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Table &c.

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log sec ζ	log k		log sec ζ	log k		log sec ζ	log k	
0.00	1.7609	1	0.33	1.7545	4	0.66	1.7280	15
01	08	1	34	41	4	67	7265	16
02	07	1	35	37	4	68	7249	16
03	06	1	36	33	4	69	7233	17
04	05	2	37	29	4	70	7216	18
05	03	1	38	25	4	71	7198	19
06	02	1	39	21	4	72	7179	19
07	01	1	40	17	5	73	7160	20
08	1.7600	1	41	12	6	74	7140	22
09	1.7599	1	42	1.7506	7	75	7118	22
10	98	2	43	1.7499	7	76	7096	23
11	96	2	44	92	6	77	7073	24
12	94	1	45	86	6	78	7049	23
13	93	2	46	80	6	79	7026	23
14	91	1	47	74	6	80	7003	24
15	90	1	48	68	7	81	6979	25
16	89	2	49	61	8	82	6954	26
17	87	2	50	53	8	83	6928	28
18	85	2	51	45	8	84	6900	29
19	83	2	52	37	9	85	6871	31
20	81	2	53	28	10	86	6840	31
21	79	2	54	18	9	87	6809	33
22	77	2	55	09	9	88	6776	33
23	75	3	56	1.7400	10	89	6743	34
24	72	2	57	1.7390	10	90	6709	34
25	70	3	58	80	10	91	6675	36
26	67	3	59	70	11	92	6639	39
27	64	2	60	59	12	93	6600	40
28	62	3	61	47	12	94	6560	42
29	59	3	62	35	13	95	6518	44
30	56	3	63	22	13	96	6474	46
31	53	4	64	1.7309	14	97	6428	45
32	49	4	65	1.7295	15	98	6383	45
0.33	1.7545		0.667	80		0.99	1.6338	

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$$\cos n = \cos\varphi \sin t_0$$

$$\sin N \sin n = \cos\varphi \cos t_0$$

$$\cos N \sin n = \sin\varphi$$

$$\sec \zeta_0 = \operatorname{cosec}(N + \delta_0) \operatorname{cosec} n$$

tabulate

$$\frac{\text{Diff. refr. in } \alpha}{k \operatorname{cosec}^2(N+\delta_0)} =$$

$$\left[\cot^2 n + \sin N \sec\delta_0 \sin(N+\delta_0)\right](\alpha' - \alpha)$$

$$- \sec^2\delta_0 \cot n \cos(N + 2\delta_0) \qquad (\delta' - \delta)$$

The coeff. of $(\alpha' - \alpha)$ may also be written

$$\sin^2 N + \cot^2 n + \sin N \cos N \tan\delta_0$$

or $\cos^2\varphi \operatorname{cosec}^2 n + \sin N \cos N \tan\delta_0$

tabulate tabulate

$\cot^2\varphi \cos^2 N$

$$\frac{\text{Diff. refr. in } \delta}{k \operatorname{cosec}^2(N+\delta_0)} =$$

$\sin N \cos N = \cot n \cos N \times \cot t_0$

$$\cot n \cos N \,(\alpha' - \alpha) - (\delta' - \delta)$$

tabulate

Making $k' = k \sin\varphi \cos\varphi$, we have

$$\frac{\text{Diff. refr. in } \alpha}{k' \sec^2\zeta}$$

$$= (\cot\varphi + \cos t_0 \tan\delta_0)(\alpha' - \alpha)$$

$$- \sin t_0 \sec N \sec^2\delta_0 \cos(N + 2\delta_0)(\delta' - \delta)$$

$$\frac{\text{Diff. refr. in } \delta}{k' \sec^2\zeta}$$

$$= \sin t_0 (\alpha' - \alpha)$$

$$- \cos t_0 \sec N \operatorname{cosec} N (\delta' - \delta)$$

This form seems to have advantages when only the terms depending on $(\alpha' - \alpha)$ are to be computed.

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$\cot h$

$\sin h \cot h = \cos\delta \tan\varphi$

$\tan^2\zeta \left[\cos^2(\pi-\eta) + \cot^2\zeta\right]$

$= \tan^2\zeta \left[\frac{1}{2} + \frac{1}{2}\cos 2(\pi-\eta)\right]$

$\tan\eta = \cot n \cdot \sec(N+\delta)$

$k \tan^2\zeta = k \sec^2\varphi \sin^2\zeta \cdot a \operatorname{cosec}^2(N+\delta_0)$

$= k \sec^2\varphi \sin^2\zeta \times \text{arg. of } k.$

$\tan^2\zeta = \dfrac{\cos^2 N}{\sin^2\varphi \sin^2(N+\delta)} - 1$

$\cos^2 N \; 1$

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Differential Refraction formulas.

φ = latitude of place.

t_0 = true hour angle of mean of the two stars

δ_0 = true declination " " " " "

ζ_0 = true zenith distance " " " " "

$$\cos n = \cos\varphi \sin t_0$$
$$\sin N \sin n = \cos\varphi \cos t_0$$
$$\cos N \sin n = \sin\varphi$$

Putting $a = \cos^2\varphi \operatorname{cosec}^2 n = \cot^2\varphi \cos^2 N$

$b = \cot\varphi \sec t_0$

$c = \cot n \cos N = a \tan\varphi \sin t_0 = \tan t_0 \cdot \sin N \cdot \cos N$

we have $\cos^2\varphi \sec^2\zeta_0 = a \operatorname{cosec}^2(N + \delta_0)$

for which as an argument Bessel's $\log k$ (Ast. Nach. III 388) is tabulated.

We have, then, if $\Delta\alpha$ $\Delta\delta$ are the observed differences of right ascension and declination,

(1) $$\frac{\text{Correction to } \Delta\alpha}{k \operatorname{cosec}^2(N+\delta_0)} = a\left(1 + \frac{1}{b}\tan\delta_0\right)\Delta\alpha + \cot n \cdot \sec^2\delta_0 \cos(N + 2\delta_0)\,\Delta\delta$$

(2) $$\frac{\text{Correction to } \Delta\delta}{k \operatorname{cosec}^2(N+\delta_0)} \qquad c\cdot\Delta\alpha \qquad + \Delta\delta$$

~~log~~ b cot δ_0 will be the argument for the Gauss log. in computing the coefficient of $\Delta\alpha$ in the first expression, it being almost always positive.

If we desire only this term of the correction to $\Delta\alpha$ we may write

$$\text{Correction to } \Delta\alpha = k\,(\text{argument of } k)\left(1 + \frac{1}{b}\tan\delta\right)\Delta\alpha$$

N, $\log a$, $\log b$, $\log \cot n$, and $\log c$, are tabulated for t_0 as argument.

~~Considering only the terms depending on $\Delta\alpha$~~

~~½ Sum of the refractions in α for same + & — declination = $\pm k(\text{arg. of } k)\,\Delta\alpha$~~

~~½ Difference " " " " = $\pm \dfrac{k(\text{arg of } k)}{b \cot\delta_0}\cdot\Delta\alpha$~~

~~Where the hour angle is the same for both stars the terms depending on $\Delta\alpha$ must be omitted.~~

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Set 2

Table for ~~log k~~. Constant to the basis
Differential Refraction Tables I

log $\frac{a}{\sin^2(N+\delta)}$	log k in ''	log k	log $\frac{a}{\sin^2(N+\delta)}$	log k in ''	log k	log $\frac{a}{\sin^2(N+\delta)}$	log k in ''	log k
9.74	1.7609	6.4465	0.07	1.7588	6.4444	0.40	1.7544	6.4400
75	09	0 4465	08	87	1 4443	41	42	2 4398
76	08	1 4464	09	86	1 4442	42	40	2 4396
77	08	0 4464	10	85	1 4441	43	38	2 4394
78	07	1 4463	11	84	1 4440	44	36	2 4392
79	07	0 4463	12	83	1 4439	45	34	2 4390
80	06	1 4462	13	82	1 4438	46	32	2 4388
81	06	0 4462	14	81	1 4437	47	30	2 4386
82	05	1 4461	15	80	1 4436	48	28	2 4384
83	04	1 4460	16	79	1 4435	49	26	2 4382
84	03	1 4459	17	78	1 4434	50	24	2 4380
85	03	0 4459	18	77	1 4433	51	22	2 4378
86	02	1 4458	19	76	1 4432	52	20	2 4376
87	02	0 4458	20	75	1 4431	53	18	2 4374
88	01	1 4457	21	73	2 4429	54	16	2 4372
89	01	0 4457	22	72	1 4428	55	14	2 4370
90	00	1 4456	23	71	1 4427	56	11	3 4367
91	1.7600	0 4456	24	70	1 4426	57	08	3 4364
92	1.7599	1 4455	25	68	2 4424	58	05	3 4361
93	98	1 4454	26	67	1 4423	59	1.7502	3 4358
94	98	0 4454	27	65	2 4421	60	1.7498	4 4354
95	97	1 4453	28	64	1 4420	61	95	3 4351
96	96	1 4452	29	63	1 4419	62	91	4 4347
97	95	1 4451	30	61	2 4417	63	88	3 4344
98	94	1 4450	31	60	1 4416	64	85	3 4341
9.99	94	0 4450	32	59	1 4415	65	82	3 4338
0.00	93	1 4449	33	57	2 4413	66	79	3 4335
01	92	1 4448	34	56	1 4412	67	76	3 4332
02	91	1 4447	35	54	2 4410	68	73	3 4329
03	91	0 4447	36	52	2 4408	69	70	3 4326
04	90	1 4446	37	50	2 4406	70	67	3 4323
05	90	0 4446	38	48	2 4404	71	64	3 4320
06	89	1 4445	39	46	2 4402	72	60	4 4316
0.07	1.7588	1 6.4444	0.40	1.7544	2 6.4400	0.73	1.7456	4 6.4312

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Log k of Bessel's table. Ast. Nach. III. 388. Set

Differential Refraction Table II

$\log \frac{a}{\sin^2(N+\delta_0)}$	$\log k$ in "	$\log k$	$\log \frac{a}{\sin^2(N+\delta_0)}$	$\log k$ in "	$\log k$	$\log \frac{a}{\sin^2(N+\delta_0)}$	$\log k$ in "	$\log k$
0·73	1·74556	6·4312	1·06	1·72778	6·4134	1·39	1·69377	6·3793
74	52	4308	07	71	4127	40	6924	3780
75	48	4304	08	63	4119	41	1·69110	3766
76	44	4300	09	55	4111	42	1·68996	3752
77	40	4296	10	47	4103	43	6882	3738
78	36	4292	11	39	4095	44	6867	3723
79	31	4287	12	31	4087	45	6852	3708
80	26	4282	13	22	4078	46	6836	3692
81	21	4277	14	13	4069	47	6820	3676
82	17	4273	15	1·72004	4060	48	1·68804	3660
83	12	4268	16	1·71995	4051	49	1·67788	3644
84	08	4264	17	86	4042	50	6771	3627
85	1·74403	4259	18	76	4032	51	6755	3611
86	1·73998	4254	19	67	4023	52	6738	3594
87	93	4249	20	57	4013	53	6721	3577
88	88	4244	21	47	4003	54	1·67704	3560
89	83	4239	22	37	3993	55	1·66687	3543
90	78	4234	23	26	3982	56	6670	3526
91	73	4229	24	15	3971	57	6652	3508
92	68	4224	25	1·71104	3960	58	6633	3489
93	63	4219	26	1·70993	3949	59	1·66614	3470
94	57	4213	27	81	3937	60	1·65594	3450
95	51	4207	28	69	3925	61	6574	3430
96	45	4201	29	57	3913	62	6554	3410
97	39	4195	30	46	3902	63	6533	3389
98	33	4189	31	34	3890	64	6511	3367
0·99	27	4183	32	23	3879	65	6489	3345
1·00	20	4176	33	1·70011	3867	66	6467	3323
01	14	4170	34	1·69999	3855	67	6444	3300
02	07	4163	35	87	3843	68	6421	3277
03	1·73300	4156	36	75	3831	69	6399	3255
04	1·72293	4149	37	63	3819	70	6376	3232
05	86	4142	38	50	3806	71	6354	3210
1·06	1·72778	6·4134	1·39	1·69377	6·3793	1·72	1·63331	6·3187

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0^h

Differential Reduction Table II

t_0	N		log a		log b		log cot n		log c		t_0
0^h 0^m	47° 37.2	1	9.7369		0.0398		$-\infty$		$-\infty$		0^h 0^m
1	37.2	0.0	69	0	98	0	7.5083		7.3371		1
2	37.1	0.1	70	1	98	0	8093		6380		2
3	37.0	0.1	70	0	98	0	7.9854		8141		3
4	36.9	0.1	70	0	98	0	8.1104		7.9391		4
5	36.8	0.2	70	0	99	1	2073		8.0360		5
6	36.6	0.3	71	1	0.0399	0	2865		1152		6
7	36.3	0.2	71	0	0.0400	1	3534	580	1822	580	7
8	36.1	0.3	72	1	0D	0	4114	512	2402	513	8
9	35.8	0.3	73	1	01	1	4626	458	2915	458	9
10	35.5	0.3	74	1	02	1	5084	414	3373	414	10
11	35.2	0.4	74	0	03	1	5498	378	3787	377	11
12	34.8	0.4	75	1	04	1	5876	348	4166	348	12
13	34.4	0.4	77	2	05	1	6224	322	4514	323	13
14	34.0	0.5	78	1	06	1	6546	298	4837	299	14
15	33.5	0.5	79	1	07	1	6844	281	5136	281	15
16	33.0	0.6	81	2	08	1	7125	265	5417	265	16
17	32.4	0.6	82	1	10	2	7390	249	5682	250	17
18	31.8	0.6	84	2	11	1	7639	235	5932	236	18
19	31.2	0.6	86	2	13	2	7874	222	6168	224	19
20	30.6	0.7	87	1	14	1	8096	212	6392	213	20
21	29.9	0.6	89	2	16	2	8308	203	6605	204	21
22	29.3	0.7	91	2	18	2	8511	194	6809	195	22
23	28.6	0.8	93	2	20	2	8705	185	7004	186	23
24	27.8	0.9	95	3	22	2	8890	178	7190	179	24
25	26.9	1.0	9.7398	2	24	2	9068	171	7369	172	25
26	26.1	0.9	9.7400	2	26	2	9239	164	7541	165	26
27	25.2	0.9	02	3	28	2	9403	158	7706	160	27
28	24.3	0.9	05	2	30	3	9561	153	7866	154	28
29	23.4	1.0	07	3	33	2	9714	148	8020	149	29
0^h 30^m	47 22.4		9.7410		0.0435		8.9862		8.8169		1^h 30^m

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0^h

t_0	N		log a		log b		log cos n		log c		t_0
$0^h\ 30^m$	47°	23'4	9.7410		0.0435		8.9862		8.8169		$0^h\ 30^m$
				1.0		3		143		145	
31		21.4	13		38		9.0005		8314		31
				1.0		3		138		137	
32		20.4	16		40		0143		8453		32
				1.1		3		134		136	
33		19.3	19		43		0277		8589		33
				1.1		3		131		132	
34		18.2	22		46		0408		8721		34
				1.1		3		126		128	
35		17.1	25		49		0534		8849		35
				1.2		3		123		124	
36		15.9	28		52		0657		8973		36
				1.1		3		120		122	
37		14.8	31		55		0777		9095		37
				1.3		4		116		118	
38		13.5	35		58		0893		9213		38
				1.3		3		114		115	
39		12.2	38		61		1007		9328		39
				1.3		3		110		112	
40		10.9	41		64		1117		9440		40
				1.3		4		108		110	
41		9.6	45		68		1225		9550		41
				1.4		4		106		107	
42		8.2	49		71		1331		9657		42
				1.4		4		102		105	
43		6.8	53		75		1433		9762		43
				1.4		3		101		103	
44		5.4	56		78		1534		9865		44
				1.5		4		98		100	
45		3.9	60		82		1632		8.9965		45
				1.5		4		97		98	
46		2.4	65		86		1729		9.0063		46
				1.6		4		94		97	
47	47	0.8	69		90		1823		0160		47
				1.5		4		92		94	
48	46	59.3	73		94		1915		0254		48
				1.6		4		91		92	
49		57.7	77		0.0498		2006		0346		49
				1.7		5		88		91	
50		56.0	82		0.0502		2094		0437		50
				1.6		4		87		90	
51		54.4	86		06		2181		0527		51
				1.8		5		85		87	
52		52.6	91		10		2266		0614		52
				1.7		5		84		86	
53		50.9	9.7496		15		2350		0700		53
				1.8		5		82		84	
54		49.1	9.7501		19		2432		0784		54
				1.8		4		81		84	
55		47.3	05		24		2513		0868		55
				1.9		5		77		81	
56		45.4	10		29		2592		0949		56
				1.8		5		78		81	
57		43.6	15		33		2670		1030		57
				1.9		6		76		79	
58		41.7	21		38		2746		1109		58
				2.0		5		75		77	
59		39.7	26		43		2821		1186		59
$1^h\ 0^m$	46	37.7	9.7531	2.0	0.0548	5	9.2895	74	9.1263	77	$1^h\ 0^m$

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6

x

2nd

1h

t_o	N		log a		log b		log cot w		log e		t_o
1h 0m	46° 37′ 7	20′	9.75531	5	0.05548	5	9.28995	73	9.12663	76	1h 0m
1	35.7	21	36	6	53	6	2968	72	1339	74	1
2	33.6	20	42	6	59	5	3040	70	1413	73	2
3	31.5	21	48	5	64	5	3110	70	1486	73	3
4	29.4	22	53	6	69	6	3180	68	1559	71	4
5	27.2	22	59	6	75	5	3248	68	1630	70	5
6	25.0	22	65	6	80	6	3316	66	1700	70	6
7	22.8	23	71	6	86	6	3382	66	1770	68	7
8	20.6	23	77	6	92	6	3448	64	1838	68	8
9	18.3	24	83	6	0.05 98	6	3512	64	1906	67	9
10	15.9	24	89	6	0.06 04	6	3576	63	1973	65	10
11	13.5	24	9.75 95	6	10	6	3639	62	2038	65	11
12	11.1	24	9.76 01	7	16	6	3701	61	2103	65	12
13	8.7	25	08	7	22	6	3762	60	2168	64	13
14	6.2	26	15	6	28	7	3822	60	2232	63	14
15	3.6	26	21	7	35	6	3882	58	2295	62	15
16	46 1.0	26	28	7	41	7	3940	58	2357	61	16
17	45 58.4	26	35	7	48	6	3998	58	2418	61	17
18	55.8	26	42	7	54	7	4056	56	2479	60	18
19	53.2	27	49	7	61	7	4112	56	2539	60	19
20	50.5	28	56	7	68	7	4168	56	2599	59	20
21	47.7	28	63	7	75	7	4224	54	2658	58	21
22	44.9	28	70	8	82	7	4278	54	2716	57	22
23	42.1	29	78	7	89	7	4332	54	2773	57	23
24	39.2	29	85	7	0.06 96	8	4386	53	2830	57	24
25	36.3	29	9.76 92	8	0.07 04	7	4439	52	2887	56	25
26	33.4	30	9.77 00	8	11	7	4491	51	2943	55	26
27	30.4	30	08	7	18	8	4542	51	2998	55	27
28	27.4	30	15	8	26	8	4593	51	3053	55	28
29	24.4	31	23	8	34	8	4644	50	3108	54	29
1h 30m	45 21.3		9.77 31		0.07 42		9.46 94		9.31 62		1h 30m

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X Set 1^h 7

t_o	N		log a		log b		log cot m		log c		t_o
$1^h\ 30^m$	45° 21′ 3	3·1	9·7731	8	0·0742	7	9·4694	49	9·3162	53	$1^h\ 30^m$
31	18·2	3·2	39	8	49	8	4743	49	3215	53	31
32	15·0	3·2	47	8	57	9	4792	49	3268	53	32
33	11·8	3·2	55	8	66	8	4841	48	3321	52	33
34	8·6	3·3	63	9	74	8	4889	47	3373	51	34
35	5·3	3·3	72	8	82	8	4936	47	3424	51	35
36	45 2·0	3·4	80	9	90	9	4983	47	3475	51	36
37	44 58·6	3·4	89	8	0·0799	9	5030	46	3526	50	37
38	55·2	3·4	9·7797	9	0·0808	8	5076	45	3576	50	38
39	51·8	3·5	9·7806	9	16	9	5121	46	3626	50	39
40	48·3	3·5	15	8	25	9	5167	45	3676	50	40
41	44·8	3·6	23	9	34	9	5212	44	3726	49	41
42	41·2	3·6	32	9	43	9	5256	44	3775	48	42
43	37·6	3·6	41	9	52	9	5300	44	3823	48	43
44	34·0	3·6	50	9	61	9	5344	43	3871	48	44
45	30·4	3·8	59	9	70	9	5387	43	3919	47	45
46	26·6	3·8	68	10	79	10	5430	42	3966	47	46
47	22·8	3·8	78	9	89	10	5472	42	4013	47	47
48	19·0	3·8	87	10	0·0899	10	5514	42	4060	47	48
49	14·2	3·9	9·7897	9	0·0909	9	5556	41	4107	46	49
50	11·3	3·9	9·7906	10	18	10	5597	41	4153	45	50
51	7·4	4·0	16	10	28	10	5638	41	4198	46	51
52	44 3·4	4·0	26	10	38	10	5679	40	4244	45	52
53	43 59·4	4·0	36	9	48	11	5719	40	4289	45	53
54	55·4	4·1	45	10	59	10	5759	40	4334	45	54
55	51·3	4·2	55	10	69	11	5799	39	4379	44	55
56	47·1	4·2	65	10	80	10	5838	39	4423	44	56
57	42·9	4·2	75	11	0·0990	11	5877	39	4467	44	57
58	38·7	4·2	86	10	0·1001	11	5916	39	4511	44	58
59	34·5	4·3	9·7996	10	12	10	5955	38	4555	43	59
$2^h\ 0^m$	43 30·2		9·8006		0·1022		9·5993		9·4598		$2^h\ 0^m$

