THE OBSERVER'S HANDBOOK FOR 1913

PUBLISHED BY

The Royal Astronomical Society of Canada

EDITED BY C. A. CHANT

FIFTH YEAR OF PUBLICATION

TORONTO
198 COLLEGE STREET
PRINTED FOR THE SOCIETY
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CONTENTS

PREFACE

Previous to 1912 the times of sunrise and sunset were given for a small number of selected places in the standard time of each place. On account of the arbitrary correction which must be made to the mean time of any place in order to get its standard time, the tables prepared for a particular place are of little use anywhere else. In order to remedy this the times of sunrise and sunset have been calculated for places on five different latitudes covering the populous part of Canada, (pages 10 to 21) and the way to use these tables at a large number of towns and cities is explained on pages 8 and 9. This feature proved to be a very satisfactory improvement and is continued this year.

In the present issue the chief changes consist in (1) a comp ete revision of pages dealing with the constellations, a number of double stars, nebulæ and clusters suitable for small instruments being added, and (2) a brief sketch of recent progress in Astronomy.

These and other minor improvements, it is hoped, will commend themselves. Suggestions are invited regarding further means of rendering the little book what it is intended to be, *A Handbook for the Amateur*.

In addition to those whose names appear in the body of the work the Editor is indebted to Mr. R. M. Stewart, of the Dominion Astronomical Observatory, Ottawa, who prepared the "Astronomical Phenomena" on the odd pages from 23 to 45.

THE EDITOR.

TORONTO, December, 1912.

SYMBOLS AND ABBREVIATIONS

SIGNS OF THE ZODIAC

♈ Aries..... 0°	♌ Leo.....120°	♐ Sagittarius...240°
♉ Taurus .....30°	♍ Virgo.....150°	♑ Capricornus..270°
♊ Gemini .....60°	♎ Libra.....180°	♒ Aquarius....300°
♋ Cancer.....90°	♏ Scorpio ....210°	♓ Pisces.....330°

SUN, MOON AND PLANETS

☉ The Sun.	☾ The Moon generally.	♃ Jupiter.
● New Moon.	☿ Mercury.	♄ Saturn.
☽ Full Moon.	♀ Venus.	♅ or ♅ Uranus.
◗ First Quarter	⊕ Earth.	♆ Neptune.
☾ Last Quarter.	♂ Mars.	

ASPECTS AND ABBREVIATIONS

☌ Conjunction, or having the same Longitude or Right Ascension.
☍ Opposition, or differing 180° in Longitude or Right Ascension.
□ Quadrature, or differing 90° in Longitude or Right Ascension.
☊ Ascending Node; ☋ Descending Node.
α or A.R., Right Ascension; δ Declination.
h, m, s, Hours, Minutes, Seconds of Time.
° ′ ″, Degrees, Minutes, Seconds of Arc.

THE GREEK ALPHABET

A, α,	Alpha.	I, ι,	Iota.	P, ρ,	Rho.
B, β,	Beta.	K, κ,	Kappa.	Σ, σ, ς,	Sigma.
Γ, γ,	Gamma.	Λ, λ,	Lambda.	T, τ,	Tau.
Δ, δ,	Delta.	M, μ,	Mu.	Υ, υ,	Upsilon.
E, ε,	Epsilon.	N, ν,	Nu.	Φ, ϕ,	Phi.
Z, ζ,	Zeta.	Ξ, ξ,	Xi.	X, χ,	Chi.
H, η,	Eta.	O, o,	Omicron.	Ψ, ψ,	Psi.
Θ, θ, ϑ,	Theta.	Π, π,	Pi.	Ω, ω,	Omega.

SOLAR AND SIDEREAL TIME

In practical astronomy three different kinds of time are used, while in ordinary life we use a fourth.

1. *Apparent Time*—By apparent noon is meant the moment when the sun is on the meridian, and apparent time is measured by the distance in degrees that the sun is east or west of the meridian. Apparent time is given by the sun-dial.

2. *Mean Time*—The interval between apparent noon on two successive days is not constant, and a clock cannot be constructed to keep apparent time. For this reason *mean time* is used. The length of a mean day is the average of all the apparent days throughout the year. The *real sun* moves about the ecliptic in one year; an imaginary *mean sun* is considered as moving uniformly around the celestial equator in one year. The difference between the times that the real sun and the mean sun cross the meridian (*i. e.* between apparent noon and mean noon) is the *equation of time.* (See next page).

