	0 59
03 57	1 00
04 02	1 01
05	1 02
10	1 03
13	1 04
18	1 05
21	1 06
26	1 07
29	1 08
34	1 09
37	1 10
42	1 11
45	1 12
50	1 13
53	1 14
04 58	1 15
05 01	1 16
06	1 17
09	1 18
14	1 19
17	1 20
22	1 21
25	1 22
30	1 23
33	1 24
38	1 25
41	1 26
46	1 27
49	1 28
54	1 29
05 57	1 30
06 02	1 31
05	1 32
10	1 33
13	1 34
18	1 35
21	1 36
26	1 37
29	1 38
34	1 39
37	1 40
06 42	1 40
42	1 41
45	1 42
50	1 43
53	1 44
06 58	1 45
07 01	1 46
06	1 47
09	1 48
14	1 49
17	1 50
22	1 51
25	1 52
30	1 53
33	1 54
38	1 55
41	1 56
46	1 57
49	1 58
54	1 59
07 57	2 00
08 02	2 01
05	2 02
10	2 03
13	2 04
18	2 05
21	2 06
26	2 07
29	2 08
34	2 09
37	2 10
42	2 11
45	2 12
50	2 13
53	2 14
08 58	2 15
09 01	2 16
06	2 17
09	2 18
14	2 19
17	2 20
22	2 21
25	2 22
30	2 23
33	2 24
38	2 25
41	2 26
46	2 27
49	2 28
54	2 29
09 57	2 30
10 00	

When the argument is an exact tabulated value, the *upper* of the two possible values of the result should be taken.

