THE GERMAN AIR ALMANAC

by

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(Extracted from the *United States Naval Institute Proceedings*, Vol. 67, N° 465, Annapolis, Nov. 1941, page 1594).

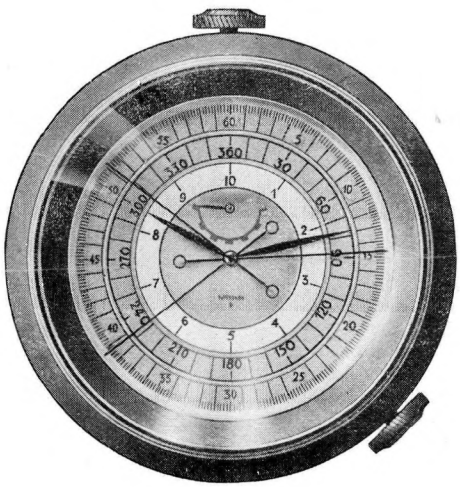
Our naval and commercial pilots are now familiar with the new American Air *Almanac* of 1941, with its convenient material, excellent arrangement, and ease of manipulation.

The United States was the pioneer in the production of the *Air Almanac*. In 1932, the U.S. Navy brought forth the initial edition of this type of work containing a new feature, in its tabulation of the Greenwich hour angle for all celestial bodies. The original Almanac, while containing the necessary material, proved to be ill arranged, unsuitable, and impractical for air purposes. In 1936 France, after some study of the American method, improved the *Almanac* greatly by furnishing perforated sheets together with all the data for sun, moon, planets, and stars recorded on one daily sheet. The elements of the celestial bodies were tabulated for every 20 minutes of Greenwich mean time and opposite, in juxtaposition, was tabulated the corresponding Greenwich sidereal time. Every heavenly body, including the sun, was recorded for its versascension (360° minus right ascension). This combination of Greenwich sidereal time with versascension supplied the required Greenwich hour angle for any heavenly body. Therefore the complete process was standardized and every kind of observation was worked and solved in the same identical manner.

For unknown reasons, the British lagged behind in the production of an air almanac. In 1937, after an exhaustive study of both the American and French editions, they incorporated the better ideas of both publications and issued a trial almanac for their flyers. In 1939, after all its service tests, they produced an air almanac, which for size, convenience, necessary material, and excellent arrangement appeared ideal. The American *Air Almanac* of 1941 is almost an exact replica of this British edition.

The German *Air Almanac* is unfamiliar to American aviators. It was also issued in 1939, and is identical in size with the British edition. It is printed quarterly, has perforated pages; the daily work sheet contains all elements of sun, moon, planet, stars and Aries, and is tabulated for every 20° (1 h. 20 m.) of Greenwich civil time, thus making but 18 tabulations of Greenwich hour angle. There is given on the same page an auxiliary interpolation table from 1° (4 m.) to 20° for all utilized celestial bodies. A *critical form* of table is also shown for the declination, tabulated for G.H.A. from 40° (2 h. 40 m.) to 360°. The time of sunrise, and duration of twilight is indicated for different latitudes, also moonrise and moonset for Greenwich, with interpolation corrections for 10° of longitude, and the moon and sun's horizontal parallax and semidiameter. On the reverse side of the daily sheet the G.H.A. is tabulated for the 16 brightest stars for G.C.T. 20° (1 h. 20 m) to 360°. A page on the back cover of the *Almanac* gives for all other navigational stars the sidereal hour angle, which, combined with the hour angle of Aries, gives the G.H.A. of any recorded star.

In the German *Almanac*, the Greenwich hour angle for all bodies is tabulated westward from the *lower* branch of the Greenwich meridian, hence differs from all other types of *Air Almanac* by 180°. Thus where the American tabulates the G.H.A. as 270°, the German records it as 90°, which appears to be a good suggestion, since all time begins at midnight. The German aviator uses a navigation watch reading to degrees, minutes, and tenths of arc and it set to G.C.T., somewhat like the type shown in the illustration. The dial consists of three circles of different colors with watch hands of corresponding color. The inner circle is red with a red pointing hand, the middle circle black and white, with a black pointing hand, while the outer circle is blue with a blue pointing hand. A fourth hand acts as a stop watch. The middle circle is graduated in steps of 10° of arc from 0° to 360° and the black pointer makes one revolution in a day. The red pointer of the interior (red) circle



Watch for aerial navigation.