3. *Sidereal Time*—This is time as determined from the stars. It is sidereal noon when the Vernal Equinox or First of Aries is on the meridian. In accurate time-keeping the moment when a star is on the meridian is observed and the corresponding mean time is then computed with the assistance of the Nautical Almanac. When a telescope is mounted equatorially the position of a body in the sky is located by means of the sidereal time.

4. *Standard Time*—In everyday life we use still another kind of time. A moment's thought will show that in general two places will not have the same mean time; indeed, difference in longitude between two places is determined from their difference in time. But in travelling it is very inconvenient to have the time varying from station to station. For the purpose of facilitating transportation the system of *Standard Time* was introduced in 1883. Within a certain belt approximately 15° wide, all the clocks show the same time, and in passing from one belt to the next the hands of the clock are moved forward or backward one hour.

In Canada we have six standard time belts, as follows:—60th meridian or Atlantic Time, 4h. slower than Greenwich; 75th meridian or Eastern Time, 5h.; 90th meridian or Central Time, 6h.; 105th meridian or Mountain Time, 7h.; 120th meridian or Pacific Time, 8h.; and 135th meridian or Yukon Time, 9h. slower than Greenwich.

Notice also that in civil reckoning the day lasts from midnight to midnight, while in astronomical reckoning it begins at noon and lasts until the next noon.

1913, EPHEMERIS OF SUN. AT GREENWICH MEAN NOON.

Date			Right Ascension			Declination				Equation of Time +, add to) −, subt. from) Apparent Time			Sidereal Time or R.A. of Mean Sun		
			h	m	s		°	′	″		m	s	h	m	s
Wed.	Jan.	1	18	45	41	S.	23	2	15	+	3	33·5	18	42	7·1
Mon.	"	6	19	7	43		22	32	26		5	51·8	19	01	49·9
Sat.	"	11	19	29	33		21	51	29		7	58·6	19	21	32·7
Thur.	"	16	19	51	8		20	59	54		9	50·5	19	41	15·5
Tue.	"	21	20	12	25		19	58	19		11	24·7	20	00	58·3
Sun.	"	26	20	33	23		18	47	27		12	39·9	20	20	41·1
Fri.	"	31	20	54	01		17	28	02		13	35·3	20	40	23·9
Wed.	Feb.	5	21	14	20		16	0	51		14	10·6	21	0	6·7
Mon.	"	10	21	34	18		14	26	46		14	25·7	21	19	49·5
Sat.	"	15	21	53	56		12	46	42		14	21·0	21	39	32·2
Thur.	"	20	22	13	15		11	01	33		13	57·7	21	59	15·0
Tue.	"	25	22	32	18		9	12	08		13	17·8	22	18	57·8
Sun.	Mar.	2	22	51	06		7	19	14		12	23·6	22	38	40·5
Fri.	"	7	23	9	43		5	23	42		11	17·4	22	58	23·3
Wed.	"	12	23	28	09		3	26	22		10	1·2	23	18	6·1
Mon.	"	17	23	46	27	S.	1	28	04		8	37·1	23	37	48·9
Sat.	"	22	0	4	40	N.	0	30	25		7	7·6	23	57	31·6
Thur.	"	27	0	22	51		2	28	21		5	35·7	0	17	14·4
Tue.	Apr.	1	0	41	2		4	25	5		4	4·2	0	36	57·2
Sun.	"	6	0	59	16		6	19	50		2	35·6	0	56	39·9
Fri.	"	11	1	17	35		8	11	53	+	1	11·8	1	16	22·7
Wed.	"	16	1	36	0		10	0	28	−	0	5 3	1	36	5·5
Mon.	"	21	1	54	34		11	44	53		1	13·6	1	55	48·2
Sat.	"	26	2	13	19		13	24	29		2	11·2	2	15	31·0
Thur.	May	1	2	32	17		14	58	38		2	56·1	2	35	13·8
Tue.	"	6	2	51	29		16	26	39		3	27·4	2	54	56·6
Sun.	"	11	3	10	54		17	47	50		3	44·6	3	14	39·4
Fri.	"	16	3	30	34		19	1	33		3	47·9	3	34	22·1
Wed.	"	21	3	50	27		20	7	13		3	37·4	3	54	4·9
Mon.	"	26	4	10	34		21	4	19		3	13·4	4	13	47·7
Sat.	"	31	4	30	53		21	52	23		2	36·8	4	33	30·5
Thur.	June	5	4	51	24		22	30	59		1	49·3	4	53	13·3
Tue.	"	10	5	12	3		22	59	42	−	0	53·4	5	12	56·1
Sun.	"	15	5	32	47		23	18	19	+	0	7·9	5	32	38·9
Fri.	"	20	5	53	34		23	26	40		1	12·0	5	52	21·7
Wed.	"	25	6	14	21		23	24	43		2	16·5	6	12	4·5
Mon.	"	30	6	35	6		23	12	27	+	3	18·7	6	31	47·3