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t_0	i	N		$\log a$		$\log b$		$\log \frac{ch}{m}$		$\log c$		t_0
$2^h\ 0^m$	$43^\circ\ 30'2$		4.4	9.80006	11	0.10222	11	9.59993	37	9.45978	43	$2^h\ 0^m$
1		25.8	4.4	17	10	33	11	6030	38	4641	43	1
2		21.4	4.4	27	11	44	12	6068	37	4684	43	2
3		17.0	4.4	38	10	56	11	6105	37	4727	42	3
4		12.6	4.6	48	11	67	11	6142	37	4769	42	4
5		8.0	4.6	59	11	78	12	6179	37	4811	42	5
6	43	3.4	4.6	70	11	0.10890	12	6216	36	4853	42	6
7	42	58.8	4.6	81	11	0.11102	12	6252	36	4895	41	7
8		54.2	4.7	9.80922	11	14	11	6288	36	4936	41	8
9		49.5	4.8	9.81033	11	25	12	6324	35	4977	41	9
10		44.7	4.8	14	11	37	13	6359	35	5018	41	10
11		39.9	4.8	25	11	50	12	6394	35	5059	41	11
12		35.1	4.8	36	11	62	12	6429	35	5100	40	12
13		30.3	4.9	47	12	74	13	6464	34	5140	40	13
14		25.4	5.0	59	11	87	12	6498	34	5180	40	14
15		20.4	5.1	70	12	0.11999	13	6532	34	5220	40	15
16		15.3	5.0	82	11	0.12120	13	6566	34	5260	39	16
17		10.3	5.1	9.81935	12	25	13	6600	34	5299	39	17
18		5.2	5.2	9.82057	12	38	13	6634	33	5338	40	18
19	42	0.0	5.2	17	12	51	13	6667	33	5378	39	19
20	41	54.8	5.2	29	12	64	13	6700	33	5417	37	20
21		49.6	5.3	41	12	77	14	6733	33	5456	38	21
22		44.3	5.3	53	12	0.12901	13	6766	32	5494	39	22
23		39.0	5.4	65	12	0.13044	14	6798	32	5533	38	23
24		33.6	5.5	77	12	18	14	6830	32	5571	38	24
25		28.1	5.5	9.82889	12	32	14	6862	32	5609	38	25
26		22.6	5.5	9.83001	12	46	14	6894	32	5647	38	26
27		17.1	5.6	13	12	60	14	6926	31	5685	38	27
28		11.5	5.6	26	12	74	15	6957	31	5723	37	28
29		5.9	5.7	38	13	0.13889	14	6988	32	5760	37	29
$2^h\ 30^m$	41	0.2		9.83351		0.14030		9.70220		9.57797		$2^h\ 30^m$

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2h

t_o	N			log a		log b		log cot n		log c		t_o
2h 30m	41°	1'2	5.7	9.8351	12	0.1403	15	9.7020	30	9.5797	37	2h 30m
31	40	54.5	5.8	63	13	18	14	7050	31	5834	37	31
32		48.7	5.8	76	12	32	15	7081	31	5871	37	32
33		42.9	5.9	9.8388	13	47	15	7112	30	5908	37	33
34		37.0	5.9	9.8401	13	62	15	7142	30	5945	37	34
35		31.1	5.9	14	13	77	16	7172	30	5981	36	35
36		25.2	6.0	27	13	0.1493	15	7202	29	6017	36	36
37		19.2	6.1	40	13	0.1508	16	7231	30	6053	37	37
38		13.1	6.1	53	13	24	15	7261	29	6090	36	38
39		7.0	6.2	66	13	39	16	7290	30	6126	36	39
40	40	0.8	6.3	79	13	55	16	7320	29	6162	36	40
41	39	54.5	6.3	9.8492	13	71	16	7349	29	6198	35	41
42		48.2	6.3	9.8505	14	0.1587	17	7378	29	6233	35	42
43		41.9	6.3	19	13	0.1604	16	7407	28	6268	36	43
44		35.6	6.5	32	13	20	16	7435	29	6304	35	44
45		29.1	6.5	45	14	36	17	7464	28	6339	35	45
46		22.6	6.5	59	14	53	17	7492	28	6374	34	46
47		16.1	6.6	73	13	70	17	7520	28	6408	35	47
48		9.5	6.7	9.8586	14	0.1687	17	7548	28	6443	35	48
49	39	2.8	6.7	9.8600	13	0.1704	17	7576	27	6478	34	49
50	38	56.1	6.7	13	14	21	17	7603	28	6512	35	50
51		49.4	6.7	27	14	39	18	7631	27	6547	34	51
52		42.7	6.9	41	14	56	17	7658	27	6581	34	52
53		35.8	7.0	55	14	74	18	7685	27	6615	34	53
54		28.8	6.9	69	14	0.1792	18	7712	27	6649	34	54
55		21.9	7.0	83	14	0.1810	18	7739	27	6683	34	55
56		14.9	7.0	9.8697	14	28	19	7766	26	6717	33	56
57		7.9	7.2	9.8711	14	47	18	7792	27	6750	33	57
58	28	0.7	7.2	25	14	65	19	7819	26	6783	34	58
59	37	53.5	7.2	39	14	0.1884	19	7845	26	6817	33	59
3h 0m	37	46.3		9.8753		0.1903		9.7871		9.6850		3h 1m

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10

+ cot

3h

t_0	N		log a		log b		log cot n	log c	t_0
3h 0m	37° 46′3	7.2	9·8753	14	0·1903	19	9·7871 26	9·6850 33	3h 0m
1	39·1	7.3	67	15	22	19	7897 26	6883 33	1
2	31·8	7.5	82	14	41	20	7923 25	6916 33	2
3	24·3	7.5	9·8796	14	60	20	7948 26	6949 33	3
4	16·8	7.6	9·8810	15	0·1980	20	7974 26	6982 32	4
5	9·2	7.5	25	14	0·2000	20	8000 25	7014 33	5
6	37 1·7	7.6	39	15	20	20	8025 25	7047 33	6
7	36 54·1	7.7	54	14	40	20	8050 25	7080 32	7
8	46·4	7.8	68	15	60	20	8075 25	7113 32	8
9	38·6	7.8	83	15	0·2080	21	8100 25	7144 32	9
10	30·8	7.9	9·8898	14	0·2101	21	8125 24	7176 32	10
11	22·9	7.8	9·8912	15	22	21	8149 25	7208 32	11
12	15·1	7.9	27	14	43	21	8174 24	7240 31	12
13	36 7·2	8.1	41	15	64	21	8198 24	7271 32	13
14	35 59·1	8.1	56	15	0·2185	22	8222 25	7303 31	14
15	51·0	8.1	71	15	0·2207	21	8247 24	7334 32	15
16	42·9	8.2	9·8986	15	28	22	8271 23	7366 31	16
17	34·7	8.3	9·9001	15	50	22	8294 24	7397 31	17
18	26·4	8.3	16	15	72	22	8318 24	7428 31	18
19	18·1	8.4	31	15	0·2294	23	8342 23	7459 31	19
20	9·7	8.4	46	15	0·2317	23	8365 23	7490 31	20
21	35 1·3	8.6	61	15	40	23	8388 24	7521 31	21
22	34 52·7	8.6	76	15	63	23	8412 23	7552 30	22
23	44·1	8.6	9·9091	15	0·2386	23	8435 23	7582 31	23
24	35·5	8.6	9·9106	15	0·2409	23	8458 22	7613 30	24
25	26·9	8.7	21	15	32	24	8480 23	7643 30	25
26	18·2	8.8	36	15	56	24	8503 23	7673 31	26
27	9·4	8.9	51	15	0·2480	24	8526 22	7704 30	27
28	34 0·5	9.0	66	15	0·2504	25	8548 22	7734 30	28
29	33 51·5	9.1	81	16	29	24	8570 23	7764 29	29
3h 30m	33 42·4		9·9197		0·2553		9·8593	9·7793	3h 30m

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X Sept

3h

11

t_o	N		log a		log b		log cot n		log c		t_o
2h 30m	33° 42′ 2″	9·0	9·91197	15	0·25553	25	9·85993	22	9·77793	30	3h 30m
31	33 4	9·1	9·92212	15	25778	25	86153	22	78223	30	31
32	24·3	9·2	27	15	26003	25	86373	22	78533	29	32
33	15·1	9·2	42	15	26228	26	86593	21	78822	30	33
34	33 5·9	9·3	58	16	26454	26	86808	22	79122	29	34
35	32 56·6	9·4	73	15	26680	26	87024	22	79411	29	35
36	47·2	9·4	9·92888	15	27006	26	87245	21	79700	29	36
37	37·8	9·5	9·93033	15	27232	26	87466	21	79999	29	37
38	28·3	9·6	18	16	27458	27	87687	21	80288	28	38
39	18·7	9·6	34	15	27685	27	87887	21	80576	29	39
40	32 9·1	9·6	49	16	28122	27	88088	21	80865	29	40
41	31 59·5	9·7	65	15	28339	27	88289	21	81154	28	41
42	49·8	9·8	80	15	28566	28	88501	20	81442	28	42
43	40·0	9·9	9·93955	16	28794	28	88701	21	81701	29	43
44	30·1	10·0	9·94111	15	29022	28	88911	20	81989	28	44
45	20·1	10·0	26	15	29250	29	89111	21	82277	28	45
46	10·1	10·1	41	16	29479	29	89321	20	82555	28	46
47	31 1·0	10·1	57	15	30008	29	89521	20	82833	27	47
48	30 49·9	10·2	72	15	30237	29	89721	20	83110	28	48
49	39·7	10·3	9·94887	15	30466	30	89922	20	83388	27	49
50	29·4	10·3	9·95053	15	30696	30	90122	19	83665	28	50
51	19·1	10·4	18	15	31256	30	90321	20	83933	27	51
52	30 8·7	10·4	33	16	31556	30	90521	19	84220	27	52
53	29 58·3	10·6	49	15	31856	31	90720	19	84477	27	53
54	47·7	10·6	64	15	32217	31	90889	20	84744	27	54
55	37·1	10·6	79	15	32548	31	91109	19	85001	26	55
56	26·5	10·7	9·95994	16	32879	32	91328	19	85527	27	56
57	15·8	10·8	9·96110	15	33111	32	91547	19	85554	26	57
58	29 5·0	10·8	25	15	33343	32	91766	18	85780	26	58
59	28 54·2	10·9	40	15	33575	33	91984	19	86066	27	59
4h 0m	28 43·3		9·96555		0·34008		9·92203		9·86333		4h 0m

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12.

Sat

4h

t_0	N		log a'		log b		log cot n		log c		t_0
4h 0m	28° 43′ 8″	1	9.96555	15	0.03408	33	9.92033	18	9.86333	25	4h 0m
1	32.2	1.0	70	15	3441	33	21	18	58	26	1
2	21.2	1.1	9.96855	15	3474	34	39	19	9.86884	26	2
3	28 10.1	1.1	9.97000	16	3508	34	58	18	9.87110	26	3
4	27 58.9	1.2	16	15	3542	34	76	18	36	26	4
5	47.7	1.2	31	15	3576	35	9.92994	18	62	25	5
6	36.4	1.3	46	15	3611	35	9.93312	18	9.87787	25	6
7	25.0	1.4	61	15	3646	36	30	17	9.88112	25	7
8	13.5	1.5	76	14	3682	36	47	17	37	25	8
9	27 2.0	1.5	9.97790	15	3718	36	64	18	62	25	9
10	26 50.5	1.6	9.98056	15	3754	36	82	17	9.88887	24	10
11	38.9	1.7	20	15	3790	37	9.93999	17	9.89111	25	11
12	27.2	1.8	35	15	3827	38	9.94116	17	36	24	12
13	15.4	1.8	50	14	3865	38	33	17	60	24	13
14	26 3.6	1.9	64	15	3903	38	50	17	9.89984	24	14
15	25 51.7	2.0	79	14	3941	38	67	16	9.90008	24	15
16	39.7	2.1	9.98993	15	3979	39	9.94833	17	32	24	16
17	27.6	2.1	9.99008	15	4018	40	9.95000	16	56	24	17
18	15.5	2.2	23	14	4058	40	16	16	9.90800	23	18
19	25 3.3	2.2	37	14	4098	40	32	16	9.91103	23	19
20	24 51.0	2.3	51	15	4138	41	48	16	26	23	20
21	38.8	2.4	66	14	4179	41	64	16	49	23	21
22	26.4	2.4	80	14	4220	42	80	16	72	23	22
23	14.0	2.5	9.99994	14	4262	43	9.95596	15	9.91995	23	23
24	24 1.5	2.6	0.00008	14	4305	43	9.96111	16	9.92218	22	24
25	23 48.9	2.6	22	14	4348	43	27	15	40	23	25
26	36.3	2.7	36	14	4391	43	42	15	63	22	26
27	23.6	2.8	50	14	4434	45	57	15	9.92285	22	27
28	23 10.8	2.8	64	14	4479	45	72	15	9.93307	21	28
29	22 58.0	2.9	78	14	4524	45	9.96687	15	28	22	29
4h 30m	22 45.1		0.00092		0.04569		9.97020		9.93350		4h 30m

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Sept

4h

13

t_o	N		log a		log b		log cot m		log c		t_o
4h 30m	22° 45′ 1	12′9	0·00092	13	0·45699	46	9·97702	15	9·93500	22	4h 30m
31	32·2	13·1	0·00105	14	46155	47	17	14	72	21	31
32	19·1	13·1	19	14	46622	47	31	14	9·93933	21	32
33	22 6·0	13·1	33	13	47099	48	45	15	9·94145	21	33
34	21 52·9	13·2	46	13	47577	48	60	14	35	21	34
35	39·7	13·2	59	14	48055	49	74	14	56	20	35
36	26·5	13·3	73	13	48534	50	9·97888	13	76	21	36
37	21 13·2	13·4	86	13	49014	50	9·98101	14	9·94497	20	37
38	20 59·8	13·5	0·00199	13	49554	51	15	13	9·95117	20	38
39	46·3	13·5	0·00212	13	50035	52	28	14	37	20	39
40	32·8	13·6	25	12	50577	53	42	13	57	19	40
41	19·2	13·6	37	13	51110	53	55	13	76	20	41
42	20 5·6	13·7	50	12	51663	54	68	13	9·95996	19	42
43	19 51·9	13·8	62	13	52217	54	81	13	9·96115	19	43
44	38·1	13·8	75	12	52771	56	9·98894	13	34	19	44
45	24·3	13·9	0·00287	13	53327	56	9·99907	12	53	18	45
46	19 10·4	13·9	0·00300	12	53883	57	19	13	71	19	46
47	18 56·5	14·0	12	12	54440	58	32	12	9·96900	18	47
48	42·5	14·1	24	12	54998	59	44	12	9·97008	18	48
49	28·4	14·1	36	12	55557	60	56	12	26	18	49
50	14·3	14·1	48	12	56117	60	68	12	44	18	50
51	18 0·2	14·2	60	11	56677	61	80	12	62	18	51
52	17 46·0	14·3	71	12	57238	63	9·99992	11	80	17	52
53	31·7	14·4	83	11	58001	64	0·00003	11	9·97997	17	53
54	17·3	14·4	0·00394	11	58655	64	14	11	9·98147	16	54
55	17 2·9	14·5	0·00405	11	59229	65	25	11	30	17	55
56	16 48·4	14·5	16	11	59994	67	36	11	47	16	56
57	33·9	14·5	27	11	60611	68	47	11	63	16	57
58	19·4	14·6	38	11	61229	69	58	10	79	16	58
59	16 4·8	14·7	49	10	61988	70	68	11	9·98995	16	59
5h 0m	15 50·1		0·00459		0·62688		0·00079		9·99911		5h 0m

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t_0	N		log a		log b		log cst n		log c		t_0
5h 0m	15° 50′ 1		0·04599		0·62688		0·00079		9·99911		5h 0m
		14·7		11		71		10		16	
1	35·4		70		6339		89		27		1
		14·8		10		73		10		15	
2	20·6		80		6412		0·00099		42		2
		14·8		11		74		10		15	
3	15 5·8		0·04491		6486		0·01009		57		3
		14·9		10		75		10		15	
4	14 50·9		0·05501		6561		19		72		4
		14·9		10		77		10		14	
5	36·0		11		6638		29		9·99986		5
		15·0		10		78		9		14	
6	21·0		21		6716		38		0·00000		6
		15·0		9		80		10		15	
7	14 6·0		30		6796		48		05		7
		15·1		9		81		9		14	
8	13 50·9		39		6877		57		29		8
		15·1		9		83		9		13	
9	35·8		48		6960		66		42		9
		15·2		10		85		8		14	
10	20·6		58		7045		74		56		10
		15·2		9		86		9		13	
11	13 5·4		67		7131		83		69		11
		15·3		9		88		9		13	
12	12 50·1		76		7219		0·01992		82		12
		15·3		9		90		8		13	
13	34·8		85		7309		0·02000		0·00995		13
		15·3		8		92		8		12	
14	19·5		0·05593		7401		08		0·01007		14
		15·4		8		94		8		12	
15	12 4·1		0·06601		7495		16		19		15
		15·5		8		97		8		12	
16	11 48·6		09		7592		24		31		16
		15·5		8		98		8		12	
17	33·1		17		7690		32		43		17
		15·5		8		101		7		11	
18	17·6		25		7791		39		54		18
		15·6		8		104		8		12	
19	11 2·0		33		7895		47		66		19
		15·6		8		106		7		11	
20	10 46·4		41		8001		54		77		20
		15·6		7		109		7		10	
21	31·8		48		8110		61		87		21
		15·7		7		112		7		11	
22	10 15·1		55		8222		68		0·01998		22
		15·7		7		114		6		10	
23	9 59·4		62		8336		74		0·02008		23
		15·8		7		118		7		10	
24	43·6		69		8454		81		18		24
		15·7		7		122		6		10	
25	27·9		76		8576		87		28		25
		15·8		7		125		6		9	
26	9 12·1		83		8701		93		37		26
		15·9		7		128		6		10	
27	8 56·2		90		8829		0·02999		47		27
		15·9		6		133		6		9	
28	40·3		0·06996		8962		0·03005		56		28
		15·9		6		137		6		8	
29	24·4		0·07002		9099		11		64		29
		16·0		5		142		5		8	
5h 30m	8 8·4		0·07007		0·92411		0·03216		0·02722		5h 30m

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5h

t_0	N			log a		log b		log cot n	log c	t_0
5h 30m	8°	8'.4	16.0	0.0707	6	0.9241	146	0.0316 6	0.0272 8	5h 30m
31	7	52.4	16.0	13	5	9387	152	22 5	80 8	31
32		36.4	16.0	18	6	9539	157	27 5	88 8	32
33		20.4	16.1	24	5	9696	163	32 5	0.0296 7	33
34	7	4.3	16.1	29	5	0.9859	170	37 4	0.0303 7	34
35	6	48.2	16.1	34	5	1.0029	176	41 4	10 7	35
36		32.1	16.2	39	5	0205	185	45 5	17 7	36
37	6	15.9	16.2	44	4	0390	192	50 4	24 6	37
38	5	59.7	16.2	48	4	0582	201	54 4	30 6	38
39		43.5	16.2	52	4	0783	212	58 3	36 6	39
40		27.3	16.2	56	4	0995	222	61 4	42 5	40
41	5	11.1	16.2	60	3	1217	234	65 3	47 5	41
42	4	54.9	16.3	63	3	1451	248	68 3	52 5	42
43		38.6	16.3	66	4	1699	263	71 3	57 5	43
44		22.3	16.3	70	3	1962	280	74 3	62 4	44
45	4	6.0	16.3	73	3	2242	299	77 3	66 4	45
46	3	49.7	16.4	76	3	2541	321	80 2	70 4	46
47		33.3	16.4	79	2	2862	348	82 2	74 3	47
48		16.9	16.3	81	2	3210	377	84 2	77 4	48
49	3	0.6	16.4	83	3	3587	414	86 2	81 3	49
50	2	44.2	16.4	85	2	4001	457	88 2	84 2	50
51		27.8	16.4	87	2	4458	512	90 2	86 3	51
52	2	11.4	16.4	89	1	4970	579	92 2	89 2	52
53	1	55.1	16.4	90	2	5549	669	94 1	91 2	53
54		38.6	16.4	92	1	6218	792	95 1	93 1	54
55		22.2	16.5	93	1	7010		96 0	94 1	55
56	1	5.7	16.4	94	1	7979		96 1	95 1	56
57	0	49.3	16.4	95	0	1.9228		97 0	96 1	57
58		32.9	16.5	95	0	2.0989		97 1	97 1	58
59		16.4	16.4	95	0	2.4000		98 0	98 0	59
6h 0m	0	0.0		0.0795		∞		0.0398	0.0398	6h 0m

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Correction for Diff. Refr. in α for $\Delta\alpha = 100^s$
Arguments δ_o and t_o.