G. C. T. M. G. Z. *Midnight*	Greenwicher Zeitwinkel *G. H. A.*													
	Sonne ☉		Venus ♀	Mars ♂		Jupiter ♃		Saturn ♄		Mond ☾		Widderp. ♈	
Mittern.	4°	3		260°	53′	227°	18′	201°	46′	34°	0′	227°	16′
20°	24	3		280	54	247	21	221	49	53	17	247	19
40	44	3		300	56	267	25	241	53	72	34	267	23
60	64	3		320	57	287	28	261	56	91	51	287	26
80	84	3		340	58	307	31	282	0	111	8	307	29
100	104	3		1	0	327	35	302	3	130	25	327	33
120	124	3		21	1	347	38	322	7	149	42	347	36
140	144	3		41	2	7	42	342	10	168	59	7	39
160	164	3	*Invisible* Nicht sichtbar	61	4	27	45	2	14	188	16	27	42
noon Mittag	184	3		81	5	47	49	22	17	207	33	47	46
200	204	3		101	6	67	52	42	21	226	50	67	49
220	224	3		121	8	87	56	62	24	246	6	87	52
240	244	3		141	9	107	59	82	28	265	23	107	56
260	264	2		161	10	128	3	102	31	284	40	127	59
280	284	2		181	12	148	6	122	35	303	56	148	2
300	304	2		201	13	168	9	142	38	323	13	168	5
320	324	2		221	14	188	13	162	42	342	29	188	9
340	344	2		241	16	208	16	182	45	1	46	208	12
Mittern.	4	2		261	17	228	20	202	49	21	2	228	15

M. G. Z.	Einschaltwerte für Greenwicher Zeitwinkel													
	Sonne ☉		Venus ♀	Mars ♂		Jupiter ♃		Saturn ♄		Mond ☾		Widderp. ♈	
1°	1°	0′		1°	0′	1°	0′	1°	0′	0°	58′	1°	0′
2	2	0		2	0	2	0	2	0	1	56	2	0
3	3	0		3	0	3	1	3	1	2	54	3	0
4	4	0		4	0	4	1	4	1	3	51	4	1
5	5	0		5	0	5	1	5	1	4	49	5	1
6	6	0		6	0	6	1	6	1	5	47	6	1
7	7	0		7	0	7	1	7	1	6	45	7	1
8	8	0		8	1	8	1	8	1	7	43	8	1
9	9	0	*Invisible* Nicht sichtbar	9	1	9	2	9	2	8	41	9	1
10	10	0		10	1	10	2	10	2	9	38	10	2
11	11	0		11	1	11	2	11	2	10	36	11	2
12	12	0		12	1	12	2	12	2	11	34	12	2
13	13	0		13	1	13	2	13	2	12	32	13	2
14	14	0		14	1	14	2	14	2	13	30	14	2
15	15	0		15	1	15	3	15	3	14	28	15	2
16	16	0		16	1	16	3	16	3	15	25	16	3
17	17	0		17	1	17	3	17	3	16	23	17	3
18	18	0		18	1	18	3	18	3	17	21	18	3
19	19	0		19	1	19	3	19	3	18	19	19	3

M. G. Z.	*Declination* Abweichnung													
	Sonne ☉		Venus ♀	Mars ♂		Jupiter ♃		Saturn ♄		Mond ☾		Änd. je 1°	
Mittern.	16° 32′	S		15° 35′	S	1° 41′	S	7° 38	N	7° 6′	S	0.′7	
40°	16 34			15 34		1		7 37		7 35		0. 7	
80	16 36			15 32		1		1		8 4		0. 7	
120	16 38	S		15 31	S	1 41	S	1		8 32	S	0. 7	
160	16 40			15 29		1 42		1		9 0		0. 7	
200	16 42			15 27		1		1		9 28		0. 7	
240	16 44	S		15 26	S	1		7 37	N	9 55	S	0. 7	
280	16 46			15 24		1		7 36		10 21		0. 7	
320	16 48			15 23		1		1		10 48		0. 6	
Mittern.	16 50	S	Nicht sichtbar	15 21	S	1 42	S	7 36	N	11 13	S		