1913, EPHEMERIS OF SUN. AT GREENWICH MEAN NOON.

Date			Right Ascension			Declination			Equation of Time +, add to \ −, subt. from / Apparent Time			Siderial Time or R.A. of Mean Sun		
			h	m	s	°	′	″		h	m	h	m	s
Sat.	July	5	6	55	46	N. 22	50	2	+	4	15·6	6	51	30·0
Thur.	"	10	7	16	18	22	17	40		5	4·2	7	11	12·9
Tue.	"	15	7	36	38	21	35	43		5	41·8	7	30	55·6
Sun.	"	20	7	56	46	20	44	35		6	6·9	7	50	38·4
Fri.	"	25	8	16	41	19	44	44		6	18·3	8	10	21·2
Wed.	"	30	8	36	21	18	36	39		6	15·6	8	30	4
Mon.	Aug.	4	8	55	46	17	20	54		5	58·0	8	49	46·8
Sat.	"	9	9	14	56	15	58	7		5	25·0	9	9	29·6
Thur.	"	14	9	33	50	14	28	58		4	37·4	9	29	12·3
Tue.	"	19	9	52	32	12	54	4		3	35·9	9	48	55·1
Sun.	"	24	10	11	1	11	14	3		2	22·4	10	8	37·9
Fri.	"	29	10	29	19	9	29	32	+	0	58·6	10	28	20·7
Wed.	Sept.	3	10	47	30	7	41	13	−	0	33·7	10	48	3·4
Mon.	"	8	11	5	33	5	49	49		2	13·0	11	7	46·2
Sat.	"	13	11	23	31	3	56	1		3	57·2	11	27	29·0
Thur.	"	18	11	41	27	2	0	31		5	43·6	11	47	11·8
Tue.	"	23	11	59	24	N. 0	3	55		7	29·3	12	6	54·5
Sun.	"	28	12	17	24	S. 1	53	54		9	11·7	12	26	37·3
Fri.	Oct.	3	12	35	30	3	49	45		10	48·4	12	46	20·1
Wed.	"	8	12	53	43	5	45	16		12	17·4	13	6	2·8
Mon.	"	13	13	12	7	7	38	53		13	36·2	13	25	45·6
Sat.	"	18	13	30	44	9	29	51		14	42·2	13	45	28·4
Thur.	"	23	13	49	36	11	17	25		15	32·9	14	5	11·1
Tue.	"	28	14	8	45	13	0	48		16	6·0	14	24	54·0
Sun.	Nov.	2	14	28	14	14	39	6		16	20·2	14	44	36·7
Fri.	"	7	14	48	2	16	11	26		16	14·6	15	4	19·5
Wed.	"	12	15	8	11	17	36	58		15	48·5	15	24	2·3
Mon.	"	17	15	28	41	18	54	53		15	1·4	15	43	45·0
Sat.	"	22	15	49	33	20	4	25		13	53·0	16	3	27·8
Thur.	"	27	16	10	44	21	4	47		12	24·39	16	23	10·6
Tue.	Dec.	2	16	32	14	21	55	14		10	37·5	16	42	53·4
Sun.	"	7	16	53	59·5	22	35	8		8	35·3	17	2	36·2
Fri.	"	12	17	15	57	23	3	59		6	20·8	17	22	19
Wed.	"	17	17	38	4	23	21	25		3	57·6	17	42	1·8
Mon.	"	22	18	0	15	23	27	10	−	1	28·9	18	1	44·6
Sat.	"	27	18	22	29	23	21	8	+	1	0·9	18	21	27·4

OCCULTATIONS OF STARS BY THE MOON, 1913

PREPARED BY R. M. MOTHERWELL

The following predictions were prepared for Ottawa and so observers at other points should allow for the difference in longitude and latitude. The occultations for 1913 are unusually interesting owing to the occulting of the Pleiades in March, July and October.