	$0^h\,0^m$	$0^h\,10^m$	$0^h\,20^m$	$0^h\,30^m$	$0^h\,40^m$	$0^h\,50^m$	$1^h\,0^m$	$1^h\,10^m$	$1^h\,20^m$	$1^h\,30^m$
$-35°$										
-34	099	100	102		109		124		149	
-33										
-32	086	087	088		094		105		124	
-31										
-30	076	076	077	079	082	085	090	097	105	115
-29	072	072	073	075	077	080	085	090	097	104
-28	068	068	069	071	073	076	080	085	091	099
-27	064	064	065	067	069	072	075	080	085	091
-26	061	061	062	063	065	068	071	075	080	085
-25	058	058	059	060	062	064	067	071	075	080
-24	055	055	056	057	059	061	063	067	071	076
-23	053	053	053	054	056	058	060	063	067	072
-22	051	051	051	053	054	056	058	061	064	068
-21	049	049	049	050	051	053	055	058	061	065
-20	047	047	047	048	049	051	053	055	058	062
-19	045	045	045	046	047	049	050	052	055	059
-18	043	044	044	045	046	047	048	050	053	056
-17	042	042	043	043	044	045	046	048	051	054
-16	040	040	041	042	042	044	045	047	049	052
-15	039	039	039	040	041	042	043	045	047	050
-14	038	038	038	039	040	041	042	044	046	048
-13	037	037	037	038	039	040	041	042	044	046
-12	036	036	036	037	038	039	040	041	043	045
-11	035	035	035	036	037	037	038	039	041	043
-10	034	034	034	035	036	036	037	038	040	042
-9	033	033	033	034	035	035	036	037	039	040
-8	032	033	033	034	034	035	035	036	038	039
-7	032	032	032	033	033	034	034	035	037	038
-6	031	031	031	032	032	033	034	035	036	037
-5	030	030	030	031	031	032	033	034	035	036
-4	030	030	030	031	031	031	032	033	034	035
-3	029	029	029	030	030	030	031	032	033	034
-2	029	029	029	029	029	030	031	032	033	034
-1	028	028	028	029	029	029	030	031	032	033
0	$0^s.028$	$0^s.028$	$0^s.028$	$0^s.029$	$0^s.029$	$0^s.029$	$0^s.030$	$0^s.031$	$0^s.032$	$0^s.033$

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Correction for Diff. Refr. in δ. for Δα = 100ˢ

Arguments δ₀ and t₀

	$0^h\,0^m$	$0^h\,10^m$	$0^h\,20^m$	$0^h\,30^m$	$0^h\,40^m$	$0^h\,50^m$	$1^h\,0^m$	$1^h\,10^m$	$1^h\,20^m$	$1^h\,30^m$
-35°										
-34		0·15	0·31	0·48	0·66	0·86	1·08	1·31	1·65	2·04
-33		13	27	42	58	75	0·95	1·17	1·43	1·75
-32		12	24	37	51	66	83	1·02	1·25	1·52
-31		10	21	33	45	58	73	0·90	1·10	1·33
-30		09	19	27	40	52	65	80	0·97	1·17
-29		09	18	27	36	46	58	71	86	1·04
-28		08	16	24	33	42	53	64	78	0·93
-27		07	15	22	30	39	48	58	71	83
-26		06	13	20	28	36	44	54	64	75
-25		06	12	18	25	32	40	49	58	69
-24		05	11	17	23	29	37	45	54	64
-23		05	10	15	21	27	34	42	50	59
-22		05	10	15	20	26	32	39	46	54
-21		04	09	13	18	23	29	35	42	50
-20	Zero.	04	08	12	17	22	27	33	39	46
-19		04	08	12	16	21	26	31	36	43
-18		03	07	11	15	19	24	29	34	40
-17		03	07	10	14	18	22	27	32	38
-16		03	06	10	14	17	21	25	30	36
-15		03	06	09	13	16	20	24	28	34
-14		03	06	09	12	15	19	23	27	32
-13		03	06	09	12	15	18	22	26	30
-12		02	05	08	11	14	17	20	24	28
-11		02	05	07	10	13	16	19	23	27
-10		02	05	07	10	13	16	19	22	26
-9		02	05	07	09	12	15	18	21	24
-8		02	04	06	09	11	14	17	20	23
-7		02	04	06	08	11	14	16	19	22
-6		02	04	06	08	10	13	15	18	21
-5		02	04	06	08	10	12	15	18	20
-4		02	04	06	08	10	12	14	17	20
-3		02	04	06	07	09	11	13	16	19
-2		02	04	05	07	09	11	13	16	18
-1		02	03	05	07	09	11	13	15	17
0		0″·02	0″·03	0″·05	0″·07	0″·09	0″·11	0″·13	0″·15	0″·17

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Correction for Diff. Refr. in α for $\Delta\alpha = 100^s$
Arguments δ_0 & t_0

	$0^h\,0^m$	$0^h\,10^m$	$0^h\,20^m$	$0^h\,30^m$	$0^h\,40^m$	$0^h\,50^m$	$1^h\,0^m$	$1^h\,10^m$	$1^h\,20^m$	$1^h\,30^m$
0°	$0^s.028$	$0^s.028$	$0^s.028$	$0^s.029$	$0^s.029$	$0^s.029$	$0^s.030$	$0^s.031$	$0^s.032$	$0^s.033$
+ 2	027	027	027	028	028	028	029	030	030	032
+ 4	026	026	026	027	027	027	028	029	030	031
+ 6	026	026	026	026	026	026	027	028	029	030
+ 8	025	025	025	026	026	026	027	027	028	029
+ 10	025	025	025	025	025	026	026	026	027	028
+ 12	024	024	025	025	025	026	026	026	027	028
+ 14	024	024	024	024	025	025	025	026	026	027
+ 16	024	024	024	024	024	024	025	026	026	027
+ 18	024	024	024	024	024	024	025	026	026	026
+ 20	024	024	024	024	024	024	025	025	026	026
+ 22	024	024	024	024	024	024	025	025	026	026
+ 24	024	024	024	024	024	024	025	025	026	026
+ 26	024	024	024	024	024	024	025	025	026	026
+ 28	024	024	024	024	024	024	025	025	026	026
+ 30	024	024	024	024	025	025	025	025	026	026
+ 32	025	025	025	025	025	026	026	026	026	027
+ 34	025	025	025	026	026	026	026	026	026	027
+ 36	026	026	026	026	026	026	026	027	027	027
+ 38	026	026	026	026	027	027	027	028	028	028
+ 40	027	027	027	027	027	028	028	028	028	028
+ 42										

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Correction for Diff. Refr. in δ for $\Delta\alpha = 100^s$
Arguments δ_0 & t_0

	$0^h\ 0^m$	$0^h\ 10^m$	$0^h\ 20^m$	$0^h\ 30^m$	$0^h\ 40^m$	$0^h\ 50^m$	$1^h\ 0^m$	$1^h\ 10^m$	$1^h\ 20^m$	$1^h\ 30^m$
0	zero	0".02	0".03	0".05	0".07	0".09	0".11	0".13	0".15	0".17
+2		02	03	04	06	08	10	12	14	16
+4		01	03	04	06	08	07	11	13	15
+6		01	03	04	06	07	09	11	12	14
+8		01	03	04	06	07	08	10	12	13
+10		01	02	04	05	07	08	10	11	12
+12		01	02	04	05	06	08	09	11	12
+14		01	02	03	05	06	07	09	10	11
+16		01	02	03	05	06	07	08	10	11
+18		01	02	03	04	06	07	08	10	11
+20		01	02	03	04	05	07	08	09	11
+22		01	02	03	04	05	06	08	09	10
+24		01	02	03	04	05	06	07	09	10
+26		01	02	03	04	05	06	07	08	10
+28		01	02	03	04	05	06	07	08	10
+30		01	02	03	04	05	06	07	08	09
+32		01	02	03	04	05	06	07	08	09
+34		01	02	03	04	05	06	07	08	09
+36		01	02	03	04	05	06	07	08	09
+38		01	02	03	04	05	06	07	08	09
+40		01	02	03	04	05	06	07	08	09

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Correction for Diff. Refr. in α for $\Delta\alpha = 100^s$

Arguments δ_o & t_o

	$1^h 30^m$	$1^h 40^m$	$1^h 50^m$	$2^h 0^m$	$2^h 10^m$	$2^h 20^m$	$2^h 30^m$	$2^h 40^m$	$2^h 50^m$	$3^h 0^m$
−30°	0.115	0.127	0.143	0.163	0.189	0.224		0.335		0.566
−29	106	117	131	148	171	201				
−28	099	108	120	135	155	180	213	257		406
−27	091	099	110	124	142	162	189			
−26	085	092	102	115	131	148	171	204		307
−25	080	086	095	107	120	136	156	185		
−24	076	082	090	099	110	125	144	168	200	242
−23	072	077	084	092	103	116	133	153	181	217
−22	068	073	079	087	097	108	122	141	165	196
−21	065	069	075	082	091	101	113	130	151	178
−20	062	066	071	077	085	094	106	120	139	163
−19	059	063	067	073	080	089	100	112	129	150
−18	056	060	064	069	075	084	094	105	120	139
−17	054	057	061	066	072	079	088	098	111	129
−16	052	055	059	063	069	075	083	092	104	120
−15	050	052	056	060	066	071	078	087	098	112
−14	048	050	054	058	063	068	074	083	093	105
−13	046	048	052	055	060	065	070	078	088	099
−12	045	047	050	053	057	062	067	074	083	093
−11	043	045	048	051	055	059	064	071	079	088
−10	042	044	046	049	053	057	062	068	075	084
−9	040	042	044	047	051	055	059	065	072	081
−8	039	041	043	046	049	053	057	062	068	076
−7	038	040	042	044	047	051	055	060	065	072
−6	037	039	041	043	046	049	053	058	063	069
−5	036	038	040	042	044	047	051	056	061	066
−4	035	037	039	041	043	046	050	054	059	064
−3	034	036	038	040	042	045	048	052	056	061
−2	034	035	037	039	041	044	047	050	054	059
−1	033	034	036	038	040	042	045	048	052	057
0	033	034	035	037	039	041	044	047	051	055
+1	032	033	034	036	038	040	043	046	049	053
+2	032	033	034	036	037	039	042	045	048	052
+3	032	032	033	035	036	038	040	043	046	050
+4	031	032	033	034	036	038	040	042	045	049
+5	031	031	032	034	035	037	039	042	045	048

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Correction for Diff. Refr. in δ for Δα = 100ˢ
Arguments δ₀ & t₀

	1ʰ 30ᵐ	1ʰ 40ᵐ	1ʰ 50ᵐ	2ʰ 0ᵐ	2ʰ 10ᵐ	2ʰ 20ᵐ	2ʰ 30ᵐ	2ʰ 40ᵐ	2ʰ 50ᵐ	3ʰ 0ᵐ
−30°	1·17	1·41		2·05		3·07		4·94		8·74
−29	1·04	1·25								
−28	0·93	1·11	1·33	1·60		2·34		3·60		5·99
−27	83	0·98	1·18	1·43						
−26	75	88	1·05	1·28	1·54	1·83		2·73		4·34
−25	69	81	0·96	1·15	1·37	1·63	1·96			
−24	64	75	88	1·04	1·23	1·47	1·76	2·14		3·28
−23	59	69	81	0·95	1·12	1·33	1·59	1·91		
−22	54	63	74	87	1·02	1·21	1·44	1·72	2·09	2·57
−21	50	58	68	80	0·94	1·11	1·31	1·56	1·88	2·29
−20	46	54	63	74	87	1·02	1·20	1·42	1·70	2·06
−19	43	50	59	69	80	0·93	1·09	1·30	1·55	1·87
−18	40	47	55	64	74	86	1·01	1·19	1·42	1·70
−17	38	44	51	60	69	80	0·93	1·10	1·30	1·55
−16	36	42	48	56	65	75	87	1·02	1·20	1·42
−15	34	39	45	52	60	70	81	0·95	1·12	1·31
−14	32	37	42	49	56	65	75	88	1·04	1·21
−13	30	35	40	46	53	61	71	82	0·96	1·12
−12	28	33	38	44	50	58	67	77	89	1·05
−11	27	31	36	41	48	55	63	72	83	0·98
−10	26	30	34	39	45	52	60	68	78	92
−9	24	28	33	38	43	49	56	64	74	86
−8	23	27	31	36	41	46	53	61	70	81
−7	22	26	30	34	39	44	50	58	67	76
−6	21	25	28	32	37	42	48	55	63	72
−5	20	24	27	31	35	40	46	52	60	68
−4	20	23	26	30	34	38	44	50	57	65
−3	19	22	25	28	32	36	41	47	54	62
−2	18	21	24	27	31	35	40	45	52	59
−1	17	21	23	26	29	33	38	43	49	56
0	17	20	22	25	28	32	37	42	47	54
+1	16	19	21	24	27	31	35	40	45	51
+2	16	18	20	24	27	30	34	38	43	49
+3	16	18	20	23	26	29	33	37	42	47
+4	15	17	19	22	25	28	32	36	40	45
+5	0″·15	0″·17	0″·19	0″·22	0″·24	0″·27	0″·30	0″·34	0″·38	0″·43

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Cor. for Diff. Refr. in α for $\Delta\alpha = 100^s$
Arguments δ_o & t_o

	$1^h\,30^m$	$1^h\,40^m$	$1^h\,50^m$	$2^h\,0^m$	$2^h\,10^m$	$2^h\,20^m$	$2^h\,30^m$	$2^h\,40^m$	$2^h\,50^m$	$3^h\,0^m$
+4°	0.030	0.032	0.033	0.034	0.036	0.038	0.040	0.042	0.045	0.049
+6	030	030	032	033	034	036	038	041	043	046
+8	029	030	031	032	033	035	037	039	041	044
+10	028	029	030	031	032	034	036	038	040	042
+12	028	028	029	030	031	033	034	036	038	041
+14	027	028	029	030	031	032	033	035	037	039
+16	027	027	028	029	030	031	032	034	036	038
+18	026	027	028	029	030	031	032	034	035	037
+20	026	027	027	028	029	030	031	033	034	036
+22	026	027	027	028	029	030	031	032	033	035
+24	026	027	027	028	029	030	031	032	033	035
+26	026	027	027	028	029	030	031	032	033	034
+28	026	027	027	028	028	029	030	031	032	034
+30	026	027	027	028	028	029	030	031	032	034
+32	027	027	027	028	029	030	030	031	032	033
+34	027	027	027	028	029	030	030	031	033	033
+36	027	028	028	029	029	030	031	032	032	033
+38	028	028	028	029	029	030	031	032	033	034
+40	028	028	029	030	030	031	032	032	033	034

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1866phae.proj..331.

Corr. for Diff. Refr. in δ for Δα = 100ˢ
Arguments δ₀ & t₀

	1ʰ 30ᵐ	1ʰ 40ᵐ	1ʰ 50ᵐ	2ʰ 0ᵐ	2ʰ 10ᵐ	2ʰ 20ᵐ	2ʰ 30ᵐ	2ʰ 40ᵐ	2ʰ 50ᵐ	3ʰ 0ᵐ
+4°	0″.15	0″.17	0″.19	0″.22	0″.25	0″.28	0″.32	0″.36	0″.40	0″.45
+6	14	16	18	21	24	26	29	33	37	42
+8	13	15	17	20	22	25	28	31	35	39
+10	12	15	17	19	21	24	26	29	33	37
+12	12	14	16	18	20	22	25	28	31	35
+14	11	13	15	17	19	21	23	26	29	33
+16	11	13	14	16	18	20	22	25	28	31
+18	11	12	14	16	17	19	21	24	27	30
+20	11	12	13	15	17	19	21	23	26	28
+22	10	12	13	15	16	18	20	22	24	27
+24	10	11	12	14	16	18	19	21	23	26
+26	10	11	12	14	15	17	19	21	23	25
+28	10	11	12	13	14	16	18	20	22	24
+30	09	10	11	13	14	16	18	20	22	24
+32	09	10	11	13	14	16	17	19	21	23
+34	09	10	11	13	14	16	17	19	21	22
+36	09	10	11	12	13	15	17	18	20	22
+38	09	10	11	12	13	15	16	18	20	22
+40	0·09	0·10	11	13	13	15	16	18	20	21

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1866phae.proj..331.

Corr. for Diff. Distr. in α for $\Delta\alpha = 100^s$
Arguments δ_0 & t_0

	$3^h\ 1^m$	$3^h\ 10^m$	$3^h\ 20^m$	$3^h\ 30^m$	$3^h\ 40^m$	$3^h\ 50^m$	$4^h\ 0^m$	$4^h\ 10^m$	$4^h\ 20^m$	$4^h\ 30^m$
-25°										
-24	242									
-23	217									
-22	196	239	298							
-21	178	215	266							
-20	163	195	239	299	387	523	740			
-19	150	178	216	268	342					
-18	139	164	196	242	304	396	538	768		
-17	129	151	179	219	273	351				
-16	120	140	165	199	246	312	409	560		
-15	112	130	152	182	223	279	361			
-14	105	121	141	168	203	252	322	425	593	872
-13	099	113	131	155	186	229	290	376		
-12	093	106	123	144	172	209	262	337	450	634
-11	088	101	115	135	159	192	238	306	398	
-10	084	094	108	126	148	177	217	277	355	481
-9	080	089	102	118	138	164	199	250	319	425
-8	076	085	096	111	129	152	184	226	288	378
-7	072	081	091	105	121	142	170	207	262	338
-6	069	077	087	099	114	133	158	191	239	315
-5	066	073	083	094	108	125	147	176	218	276
-4	064	070	079	089	102	118	138	164	201	252
-3	061	067	075	085	097	111	130	154	186	231
-2	059	065	072	081	092	105	122	144	173	213
-1	057	062	069	077	087	100	115	135	161	196
0	055	060	067	074	083	095	109	127	151	182
$+1$	053	058	064	071	079	090	103	120	142	170
$+2$	052	056	062	069	076	086	098	113	133	159
$+3$	050	054	060	066	073	082	093	107	125	149
$+4$	049	053	058	064	071	079	089	102	119	140
$+5$	048	051	056	062	068	076	085	097	113	131
$+6$	046	050	054	060	066	073	082	093	107	124
$+7$	045	049	053	058	063	070	079	089	102	118
$+8$	044	048	052	056	061	068	076	085	097	112
$+9$	043	046	050	054	059	066	073	081	093	106
$+10$	042	045	049	053	058	064	070	078	089	101

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Corr. for Diff. Ref. in δ for Δx = 100″
Arguments δ₀ & t₀