Halbm. d. S. ☉ $\rho = 16'$
Semidiometer

Mittlere Ortszeit des Sonnen- und Mond-Auf- und -Untergangs
Mond für 0° Länge

Breite	10° S	10° N	30° N	40° N	50° N	60° N	70° N
Sonnenaufgang	$5^h 28^m$	$5^h 52^m$	$6^h 20^m$	$6^h 37^m$	$7^h 1^m$	$7^h 40^m$	$9^h 8^m$
Sonnenunterg.	17 59	17 36	17 8	16 50	16 26	15 47	14 18
Dauer d. Damm.	0 35	0 34	0 39	0 44	0 53	1 11	2 2
Mondaufgang	3 47	3 59	4 12	4 21	4 33	4 51	5 29
Monduntergang	16 26	16 11	15 54	15 44	15 29	15 6	14 22
Aufg. | Änd. f. 10°	−1	−2	−2	−2	−2	−2	−3
Unth. / O-Länge	−2	−1	−1	−1	−1	−1	0

Halbm. d.M. ☾ $\rho = 16'$
Parallaxe d.M. ☾ $\pi = 60'$ bis M.G.A. = 203°
$= 59'$ ab M.G.Z. = 204°

G. C. T. M. G. Z.	Alde-baran		Arktur		Atair		Betei-geuze		Capella		Deneb		Dubhe		Fomal-haut		Hamel		Pollux		Regulus		Rigel		Sirius		Sirrah		Spika		Wega	
	Greenwicher Zeitwinkel																															
Mittern.	159°	9′	14°	3	290°	18′	139°	17′	149°	12′	277°	25′	62°	16	243°	41′	196°	19′	111°	51′	75°	59′	149°	21′	126°	38′	225°	57′	26°	46′	308°	33
20°	179	12	34	6	310	22	159	20	169	15	297	29	82	19	263	44	216	22	131	55	96	2	169	24	146	42	246	0	46	49	328	36
40	199	15	54	9	330	25	179	24	189	18	317	32	102	23	283	47	236	26	151	58	116	5	189	28	166	45	266	3	66	53	348	39
60	219	19	74	12	350	28	199	27	209	22	337	35	122	26	303	51	256	29	172	1	136	8	209	31	186	48	286	6	86	56	8	43
80	239	22	94	16	10	32	219	30	229	25	357	38	142	29	323	54	276	32	192	4	156	12	229	34	206	51	306	10	106	59	28	46
100	259	25	114	19	30	35	239	33	249	28	17	42	162	32	343	57	296	35	212	8	176	15	249	37	226	55	326	13	127	2	48	49
120	279	28	134	22	50	38	259	37	269	32	37	45	182	36	4	1	316	39	232	11	196	18	269	41	246	58	346	16	147	6	68	52
140	299	32	154	26	70	41	279	40	289	35	57	48	202	39	24	4	336	42	252	14	216	22	289	44	267	1	6	20	167	9	88	56
160	319	35	174	29	90	45	299	43	309	38	77	52	222	42	44	7	356	45	272	18	236	25	309	47	287	5	26	23	187	12	108	59
Mittag	339	38	194	32	110	48	319	47	329	41	97	55	242	46	64	10	16	49	292	21	256	28	329	51	307	8	46	26	207	16	129	2
200	359	42	214	35	130	51	339	50	349	45	117	58	262	49	84	14	36	52	312	24	276	31	349	54	327	11	66	29	227	19	149	6
220	19	45	234	39	150	55	359	53	9	48	138	1	282	52	104	17	56	55	332	27	296	35	9	57	347	14	86	33	247	22	169	9
240	39	48	254	42	170	58	19	56	29	51	158	5	302	55	124	20	76	58	352	31	316	38	30	0	7	18	106	36	267	25	189	12
260	59	51	274	45	191	1	40	0	49	55	178	8	322	59	144	24	97	2	12	34	336	41	50	4	27	21	126	39	287	29	209	15
280	79	55	294	49	211	4	60	3	69	58	198	11	343	2	164	27	117	5	32	37	356	45	70	7	47	24	146	43	307	32	229	19
300	99	58	314	52	231	8	80	6	90	1	218	15	3	5	184	30	137	8	52	41	16	48	90	10	67	28	166	46	327	35	249	22
320	120	1	334	55	251	11	100	10	110	4	238	18	23	9	204	33	157	12	72	44	36	51	110	14	87	31	186	49	347	39	269	25
340	140	5	354	58	271	14	120	13	130	8	258	21	43	12	224	37	177	15	92	47	56	54	130	17	107	34	206	52	7	42	289	29
Mittern.	160	8	15	2	291	18	140	16	150	11	278	24	63	15	244	40	197	18	112	50	76	58	150	20	127	37	226	56	27	45	309	32
δ	16° 23′ N		19° 30′ N		8° 43′ N		7° 24′ N		45° 56′ N		45° 4 N		62° 4 N		29° 56′ S		23° 11′ N		28° 10 N		12° 16′ N		8° 16′ S		16° 38′ S		28° 46′ N		10° 51′ S		38° 44′ N	
colg cos δ	0.0180		0.0257		0.0050		0.0036		0.1577		0.1510		0.3293		0.0622		0.0366		0.0547		0.0100		0.0045		0.0186		0.0572		0.0078		0.1079	
360°−α	291°	53′	146°	47′	63°	2′	272°	1′	281°	56′	50°	9	195°	0′	16°	25	329°	3′	244°	35′	208°	42′	282°	5′	259°	22′	358°	40′	159°	30′	81°	17′