Star	Mag.	Date	*Immersion		*Emersion		Position Angle	
							Immersion	Emersion
			h	m	h	m	°	°
β Virginis	3·8	January 25	10	57·8	11	30·3	65	1
W Sagittarii	4·3	February 28	20	29·8	21	50·8	94	254
17 Tauri	3·8	March 13	3	17·5	4	3·0	9	300
23 Tauri	4·3	March 13	3	35·4	4	53·9	92	231
η Tauri	3·0	March 13	4	24·4	5	46·4	74	244
27 Tauri	3·7	March 13	5	36·0	6	28 0	123	202
48 β Scorpii	4·9	April 22	9	59·9	10	54·9	92	328
π Scorpii	3·0	July 13	9	8·0	10	28·0	96	294
φ Aquarii	4·4	July 21	19	40·8	20	38·3	32	264
17 Tauri	3·8	July 27	16	37·3	17	48·0	46	262
20 Tauri	4·1	July 27	17	35·9	18	16·9	8	302
23 Tauri	4·3	July 27	17	22.4	18	8·4	117	192
η Tauri	3·0	July 27	18	2·9	19	1·4	108	203
τ Scorpii	2·9	August 10	5	58·5	6	14·0	177	220
W Sagittarii	4·3	October 5	8	26·9			112	
φ Aquarii	4·4	October 11	14	41·8			62	
17 Tauri	3·8	October 17	13	21·4	14	17·9	115	200
q Tauri	4·3	October 17	13	46·1	15	00·6	42	275
20 Tauri	4·1	October 17	13	57·2	15	20·7	76	244
φ Aquarii	4·4	December 5	3	32·3	4	43·3	26	262

*Eastern Standard Astronomical Time. (Hours numbered from noon).

TIMES OF SUNRISE AND SUNSET

In the tables on pages 10 to 21 are given the times of sunrise and sunset for places in latitudes 44°, 46°, 48°, 50° and 52°, which cover pretty well the populated part of Canada. The times are given in Mean Solar Time, and in the table on page following this are given corrections to adopt these times to the Standard or Railroad times of the cities and towns named or for places near them.

How the Tables are Constructed

The time of sunrise and sunset at a given place, in mean solar time, varies from day to day, and depends principally upon the declination of the sun. Variations in the equation of time, the apparent diameter of the sun and atmospheric refraction at the points of sunrise and sunset also affect the final result. These quantities, as well as the solar declination, do not have precisely the same values on corresponding days from year to year, and so it is impossible to give in any general table the exact time of sunrise and sunset day by day.

With this explanation the following general table has been computed, giving the rising and setting of the upper limb of the sun, corrected for refraction, using the values of the solar declination and equation of time given in the Nautical Almanac for 1899; these are very close average values and may be accepted as approximately correct for years. It must also be remembered that these times are computed for the sea horizon, which is only approximately realised on land surfaces, and is generally widely departed from in hilly and mountainous localities. The greater or less elevation of the point of view above the ground must also be considered, to get exact results.

The Times for Any Station

In order to find the time of sunrise or sunset for any place on any day, first from the list below find the approximate latitude of the place and the correction, in minutes, which follows the name. Then find in the monthly table the time of sunrise and sunset for the proper latitude, on the desired day, and apply the correction.