	2h 0m	2h 10m	2h 20m	2h 30m	2h 40m	2h 50m	3h 0m	3h 10m	3h 20m	3h 30m
−25°										
−24	3·28									
−23	2·90									
−22	2·57	3·22	4·10							
−21	2·29	2·86	3·60							
−20	2·06	2·55	3·18	4·07	5·36	7·34	10·52			
−19	1·87	2·29	2·83	3·58	4·67					
−18	1·70	2·06	2·54	3·19	4·10	5·43	7·49	10·85		
−17	1·55	1·86	2·29	2·86	3·63	4·75				
−16	1·42	1·70	2·08	2·57	3·24	4·18	5·58	7·76		
−15	1·31	1·57	1·89	2·32	2·91	3·71	4·88			
−14	1·21	1·44	1·73	2·11	2·62	3·32	4·31	5·79	8·14	12·09
−13	1·12	1·32	1·59	1·93	2·37	2·99	3·84	5·08		
−12	1·05	1·23	1·47	1·77	2·16	2·70	3·44	4·49	6·09	8·66
−11	0·98	1·15	1·36	1·63	1·98	2·45	3·09	4·01	5·35	
−10	0·92	1·07	1·26	1·51	1·82	2·24	2·80	3·59	4·73	6·47
− 9	0·86	1·00	1·18	1·40	1·68	2·05	2·55	3·23	4·22	5·68
− 8	0·81	0·94	1·10	1·30	1·56	1·89	2·33	2·93	3·78	5·02
− 7	0·76	0·88	1·03	1·22	1·45	1·75	2·14	2·67	3·40	4·47
− 6	0·72	0·83	0·97	1·14	1·35	1·62	1·97	2·44	3·08	4·01
− 5	0·68	0·78	0·91	1·07	1·26	1·50	1·82	2·23	2·80	3·61
− 4	0·65	0·74	0·86	1·01	1·18	1·40	1·69	2·06	2·57	3·27
− 3	0·62	0·70	0·81	0·95	1·11	1·31	1·57	1·91	2·37	2·97
− 2	0·59	0·67	0·77	0·90	1·05	1·23	1·47	1·77	2·18	2·72
− 1	0·56	0·64	0·73	0·85	0·99	1·16	1·38	1·65	2·01	2·50
0	0·54	0·61	0·70	0·80	0·94	1·09	1·29	1·54	1·87	2·31
+ 1	0·51	0·58	0·67	0·76	0·89	1·03	1·22	1·45	1·74	2·13
+ 2	0·49	0·56	0·64	0·73	0·84	0·98	1·15	1·36	1·63	1·98
+ 3	0·47	0·53	0·61	0·70	0·80	0·93	1·09	1·28	1·53	1·84
+ 4	0·45	0·51	0·58	0·67	0·76	0·88	1·03	1·21	1·43	1·72
+ 5	0·43	0·49	0·56	0·64	0·73	0·84	0·98	1·14	1·34	1·62
+ 6	0·42	0·47	0·54	0·61	0·70	0·80	0·93	1·08	1·27	1·52
+ 7	0·40	0·45	0·52	0·58	0·67	0·76	0·88	1·03	1·20	1·43
+ 8	0·39	0·44	0·50	0·56	0·64	0·73	0·84	0·98	1·14	1·35
+ 9	0·38	0·42	0·48	0·54	0·61	0·70	0·80	0·93	1·08	1·28
+ 10	0·37	0·41	0·46	0·52	0·59	0·67	0·77	0·89	1·03	1·21

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Corr. for Diff. Refr. in α for $\Delta\alpha = 100^s$
Arguments δ_0 & t_0

	$3^h\ 0^m$	$3^h\ 10^m$	$3^h\ 20^m$	$3^h\ 30^m$	$3^h\ 40^m$	$3^h\ 50^m$	$4^h\ 0^m$	$4^h\ 10^m$	$4^h\ 20^m$	$4^h\ 30^m$
+10°	0.042	0.045	0.049	0.053	0.058	0.064	0.070	0.078	0.089	0.101
+12	041	044	047	051	055	060	066	073	082	093
+14	039	042	045	048	052	056	062	068	076	085
+16	038	040	043	046	050	054	058	064	071	079
+18	037	039	042	044	047	051	055	060	066	074
+20	036	038	040	043	046	049	053	057	063	069
+22	035	037	039	042	044	047	051	054	059	065
+24	035	036	038	041	043	046	049	052	057	062
+26	034	036	038	040	042	044	047	050	054	059
+28	034	035	037	039	041	043	046	048	052	056
+30	034	035	036	038	040	042	044	047	050	054
+32	033	035	036	038	039	041	043	046	049	052
+34	033	035	036	037	039	041	042	045	047	050
+36	033	035	036	037	038	040	042	044	046	049
+38	034	035	036	037	038	040	041	043	045	047
+40	034	035	036	037	038	039	041	043	044	046

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Corr. for Diff. Refr. in δ for $\Delta\alpha = 100^s$
Arguments S_0 & t_0

	$3^h\,0^m$	$3^h\,10^m$	$3^h\,20^m$	$3^h\,30^m$	$3^h\,40^m$	$3^h\,50^m$	$4^h\,0^m$	$4^h\,10^m$	$4^h\,20^m$	$4^h\,30^m$
+10°	0".37	0".41	0".46	0".52	0".59	0".67	0".77	0".89	1".03	1".22
+12	35	39	43	49	55	62	71	81	0.94	1.09
+14	33	37	41	46	51	58	66	75	86	0.99
+16	31	35	38	43	48	54	61	69	79	91
+18	30	33	36	41	46	51	57	65	73	84
+20	28	31	35	39	43	48	54	60	68	77
+22	27	30	33	37	41	45	51	57	64	72
+24	26	28	32	35	39	43	48	54	60	67
+26	25	27	30	33	37	41	46	51	57	63
+28	24	26	29	32	36	39	44	48	54	60
+30	24	26	28	31	34	38	42	46	51	57
+32	23	25	28	30	33	36	40	44	49	54
+34	22	25	27	29	32	35	39	42	47	51
+36	22	24	26	28	31	34	37	41	45	49
+38	22	24	26	28	30	33	36	39	43	47
+40	21	23	25	27	30	32	35	38	42	45
+										

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July 16, 1877.

The preparation for the press of the most readily available part of the equatorial and miscellaneous observations made at Harvard College Observatory between the installations, as Director of the Observatory, of Professors Winlock and Pickering, is, at present regarded as desirable. To make it possible, the following index has been prepared. It is intended to enable reference to be made to the observations recorded in the books of series N, so far as these books contain observations of different kinds, so as to require an additional index to that given in book M 36, pp. 23, 24, 25, where the contents of each book in series N are mentioned. For the present, however, the observations of double stars are left without an index, as they were collected and to a great extent electrotyped some years ago. An examination of the work will show hereafter whether any index is necessary; if one is needed, it can be added to the present index.

Besides the observations recorded in the books of series N, there are similar ones in series O and Q which have been included in this index.

In general, the arrangement of the index explains itself. The books are referred to by their numbers in the series to which they belong and by the page or pages containing the observations indexed. The books of series Q, and often of series O, are not paged, and the reference is then merely to the number of the book in its series; the date enables the observations to be readily found in all such cases. The spectroscopic observations are referred to in the right hand column of the index, when any such observations occur.

Principal subdivisions of the index.

Records relating to zero of position of large filar micrometer, pp. 36, 37.
" " " coincidence of wires " " " " p. 37.
" " " screw revolutions, given intervals of " " " p. 37.
Miscellaneous records apparently referring to micrometers, p. 38.
Records relating to the condition of the East Equatorial, p. 38.
Miscellaneous records relating to instruments, etc., p. 38.
Records of observations of aurora, pp. 39, 40
" " " " zodiacal light p. 41
" " " " meteors p. 41
" " miscellaneous occasional phenomena p. 41

Records of astronomical work.

Sun and solar spectrum, p. 42
Larger planets pp. 42, 43
Asteroids pp. 43 to 46
Moon p. 46
Satellites of the superior planets pp. 47, 48
Comets pp. 48, 49
Nebulae pp. 49 to 54
Stars pp. 55 to 57

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Records relating to zero of position of large filar micrometer.

The columns headed M give the date, volume, and page to be consulted for measurements of zero; those headed C contain the corresponding data for records of change in the zero, by removal of micrometer, screwing it up more firmly, etc.; a record of spectroscopic work implies the removal of the micrometer.

M		C	
1866	N	1866	N
May 10	34, 1		
15	34, 1		
June 2	34, 2		
7	34, 3		
9	34, 5		
26	34, 10	June 26	34, 10
July 1	34, 14	July 2	34, 14
2	34, 15		
3	34, 18		
~~10~~	~~34, 24~~		
11	34, 25		
15	34, 37		
22	34, 42		
26	34, 44		
31	34, 53 & 54		
Aug. 8	34, 65		
13	34, 75	Aug. 15	34, 75
17	34, 76	17	34, 76
20	34, 79	20	34, 78 & 79
24	34, 84		
27			
Sept. 10			
22			
Oct. 1	35, 97	Oct. 11	35, 80
5			
20		Oct. 23	36, 3
23	36, 4 & 6		
24	36, 9		
Nov. 2	36, 21		
17	36, 38	Nov. 19	36, 38
19	36, 38		
25	36, 42		
Dec. 7	36, 58		
14	36, 66		~~36, 84~~
1867		1867	
Jan. 12	36, 92		
19	37, 7		
26	37, 25		
Feb. 16	37, 34		
26	37, 49		
March 19	37, 56	March 11	37, 54
21	37, 58		
28	37, 63		
April 5	37, 74		
21	37, 87	May 18	38, 14
May 18	38, 14		
July 10	38, 23		
15	38, 28		
16	38, 29		
24	38, 34		
26	38, 36		
28	38, 44	July 30	38, 38
30	38, 38		
Aug. 2	38, 42	Aug. 18	38, 54 & 55
19	38, 55		
20	38, 58		
21	38, 59		
26	38, 60 & 61	Aug. 26	38, 60 & 61
27	38, 63		
31	38, 66		
Sept. 19	38, 68	Sept. 19	38, 68
21	38, 69		
22	38, 69		
22	38, 70		
24	38, 72 & 73		
25	38, 75		
27	38, 78 & 79		

M		C	
1867	N	1867	N
Sept. 29	38, 80	Sept. 28	38, 78
30	38, 81		
30	38, 83		
Oct. 1	38, 84	Oct. 1	38, 84
2	38, 87		
6	38, 89	6	38, 88
7	38, 90	7	38, 90
7	38, 91	8	38, 94
16	38, 92	22	39, 1
17	38, 93		
18	38, 94		
18	38, 94		
19	38, 96		
19	38, 97		
Oct. 1867 to Feb. 1868	39, 101	Nov. 11	39, 101
1868		1868	
Feb. 4	40, 10		
16	40, 24	Feb. 16	~~39, 101~~
18	40, 26	18	40, 26
20	40, 32		
March 5	40, 49		
11	40, 56	March 19	40, 63
22	40, 67	23	40, 69
23	40, 69	24	40, 70
24	40, 71	25	40, 71
April 1	40, 79	30	40, 73
3	40, 82	April 23	40, 82
26	40, 83	26	40, 83
28	40, 83	28	40, 84
May 4	40, 86		
9	40, 89		
12	40, 92	May 12	40, 93
14	40, 93		
22	40, 94		
31	40, 95		
June 14	40, 96		
28	40, 99		
July 10	13, 44	July 10	13, 45
16	13, 48		
28	13, 50		
Aug. 9	13, 52		
21	13, 67		
23	13, 68	Aug. 27	13, 70
31	13, 72		
Sept. 16	13, 82	Sept. 18	13, 84
29	13, 88	29	13, 87
Oct. 3	13, 90	Oct. 3	13, 90
9	13, 91		
23	14, 24		
28	14, 32		
Nov. 5	14, 48	Nov. 6	14, 50
23	14, 69	23	14, 70
Dec. 10	14, 84	Dec. 10	14, 84
15	14, 88	13	14, 87
1869 Jan. 4	15, 16	15	14, 90
Jan. 22	15, 22	19	14, 94
Feb. 1	15, 41	28	15, 6
4	15, 50	1869	
7	15, 52	Jan. 14	15, 16
13	15, 54	16	15, 19
March 3	15, 70	Feb. 2	15, 27
15	15, 74	4	15, 49
25	15, 80	4	15, 51
April 3	15, 81	13	15, 54
5	15, 85	March 9	15, 71
8	15, 88	April 5	15, 85
June 19	16, 29 & 30	10	15, 90

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M		C		M		C	
1869	N	1869	N	Dec. 20, 1869 to Oct. 4, 1871	49	1871	N
Aug. 22	16, 37	April 28	16, 1	1871		Aug. 31	48, 70
26	16, 43	Eclipse expedition	16, 34	Nov. 5	18, 1	Nov. 12	48, 82
31	16, 46	Aug. 24	16, 41	6	18, 2	1872	
Sept. 5	16, 51	Oct. 31	17, 4	1872		Jan. 8	48, 88
11	16, 53	Dec. 24 1870 Feb. 20 March 20 1871 April 7 Oct. 4	49	Jan. 18	18, 8	Feb. 19	48, 99
19	16, 63			Jan. 25 Jan. 29 Feb. 16	49		
24	16, 65						
Oct. 31	17, 4						
Nov. 4	17, 5						
11	17, 7						
12	17, 8						
25	17, 23						

Mr. Waldo's measures in 1875, after repairs of micrometer, not entered here.

Records relating to coincidence of wires in large filar micrometer.

The headings M and C have a meaning corresponding to that given them in the preceding index of zeros. The column M is not complete, but probably contains all the references required for measures of coincidence made accurately by numerous settings, besides many of the others. Ordinarily, the coincidence was determined whenever the micrometer was used.

To the column C may be added the references under the head "Breaking of wires" on this page, below; and those under the heads "Screw revolution", "Backlash", and "Wire intervals", must also be consulted, as the coincidence was sometimes changed during examinations of the screw.

M		C		M		C	
1866	N	1867 Jan. 4	N 36, 84	1867	N	1869	N
Aug. 10	34, 69	1867	N	Jan. 12	36, 87 & 89	Jan. 22	15, 21
24	34, 87 & 88	Jan. 23	37, 10	Feb. 25	37, 44 & 45	25	15, 25
25	34, 95	March 30	37, 68	1868		Feb. 4	15, 50
27	35, 3	April 6	37, 75	Sept. 1	13, 73	Dec. 17, 1869 to Nov. 5, 1871	49
Sept. 10	5, 88	Nov. 21	39, 25	Oct. 8	13, 80	Nov. 6, 1871	48, 80
16	6, 21 & 29	1868		Dec. 17, 1869 to Feb. 16, 1872	141, 165, 17 49	Nov. 7, 1871 to Feb. 16, 1872	49
23	6, 57	Feb. 4	40, 76 & 9				
30	6, 79	April 1	40, 77				
Oct. 1	6, 85 & 87	18	40, 80				
3	7, 3	May 11	46, 90				
3	7, 5 & 7	June 14	13, 4				
4	7, 11 to 19	Sept. 8	13, 7 (not 8)				
5	7, 29	Oct. 11	14, 3				
5	7, 35 & 37	28	14, 32				
5	7, 39						
20	7, 89						
Nov. 2	36, 22 to 25						
Dec. 1	36, 47						

Records relating to screw revolutions and wire intervals of large filar micrometer.

Screw revolution		Backlash		Wire intervals		Breaking of wires or change of diaphragm.	
1866 Aug. 3	N 34, 57	1866 July 6	N 34, 19	1866 Sept. 10	N 35, 22 to 25	1866	N
23	34, 83	Aug. 23	34, 83	Oct. 6	35, 74	Oct. 11	35, 80
29	35, 6 to 9	29	35, 7 to 9	11	35, 78		
Sept. 21	35, 39 & 40	Sept. 21	35, 40	19	35, 81 to 88		
Oct. 22	36, 1 & 2	Nov. 9	36, 30	20			
23	36, 2 & 3	13	36, 34	Nov. 8	36, 26 to 28		
24	36, 8			Dec. 14	36, 66 & 67		
Nov. 2	36, 19 & 20			1867			
8	36, 26			Jan. 12	36, 88 to 91	1867	
9	36, 29 & 30			14	36, 93 to 95	July 30	N 38, 38
13	36, 34			14	37, 1 & 2	1868 Aug. 21	N 13, 67 ; N 13, 73.
20	36, 39			16	37, 3 & 4	1870	
21	36, 40			19	37, 7 & 8	April 1	N 48, 45
22	36, 41			April 26	37, 95 & 96	1872	
1867 April 26	37, 95 & 96					Feb. 19	N 48, 99

Note May 28, 1880. Inquiries for screw revolution also made on Dec. 20, 1866; N 36, 71 & 72.

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Miscellaneous records apparently referring to micrometer.

Clamp vernier read 260° 30′ when movable wire was on a parallel of declination, 1866 Oct. 5, N 35, 67.

Screw reading for middle of field 1866 July 7, Aug. 5; N 34, 56.

" " " 1866 Nov. 10 N 34, 1.
1867 March 5 N 37, 58.

{Comparison of original and additional (coarse) graduations of position circle. 1867 March 19 N 37, 56.
July 23 N 38, 31.

"Screw head turned round" (loose?). 1868 Aug. 23 N 13, 69

Small micrometer 1868 Aug. 27 N 13, 70

Value of squares ruled on glass ----- 1875 April 14 N 33, 4
" " " Sept. 9 O 27, 39
" " " 1876 July 16 O 27, 47

Comparison of position & negative eye-pieces, 1875 Oct. 2, O 27, 43

Records relating to the condition of the East Equatorial.

Stellar foci

1867	N
Jan. 16	37, 3
23	37, 9
29	37, 22
30	37, 26
March 18	37, 54
26	37, 61
July 10	38, 23
15	38, 27

Verniers for middle of field, etc.

1866	N
July 7, Aug. 3	34, 56
Sept. 22	35, 41
27	35, 43
Oct. 5	35, 67
Oct. 6	35, 74
11	35, 78

Horn & declination circles

1867	N
March 5	37, 52
1869	
April 30	16, 6
May 6	16, 9
10	16, 11 & 12
11	16, 13 & 14
12	16, 16 & 17
June 19	16, 29
Aug. 26	16, 43 & 44
1870	
Feb. 21 to 23	17, 39 to 43

Instrument in good condition } 1866 Aug. 3 N 34, 57

Decl. axis 1866 July 6 N 34, 19

Raw hide washer } 1867 Jan. 4 N 36, 82

Diaphragms 1868 Sept. 15 N 13, 81

Miscellaneous records relating to instruments, etc.

Time-pieces

1867	N
Jan.–April	37, 0
April–Sept.	38, 0
Sept.–Oct.	38, (−2)
Nov.–Jan.	39, 0
1868	
Feb. 16	40, 25
April 17	40, 80
May 31	40, 96
June 14	40, 96
Aug. 16	13, 61
21	13, 66
23	13, 68
Oct. 10	14, 2
11	14, 3 & 4
12	14, 8
17	14, 17
26	14, 28
28	14, 31
29	14, 34
Nov. 5	14, 48 & 49
15	14, 54
23	14, 69
27	14, 72
Dec. 10	14, 84
15	14, 88
1869	
Feb. 11	15, 53
March 1	15, 68
April 28, 29, 30	16, 1; 16, 3; 16, 7
Oct. 31	17, 4
Nov. 24	17, 20
1870	
April 26	17, 63

Stopwatch

1869	N
July 5	16, 33
6	16, 34
Aug. 26	16, 44
31	16, 46
Sept. 12	16, 55
28	16, 71
29	16, 73
30	16, 75
Oct. 1	16, 77
2	16, 80
5	16, 81

Personal equation

1868	N
Feb. 4	40, 7 to 9
8	40, 14 & 15

Spectroscope scale

1868	N
Nov. 7	14, 52
1869	
Feb. 2	15, 47

1867
Oct 22 39, 1

Note Nov. 4, 1870. Place of Na line (D) observed 1868, Sept. 18, N 13, 84, and of Mg line 1868, Oct. 3, N 13, 89. See also photographic observations of the sun's angle to the moon.

Level divisions of meridian circle

1870	N
July 28	21, 25
29	21, 28 & 29

List of small apparatus
1875, Sept. O 27, 101 to 120

List of furniture
1876, June O 27, 131 to 135

List of instruments and books bought from Phillips Fund
1876, June O 27, 141 to 167

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Records of observations of aurora; those in parentheses are merely negative.