XIV.—CONVERSION OF ARC TO TIME

DEGREES														MINUTES	
°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	′	m s
0	0 00	60	4 00	120	8 00	180	12 00	240	16 00	300	20 00	0	0 00	0	0 00
1	0 04	61	4 04	121	8 04	181	12 04	241	16 04	301	20 04	1	0 04	1	0 04
2	0 08	62	4 08	122	8 08	182	12 08	242	16 08	302	20 08	2	0 08	2	0 08
3	0 12	63	4 12	123	8 12	183	12 12	243	16 12	303	20 12	3	0 12	3	0 12
4	0 16	64	4 16	124	8 16	184	12 16	244	16 16	304	20 16	4	0 16	4	0 16
5	0 20	65	4 20	125	8 20	185	12 20	245	16 20	305	20 20	5	0 20	5	0 20
6	0 24	66	4 24	126	8 24	186	12 24	246	16 24	306	20 24	6	0 24	6	0 24
7	0 28	67	4 28	127	8 28	187	12 28	247	16 28	307	20 28	7	0 28	7	0 28
8	0 32	68	4 32	128	8 32	188	12 32	248	16 32	308	20 32	8	0 32	8	0 32
9	0 36	69	4 36	129	8 36	189	12 36	249	16 36	309	20 36	9	0 36	9	0 36
10	0 40	70	4 40	130	8 40	190	12 40	250	16 40	310	20 40	10	0 40	10	0 40
11	0 44	71	4 44	131	8 44	191	12 44	251	16 44	311	20 44	11	0 44	11	0 44
12	0 48	72	4 48	132	8 48	192	12 48	252	16 48	312	20 48	12	0 48	12	0 48
13	0 52	73	4 52	133	8 52	193	12 52	253	16 52	313	20 52	13	0 52	13	0 52
14	0 56	74	4 56	134	8 56	194	12 56	254	16 56	314	20 56	14	0 56	14	0 56
15	1 00	75	5 00	135	9 00	195	13 00	255	17 00	315	21 00	15	1 00	15	1 00
16	1 04	76	5 04	136	9 04	196	13 04	256	17 04	316	21 04	16	1 04	16	1 04
17	1 08	77	5 08	137	9 08	197	13 08	257	17 08	317	21 08	17	1 08	17	1 08
18	1 12	78	5 12	138	9 12	198	13 12	258	17 12	318	21 12	18	1 12	18	1 12
19	1 16	79	5 16	139	9 16	199	13 16	259	17 16	319	21 16	19	1 16	19	1 16
20	1 20	80	5 20	140	9 20	200	13 20	260	17 20	320	21 20	20	1 20	20	1 20
21	1 24	81	5 24	141	9 24	201	13 24	261	17 24	321	21 24	21	1 24	21	1 24
22	1 28	82	5 28	142	9 28	202	13 28	262	17 28	322	21 28	22	1 28	22	1 28
23	1 32	83	5 32	143	9 32	203	13 32	263	17 32	323	21 32	23	1 32	23	1 32
24	1 36	84	5 36	144	9 36	204	13 36	264	17 36	324	21 36	24	1 36	24	1 36
25	1 40	85	5 40	145	9 40	205	13 40	265	17 40	325	21 40	25	1 40	25	1 40
26	1 44	86	5 44	146	9 44	206	13 44	266	17 44	326	21 44	26	1 44	26	1 44
27	1 48	87	5 48	147	9 48	207	13 48	267	17 48	327	21 48	27	1 48	27	1 48
28	1 52	88	5 52	148	9 52	208	13 52	268	17 52	328	21 52	28	1 52	28	1 52
29	1 56	89	5 56	149	9 56	209	13 56	269	17 56	329	21 56	29	1 56	29	1 56
30	2 00	90	6 00	150	10 00	210	14 00	270	18 00	330	22 00	30	2 00	30	2 00
31	2 04	91	6 04	151	10 04	211	14 04	271	18 04	331	22 04	31	2 04	31	2 04
32	2 08	92	6 08	152	10 08	212	14 08	272	18 08	332	22 08	32	2 08	32	2 08
33	2 12	93	6 12	153	10 12	213	14 12	273	18 12	333	22 12	33	2 12	33	2 12
34	2 16	94	6 16	154	10 16	214	14 16	274	18 16	334	22 16	34	2 16	34	2 16
35	2 20	95	6 20	155	10 20	215	14 20	275	18 20	335	22 20	35	2 20	35	2 20
36	2 24	96	6 24	156	10 24	216	14 24	276	18 24	336	22 24	36	2 24	36	2 24
37	2 28	97	6 28	157	10 28	217	14 28	277	18 28	337	22 28	37	2 28	37	2 28
38	2 32	98	6 32	158	10 32	218	14 32	278	18 32	338	22 32	38	2 32	38	2 32
39	2 36	99	6 36	159	10 36	219	14 36	279	18 36	339	22 36	39	2 36	39	2 36
40	2 40	100	6 40	160	10 40	220	14 40	280	18 40	340	22 40	40	2 40	40	2 40
41	2 44	101	6 44	161	10 44	221	14 44	281	18 44	341	22 44	41	2 44	41	2 44
42	2 48	102	6 48	162	10 48	222	14 48	282	18 48	342	22 48	42	2 48	42	2 48
43	2 52	103	6 52	163	10 52	223	14 52	283	18 52	343	22 52	43	2 52	43	2 52
44	2 56	104	6 56	164	10 56	224	14 56	284	18 56	344	22 56	44	2 56	44	2 56
45	3 00	105	7 00	165	11 00	225	15 00	285	19 00	345	23 00	45	3 00	45	3 00
46	3 04	106	7 04	166	11 04	226	15 04	286	19 04	346	23 04	46	3 04	46	3 04
47	3 08	107	7 08	167	11 08	227	15 08	287	19 08	347	23 08	47	3 08	47	3 08
48	3 12	108	7 12	168	11 12	228	15 12	288	19 12	348	23 12	48	3 12	48	3 12
49	3 16	109	7 16	169	11 16	229	15 16	289	19 16	349	23 16	49	3 16	49	3 16
50	3 20	110	7 20	170	11 20	230	15 20	290	19 20	350	23 20	50	3 20	50	3 20
51	3 24	111	7 24	171	11 24	231	15 24	291	19 24	351	23 24	51	3 24	51	3 24
52	3 28	112	7 28	172	11 28	232	15 28	292	19 28	352	23 28	52	3 28	52	3 28
53	3 32	113	7 32	173	11 32	233	15 32	293	19 32	353	23 32	53	3 32	53	3 32
54	3 36	114	7 36	174	11 36	234	15 36	294	19 36	354	23 36	54	3 36	54	3 36
55	3 40	115	7 40	175	11 40	235	15 40	295	19 40	355	23 40	55	3 40	55	3 40
56	3 44	116	7 44	176	11 44	236	15 44	296	19 44	356	23 44	56	3 44	56	3 44
57	3 48	117	7 48	177	11 48	237	15 48	297	19 48	357	23 48	57	3 48	57	3 48
58	3 52	118	7 52	178	11 52	238	15 52	298	19 52	358	23 52	58	3 52	58	3 52
59	3 56	119	7 56	179	11 56	239	15 56	299	19 56	359	23 56	59	3 56	59	3 56