44°		46°		48°		50°		52°	
	mins.		mins.		mins.		mins.		mins.
Barrie	+ 17	Charlotte-		Port Arthur	+ 57	Brandon	+ 40	Calgary	+ 36
Brantford	+ 21	town	+ 13	Victoria	+ 13	Indian		Edmon-	
Chatham	+ 29	Fredericton	+ 26			Head	- 5	ton	+ 34
Goderich	+ 27	Montreal	- 6			Kamloops	+ 2	Prince	
Guelph	+ 21	Ottawa	+ 3			Kenora	+ 18	Albert	+ 4
Halifax	+ 14	Parry Sound	+ 20			Medicine		Saska-	
Hamilton	+ 20	Quebec	- 15			Hat	+ 22	toon	+ 6
Kingston	+ 6	Sherbrooke	- 12			Moose Jaw	+ 2		
London	+ 25	St. John,				Moosomin	+ 46		
Orillia	+ 18	N.B.	+ 24			Nelson	- 11		
Owen Sound	+ 24	Sydney	+ 1			Portage La			
Peterboro	+ 13	Three Rivers	- 10			Prairie	+ 33		
Port Hope	+ 14					Regina	- 2		
Stratford	+ 24					Vancouver	+ 12		
Toronto	+ 18					Winnipeg	+ 28		
Windsor	+ 32								
Woodstock	+ 23								
Yarmouth	+ 24								

Example.— Find the time of sunrise at Owen Sound, also at Regina, on February 11.

In the above list Owen Sound is under "44°", and the correction is + 24 min. On page 11 the time of sunrise on February 11 for latitude 44° is 7.05; add 24 min. and we get 7.29 (Eastern Standard Time). Regina is under "50°", and the correction is - 2 min. From the table the time is 7.18, and subtracting 2 min. we get the time of sunrise 7.16 (Central Standard Time).

JANUARY

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

For an explanation of this table and its use at various places, see pages 8 and 9

FEBRURAY

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

For an explanation of this table and it use at various places, see pages 8 and 9

MARCH

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

For an explanation of this table and its use at various places see pages 8 and 9

APRIL

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

For an explanation of this table and its use at various places, see pages 8 and 9

MAY

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

For an explanation of this table and its use at various places, see pages 8 and 9

JUNE

Day of Month	Latitude 44°		Latitude 46°		Latitude 48°		Latitude 50°		Latitude 52°	
	Sunrise	Sunset	Sunrise	Sunset	Sunrise	Sunset	Sunrise	Sunset	Sunrise	Sunset
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
1	4 20	7 35	4 12	7 43	4 4	7 51	3 56	8 0	3 45	8 10
2	4 19	7 36	4 12	7 44	4 4	7 52	3 55	8 1	3 44	8 11
3	4 19	7 37	4 11	7 44	4 3	7 52	3 54	8 2	3 44	8 11
4	4 18	7 38	4 11	7 45	4 3	7 53	3 54	8 3	3 43	8 12
5	4 18	7 39	4 10	7 46	4 2	7 54	3 53	8 4	3 43	8 13
6	4 17	7 39	4 10	7 47	4 2	7 55	3 52	8 4	3 43	8 14
7	4 17	7 40	4 10	7 48	4 1	7 56	3 52	8 5	3 42	8 15
8	4 17	7 41	4 9	7 48	4 1	7 57	3 52	8 6	3 42	8 15
9	4 17	7 41	4 9	7 49	4 1	7 57	3 51	8 7	3 41	8 16
10	4 16	7 42	4 9	7 49	4 0	7 58	3 51	8 8	3 41	8 17
11	4 16	7 42	4 9	7 50	4 0	7 59	3 50	8 8	3 41	8 18
12	4 16	7 43	4 9	7 51	4 0	7 59	3 50	8 9	3 41	8 18
13	4 16	7 43	4 8	7 51	4 0	8 0	3 50	8 10	3 40	8 19
14	4 16	7 44	4 8	7 52	4 0	8 0	3 50	8 10	3 40	8 19
15	4 16	7 44	4 8	7 52	4 0	8 1	3 50	8 11	3 40	8 20
16	4 16	7 45	4 8	7 53	4 0	8 1	3 50	8 11	3 40	8 21
17	4 17	7 45	4 8	7 53	4 0	8 2	3 50	8 12	3 40	8 21
18	4 17	7 45	4 8	7 54	4 0	8 2	3 50	8 12	3 39	8 22
19	4 17	7 46	4 8	7 54	4 0	8 2	3 50	8 12	3 39	8 23
20	4 17	7 46	4 8	7 54	4 0	8 3	3 50	8 13	3 39	8 23
21	4 17	7 46	4 8	7 54	4 0	8 3	3 50	8 13	3 39	8 23
22	4 18	7 46	4 9	7 55	4 0	8 3	3 50	8 13	3 39	8 23
23	4 18	7 46	4 9	7 55	4 1	8 3	3 51	8 13	3 40	8 23
24	4 18	7 47	4 10	7 55	4 1	8 3	3 51	8 13	3 40	8 23
25	4 18	7 47	4 10	7 55	4 1	8 3	3 51	8 13	3 40	8 23
26	4 19	7 47	4 10	7 55	4 2	8 3	3 52	8 13	3 41	8 23
27	4 19	7 47	4 11	7 55	4 2	8 3	3 52	8 13	3 41	8 23
28	4 19	7 47	4 11	7 55	4 3	8 3	3 53	8 13	3 42	8 23
29	4 20	7 47	4 12	7 55	4 3	8 3	3 53	8 13	3 42	8 23
30	4 20	7 47	4 12	7 54	4 4	8 3	3 54	8 13	3 43	8 23