Miscellaneous

1866
Aug. 11 N 34, 70
Sept. 8 N 35, 20
Oct. 31 Q 1
1867
Jan. 12 Q 1
13 Q 1
30 N 37, 26
July 28 Q 1
29 Q 1
Aug. 21 Q 1
26 Q 1
Sept. 1 Q 1
19 Q 1
21 Q 1
22 Q 1
23 Q 1
25 Q 1
28 Q 1
29 Q 1
Oct. 2 Q 1
3 Q 1
8 Q 1
24 Q 1
Nov. 26 Q 1
1868
March 19 Q 1
22 Q 1
April 13 Q 1
18 N 13, 12; Q 1
26 N 13, 15
28 Q 1
July 10 N 13, 45
Sept. 5 N 13, 65
Nov. 19 Q 1
1869
Jan. 6 Q 2
7 Q 2
Feb. 15 Q 2
March 9 N 15, 71
April 5 N 15, 85
9 Q 2
10 N 15, 90
15 N 15, 92
16 Q 2
May 7 Q 2
June 6 N 16, 22 & 23; Q 2
29 N 16, 31; Q 2
30 Q 2
Aug. 6 Q 2
24 N 16, 41 & 42
Sept. 3 N 16, 50
5 Q 2
11 Q 2
13 Q 2
14 Q 2
15 Q 2
27 N 16, 69; Q 2
28 Q 2
29 Q 2
Oct. 1 Q 2
2 Q 2
6 N 16, 84; Q 2
25 Q 2
27 Q 2
31 Q 2
Nov. 8 Q 2
[illegible] Q 2
25 N 18, 1
1870
Jan. 3 (A.M.) Q 3
3 (P.M.) Q 3; N 18, 15
5 Q 3
21 N 18, 20
26 Q 3
28 Q 3; N 18, 21

Miscellaneous

1870
Feb. 1 Q 3; N 18, 22
23 Q 3; N 18, 31
March 9 Q 3; N 18, 36
19 Q 3; N 18, 39
21 Q 3
22 Q 3
24 N 17, 53; Q 3; N 18, 41
25 Q 3
26 N 18, 43
30 Q 3
April 1 Q 3
1 Q 3; N 18, 45
7 Q 3
8 Q 3; N 18, 46
25
29
May 1
17
18
25
27
29
June 12
July 18
30
Aug. 19 } Q 3
28
31
Sept. 1
7
15
18
20
24
26
Oct. 14
18
24
Nov. 13 N 44
14 Q 3
16 N 44; Q 3
17 Q 3
18 Q 3
19 Q 3
23 Q 3
24 Q 3
30 (N 44)
Dec. 10
14
15
16 } Q 3
17
18
21
22
1871
Jan. 13 Q 3
Feb. 3 Q 3
10 Q 3; N 44
11 Q 3
13 Q 3
15 (N 44)
21 N 44
March 1 N 44
2 (N 44)
9 Q 3
10 Q 3
14 Q 3
17 Q 3
19 Q 3; N 18, 49
22 Q 3; N 18, 50
24 Q 3
April 13 Q 3
14 Q 3
17 Q 3
23 Q 3

Miscellaneous

1871
May 8 Q 3
10 Q 3; N 18, 54
13 Q 3; N 44
14 Q 3; N 44
15 (N 44)
16 (N 44)
17 (N 44)
18 (N 44)
19 Q 3; N 44
21 Q 3; N 44
23 (N 44)
24 (N 44)
26 Q 3
28 (N 44)
June 4 (N 44)
10 Q 3; N 44
12 N 44; N 18, 63
17 Q 3; N 44
21 Q 3; N 44
22 N 44
23 Q 3
25 Q 3
July 5 N 44
6 N 44
14 Q 3; N 44
15 N 44
20 Q 3; N 44
22 Q 3; N 44
23 Q 3; N 44
Aug. 9 Q 3; N 44
10 Q 3; N 44
17 Q 3; N 44
23 N 44
24 N 44
31 (N 44)
Sept. 6 Q 3; N 44; N 18, 72
7 Q 3; N 44
8 Q 3; N 44
9 Q 3
11 Q 3
14 (N 44)
16 (N 44)
17 (N 44)
18 (N 44)
20 (N 44) Q 3
21 (N 44)
22 N 44
28 (N 44)
Oct. 3 (N 44)
4 Q 3; N 44
8 (N 44)
9 (N 44)
12 Q 3
16 Q 3; N 44
18 Q 3; N 44
Nov. 1 Q 3; N 44
2 Q 3
4 Q 3
9 Q 3; N 44; N 18, 3; N 18, 81.
10 N 44
12 N 44 — Nov. 14. N. 18, 5
14 Q 3
17 (N 44)
19 Q 3; N 44
23 N 44
Dec. 8 Q 3; N 44
9 Q 3; N 44
11 Q 3; (N 44)
12 Q 3; N 44
14 Q 3; (N 44)
18 (N 44)

Spectroscopic

1868
July 10 N 13, 45
1869
March 9 N 15, 71
April 5 N 15, 85 & 86
10 N 15, 90
15 N 15, 92 & 93
May 7 N 16, 10
June 6 N 16, 22 & 23
29 N 16, 31
Aug. 24 N 16, 41
Sept. 3 N 16, 48 to 50
1870 Jan. 3 N 18, 15
March 9 Q 3
Sept. 15 Q 3
Oct. 14 Q 3
1871
Sept. 7 Q 3
Nov. 19 N 18, 3

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Records of observations of aurora; the references in parentheses are to recorded absences of aurora.

Miscellaneous		Miscellaneous		Miscellaneous		Spectroscopic	
1872		1872		1873		1872	
Jan. 5	N44	Sept. 3	N44	July 12	Q4	Feb. 4	N48,94
6	Q4	4	Q4	13	N45	Oct. 14	N44; N48,103
13	N44	6	N44	20	N45		
29	N44	9	Q4; N44	23	Q4		
30	N44; N48,93	28	Q4	30	Q4		
31	N44	Oct. 2	Q4; N44	Aug. 4	Q4; N45		
Feb. 4	Q4; N44; N48,94	9	Q4	12	N45		
5	Q4; N48,95	14	Q4; N44; N48,103	17	Q4		
7	Q4; N44	24	N44	23	N45		
15	N44	28	Q4; N44	24	N45		
18	N44	29	Q4; N44	25	N45		
19	N44; N48,99	Nov. 1	Q4; N44	26	N45		
20	N44	9	Q4	28	N45		
27	Q4; N44	10	Q4; N44	Sept. 14	N45		
March 1	Q4; N44	13	N44	21	Q4; N45		
5	Q4; N44	27	Q4; N44	22	Q4		
6	Q4; N44	Dec. 7	Q4	26	N45		
8	Q4; N44	27	Q4; N44	30	N45		
11	N44	1873		Oct. 1	N45		
15	Q4; N44	Jan. 7	Q4; N44	9	N45		
21	N44	19	N44	14	N45		
28	Q4; N44	24	(N44)	22	Q4		
April 1	(N44)	25	N44	23	N45		
2	N44	26	Q4	29	N45		
3	Q4; N44	Feb. 20	N44	Nov. 1			
5	N44	24	N44	19			
6	(N44)	March 1	Q4; N44	22	N45		
10	Q4; N44	10	N44	26			
11	Q4	22	N44	Dec. 6			
14	N44	23	N44	7			
16	N44	24	N44	1874			
18	N44	26	N44	Jan. 15	Q4; N45		
19	N44	27	N44	16	Q4; N45		
21	N44 — Apr. 26 N44	April 1	Q4; N44	17	Q4; N45		
28	N44	15	N45	Feb. 5	Q4; N45		
May 3	Q4	19	N45	14	N45		
24	Q4; N44	20	Q4; N45	March 24	N45		
28	Q4; N44	27	N45	April 3	N45		
June 3	Q4; N44	30	N45	4	N45		
6	N44	May 5	(N45)	6	Q4; N45		
9	Q4	6	(N45)	13	N45		
July 2	Q4; N44	15	N45	Sept. 7	N45		
16	Q4	16	N45	Oct. 13	Q4		
27	Q4; N44	19	Q4; N45	4	Q4		
30	N44	23	N45 — May 29 N44	15	Q4		
Aug. 4	Q4; N44	31	(N45)	Nov. 6	Q4		
8	Q4; N44	June 2	N45	1875			
9	Q4; N44	5	(N45)	Feb. 26	Q4		
20	Q4	13	N45	28	Q4		
23	(N44)	15	N45	April 10	Q4		
24	N44	16	(N45)	Nov. 21	Q4		
25	Q4; N44	18	N45	22	Q4		
31	Q4	20	Q4	1876			
		21	N45	Feb. 19	Q4		
		23	Q4; N45	July 22	Q4		
		24	N45	Sept. 13	Q4		
		26	Q4; N45	22	Q4		
		27	Q4; N45	Oct. 18	Q4		
		29	Q4				

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Records of observations of zodiacal light.

Miscellaneous

1867
Jan. 24 N 37,12
25 N 37,14
29 N 37,22
30 N 37,26
Feb. 1 N 37,29
26 N 37,47
27 N 37,50
1869
Nov. 14 N 17,8
1870
Feb. 19 Q 3
23 N 48,31
25 N 48,32
March 22 N 48,40
25 N 48,42
1871
Feb. 10 Q 3
13 Q 3
March 14 Q 3
March 19 Q 3
1872
Feb. 27 N 44 Feb. 28 N. 44
April 1 N 44 Mar. 3 N. 44
5 N 44 28 N 44
6 N 44 Apr. 4. N 44
19 N 44

Miscellaneous

1874
Jan. 11
12
16
18
Feb. 5
7
10
11
12
14
16
17
18
March 5
9
13
15
April 12
13
Nov. 15
1875
Jan. 26
Feb. 1
28
} Q 4

Miscellaneous

1875
Nov. 22
Dec. 22
23
27
1876
Jan. 13
21
24
26
Feb. 12
13
16
17
19
20
24
March 17
22
23
April 11
12
May 11
Dec. 15
16
} Q 4

Spectroscopic

1868
March 24 N 40,70
1869
Nov. 14 N 17,8

Records of observations of meteors.

1866
Nov. 13 N 36,35
17 N 36,37
17 37'
17 37"
Dec. 1 N 36,46
7 N 36,59
1867
Nov. 13 N 39,20
1868
March 30 N 40,73
Aug. 10 N 13,55
Sept. 29 N 13,88
Oct. 17 N 14,19
Nov. 13 N 14,56 57

1869
Aug. 30 Q 2
Nov. 6 Q 2
Nov. 12,13,14 N 17,10 to 14
28 N 48,2
Dec. 3 N 48,3
7 N 48,4
1870
Feb. 19 Q 3
March 15 N 18,38
April 26 N 17,63
Aug. 11 Q 3
29 N 21,38
30 N 21,39
31 N 21,46
Sept. 1 Q 3
1 N 21,41
19 N 21,63
21 N 21,66
26 N 21,72
28 N 21,70
Oct. 9 N 21,47
22 N 21,84
Nov. 27 Q 3
Dec. 12 Q 3

1871
Jan. 9 Q 3
Nov. 13 N 18,5
Nov. 13 6 14 Q 3
1872
April 10 Q 4
July 31 Q 4
Aug. 9 Q 4
10 Q 4
20 Q 4
Nov. 14 Q 4
15 Q 4
27 Q 4
27 N 18,11 12
1873
July 21 Q 4
Aug. 9 Q 4
10 N 45
October 25 Q 4
1874
Nov. 14 Q 4
1875
Nov. 24 Q 4
1876
November Q 4

Records of miscellaneous occasional phenomena.

Halos.

1867 March 20 N 37,57
1870 Feb. 10 Q 3
Nov. 3 Q 3 (Dec 2)
1872 Dec. 7 Q 4
13 Q 4
14 Q 4
1873 Jan. 4 Q 4
1874 Nov. 19 Q 4
1875 June 5 Q 4
1876 June 3 Q 4
Dec. 28 Q 4

Parhelia

1867 Jan. 27 Q 1
1872 May 12 Q 4

Earthquakes

1870 Oct. 20 Q 3
1871 July 20 N 44
1875 Jan. 9 Q 4

Snow

1867 Jan. 25 N 37,14
1868 Oct. 6

Three reports

1868 Oct. 6 N 13,91

Fire on Mt. Washington

1871 Sept. 13 N 48,173

Spectroscopic observations

Unrecorded observations
1868 March 19 N 40,63
23 N 40,69
25 N 40,71
April 5 N 40,78
Hydrogen 1869 April 5 N 15,86
15 N 15,93
" 17 N 15,94
Various objects
Hydrogen, 2 sheets May 21 N 16,18
Platinum & air June 6 N 16,23
Fireworks July 5 N 16,33

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Records of observations of the sun, and solar spectrum.

Rough sketches

1870	N
March 8	17, 46
9 to 14	17, 48
19	17, 49
21 & 22	17, 50
23	17, 51
24 to 30	17, 55
March 31 to April 7	17, 56 & 57
April 8 to April 13	17, 58 & 59
" 14 " 22	17, 60 & 61
" 23 & 25	17, 62
26	17, 64
27 & 28	17, 65
29 & 30	17, 66
May 1	17, 67
2 & 3	17, 68
4 & 5	17, 69
14	17, 9 & 9
15	17, 70
17	17, 71

Notes on drawings by Lt. Trouvelot

1870 Oct. 30 to 1873 April 13 inclusive	N 44
1873 April 14 to 1874 Sept. 30 inclusive	N 45
Various dates some not known	O 27, 16 & 22, 28, 31, 34 & 38.

Photography

1869	
May 10	N 16, 12
11	N 16, 13
27	N 16, 19
1870 July to end of 1876	N 46

Inspection of sun for intra-mercurial planet

1876 Oct. 2	O 27, 83
3	O 27, 84
9	O 27, 85
10	O 27, 85

Spectroscopic work

1867	N
Oct. 22	39, 1
Nov. 9	39, 18
1868	
March 30	40, 74 & 75
April 1	40, 75 & 76
Nov. 7	14, 52
1869	
Jan. 10	15, 12
Feb. 2	15, 47
March 17	15, 71
May 21	16, 18
1870 Oct. 30 to 1873 April 13 inclusive	44
1873 April 14 to 1874 Sept. 30 inclusive	45

Records of observations of the larger planets.

These observations are principally of the general appearance of the planet observed; they contain, however, some micrometrical measures of diameter, of Saturn's ring, Jupiter's belts, etc.; the letter d attached to a reference, indicates that the observation referred to was, in part at least, a measure of diameter.

Mercury

1867 May 1 N 38, 6 (occultation)

1870 May 2 N 17, 68

Venus

1868 Feb. 8 N 40, 13

1868 March 28 N 40, 72

Mars

1866	N
Dec. 2	36, 50
5	36, 57
7	36, 61
30	36, 78
1867	
Jan. 12	36, 92
27	37, 16
28	37, 19
29	37, 23
30	37, 27

1867	N
Feb. 6	37, 32
7	37, 37
25	37, 44
26	37, 48
27	37, 51
1869	
Jan. 14	15, 17
Feb. 28	15, 67
March 3	15, 70

1869	N
April 6	15, 87
18	15, 95

Jupiter

1866	N
July 11	34, 27 d
12	34, 32 d
31	34, 53
Aug. 16	34, 75 d
20	34, 78 d

1866	N
Sept. 2	35, 12
12	35, 31 & 32 d
Oct. 23	36, 3
1867 Nov. 1	39, 10
1868 Sept. 29	13, 88

1868 Oct. 13	N 14, 11 & 12
1869 Nov. 20	N 17, 18 d
Dec. 31	N 17, 30
1870 Jan. 3	N 17, 32
Feb. 16	N 17, 36 & 37
1872 Jan. 25	N 18, 0
1872 & 1873	O 27, 15 & 16, & 34
1872 & 1873	O 27, 22 & 28 (Lt. Trouvelot)
1876 Aug. 6, Sept. 2, Dec. 13,	O 27, 77 & 78, 80 & 81.

Saturn

1866	N
June 7	N 34, 3
11	N 34, 7 d
July 1	N 34, 14
2	N 34, 14
3	N 34, 16
9	N 34, 20 d

1866	N
July 10	N 34, 22 d
11	N 34, 29
12	N 34, 29 d
1867 April 26	N 38, 3 d
May 4	N 38, 10 d
14	N 38, 12 d

1869 June 19	N 16, 30
30	N 16, 32
Aug. 22	N 16, 36
23	N 16, 39
1871 June 19	N 48, 65
1872 Oct. 4 & 9	N 8, 101 & 102

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Uranus

1866	N
Oct. 31	36,16
Dec. 5	36,56 d

1867	N
Jan. 3	36,80 d
4	36,83 d
23	37,9 d
27	37,15 d

1867	N
Feb. 6	37,32
7	37,36 d

Neptune

1866	N
Sept. 12	35,33 d
16	35,37 d
Oct. 31	36,16 d
Nov. 1	36,19 d

1866	N
Dec. 5	36,53
1867	
Nov. 21	39,25

1868	N
Nov. 4	14,42 & 43

Records of observations of asteroids.

All these observations are of position.

Note Dec. 27 1880. Observations of (30) (37) (49) (100) (111) (104) to be omitted in this index to be printed. See book R15, p. 166.

Juno (3)

1874,	Oct 15 & 20	N 33,62

Astraea (5)

1869	Aug. 31	N 16,46

Hebe (6)

1868	Jan. 9	N 39,66
1870	July 14	N 21,687
	17	N 21,8
	23	N 21,18
	28	N 21,26
Aug.	8	N 21,31
	9	N 21,32
	11	N 21,33

Flora (8)

1868	N
Feb. 7	40,12
11	40,19 & 20
22	40,34

Parthenope (11)

1866	N
Aug. 10	34,68 & 69
13	34,73 & 74
26	34,94 & 95
27	35,2 & 3
1867	
Dec. 26	39,55 & 56
28	39,57
1868	
Jan. 10	39,69
1870	
Oct. 8	21,75
9	21,76
10	21,78

Egeria (13)

1867	Dec. 8	N 39,40
	9	N 39,41
1870	Sept. 7	N 21,51

Irene (14)

1869	Oct. 11	N 16,86

Eunomia (15)

1867	N
April 3	37,72
11	37,77
13	37,79

Melpomene (18)

1866	N
July 19	34,40
24	34,42 & 43
26	34,45 & 48
29	34,49 & 51
1868	
Feb. 3	40,2
11	40,19
22	40,33 & 34
23	40,35 & 36

Massalia (20)

1867	N
Oct. 1	38,84
2	38,86
6	38,88
7	38,90
1870	
July 13	21,1
14	21,5
17	21,9
18	21,13
21	21,16
23	21,17
24	21,21

Lutetia (21)

1867	N
Oct. 1	38,84
6	38,88 & 89
19	38,96

Calliope (22)

1867	N
Dec. 8	39,40
9	39,41

Themis (24)

1867	N
Sept. 24	38,73
25	38,75

Proserpina (26)

1867	N
Sept. 24	38,72
25	38,74
27	38,76
28	38,78

Euterpe (27)

1870	N
July 24	21,22
25	21,23 & 24

Bellona (28)

1870	N
Sept. 20	21,65
21	21,66
22	21,69

Urania (30)

(not fully identified)

1869	Oct. 18	N 16,87

Pomona (32)

1866	N
Sept. 16	35,37 & 38
22	35,41
27	35,45 & 46
1870	
Sept. 1	21,42
7	21,49
8	21,53
10	21,57

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Circe (34)

1868	N
Feb. 29	40, 43
March 4	40, 46 & 47
1870	
Oct. 12	21, 79

Leucothea (35)

1867	N
Aug. 27	38, 63
Sept. 19	38, 68
22	38, 70
23	38, 71
24	38, 72 & 73
25	38, 74
27	38, 76 & 77
28	38, 78 & 79
29	38, 80
30	38, 81

Fides (37)

1868 Oct. 10 N 14, 2 & 3

Leda (38)

1867	N
Aug. 30	38 64 & 65
31	38, 66
Sept. 1	38, 67

Daphne (41)

1867	N
Sept. 30	38, 83
Oct. 1	38, 85
2	38, 86 & 87
7	38, 91
16	38, 92
17	38, 93
18	38, 94 & 95
27	39, 4
31	39, 8
Nov. 2	39, 11

Isis (42)

1867	N
April 5	37, 74
6	37, 75
18	37, 81
23	37, 91

Ariadne (43)

1867	N
May 31	38, 19

Nysa (44)

1866		N
Sept.	28	N 35, 57 (note)
Oct.	1	N 35, 57
	2	N 35, 58
	3	N 35, 62
	4	N 35, 66
	5	N 35, 73
	20	N 35, 92 & 93
	23	N 36, 7
	24	N 36, 10
	25	N 36, 12
Nov.	12	N 36, 31 & 32

Eugenia (45)

1867	N
Sept. 28	38, 79
29	38, 80 & 81
30	38, 82

Aglaia (47)

1867	N
Sept. 30	38, 82
Oct. 24	39, 3
27	39, 5
31	39, 9
Nov. 2	39, 12

Pales (49)

1868 Sept. 29 N 13, 87 & 88

Virginia (50)

1866	N
Dec. 14	36, 68
15	36, 70
28	36, 76
29	36, 77
30	36, 79
1867	
Jan. 3	36, 80 & 81
1870	
Oct. 12	21, 80

Nemausa (51)

1866	N
July 14	34, 34 & 35
15	34, 36 & 37
16	34, 39 & 40
17	34, 40
19	34, 41
22	34, 41 & 42
1867	
Oct. 19	38, 97
27	39, 6
1870	
Sept. 7	21, 48
8	21, 54

Europa (52)

1867	N
Nov. 5	39, 14 & 15
6	39, 17
26	39, 29
30	39, 31

Calypso (53)

1867 April 27 N 38, 4

Maelete (56)

1866	N
Nov. 12	36, 32 & 33
13	36, 36
30	36, 45
Dec. 1	36, 47
12	36, 64

Mnemosyne (57)

1867	N
Jan. 30	37, 27
Feb. 28	37, 51
March 8	37, 53

Concordia (58)

1870	N
July 18	21, 12
21	21, 15
23	21, 19

Elpis (59)

1869	N
Sept. 30	16, 74 & 75
Oct. 2	16, 80
6	16, 84
7	16, 85

Danae (61)

1868	N
Feb. 3	40, 4
4	40, 10

Erato (62)

1875 May 26 June 2 N 33, 47 & 50

Ausonia (63)

1866	N
Sept. 27	35, 46 & 47
28	35, 49
Oct. 20	35, 91 & 92
23	36, 6
24	36, 10
25	36, 11 & 12
27	36, 13
28	36, 14
1868	
Feb. 3	40, 3 & 4
4	40, 9