makes one revolution in the same time that the black pointer covers one division on the middle circle. Three hundred divisions on the outer circle (blue) are each equal to an arc of 0.2' each, and the blue pointer that moves over it divides the degrees marked on the inner circle into minutes and tenths of arc. Thus the reading on the black, hand is 70°, on the red hand 8°, on the blue hand 15'.8 or the total reading is 78° —15'. 8.

With the hour angle and declination found from the *Air Almanac,* an epitomized navigational table is entered to give directly the altitude and azimuth from which the line of position is plotted. The Germans use the "F" table, a process similar to that of H.O. 208. The British and Americans adopt the fast process as given in H.O. 214.

The following problems demonstrate the operation of the tables :

Example : At sea, November 9, 1939, in longitude 68° W. at 0830, find the G.H.A. and declination of the sun. G.C.T. 187° —40'. O (12^h 30^m 40^s).

G.C.T.	180°	=	184° —03'	(German *Air Almanac*)
Corr.	7° —40'	=	7 —40	(Interpolation Table)
G.H.A. Sun			191 —43	(Measured from midnight)
or H.A.			11° —43'	W.

(Declination, (by inspection) 16° —41' S.

From British : G.H.A. Sun Dec.
G.M.T. 12^h 30^m 11° —33' S 16° —41' Corr. 40^s = 10'

Therefore for 12^h 30^m 40^s, the G.H.A. is 11° —43' W.
Dec. 16° —41' S.

Example : At sea, November 8, 1939, in longitude 120° W., find the G.H.A. and declination of planet Jupiter and star Regulus. G.C.T. 47° —31'.3 (3^h 10^m 05^s)

JUPITER

G.C.T.	40°	=	267° —25'	(German *Air Almanac*)
Corr.	7° —31'	=	7 —32	(Interpolation Table)
G.H.A. Jupiter			274° —57'	(Measured from midnight)
or H.A.			94° —57'	W.

Dec. 1° —41' S. (by inspection)

From British : G.H.A. Jupiter Dec. Inter. tab.
G.M.T. 03^h 92° —25' S. 1° —41' 10^m —04^s 2° —32'
10^m —08^s

Therefore
G.C.T. 3^h 10^m 05^s = 92° —25' + 2° —32' = 94° —57' W.

REGULUS

G.C.T.	40°	=	116° —05'	(German *Air Almanac*)
Corr.	7° —31'	=	7 —32'	(Interpolation Table)
G.H.A. Regulus		=	123° —37'	(Measured from midnight)
or H.A.			56° — 23'	E.

Dec. 12° —16' N. (by inspection)

From British :	G.H.A.	
G.M.T. 0310	94° —54'	Regulus 208° —42';
Corr. for G.M.T. 05^s	— 1'	Dec. 12° —16' N.
S.H.A. Regulus	208 —42'	
G.H.A. Regulus	303° —37'	W.
or H.A.	56° —23'	E.

Dec. 12° —16' N. (by inspection)