XV.—CORRECTION TO TABULATED ALTITUDE FOR MINUTES OF DECLINATION

d ′	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	d ′
00	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	00
01	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	01
02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	02
03	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	03
04	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	04
05	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	05
06	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	06
07	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	07
08	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	08
09	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4	4	4	4	4	09
10	0	0	0	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	10
11	0	0	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	5	5	5	5	5	6	11
12	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4	4	4	5	5	5	5	5	6	6	6	12
13	0	0	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4	4	5	5	5	5	5	6	6	6	6	6	13
14	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	14
15	0	0	1	1	1	2	2	2	2	2	3	3	3	4	4	4	4	4	5	5	5	6	6	6	6	6	7	7	7	8	15
16	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	16
17	0	1	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5	5	6	6	6	7	7	7	7	8	8	8	8	17
18	0	1	1	1	2	2	2	2	3	3	3	4	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	8	9	9	18
19	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	19
20	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10	20
21	0	1	1	1	2	2	2	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10	21
22	0	1	1	1	2	2	3	3	3	4	4	4	5	5	6	6	6	7	7	7	8	8	8	9	9	10	10	10	11	11	22
23	0	1	1	2	2	2	3	3	3	4	4	5	5	5	6	6	7	7	7	8	8	8	9	9	10	10	10	11	11	12	23
24	0	1	1	2	2	2	3	3	4	4	4	5	5	6	6	6	7	7	8	8	8	9	9	10	10	10	11	11	12	12	24
25	0	1	1	2	2	2	3	3	4	4	5	5	5	6	6	7	7	8	8	8	9	9	10	10	10	11	11	12	12	12	25
26	0	1	1	2	2	3	3	3	4	4	5	5	6	6	6	7	7	8	8	9	9	10	10	10	11	11	12	12	13	13	26
27	0	1	1	2	2	3	3	4	4	4	5	5	6	6	7	7	8	8	9	9	9	10	10	11	11	12	12	13	13	14	27
28	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	28
29	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	14	29
30	0	1	2	2	2	3	4	4	4	5	6	6	6	7	8	8	8	9	10	10	10	11	12	12	12	13	14	14	14	15	30
31	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	16	31
32	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	32
33	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10	10	11	12	12	13	13	14	14	15	15	16	16	33
34	1	1	2	2	3	3	4	5	5	6	6	7	7	8	8	9	10	10	11	11	12	12	13	14	14	15	15	16	16	17	34
35	1	1	2	2	3	4	4	5	5	6	6	7	8	8	9	9	10	10	11	12	12	13	13	14	15	15	16	16	17	18	35
36	1	1	2	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	11	12	13	13	14	14	15	16	16	17	17	18	36
37	1	1	2	2	3	4	4	5	6	6	7	7	8	9	9	10	10	11	12	12	13	14	14	15	15	16	17	17	18	18	37
38	1	1	2	3	3	4	4	5	6	6	7	8	8	9	10	10	11	11	12	13	13	14	15	15	16	16	17	18	18	19	38
39	1	1	2	3	3	4	5	5	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19	20	39
40	1	1	2	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18	19	19	20	40
41	1	1	2	3	3	4	5	5	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19	20	20	41
42	1	1	2	3	4	4	5	6	6	7	8	8	9	10	10	11	12	13	13	14	15	15	16	17	18	18	19	20	20	21	42
43	1	1	2	3	4	4	5	6	6	7	8	9	9	10	11	11	12	13	14	14	15	16	16	17	18	19	19	20	21	22	43
44	1	1	2	3	4	4	5	6	7	7	8	9	10	10	11	12	12	13	14	15	15	16	17	18	18	19	20	21	21	22	44
45	1	2	2	3	4	4	5	6	7	8	8	9	10	10	11	12	13	14	14	15	16	16	17	18	19	20	20	21	22	22	45
46	1	2	2	3	4	5	5	6	7	8	8	9	10	11	12	12	13	14	15	15	16	17	18	18	19	20	21	21	22	23	46
47	1	2	2	3	4	5	5	6	7	8	9	9	10	11	12	13	13	14	15	16	16	17	18	19	20	20	21	22	23	24	47
48	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16	17	18	18	19	20	21	22	22	23	24	48
49	1	2	2	3	4	5	6	7	7	8	9	10	11	11	12	13	14	15	16	16	17	18	19	20	20	21	22	23	24	24	49
50	1	2	2	3	4	5	6	7	8	8	9	10	11	12	12	13	14	15	16	17	18	18	19	20	21	22	22	23	24	25	50
51	1	2	3	3	4	5	6	7	8	8	9	10	11	12	13	14	14	15	16	17	18	19	20	20	21	22	23	24	25	26	51
52	1	2	3	3	4	5	6	7	8	9	10	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	23	24	25	26	52
53	1	2	3	4	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	18	19	19	20	21	22	23	24	25	26	26	53
54	1	2	3	4	4	5	6	7	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22	22	23	24	25	26	27	54
55	1	2	3	4	5	6	6	7	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24	25	26	27	28	55
56	1	2	3	4	5	6	7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	21	22	23	24	25	26	27	28	56
57	1	2	3	4	5	6	7	8	9	10	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	28	57
58	1	2	3	4	5	6	7	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	58
59	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	59