Asia (67)

1868	N
Feb. 29	40, 43
March 4	40, 46
1869	
Sept. 11	16, 53 & 54
12	16, 55

Leto (68)

1867	N
Oct. 6	38, 89
7	38, 91
19	38, 97
23	39, 1
24	39, 3
27	39, 6

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Hesperia (69)

1869	N
Sept. 14	16, 56
28	16, 71 & 72
Oct. 1	16, 78
2	16, 79
5	16, 82 & 83

Panopaea (70)

1866	N
Sept. 22	35, 42
Oct. 1	35, 56 & 57
4	35, 65
5	35, 72
1870	
Sept. 7	21, 50
8	21, 55
10	21, 58

Niobe (71)

1870	N
Aug. 11	21, 34
30	21, 39
Sept. 1	21, 41

Feronia (72)

1869 Oct. 25 N 17, 2

Galatea (74)

1867	N
Dec. 1	39, 33
2	39, 36
17	39, 47
18	39, 50
19	39, 52 & 53

Eurydice (75)

1868	N
Feb. 1	39, 96
3	40, 3

Eurynome (79)

1867	N
Nov. 5	39, 15
6	39, 17
21	39, 26
26	39, 29
Dec. 2	39, 35

Sappho (80)

1867	N
April 9	37, 76
18	37, 80

Terpsichore (81)

1867 May 4	N 38, 8
12	N 38, 13
1871 Feb. 13	N 22, 3
21	N 22, 6
22	N 22, 7 & 8
27	N 22, 9
March 1	N 22, 11

Alcmene (82)

1867	N
July 23	38, 33
24	38, 35
26	38, 36
28	38, 43 & 44
30	38, 38 & 39
31	38, 40 & 41
Aug. 2	38, 42

Beatrix (83)

1866	N
Nov. 5	36, 25
10	36, 30
1867	
Dec. 28	39, 57

Thisbe (88)

1866	N
Aug. 27	35, 2
28	35, 5
Sept. 1	35, 10
2	35, 13 & 14
3	35, 14 & 15
Oct. 1	35, 54 & 55
3	35, 59 & 60
4	35, 63
5	35, 69
20	35, 89 & 90
24	36, 9 & 10
25	36, 11
1867	
Nov. 4	39, 12 & 13
5	39, 14
6	39, 16
Dec. 17	39, 47

Julia (89)

1866	N
Sept. 30	35, 51
Oct. 1	35, 55 & 56
4	35, 63 & 64
5	35, 71
Nov. 21	36, 40 & 41
1867	
Dec. 28	39, 58
1868	
Jan. 9	39, 67
Feb. 4	40, 10
7	40, 11 & 12
8	40, 16
10	40, 17 & 18

Antiope (90)

1866	N
Nov. 26	36, 43
1867	
Dec. 5	39, 37
17	39, 48
18	39, 51
30	39, 61

Aegina (91)

1867 Feb. 7 N 37, 35

Undina (92)

1867	N
July 13	38, 25
14	38, 26
15	38, 28
16	38, 29
23	38, 32
28	38, 43
30	38, 39
31	38, 41
Aug. 11	38, 49 & 50
17	38, 53
19	38, 55
20	38, 58
21	38, 59
26	38, 61
27	38, 63

Minerva (93)

1867	N
Aug. 30	38, 65
Sept. 21	38, 69
22	38, 69
Dec. 26	39, 54

Aurora (94)

1867 Dec. 30 N 39, 60

Arethusa (95)

1868	N
Feb. 19	40, 29
22	40, 33

Aegle (96)

1870 Sept. 5 N 21, 44

Xanthe (98)

1868 April 23 N 40, 82

Hecate (100)

1868 July 26 N 13, 50

Helena (101)

1868 Sept. 1 N 13, 74

Clymene (104)

1868 Sept. 17 N 13, 83

Felicitas (109)

1871	N
Feb. 27	22, 10
March 1	22, 12
22	22, 13
25	22, 14
28	22, 15
29	22, 16
April 13	22, 17
1875	
Jan. 27 to Feb. 2	33, 34 to 36
Feb. 18	33, 41

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Ate (111)

1870	N
Aug. 17	21, 35
18	21, 36
21	21, 37
Sept. 5	21, 43
6	21, 46
7	21, 47
8	21, 52
10	21, 56
12	21, 60
13	21, 61
14	21, 62
20	21, 64
21	21, 67
22	21, 68
27	21, 74
29	21, 83
Dec. 21	21, 90

Iphigenia (112)

1870	N
Oct. 22	21, 81
29	21, 82
Nov. 2	21, 84
16	21, 89
1874	
Nov. 7	33, 15
1875	
March 4 to 25	33, 43 to 46

Cassandra (114)

1871	N
Aug. 6	22, 18
9	22, 19
10	22, 20

Thyra (115)

1871 Aug. 10 N 22, 21

Records of observations of the moon.

Occultations

Object	1866	N	
λ Gem.	Aug. 7	34, 65	(2d time)
α Tauri	Sept. 28	35, 49	(1st time)
λ Gem.	Oct. 28	36, 14	(2d time)
1 Cancri	Nov. 25	36, 43	
9 Aquar.	Dec. 11	36, 63	
Anon.	12	36, 64	
B.A.C. 7620	12	36, 64	
44 Pisc.	15	36, 69	
115 Tauri	20	36, 73	
	1867		
α Tauri	Jan. 16	37, 3	(2d time)
α Tauri	Feb. 12	37, 38	(3d time)
ξ Leonis	17	37, 39	
η Leonis	24	37, 44	
Unn. (several)	March 19	37, 56	
B.A.C. 1526	April 8	37, 76	(1st time)
Anon (several)	9	37, 76	
96 Virg.	18	37, 81	
24 Coll.	21	37, 88	
λ Aquar.	Sept. 12	38, 67	
10 Ceti	14	38, 67	
B.A.C. 408	15	38, 68	
48 Tauri	18	38, 68	
Rumk. 1283	Oct. 16	38, 92	
130 Tauri	17	38, 93	
82 Aquar.	Nov. 6	39, 16	
W XXII 1203	6	39, 16	
111 Tauri	13	39, 20	(1st time)
115 Tauri	13	39, 20	
B.A.C. 1526	Dec. 10	39, 42	(2d time)
κ Virg.	18	39, 51	
	1868		
γ Tauri	Jan. 6	39, 64	
70 Tauri	6	39, 65	
Rumk. 1203	6	39, 65	(1st time)
δ Tauri	6	39, 65	(1st time)
Rumk. 1210	6	39, 65	(1st time)
B.A.C. 1391	6	39, 65	(1st time)
B.A.C. 1394	6	39, 65	(1st time)
B.A.C. 1406	6	39, 65	(1st time)
α Tauri	6	39, 65	(4th time)
111 Tauri	7	39, 65	(2d time)
f Gem.	9	39, 66	(1st time)
18 Leon.	11	39, 70	
ζ² Virg.	15	39, 72	
B.A.C. 1826	Feb. 3	40, 1	(3d time)
48 Virg.	11	40, 19	
f Gem.	March 4	40, 44	(2d time)
δ¹ Tauri	28	40, 72	(2d time)
δ² Tauri	28	40, 72	
B.A.C. 1391	28	40, 72	(2d time)
B.A.C. 1394	28	40, 72	(2d time)
Rumk. 1210	28	40, 72	(2d time)
Rumk. 1291	28	40, 72	

Occultations

Object	1868	N	
Rumk. 1294	March 28	N 40, 72	
Anon. (two)	28	N 40, 72	
94 Virg.	June 28	N 40, 99	
64 Aquar.	Sept. 28	N 13, 86	
71 Orion.	Dec. 28	N 15, 6	
	1869		
α Tauri	Jan. 23	N 15, 24	(5th time)
α Leonis	28	N 15, 33	
μ Ceti	Feb. 17	N 15, 57	
Rumk. 1203	19	N 15, 62	(2d time)
75 Tauri	19	N 15, 62	(1st time)
B.A.C. 1391	19	N 15, 62	(3d time)
Star s.f. B.A.C. 1391	19	N 15, 63	
B.A.C. 1406	19	N 15, 63	(2d time)
Rumk. 1197	April 29	N 16, 45	
75 Tauri	29	N 16, 45	(2d time)
Rumk. 1232	29	N 16, 45	
	1870		
B.A.C. 5866	Aug. 6	O 8	
Anon.	Sept. 4	O 8	
Capr.	6	O 8	
η ζ Tauri	Oct. 14	O 8	
μ Gem.	Nov. 11	O 8	
μ² Cancri	13	O 8	
ν Virg.	17	O 8	
44 Gem.	Dec. 9	O 8	
	1871		
χ Sagittarii	Oct. 21	N 18, 0	
	1872		
Anon.	Feb. 19	N 18, 10	
	1874		
ψ Aquar.	Oct. 21		
4 Ceti	Oct. 22		
5 Ceti	22		
B.A.C. 6	22		
33 Tauri	26		
ρ² Arietis	Dec. 19	N 33, 1 & 3	
ρ³ Arietis	19		
	1875		
c Gem.	Jan. 20		
Anon.	March 12		
36 Tauri	12		
Anon.	12		
ξ Leonis	19		
B.A.C. 5253	April 22		

Mercury 1867 May 1 N 38, 6

Saturn 1876 Aug. 16 & Sept. 2 O 27, 7 & 8, 8 & 80

Lunar eclipses.

1867 March 19 N 37, 56

Aug. 19 N 38, 55

1869 Jan. 27 N 15, 29

Physical observations

1866	N	
Dec. 15	36, 69	
1867		
Feb. 7	37, 35	
10	37, 38	
15	37, 38	
17	37, 39 & 40	
18	37, 40	
22	37, 42 & 43	
24	37, 44	
25	37, 46	
26	37, 49	
March 11	37, 54	
14	37, 54	
18	37, 54	
19	37, 56 & 57	
April 9	37, 76	
11	37, 77	
13	37, 79	
18	37, 81	
21	37, 88	
May 10	38, 11	
11	38, 13	
12	38, 13	
July 10	38, 23	
11	38, 24	
Aug. 7	38, 48	
11	38, 49	
19	38, 53	
Sept. 12	38, 57	
1868		
May 28	40, 95	
Dec. 18	14, 91	
19	14, 94	
28	15, 6	
1869		
June 17	16, 28	
1870		
April 12	17, 59	
13	17, 60	
May 2	17, 68	

1872 & 1873 O 27, 17, 22, 28 to 31

Spectroscopic observations

1868	N	
March 30	40, 73	
April 28	40, 84	
Nov. 24	14, 76	
27	14, 38, 74	
Dec. 2	14, 79	
26	15, 4	
28	15, 6	
30	15, 8	
1869		
May 21	16, 18	

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Records of observations of the satellites of the superior planets.

The observations are mostly of position; those described as physical are generally notices of the invisibility of satellites on particular dates.

Satellites of Jupiter.

Position

	1866	N
Sat. I	Aug. 8	34, 65
Sat. I	Sept. 3	35, 19
	1867	
Anon.	Nov. 5	39, 13

	1868	N
Sat. II.	Oct. 13	14, 12
Anon.	Nov. 23	14, 69

Physical

	1866	
Sat. I	Sept. 3	N 35, 19

Satellites of Saturn.

Mimas 1866 July 1 N 34, 12 seen at one time, invisible later; remaining observations all of position.

Enceladus

1866	N
June 2	34, 2
7	34, 3
July 1	34, 12
3	34, 16
12	34, 29

Tethys

1866	N
June 7	34, 3
9	34, 5
10	34, 5
11	34, 7
15	34, 8 & 9
26	34, 9
July 1	34, 12
2	34, 15
3	34, 16
5	34, 19
10	34, 21
11	34, 25
12	34, 29

Dione

1866	N
June 7	34, 3
9	34, 5
10	34, 6
11	34, 7
15	34, 8 & 9
26	34, 10
30	34, 11
July 1	34, 13
2	34, 15
3	34, 17
10	34, 21
11	34, 25
12	34, 29 & 30

Rhea

1866	N
June 7	34, 3
9	34, 4
10	34, 6
11	34, 6 & 7
15	34, 8
26	34, 9
30	34, 10 & 11
July 1	34, 12 & 13
2	34, 15
3	34, 17 & 18
5	34, 19
10	34, 21 & 22
11	34, 25
12	34, 30

Titan

1866	N
June 2	34, 2
7	34, 3
9	34, 4 & 5
10	34, 5
11	34, 6 & 7
15	34, 8
26	34, 9 & 10
30	34, 11
July 1	34, 13
2	34, 14 & 15
3	34, 17
9	34, 20
10	34, 20
11	34, 24 & 25
12	34, 31
14	34, 33
15	34, 36
1867	
April 26	38, 1
May 4	38, 9
10	38, 12
20	38, 15
Aug. 13	38, 51

Iapetus

1866	N
July 11	34, 24
12	34, 30
14	34, 32 & 33
15	34, 35

Satellites, not identified

not to be included

1867	N
April 26	38, 2
May 4	38, 9
10	38, 11
20	38, 15 & 16
24	38, 17 & 18
July 10	38, 23
15	38, 27
23	38, 31
Aug. 13	38, 51

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Satellites of Uranus

Position 1866	N
Dec. 2	36,49 & 50
5	36,55 & 57
7	36,59 & 66
10	36,62
13	36,65
26	36,75
30	36,78
1867	
Jan. 3	36,80
4	36,84
9	36,85 & 86
23	37,15
27	37,15
28	37,17
29	37,23
30	37,27

Position 1867	N
Feb. 7	37,36
22	37,41
25	37,45
26	37,48
27	37,51
March 26	37,61
Dec. 26	39,55
28	39,58 ×
1868	
Jan. 17	39,76
24	39,85
30	39,89
31	39,93
March 11	40,54

Physical (satellites invisible). 1866	N
Dec. 12	36,64
1867	
Dec. 28	39,58

Satellite of Neptune

Position 1866	N
Dec. 2	36,48 & 49
5	36,53 & 54
7	36,58
14	36,63
26	36,74
1867	
Oct. 31	39,8 (no measure)
Nov. 2	39,10
15	39,21 (no measure)
16	39,21
18	39,23 (no measure)
19	39,24 (no measure)
21	39,25 (no measure)
26	39,28 & 29
27	39,30 (no measure)

Position 1867	N
Dec. 16	39,46
18	39,49 (no measure)
19	39,52
26	39,54 (no measure)
30	39,60
1868	
Jan. 13	39,71 (no measure)
17	39,74
22	39,80 (no measure)
Dec. 10	14,84 (no measure)
12	14,85 (no measure)
13	14,87 (no measure)
15	14,88 (no measure)

Physical (satellite invisible). 1866	N	
Aug. 5	34,63	×
17	34,77	×
Oct. 15	35,80	×
Dec. 3	36,51	×
12	36,64	×
30	36,78	×
1867		
Jan. 9	36,85	×
1868		
Nov. 3	14,38	×
4	14,42 & 43	×

To this class also belong the dates in the other columns marked "no measure".

Records of observations of comets

Comet 1867 I.

Position 1867	N
March 2	37,52
5	37,52
26	37,60
28	37,62
29	37,64
March 30	37,67
31	37,69
April 2	37,70
3	37,71
6	37,75

Physical 1867	N
March 2	37,52
31	37,69

Spectroscopic

Comet 1867 II.

Position 1867	N
June 11	38,20
July 23	38,32
24	38,34
26	38,36
July 28	38,37
31	38,40
Aug. 18	38,54

Physical 1867	N
July 31	38,40

Brorsen's

Position 1868	N
April 13	40,78
17	40,79
18	40,80 & 81
22	40,81
23	40,82
26	40,83
28	40,83 & 84
May 4	40,86
8	40,87
May 9	40,89
11	40,90 & 91
12	40,92
14	40,93 & 94
22	40,94 & 95
28	40,95 & 96
June 14	40,97
19	40,97

Physical 1868	N
April 17	40,79
18	40,81
22	40,81
May 8	40,87
9	40,89
11	40,91
12	40,92
14	40,93
31	40,95
June 14	40,97
15	40,97
19	40,97

1868	N
April 23	40,82
26	40,83
28	40,84
May 1	40,85
3	40,85
12	40,93

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Encke's

Position		Position		Physical		Spectroscopic	
1868	N	1875	N	1868	N	1871	N
Aug. 16 (astron.)	13,63	Feb. 26	33,42	Aug. 16 (astron.)	13,63	Nov. 12	18,4
17	13,64	March 4	33,43	17	13,64	18	18,6
24	13,67	8	33,44	21	13,67		
23	13,69			23	13,69		
1871				1871			
Nov. 5	18½19,6			Nov. 5	19,6		
				12	18,4		

Winnecke's

1869	N	1869	N	1869	N	1869	N
April 30	16,6	Aug. 26	16,43½44	May 6	16,9	May 10	16,12
May 6	16,8½9	1875		7	16,10	June 3	16,20
10	16,11½12	Feb. 8	33,37	12	16,16	9	16,24
11	16,13½14	9	33,38	Aug. 29	16,45	12	16,25
12	16,15 to 17	15	33,39	Oct. 27	17,3	16	16,27
June 3	16,20	16	33,40	31	17,4		
19	16,29½30			Nov. 7	17,5		
				10	17,6		

Comet 1869 III

1869	N	1870	N	1869	N
Dec. 24	19,1	Jan. 3	19,4	Dec. 24	19,1
Dec. 30½31	19,2½3			Dec. 30½31	19,2½3
				1870	
				Jan. 3	19,4

Comet 1874, I

1874	N	1874	N
April 14	19,7	April 14	19,7

Comet 1874, III (Coggia's)

		1874	N
1874	N	July 2	19,7
July 2	19,7	13	19,10
8	19,8		
9	19,9		
13	19,10		
14	19,10		
15	19,11		
21	19,12		

Records of observations of nebulae.

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Records of observations of stars.

This section may be subdivided thus: 1. Stars incidentally observed during other work with the equatorial, including those observed with the Spectroscope (for practice rather than to investigate their spectra); 2. Stars, almost exclusively in series from the Durchmusterung, observed with the special intention of finding whether any of them were double, but also to some extent examined with regard to magnitude and color; 3. Double stars from the Dorpat list; 4. Other double stars, mostly discovered at this Observatory. These last two subdivisions (3 & 4) are at present supposed to have been sufficiently indexed in preparing the work for the press some years ago (see p. 35).

1. Stars incidentally observed.

These observations are probably of too little importance to be arranged in order of right ascension, which would require a careful study of the original records. The following abbreviations may be used: Jl for Sir John Herschel's general Catalogue of Nebulae in the Phil. Trans. Vol. 154, Part I; Mr for Messier; Ou for Oeltzen's catalogue of stars in Argelander's southern zones, −15° to −31° (Vienna 1857); We for Weisse's catalogue of stars near the equator from Bessel's zones; Σ as usual for the Dorpat list, and DM for Durchmusterung.

Observations of position

Name	Date	N
Near Jl 1191	1868 Jan. 31	39, 93
	Feb. 3	40, 2
Jn Jl 4403	1866 Aug. 25	34, 92
Jn Jl 4627	1866 Oct. 31	36, 45
On 10285	1868 Feb. 19	40, 30
On 10567	19	40, 30
On 10572	19	40, 30
Double stars near On 7+103	1867 Aug. 11	38, 49 [illegible]50
We 0h 818	1867 Oct. 6	38, 88
We 1h 803	1867 Sept. 30	38, 83
We 2h 1007	1868 Jan. 11	39, 70
We 3h 1182	1867 Nov. 26	39, 29
We 12h 750	1867 April 11	37, 77
We 1h 540	1866 Sept. 28	35, 50
We 1h 504	1866 Sept. 28	35, 50
We 20h 572	1866 Oct. 5	35, 71
We 22h 304	1866 Aug. 26	35, 18
We 22h 313	1866 Aug. 26	35, 18
Σ 844	1848 1869 Feb. 19	15, 59 662

Physical observations

Name	Date	N
Near Jl 1227	1868 Feb. 10	40, 17
Jl 1361	1869 Feb. 19	15, 59
Jl. 2319	1868 Jan. 21	39, 79
Jl 4264 = Mr 92	1866 Nov. 2	36, 21
Jl 4668 = Mr 72	1866 Sept. 3	35, 19
Jl 4670 = Mr 15	1866 Aug. 13	34, 75
Jl 4678 = Mr 2	1866 Aug. 13	34, 75
Jl 4687 = Mr 30	1866 Aug. 13	34, 75
Jl. Jl. 5079	1867 Nov. 27	39, 30
On 7033	1868 Feb. 29	40, 41
On 10163	1868 Feb. 19	40, 30
On 20070	1866 Aug. 11	34, 70
On 20096	1866 Aug. 11	34, 70
Σ 536 or near it	1868 Feb. 10	40, 17

Spectroscopic observations

Name	Date	N
Jn Jl 1179	1868 Nov. 23	14, 70
n.f. Jl 1179	1868 Dec. 22	15, 11
Jn Jl 4355	1868 Sept. 18	13, 84
α Arietis	1868 Nov. 13	14, 56
α Aquilae	1868 Nov. 6	14, 50
Star in Auriga	1868 March 24	40, 70
α Bootis	1868 March 30	40, 73
	Sept. 18	13, 84
	Nov. 28	14, 74
	1869 June 9	16, 24
	Aug. 24	16, 41
ε Bootis	1868 March 30	40, 73
α Can. Maj.	1868 Nov. 23	14, 70
	1869 Feb. 4	15, 51
	13	15, 54
α Can. Min.	1868 March 24	40, 70
o Ceti	1868 Dec. 3	14, 80
	8	14, 82
α Ceti	19	14, 94
α Herculis	1869 Aug. 24	16, 41

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Observations of position

Name	Date	N
DM −0° 120	1868 Nov. 19	14, 67
+0° 205	1866 Oct. 23	36, 4
+8° 1427	1868 Jan. 19	39, 78
+10° 562	1867 Nov. 5	39, 15
+14° 577	21	39, 27
+35° 1828	1867 April 13	37, 79

Anonymous

Star	1866 Dec. 1	36, 46
Star	15	36, 69
g	1866 Oct. 25	36, 11
h	Nov. 25	36, 42
a, b, c, d, e, f,	Dec. 28	36, 76
Star	1866 Oct. 21	36, 184
Star	1867 Jan. 19	37, 6
	23	37, 9
Star	Feb. 6	37, 32
	7	34, 35
Star	April 3	37, 71
several stars	4	37, 73
several stars	13	37, 78
Star	July 15	38, 27
Star	31	38, 41
Star	Aug. 30	38, 65
Star	1867 July 23	38, 32
Star	24	38, 35
Star	30	38, 38
Star (var.?)	1867 Nov. 21	39, 27
	Dec. 16	34, 46
Star	1867 Nov. 4	39, 12
Star	21	34, 26
Star	Dec. 10	39, 412
Star	11	34, 45
Star	1868 Jan. 18	34, 77
Star	22	34, 810
Star	1867 Nov. 6	39, 16
Star	1868 Feb. 23	40, 35
Star	March 18	40, 60 861
Star	May 4	40, 86
Star	8	40, 87
Star	1868 April 23	40, 82
Star	May 11	40, 90
Star	12	40, 92
Star	14	40, 94
Star	31	40, 96
Star	June 14	40, 97
Star	June 25	40, 99
Stars taken for Diana	1869 Sept. 6	16, 52
Comparison stars for Juno	1874	33, 25
Star	1870 July 17	21, 10; 25
Star	July 28	21, 27; 25

Physical observations

Name	Date	N
DM +0° 149	1868 Nov. 27	14, 72
+0° 205	1866 Oct. 23	36, 7
Star following	1868 Nov. 27	14, 73
DM +1° 212	Dec. 2	14, 75
Near DM +1° 226	2	14, 76
DM +2° 32	1869 Nov. 25	17, 23
+14° 577	1867 Nov. 21	39, 27
	Dec. 16	39, 46
+23° 528	1868 Jan. 25	39, 87
532	25	36, 87
533	25	39, 87
+38° 4003	1869 Oct. 17	16, 86
* Companion of Sirius	1870 March 8	48, 35
	1870 March 9	17, 47
Sirius (red)	1870 March 14	17, 50
J Cygnae	1867 April 25	37, 94
R Leonis	1868 Jan. 11	39, 70
E Lyrae	1868 Aug. 13	13, 56 57
β Ceti	1869 Jan. 10	15, 13
41 Tauri	1868 Jan. 12	39, 70
B. A. C. 2057	1868 Jan. 12	39, 70
B. A. C. 3637	1869 April 22	15, 96
Red star	1870 Feb. 12	17, 34

* Note May 28, 1880. Companion of Sirius seems bluish tho W. Jan. 27, 1867 (N 37, 16).

Spectroscopic observations

Name	Date	N
α Hydrae	1868 March 24	40, 70
α Leonis	24	40, 70
α Orionis	24	40, 70
	Dec. 2	14, 79
	9	14, 83
	22	15, 2
	30	15, 8
	1869 April 10	15, 90
β Orionis	1868 March 24	40, 70
	Nov. 13	14, 56
Sor {Orionis	March 24	40, 70
c Orionis	Dec. 22	15, 1
ε Orionis	28	15, 7
71 Orionis	28	15, 6
3 Persei	Dec. 3	14, 81
α Scorpii	1869 June 19	16, 30
α Tauri	1868 March 24	40, 70
	Nov. 12	14, 54
	13	14, 56
	Dec. 9	14, 83
	22	15, 1
α Urs. Min.	1868 March 30	40, 73
β Urs. Min.	30	40, 73
γ Urs. Min.	30	40, 73
α Virginis	30	40, 73

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2. Stars examined chiefly to see if they were double, but also for estimations of magnitude and color.

Among these, the following were considered double: 5 Corvi; and from the Durchmusterung, $-1°$ Nos. 75, one near 116, 935, 937, 981, 985, and on one of the observations of 1869 Jan. 30, 949; (it seems a little doubtful, as some numbers are repeated on this date, whether all the stars observed were in zone $-1°$ as recorded; interpolate); $-0°$, Nos. 33, 59, 64, and one near 64 & 112; $+0°$, No. 174; $+1°$, Nos. 174, 213, 241, 242; $+2°$, Nos. 28, one near 32, 44, 71, 73, 81, 83, 178, 180, 205, one near 207; $+3°$, Nos. 4, 18, 28, 66, one near 69, 418, one near 429; $+4°$, Nos. 9, 14, 17; $+6°$, Nos. 47, two near 50; $+7°$, Nos. 37, 41, 43.

Note June 4, 1881. The observations of 1869 Jan. 30 were by two different observers, the second of whom probably examined part of the stars seen by the first.

1870 April 8 N 17, 58 Stars in Corvus; β, δ, η, γ, ε, α, 5.

Stars from the Durchmusterung.

Zone $-1°$	1868 Nov. 15	N 14, 60	Nos. 58, 60, 62, 66 to 71 inclusive, 73, 74, 75, 76 to 80 inclusive, 108, 109,
		14, 61	112 to 117 inclusive
	1869 Jan. 30	N 15, 34 & 35	118 to 134 inclusive.
			928, 930, 932, 933, 935, 936, 938, 939, 942 (twice), 943 (twice),
			944 to 948 inclusive, 949 (twice), 950, 952, 953 (twice), 956, 957,
			961, 963, 965, 966, 968, 969, 972 to 982 inclusive, 984, 985, 986,
			987, 988, 989, 990, 991, 992.
	1872 Jan. 9	N 18, 1	935, 937.
Zone $-0°$	1868 Nov. 15	N 14, 59	Nos. 32, 33, 35 to 42 inclusive, 46, 51 to 60 inclusive, 62, 63, 64, 69.
		14, 60	68, 70, 71, 72, 76, 78.
	Nov. 19	14, 67	107 to 128 inclusive.
Zone $+0°$	1868 Nov. 27	N 14, 72	No. 149
	Nov. 29	14, 67	Nos. 171 to 180 inclusive.
		68	181 to 191 inclusive.
Zone $+1°$	1868 Nov. 27	N 14, 72	Nos. 167 to 171 inclusive, 173, 174, 176 to 180 inclusive, 182, 183, 185, 187, 191, 194.
		73	198, 202 to 207 inclusive, 212.
	Dec. 2	76	213 to 231 inclusive, 233 to 246 inclusive
	18	93	534, 538, 539, 540, 541, 543 to 548 inclusive.
Zone $+2°$	1868 Nov. 17	N 14, 64	Nos. 26, 28, 32, 34, 40, 42, 44.
		N 14, 65 & 66	62 to 76 inclusive, 78 to 84 inclusive.
	Dec. 2	N 14, 77	171 to 180 inclusive, 183, 184, 185, 187 to 200 inclusive; stars near 190 and 195.
		78	202 to 211 inclusive, 213 to 218 inclusive, 220, 221, 222, 224, 225, 229 to 236 inclusive,
			241 to 246 inclusive.
	18	79	250, 251, 252, 254, 255, 256, 259, 260, 267 268, 270.
		92	474, 477, 478, 479, 480, 481, 482, 483, 488, 490.
Zone $+3°$	1868 Nov. 17	N 14, 63	Nos. 4, 8, 9.
		64	10, 12, 13, 14, 15, 18, 26, 27, 28, 29, 41 to 47 inclusive.
		65	48, 51, 55, 57 to 63 inclusive, 65, 66, 68, 69, 70.
	Dec. 18	92	416 to 418 inclusive, 420, 422, 425, 426, 428 to 434 inclusive.
Zone $+4°$	1868 Nov. 17	N 14, 63	Nos. 1 to 23 inclusive.
Zone $+6°$	1868 Nov. 13	N 14, 55 & 56	Nos. 31 to 34 inclusive, 36 to 50 inclusive, 52, 54, 55.
Zone $+7°$	1868 Nov. 13	N 14, 55	Nos. 34 to 41 inclusive, 43.
	Dec. 18	14, 92	316, 317, 319, 320.
		91	321 to 324 inclusive, 327 to 332 inclusive, 334, 335, 338, 342, 345, 346,
			347, 348.
Zone $+8°$	1868 Dec. 18	N 14, 91	Nos. 338, 340, 341, 342.

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Data for reduction of observations made with the large filar micrometer of Harvard College Observatory during the years 1866–1872.

The filar micrometer used with the East Equatorial 1866–1872 had a fixed position circle, reading to degrees and minutes by two opposite verniers attached to a movable frame. The movable wire of the micrometer was stretched from vernier to vernier, the micrometer screw being set 90° from either vernier. The position circle was graduated continuously to 360°, and was originally set so that when the verniers were north and south their respective readings were about 360° and 180°. By forcibly screwing up the micrometer when first put on after any of its frequent removals, or when it became loose, the fixed position of the circle was shifted in the course, north preceding south following; and as the graduation itself followed the same course, the readings of the verniers when placed north and south were continually diminished, and came at last in 1872 to be about 320° and 140°.

Owing to the course followed by the graduation, any position angle is to be found from the corresponding position reading by subtracting this reading from the reading of the same vernier when (the object measured is) placed at the north. The verniers were often used indiscriminately, so that the question whether any position angle was greater or less than 180° must be answered, if at all, by information derived from notes or from previous knowledge.

The zero of position was determined as usual by setting the movable wire in the direction apparently taken by stars in their passage through the field of the telescope, and reading one or both verniers for this setting. Either 90° or 270° must accordingly be added to each reading thus obtained in order to find the reading of the northern vernier when the movable wire is placed north and south (or what is usually called the zero of position). No more regard was paid during the work to the slight changes of zero which may be occasioned by moving the telescope into different positions than was enough to show that they were small. They are to be neglected in any reduction of the observations which may be attempted.

In the spring of 1867, the edge of the position circle was graduated to degrees, and readings were afterwards made upon this graduation to degrees and tenths, the old graduation being afterwards little used, as it was difficult to read.

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In the spring of 1876, the micrometer, after having been laid aside since 1872, was repaired to adapt it to some proposed observations in charge of Mr. Walds. At this time the graduations read by the verniers were made plainer, and the graduation of 1867 was removed.

The following pages contain a statement of the zeros of position which should apparently be used in any reduction of the micrometric work of 1866–1872, with notes explaining the conclusions reached in doubtful cases by means of the records of measures made of the east and west position of the movable wire, and of changes of zero by removal of the micrometer or otherwise, (for the index to both of which see pp. 36 and 37 of this book); as well as by means of the values of the zero adopted by Mr. C. S. Peirce in reducing the observations made of double stars. In this reduction, however, he decided not to confine himself to one uniform rule, but to enter as the zero, at one time or another, the reading of either vernier either in its eastern or in its northern position.

For convenience of reference, the conclusions adopted are first given by themselves. They are followed by notes, to which reference is made in the statement preceding them by underlining the numbers of the periods discussed in the notes. The notes largely depend on the data given in two appendixes following them, which respectively contain figures extracted from the record books and from Mr. Peirce's reductions.

In the column of the statement headed "Extent of period", both dates given for each period are included in it, with all intermediate dates. To facilitate the use of the statement, each period is made to begin immediately after the end of the preceding one, although of course it often happened that after the micrometer had been removed it was not replaced for several days, or that a considerable time passed without the making of any observations with the micrometer.

The column headed "Adopted zero" gives the readings which must presumably have been those of a vernier set to the north point when the telescope was west of the pier. The records do not give the reversals of the instrument, and as stated above, the point used as the centre of the field in any measurement of position must be inferred by some means independent of the mere figures of the measurement.

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Concluded zeros of position, 1866–1872.

No. of period.	Extent of period.	Adopted zero.
1	1866 May 10 — June 1	13° 15′
2	June 2 — June 25	19° 22′
3	June 26 (first observations)	13° 43′
4	June 26 (last observations) — July 1	357° 33′
5	July 2 — Aug. 14	354° 20′
6	Aug. 15 — Aug. 19	358° 46′
7	Aug. 20 — Oct. 11	350° 26′
8	Oct. 12 — Oct. 22	0° 51′
9	Oct. 23 — Nov. 18	349° 54′
10	1866 Nov. 19 — 1867 March 10	350° 42′
11	1867 March 11 — May 12	{354° 27′ (old circle) / 354° 50 (new circle)}
12	May 13 — July 29	{354° 56 (old circle) / 355° 00 (new circle)}
13	July 30 — Aug. 18	352°.60
14	Aug. 19 — Aug. 24	353°.97
15	Aug. 25 — Aug. 26 (first observations)	8°.30
16	Aug. 26 (last observations) — Sept. 1	351°.06
17	Sept. 2 — Sept. 19	351°.67
18	Sept. 20 — Sept. 27	350°.85
19	Sept. 28 — Sept. 30	348°.25
20	Oct. 1 — Oct. 5	349°.22
21	Oct. 6	348°.18
22	Oct. 7 — Oct. 15	347°.78
23	Oct. 16 — Oct. 17	348°.20
24	Oct. 18 — Oct. 21	349°.77
25	Oct. 22 — Nov. 11 (first observations)	349°.94
26	1867 Nov. 11 (last observations) — 1868 Feb. 17	349°.24
27	1868 Feb. 18 — March 18	348°.24
28	March 19 — March 22	349°.08
29	March 23	347°.77
30	March 24	348°.33
31	March 25 — April 5	351°.60
32	April 6 — April 23	353°.60
33	April 24 — April 26	349°.70
34	April 27 — April 28	351°.60
35	April 29 — May 7	355°.10
36	May 8 — May 10	351°.50
37	May 11 — May 12	350°.90
38	1868 May 13 — May 21	350°.90
39	May 22 — May 27	351°.60
40	May 28 — May 31	348°.80
41	June 1 — June 20	351°.90
42	June 21 — June 30	349°.80
43	July 1 — July 10	351°.45
44	July 11 — July 25	349°.10
45	July 26 — July 31	349°.70
46	Aug. 1 — Aug. 17	349°.10
47	Aug. 18 — Aug. 26	348°.50
48	Aug. 27 — Sept. 10	348°.13
49	Sept. 11 — Sept. 18	350°.10
50	Sept. 19 — Sept. 30	350°.00
51	Oct. 1 — Oct. 22	348°.40
52	Oct. 23 — Oct. 27	347°.42
53	Oct. 28 — Nov. 4	345°.77
54	Nov. 5	347°.90
55	Nov. 6 — Nov. 23	347°.80
56	Nov. 24 — Dec. 13	348°.05
57	Dec. 14 — Dec. 15	349°.20
58	1868 Dec. 16 — 1869 Jan. 15	347°.55
59	1869 Jan. 16 — Jan. 28	347°.80
60	Jan. 29 — Feb. 1	346°.82
61	Feb. 2 — Feb. 4	347°.40
62	Feb. 5 — Feb. 12	344°.15
63	Feb. 13 — March 8	342°.53
64	March 9 — March 16	343°.00
65	March 17 — March 31	344°.84
66	April 1 — April 5	341°.68
67	April 6 — April 9	341°.00
68	April 10 — April 27	341°.80
69	April 28 — August 21	344°.10
70	Aug. 22 — Aug. 23	345°.87
71	Aug. 24 — Sept. 3	344°.35
72	Sept. 4 — Sept. 23	346°.61
73	Sept. 24 — Oct. 18	348°.52
74	Oct. 19 — Oct. 31	347°.70

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Concluded zeros of position, 1866 – 1872, (continued).

No. of period.	Extent of period.	Adopted zero.
75	1869 Nov. 1 — Nov. 10	342°.58
76	Nov. 11 — Dec. 24	341°.48
77	1869 Dec. 25 — 1870 Feb. 18	342°.69
78	1870 Feb. 19 — March 20	340°.34
79	March 21 — April 8 (first observation)	342°.07
80	April 8 (last observation) — April 30	339°.20
81	May 1 — June 30	341°.90
82	July 1 — Dec. 31	344°.25
83	1871 Jan. 1 — April 7 (first observation)	325°.55
84	April 7 (last observation, if any)	324°.23
85	April 8 — May 31	323°.54
86	1871 June 1 — Aug. 30	326°.35
87	Aug. 31 — Sept. 15	323°.73
88	Sept. 16 — Sept. 30	324°.92
89	Oct. 1 — Oct. 31	323°.80
90	Nov. 1 — Nov. 12	322°.05
91	1871 Nov. 13 — 1872 Jan. 20	321°.00
92	1872 Jan. 21 — Jan. 31	320°.57
93	Feb. 1 — Feb. 19	321°.07

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Notes on preceding statement.

Periods 1,2,3,4. It is probable that the micrometer was not screwed up firmly until June 26. On that date, during the observations, its want of firmness seems to have been noticed; and after a determination of the zero, the instrument was screwed up, and a new determination made. The result of this determination was 177° 33′ (for the south point) according to the mean of the observations; the approximate value 177° 30′ was used in the reductions made both by G.M.S. & by C.S.P. In combining the observations of May 10 & 15, (Period 1), G.M.S. used the readings of opposite verniers as separate observations; this seems to be an error, not adopted by C.S.P. The first three periods are formed according to the indications of change found in the observations for zero themselves; the micrometer was very likely on the telescope throughout.

Period 5 There seems to have been a change of zero July 2, produced most likely by again screwing up the micrometer. The values found from this time to Aug. 13 are near enough to each other to be all combined. Four values were used by G.M.S. and C.S.P. during this period. The value adopted in the preceding statement depends on some additional observations found in the record, as well as upon those used by G.M.S. and C.S.P. The micrometer was removed Aug. 15.

Periods 6,7. Micrometer removed Aug. 17, replaced Aug. 20, removed for new diaphragm after Period 7.

Period 8. The value adopted is the mean of the separate observations. Micrometer screwed up Oct. 23 before observations.

Periods 9,10. Verniers adjusted Nov. 19; micrometer removed March 11.

Periods 11,12. The graduation on the edge of the position circle (see foot of p. 71 and top of p. 72) was found on July 23, 1867, to average about 3′ or 0°.05 larger for any reading than the old circle. The zero for Period 11 from all the observations is 354° 27′ by the old graduation; this would be 354°.50 by the outer graduation, allowing for its excess; C.S.P. uses 354°.45, neglecting this allowance. In Period 12 he uses 355°.00 except July 17 in the case of one star, where he uses 355°.10. The mean of the observations for Period 12 is 354°.96; but the value 355°.00 adopted by C.S.P. may be retained, as he perhaps had some reason for it in addition to its convenience. The corresponding value for the old graduation is 354° 56′ or 57′.

The micrometer was off May 13 to 18.

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Notes, continued.

No. of period.

13 Wires broken July 30; micrometer removed Aug. 18. The mean of the observations for the time between these dates makes the zero 352°.60 which according to precedent should be used throughout the period. C.S.P. uses various values.

15 The micrometer apparently became loose before Aug. 25, and the observations of that date and part of the next must be rejected or reduced with a conjectural zero found by G.M.S. Aug. 26. C.S.P. uses 354°.00 by oversight.

17 The micrometer perhaps remained in place through Periods 16 and 17, but the difference of the August and September determinations warrants the division of the interval into two periods, as there was a considerable break in the observations. Micrometer removed Sept. 19.

23 No record of removal of micrometer between Periods 22 and 23, but the interval is considerable and some change is apparent. Micrometer removed Oct. 18.

24 Adjustment of spectroscope Oct. 22 probably implies the removal of the micrometer.

25, 26 For formation of these periods see book N 39, page 101. C.S.P. uses the zeros adopted here, except in the case of Σ 1109, observed on Feb. 8. The value used with this star seems to be wrong by accident.

27 The micrometer does not seem to have been removed during this period, and the observations of stars are tolerably continuous through it, so that it appears best to combine all the determinations of the zero made Feb. 18 and 20 and March 5 and 11. C.S.P. uses three principal values more or less in alternation, without confining either to a definite period. Micrometer removed Feb. 18.