XV.—CORRECTION TO TABULATED ALTITUDE FOR MINUTES OF DECLINATION

d	31 32 33	34 35 36	37 38 39	40 41 42	43 44 45	46 47 48	49 50 51	52 53 54	55 56 57	58 59 60	d
′											′
00	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	00
01	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 1 1	1 1 1	01
02	1 1 1	1 1 1	1 1 1	1 1 1	1 1 2	2 2 2	2 2 2	2 2 2	2 2 2	2 2 2	02
03	2 2 2	2 2 2	2 2 2	2 2 2	2 2 2	2 2 2	2 2 3	3 3 3	3 3 3	3 3 3	03
04	2 2 2	2 2 2	2 3 3	3 3 3	3 3 3	3 3 3	3 3 3	3 4 4	4 4 4	4 4 4	04
05	3 3 3	3 3 3	3 3 3	3 3 4	4 4 4	4 4 4	4 4 4	4 4 4	5 5 5	5 5 5	05
06	3 3 3	3 4 4	4 4 4	4 4 4	4 4 4	5 5 5	5 5 5	5 5 5	6 6 6	6 6 6	06
07	4 4 4	4 4 4	4 4 5	5 5 5	5 5 5	5 5 6	6 6 6	6 6 6	6 7 7	7 7 7	07
08	4 4 4	5 5 5	5 5 5	5 5 6	6 6 6	6 6 6	7 7 7	7 7 7	7 7 8	8 8 8	08
09	5 5 5	5 5 5	6 6 6	6 6 6	6 7 7	7 7 7	7 8 8	8 8 8	8 8 9	9 9 9	09
10	5 5 6	6 6 6	6 6 6	7 7 7	7 7 8	8 8 8	8 8 8	9 9 9	9 9 10	10 10 10	10
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