31 The determination of zero for this period is found in the original record for April 1, but does not appear in the copy.

36, 37 No record of change between these periods. It is of little consequence whether they are combined or kept separate. Spectroscope used after observations of May 12, where accordingly Period 37 is made to end. But Period 38 has the same zero.

43 Spectroscope used after observations of July 10. The few periods preceding this are established merely by the considerable apparent changes of zero. There are no records of change.

45 The determination of zero for this period is found only in the original record, for July 26. The change seems to be sufficient to separate Periods 44 and 45.

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No. of period.

46, 47 The determinations of August 9 and 10, and those of August 21 and 23, do not agree well enough to be used together. There are observations of stars August 9, 10, 13, 14, 16, 17, 21, 23. Micrometer removed August 27. The limit between Periods 46 and 47 must be fixed arbitrarily.

48, 49 The determinations of zero made August 31 and September 16 are not accordant. There are observations of stars Sept. 1, 5, 8, 15, 16. The determination of zero made Sept. 16 is called approximate, but can hardly be supposed two degrees in error. Micrometer removed Sept. 18.

51 Observations with micrometer begin Oct. 3. The determinations of zero for this period were made Oct. 3 and 9. The period is extended to Oct. 22 because it may be conjectured that the fresh determination of Oct. 23 was made then because the micrometer had just been screwed up. Moreover, C. S. P. uses one value Oct. 9 to Oct. 20.

53 The determination of zero Oct. 28 disagrees with that of Oct. 23, and perhaps the micrometer was again screwed up just before making it. C. S. P. changes the value he uses at about this point.

54 The telescope was oiled Nov. 5 and the adjustment of the finder disturbed. The zero may have been changed also. C. S. P. uses 347°.90 for Nov. 5 only. The spectroscope was used Nov. 6.

58 The measures found in the record for Jan. 14 are not stated there to be a determination of zero, but have been used as such by C. S. P. as well as here.

63 In forming the zero for this period, the observations of March 3 have been taken into account. C. S. P. uses only those of Feb. 13. Spectroscope used March 9.

66 Spectroscope used March 17 and April 5. No record of change of zero between these dates, but the measures of March 25 and April 3 disagree too much to be placed in one period.

67, 68 In a rough reduction of an observation of a new double star (see book N 15, 99), C. S. P. seems to use 71.8 as a constant for determining position angles April 22. The observation on which this number rests does not seem to be on record, but as the spectroscope was used April 10, Period 67 should not be extended beyond that date, and 341°.80 may be used as the zero for the next period, the end of which is marked by spectroscopic work April 28.

69 Hardly any observations. Eclipse expedition at this time.

72, 73, 74 Spectroscopic work Oct. 3, perhaps only with hand spectroscopes, but this is not certain. No record of change between Sept. 19 and 24, but the determinations of those dates disagree. Spectroscopic work after determination of Oct. 31.

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Notes, continued.

No. of Period

76 The micrometer may have been tightened Nov. 11; it was removed Dec. 24. The value adopted is the mean of the separate determinations Nov. 11, 12, 25, and Dec. 20. C. S. P. uses the value of Nov. 12, and a value intermediate between the results of Nov. 11 & 12, more or less in alternation.

78 The value adopted is the mean of the separate observations. C. S. P. uses four values more or less in alternation.

80, 81, 82 Periods formed because the measures of April 8, June 4, and July 14, disagree with each other. No record of change. C. S. P. uses the round number 342°.00 part of the time; perhaps he thought that the record was insufficient to determine the zero accurately.

83 On April 7 the micrometer was at first loose; the determination was apparently made after tightening it.

85 No indication of change during this period. Reason for values used by C. S. P. not obvious.

86 to 93 No distinct records. Periods somewhat arbitrarily separated. The following memoranda exist: Aug. 31; micrometer put on; Oct. 4; micrometer put on; Nov. 12; micrometer off; Jan. 8; large micrometer (new position aids?) put on; Jan. 30; ocular comet-seeker adjusted and tested (perhaps the large negative eye-piece, to use which the micrometer must be off); Feb. 19; micrometer off.

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Appendix I. Figures extracted from the record books, showing determinations of zero of position.

No. of period				No. of period				No. of period			
1 to 7	See book N34, 99, as well as references in index p. 36 of this book	The separate observations for these periods were not extracted because they had nearly all been collected & arranged in periods in books N34, N35, N36, N37, because these results had been adopted by C.S.P.		19	Sept. 28	78.5		28	March 22	79.0	
						78.2				79.0	
						78.5				79.2	
						78.6				79.1	
					29	78.0					
						78.4		29	March 23	77.77	3 settings
						78.2					
7, 8	See book N35, 97					78.1		30	March 24	78.33	3 settings
					30	78.1					
						78.1		31	April 1	81.6	(in original)
						78.1					
9, 10, 11	See books N36, 98, N37, 105, as well as reference in index p. 36 of this book							32	April 17	263.6	
				20	Oct. 1	259.1			23	263.6	
						259.3					
						259.3		33	April 26	259.7	
						259.2					
					2	259.2		34	April 28	261.6	
				21	Oct. 6	258.1					
						258.3		35	May 4	265.1	
						258.1		36	May 8	261.5	
						258.2			9	261.5	
12	May 18	264.8		22	Oct. 7	257.8		37	May 12	260.9	
		264.8				257.9					
	20	265.0				257.7		38	May 14	260.9	
		265.0				257.7					
		264.9				257.8		39	May 22	81.6	
	24	265.0		23	Oct. 16	258.2		40	May 31	258.8	
		264.9			17	78.2					
	July 10	85.0						41	June 14	261.9	
		85.0		24	Oct. 18	79.7					
	15	85.0				79.8		42	June 28	79.8	
	16	85.1				79.7					
	24	85.0				80.0		43	July 10	261.45	2 settings
	26	85.1				79.7					
	28	84.9				79.8		44	July 16	259.10	2 settings
					19	79.8					
13	July 30	82.5				79.7		45	July 26	79.7	
		82.6		25	See book N39, 101	Separate observations not extracted,					
	Aug. 2	82.5						46	Aug. 9	79.0	
	11	82.7		26	See book N39, 101, as well as references in index, p. 36 of this book	for reasons like those given above for Periods 1 to 11 inclusive.			10	79.1	
		82.7								79.1	
										79.3	
14	Aug. 19	263.9								79.0	
	20	264.0									
	21	264.0						47	Aug. 21	258.4	
									23	258.6	
15	Aug. 26	278.3									
								48	Aug. 31	258.1	
16	Aug. 26	261.0		27	Feb. 18	78.2				258.2	
		261.2				78.2				258.1	
		261.0				78.2					
	27	261.0			20	78.2		49	Sept. 16	80.3	
	31	261.1				78.1				80.0	
						78.3					
17	Sept. 19	81.7			March 5	78.7		50	Sept. 29	260.0	
		81.7				78.7				259.9	
		81.6				78.3				260.1	
						78.2					
18	Sept. 21	81.0				78.1		51	Oct. 3	258.26	5 settings
		81.0				78.1			9	258.54	5 "
	22	80.6				78.3					
		80.7				78.0		52	Oct. 23	257.42	5 settings
		81.0				78.8					
		80.8				78.3		53	Oct. 28	75.7	
	24	81.0				78.1				75.8	
		80.8			11	78.4				75.8	
		80.7				78.0					
	25	80.8				78.0		54	Nov. 5	257.9	
		81.0				77.9					
						78.2		55	Nov. 23	77.8	

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Appendix I, continued.

No. of period		
56	Dec. 10	258.8 (reject)
		258.0
		258.1
57	Dec. 15	259.2
		259.2
58	Jan. 14	257.6
		257.5
59	Jan. 22	257.8
		257.8
60	Feb. 1	76.82 (5 settings)
61	Feb. 4	77.4
		77.4
62	Feb. 7	74.2
		74.1
63	Feb. 13	72.7
		72.6
		72.4
	March 3	252.5
		252.6
		252.4
64	March 15	73.0
		73.0 (unsatisfactory)
65	March 25	74.84 (9 settings)
66	April 3	71.2
	5	71.7
		72.0
		71.5
		71.6
		72.1
67	April 8	71.0
69	June 19	254.1
70	Aug. 22	75.87 (3 settings)
71	Aug. 26	254.5
	31	254.2
72	Sept. 5	256.5
		256.5
		256.6
	11	256.7
		256.1
		256.5
		256.2
		256.4
	19	77.3
		76.6
		76.7
		77.0
		76.8
73	Sept. 24	78.52 (5 settings)
74	Oct. 31	77.70 (5 settings)
75	Nov. 4	72.58 (5 settings)

No. of period		
76	Nov. 11	251.2
	12	251.5
		251.8
		251.8
		251.2
		251.7
	25	71.6 (star trembling)
	Dec. 20	71.1
		71.3
		71.6
77	Jan. 7	252.52 (5 settings)
	Feb. 12	252.86 (5 settings)
78	Feb. 20	70.35
		70.35
		70.35
		70.35
	March 2	70.4
	14	250.3
		250.2
	19	70.3
		69.8 (reject)
		70.5
		70.4 (good)
		70.3
		70.3
79	March 22	72.2
		72.8
		72.0
		71.8
	24	72.1
	25	72.0
		72.0
		72.05
		71.9
	31	252.0
		251.95
80	April 8	69.2
81	June 4	71.9
		71.9
82	July 14	74.25
83	March 10	325.5
	22	145.6
84	April 7	234.3
		234.2 (better)
		234.2
85	May 1	233.3
	10	233.5
		233.7
		233.5
		233.5
		233.3
	11	54.0
86	June 9	56.0
		56.2
		56.1
	July 5	236.7
		236.6
		236.5
		236.3
		236.4
87	Aug. 31	234.0
		233.4
		233.8

No. of period		
88	Sept. 29	54.9
		55.0
		54.9
		54.9
89	Oct. 4	233.7
		233.9
90	Nov. 5	232.0
	6	52.1
91	Jan. 18	231.
92	Jan. 25	230.3
		230.5
		230.1 (bad)
		230.4
		230.2
	29	230.6 (too small)
		230.7 (good)
		231.6 (too large)
		230.9
		231.0
93	Feb. 16	51.0
		51.0
		51.1
		51.2

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Appendix III. Zeros of position adopted by C. S. Peirce, and extracted from the proof-sheets of the electrotyped observations of double stars prepared 1872–1875 under his supervision. They have been used as guides in doubtful cases during the preparation of the list on pages 73 and 74 of this book, which is explained in the introduction to it on pages 71 and 72.

Date	Zero from proof-sheets	Page of proof-sheets
1866 May 15	13° 15′	
June 30	177° 30′	
July 2 to 26 inclusive	354° 17′	
July 29 & 31	354° 28′	
Aug. 2 to 8 inclusive	354° 25′	
Aug. 10 to 13 inclusive	354° 23′	
Aug. 17	358° 46′	
Aug. 20 to Oct. 11	350° 26′	
Oct. 23 to Nov. 17	349° 54′	
Nov. 25 to Feb. 27	350° 42′	
1867 March 19 to May 10	354.45	
July 11	355.00	77
17	355.00	57
17	355.00	75
17	355.10	77
24	355.00	72
July 31	352.63	75
Aug. 5	352.50	60, 72
9	352.70	72
Aug. 2	354.00	75
Oct. 23 to first observation of Nov. 11	349.94	
Nov. 11 to 1868 Feb. 16	349.24	
except as follows:		
Feb. 8	348.20	30
Feb. 8	349.24	28
Feb. 20	348.20	52
25	78.20	29
29	78.33	28
March 4	78.20	28
	348.20	32
	78.33	35
	348.33	36

Date	Zero from proof-sheets	Page of proof-sheets
1868 March 9	348.33	36
	78.33	39
	78.21	44
	348.33	49
	348.33	52
	348.33	54
	348.33	56
11	348.33	27
	348.33	32
	348.33	38
	348.10	45
14	348.10	42
	348.10	45
18	348.10	30
	348.10	36
	348.10	38
	348.10	41
March 19	349.10	40
	349.10	44
	349.10	50
22	349.10	36
	349.08	39
April 1	81.6	31
5	81.6	30
June 28	79.8	75
Aug. 10	79.15	75
	79.10	76
14	79.15	74
16	79.15	76
Sept. 5	348.17	88
8	348.17	94
Oct. 3	348.26	1
6	258.26	8
	348.26	89
	348.26	90
7	348.40	102
	348.40	105
9	258.54	100
10	258.54	103
12	258.54	86, 89, 96
16	258.54	100
17	258.54	60, 68
20	258.54	7, 68, 69, 84, 97
23	257.42	3, 4, 7, 97
24	257.42	100
26	257.42	79, 85, 97
30	75.77	82, 98, 102, 103
Nov. 3	75.77	7, 8, 11, 97
5	257.90	8
	347.90	9
23	77.8	12
Dec. 10	258.05	12
12	258.05	13

Date	Zero from proof-sheets	Page of proof-sheets
1869 Jan. 14	257.55	24
22	357.80	17
25	257.80	27, 31
28	357.80	22
28	257.80	22, 29, 36
Feb. 7	74.15	17
14	74.15	29
Feb. 13	72.57	30, 37
17	72.54	12, 37, 40
19	72.54	23, 24
25	72.57	25
27	72.57	24
April 5	71.78	40
8	71.0	42
Aug. 22	75.87	81, 89
Sept. 3	254.2	78, 82, 95, 101
13	256.38	97
15	256.63	97, 98
16	257.63	83, 84
18	257.63	83, 84, 91
23	76.88	71, 73
24	78.52	73, 76, 77, 100
25	78.52	73
28	78.52	67, 92
28	76.9	85
29	78.52	92
Oct. 1	78.52	92, 93, 94, 101
Nov. 11	251.40	4
	251.60	4
15	251.40	13
18	341.60	9
19	251.60	3
	251.40	3
	341.40	10
	161.40	10, 11
1870 Jan. 19	342.69	33
21	342.69	33
28	342.52	30, 46
Feb. 1	252.86	26
	342.52	31
	252.52	31
	342.86	34
25	340.35	46, 48
	160.35	48
March 2	340.35	34
	70.35	41
14	340.25	33
15	340.25	37, 40
19	340.36	40
	340.26	44
22	72.20	34
25	342.00	37, 38, 41, 43
26	342.00	38
31	342.00	38, 40, 44, 54

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Appendix II, continued.

Date	Zero from proof sheets	Page of proof sheets
1870 April 1	342°.00	47
8	339°.20	40, 41, 43, 45
	69°.2	44
9	339°.20	41
13	339°.20	48
May 18	342°.00	60
19	342°.00	60
20	342°.00	61
26	342°.00	61
June 4	341°.90	54
1871 March 19	325°.55	52
April 14	323°.30	43
May 1	323°.30	59, 66, 70
	233°.30	56
2	323°.30	58, 65
1871 May 10	233°.5	54
	323°.50	50, 59, 61
11	54°.0	58
12	323°.50	63, 69
13	323°.50	31
15	323°.50	45, 55, 56
June 2	323°.50	54
5	326°.10	70
	323°.50	55, 64
9	326°.10	55
12	326°.30	55, 65, 69, 70
14	326°.50	59, 52
	326°.30	65
19	326°.30	59, 78
	56°.1	71
1871 July 5	326°.50	67, 78
7	326°.50	78
	326°.55	83
14	326°.50	61, 62
	236°.50	63
Aug. 31	323°.73	85
Sept. 21	324°.92	91, 94
28	324°.92	94
29	324°.92	102, 104
Oct. 4	233°.80	14, 15

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Values to be used for coincidence of movable and fixed wires, 1866 – 1872.

The customary method of observing was at first that of alternate coincidences; that is, every measure of distance is accompanied by a measure of coincidence, and the difference of the two measures gives the observed distance expressed in revolutions of the screw. At p. 57 of book N 34 are some double distances, and similar observations may occur later; they become somewhat frequent after p. 32 of book N 37. In this method of observing, the fixed wire is used only as a line of reference, and the difference of the two readings is twice the observed distance expressed in revolutions of the screw. An observation of double distance is sometimes indicated in the record by "2 dist."; sometimes not distinctly indicated, as in the observation of 49 Leonis, April 25, 1867, p. 92 of book N 37.

While these methods of observation were in common use, it was needless to retain the reticule in a fixed position upon the micrometer scale, and it seems in fact to have been very often moved. The first set of coincidence readings which has been noticed occurs at p. 67 of book N 34, but the reticule was moved for the next observations. In book N 35, pp. 56 to 58, begin notes stating that the reticule was not moved during a given series of observations. But throughout books N 34 to N 40 inclusive (which contain the copy of the record of the years 1866, 1867, and 1868 to June 28) it is undesirable to adopt a single value of coincidence for the whole of one date. The best way to reduce the observations will ordinarily be to use the coincidence nearest each observation in connection with it; but as the copy is clear and distinct, there is no great difficulty in examining the whole record for each date to decide any doubtful cases.

Even before June 28, 1868, it became rather customary to keep the reticule in a fixed place, and to make several settings for coincidence in immediate succession, the mean of the series being used in the reduction of various measures of distance of different objects. The subsequent measures of distance are generally dependent on observations of this kind. To facilitate reductions, the observations of coincidence have recently (May and June 1880) been examined, and the results given at the beginning of each date in books N 13 (after June 25, 1868), N 14, N 15, N 16, N 17, and N 18. After the middle of November, 1869, (book N 17, about p. 20), the entire

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record was not made in the books of series N, but part of it on detached sheets prepared with blank forms for the entries. These were partly pasted into scrap books, and were used in printing the proof sheets of the double star observations designed 1872-75 to be published in the Annals of the Observatory. It is as yet uncertain how far this portion of the original record is complete. The detached sheets were presumably never used for observations of coincidence.

From and after December 17, 1869, records of coincidence were generally made in the small separate book N 19. As these records are not very extensive, a copy of their results is given here. There are commonly 5 settings for every determination.

1869	Dec. 17	52.7594	1870	March 15	52.682	1871	June 19	49.685
	20	52.740		25	52.685		Sept. 28	49.704
1870	Jan. 7	52.748			52.668		29	49.630
	19	52.7215 (10 settings)			52.676 (mean)		Oct. 4	49.638
		52.7202 (5 ")		31	52.704	1872	Jan. 25	51.408
		52.721 (mean)		April 9	52.196		29	51.400
	Feb. 10	52.683		May 5	52.217		Feb. 5	51.411
	16	52.756 (5 settings)	1871	March 19	49.63		14	51.508
		52.7234 (10 ")		22	49.65 (also 24.56)		16	51.420
		52.734 (mean)		April 7	49.662			
	20	52.662		May 1	49.63			
		52.684		10	49.638			
		52.670		12	49.660			
		52.672 (mean)		15	49.690			
	25	52.725		June 5	49.630			
	March 8	52.740						
	14	52.677						
		52.672						
		52.674 (mean)						

Four reticules seem to have been successively employed in the observations. The first two have been mentioned, and their intervals discussed, in the collection of observations for determining the pitch of the screw which has been prepared for printing. The intervals of the third reticule are noticed in book N 13, pp. 73 and 75; no materials are known for determining those of the fourth except the two coincidences for March 22, 1871, given above on this page. The three wires of the first reticule are here called α, β, γ (in the original a, b, c); the five of the second a, b, c, d, e (as in the original); the two of the third f, g, h (no letters assigned in the original). On all, the letter first named denotes the wire the coincidence with which answers to the smallest reading, or the wire furthest

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from the screw-head, towards which the movable wire is drawn as the reading increases. The adopted values of the intervals are given below, in revolutions of the screw.

First reticule, in use during 1866 up to Oct. 11 inclusive: α to β, 25.016; β to γ, 25.002.

Second " , " " after Oct. 11, 1866, to Aug. 21, 1868, inclusive (a, b, c, removed July 30, 1867, apparently before any observations of that date):

a	from the mean of the five	20.852	
b	" " " " " "	15.790	; from a, 5.062
c	" " " " " "	3.220	; " b, 12.570
d	" " " " " "	4.216	; " c, 0.996
e	" " " " " "	29.206	; " d, 24.990

Third* " , " " Sept. 1, 1868, to April 1, 1870, inclusive:

f from g 25.077; * g from h 25.035 *.

Fourth " , " " April 8, 1870, to Feb. 19, 1872, inclusive:

Interval between the 5 wires 25.090.

The middle of the field is at the screw reading 51.6 to 51.8 by observations of 1866 and 1867; see index in this book, p. 35.

When, as should be always the case, the coincidence with one of the side wires is observed on the same date upon which observations of distance are made with the aid of that wire, the actually observed coincidence should be used instead of one obtained indirectly by means of the wire intervals. It is apparently best to use no value of coincidence for a longer period than one date, except where observations are wanting.

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* Mr. Wendell has a distinct recollection (June, 1880), that the reticule used in the autumn of 1868 was broken about the end of that year. In this case, the reticule called the third above must be regarded as made up of two; the first having the intervals fg 25.164, gh 25.052; for the second, fg is 24.990, gh 25.018.

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