For an explanation of this table and its use at various places, see pages 8 and 9

JULY

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

For an explanation of this table and its use at various places, see pages 8 and 9

AUGUST

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

For an explanation of this table and its use at various places see pages 8 and 9

SEPTEMBER

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

For an explanation of this table and its use at various places, see pages 8 and 9

OCTOBER

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

For an explanation of this table and its use at various places, see pages 8 and 9

NOVEMBER

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

For an explanation of this table and its use at various places, see pages 8 and 9

DECEMBER

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

For an explanation of this table and its use at various places, see pages 8 and 9

THE SKY FOR JANUARY

The Sun.—During January the sun's R.A. increases from 18h 46m to 20h 54m, and its Decl. changes from 23° 2′ S. to 17° 28′ S. The equation of time increases from 3m 34s to 13m 35s and due to this rapid rise in value the time of mean noon appears to remain, for the first ten days, at the same distance from the time of sunrise, *i.e.*, the forenoons as indicated by our clocks are of the same length. The sun is nearest the earth at 8 p.m. on December 31st, 1912.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 25th the moon occults β Virginis, mag. 3·8. (See page 8).

Mercury on January 1st crosses the meridian at 10.29 a.m. (M.T.); at 10.56 on the 15th; it was in inferior conjunction with the sun on December 8th, 1912, and reached greatest elongation west on December 28th. Its low declination, 23° S., prevents it from being well seen.

Venus on January 15th is in R.A. 22h 46m, Decl. 8° 58′ S. It crosses the meridian at 3.09 p.m. (M.T.). It is separating from the sun and is a prominent evening star. It is in conjunction with the moon on the 11th, (see opposite page).

Mars on the 15th is in R.A. 18h 16m, Decl. 24° S., and crosses the meridian at 10.39 a.m. (M.T.). On that date it is 218 millions of miles from the earth. It is slowly increasing in brightness, but is not well placed for observation.

Jupiter on the 15th is in R.A. 18h 12m, Decl. 23° 13′ S., and crosses the meridian at 10.35 a.m, It is not well placed for observation.

Saturn on the 15th is in R.A. 3h 42m, Decl. 17° 35′ N., and crosses the meridian at 8.03 p.m. It continues to retrograde until the 29th when it becomes stationary (see opposite page), and then begins to go forward. It is almost south of the Pleiades and is well placed for observation. In conjunctlon with the moon on the 18th (see opposite page).

Uranus on the 15th is in R.A. 20h 22m, Decl. 20° 4′ S., and crosses the meridian at 0.44 p.m. (M.T.).

Neptune on the 15th is in R.A. 7h 45m, Decl. 20° 43′ N., about 7° S. of Pollux.

For the minima of Algol and the configurations of Jupiter's satellites see opposite page. On account of Jupiter's proximity to the sun the latter are not given prior to January 17.

JANUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 6h 30m.
			h m	
Wed.	1			Invisible on account of proximity to sun
Thur.	2		1 51	
Fri.	3			
Sat.	4		22 40	
Sun.	5	9h 36m ☌ ☿ ☾, ☿ 5° 41′ N.; 14h 36m ☌ ♂ ☾,		
Mon.	6	[♂ 4° 25′ N.; 22h 34m ☌ ♃ ☾, ♃ 5° 11′ N.		
☉Tues.	7	5h 28m·3 New Moon.	19 29	
Wed.	8	11h 28m ☌ ♅ ☾, ♅ 4° 5′ N.		
Thur.	9	15h ☌ ☿ ♂, ☿ 0° 46′ N.		
Fri.	10	19h·5 ☾ in Apogee.	18	
Sat.	11	5h 29m ☌ ♀ ☾, ♀ 1° 28′ N.; 9h ☿ in ♉; 10h ☌		
Sun.	12	[☿ ♃, ☿ 0° 33′ S.		
Mon.	13	16h ☌ ♂ ♃, ♂ 0° 47′ S.	13 07	
Tues.	14			
☽Wed.	15	3h ☍ ♆ ☍; 11h 11m·6 Moon's First Quarter.		
Thur.	16		9 56	
Fri.	17			
Sat.	18	1h 46m ☌ ♄ ☾, ♄ 6° 14′ S.		321○4
Sun.	19		6 45	24○1●
Mon.	20			41○23
Tues.	21	15h ☿ in Aphelion; 21h 6m ☌ ♆ ☾, ♆ 5° 24′ S.		4○213
☺Wed.	22	10h 40m·1 Full Moon.	3 34	421○3
Thur.	23	6h·4 ☾ in Perigee; 20h ☌ ☉ ☍.		43○1●
Fri.	24			43○2●
Sat.	25		0 23	♃432○
Sun.	26			423○1
Mon.	27		21 12	;○423
Tues.	28			○2143
☾Wed.	29	2h 34m·0 Moon's Last Quarter; 3h ♄ Stationary;		21○34
Thur.	30	[10h ☿ in ♌.	18 01	32○14
Fri.	31			31○24

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars, ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR FEBRUARY

The Sun.—During February the sun's R.A. increases from 20h 58m to 22h 44m, and its Decl. changes from 17° 11′ S. to 8° 5′ S. The equation of time reaches its maximum value 14m 26s on the 11th. On the 28th it is 12m 47s.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 28th the moon occults W Sagittarii, mag. 4·3. (See page 8).

Mercury comes into superior conjunction with the sun on the 12th, and is not well placed for observation.

Venus on the 15th is in R.A. oh 45m, Decl. 6° 37′ N. and crosses the meridian at 3.05 p.m. (M.T.). It reaches its greatest elongation, 46° 43′ E. on the 12th, and so is a prominent evening star. It is in conjunction with the moon on the 10th. Its phase, like a half-moon, can be easily seen in a small telescope.

Mars on the 15th is in R.A. 19h 57m, Decl. 21° 38′ S., and crosses the meridian at 10.18 a.m. (M.T.). On that date it is 206½ millions of miles from the earth. Still improving its position, but not well placed for observation. It is in conjunction with the moon on the 3rd and with Uranus on the 26th, (see opposite page).

Jupiter on the 15th is in R.A. 18h 40m, Decl. 22° 58′ S., and crosses the meridian at 9.01 a.m. (M.T.). It is in Sagittarius; not yet well placed for observations but improving.

Saturn on the 15th is in R.A. 3h 43m, Decl. 17° 45′ and crosses the meridian at 6.02 p.m. (M.T.). It is now moving forward. It is in conjunction with the moon on the 14th and in quadrature with the sun on the 16th (see opposite page). Still in Taurus and well placed for evening observations.

Uranus on the 15th is in R.A, 20h 29m, Decl. 19° 38′ S., and crosses the meridian at 10.50 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 42m, Decl. 20° 51′ N., and crosses the meridian at 10·01 p.m. (M.T.).

For the minima of Algol and the configurations of Jupiter's satellites see the opposite page.

FEBRUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 5h 30m.
			h m	
Sat.	1	2h ☌ ☿ ♅, ☿ 1° 23′ S.		♃3○14
Sun.	2	15h 44m ☌ ♃ ☾, ♃ 5° 17′ N.	14 50	23○4●
Mon.	3	13h 38m ☌ ♂ ☾, ♂ 4° 12′ N.		1○234
Tues.	4	20h 56m ☌ ♅ ☾, ♅ 4° 1′ N.		○4123
Wed.	5	11h 14m ☌ ☿ ☾, ☿ 2° 9′ N.	11 39	214○3
(New) Thur.	6	0h 21m·9 New Moon.		42○31
Fri.	7	2h·8 ☾ in Apogee.		431○2
Sat.	8		8 28	43○21
Sun.	9			423○●
Mon.	10	7h 13m ☌ ♀ ☾, ♀ 0° 51′ N.		41○23
Tues.	11	0h ☿ Greatest Hel. Lat. S.	5 17	4○123
Wed.	12	9h ♀ Greatest Elong. E. 46° 43′; 18h ☌ ☿ (New)		421○3
Thur.	13	[Superior.		2○431
(1st Q.) Fri.	14	3h 33m·9 Moon's First Quarter; 10h 33m ☌ ♄ ☾,	2 06	31○24
Sat.	15	[♄ 6° 20′ S.		3○214
Sun.	16	13h □ ♄ (New).	22 54	321○4
Mon.	17			♃○34●
Tues.	18	7h 11m ☌ ♆ ☾, ♆ 5° 30′ S.		○1234
Wed.	19		19 43	21○34
(Perig.) Thur.	20	19h·1 ☾ in Perigee; 21h 3m·3 Full Moon.		2○314
Fri.	21			31○42
Sat.	22		16 32	34○21
Sun.	23			4321○
Mon.	24			4○1●●
Tues.	25		13 21	4○23●
Wed.	26	0h ☌ ♂ ♅, ♂ 0° 26′ S.		421○3
(Last Q.) Thur.	27	16h 15m·4 Moon's Last Quarter.		42○13
Fri.	28		10 10	413○2

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; (New) Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR MARCH

The Sun.— On March 1st the sun's R.A. is 22h 47m and its Decl. is 7° 42′ S. It reaches the equator on the 21st (see opposite page) and on the 31st the R.A. is 0h 37m, Decl. 4° 2′ N. During the month the equation of time decreases from 12m 36s to 4m 23s.

The Moon.— For its phases and conjunctions with the planets, see opposite page. On the 13th the moon occults the Pleiades (see page 8), a very interesting observation. On the 22nd is a total eclipse of the moon. (See page 48).

Mercury on the 11th reaches its greatest elongation E. 18° 19′. This is a good time of the year to observe an eastern elongation, but its angular distance from the sun is not nearly so great as at some times (28°). The planet should be looked for immediately after sunset, just above the sunset point. Use an opera glass if possible. On the 27th the planet comes into inferior conjunction with the sun.

Venus on the 15th is in R.A. 2h 8m, Decl. 18° 15′ N. and crosses the meridian at 2.38 p.m. (M.T.). It attains its greatest brilliancy on the 19th, at which time its stellar magnitude is − 4·3, or 14½ times as bright as Sirius. Through a small telescope it then appears like a crescent moon 4 days old. It is rapidly approaching the sun, but does not reach inferior conjunction until April 24th.

Mars on the 15th is in R.A. 21h 26m, Decl. 16° 20′ S,, and crosses the meridian at 9.56 a.m. (M.T.). It is in Capricornus, just north of Delta, and it is 194½ millions of miles from the earth. It is a morning star but is not very bright nor well placed for observing.

Jupiter on the 15th is in R.A. 19h 1m, Decl. 22° 36′ S., and crosses the meridian at 7.31 a.m. (M.T.). Its stellar magnitude is − 1·5, about equal to Sirius. A prominent morning star, seen in the south-east.

Saturn on the 15th is in R.A. at 3h 49m, Decl. 18° 13′ N., and crosses the meridian at 4.18 p.m. (M.T.). In Taurus still, being about 3° south and a little east of the Pleiades.

Uranus on the 15th is in R.A. 20h 35m, Decl. 19° 17′ S., and crosses the meridian at 9·06 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 40m, Decl. 20° 57′ N., and crosses the meridian at 8.09 p.m. (M.T.).

For the minima of Algol and the configurations of Jupiter's satellites see opposite page.

MARCH

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 4h 30m.
			h m	
Sat.	1			34○21
Sun.	2	0h ☿ in ☊ ; 7h 24m ☌ ♃ ☾, ♃ 5° 22′ N.		321○4
Mon.	3		6 59	23○14
Tues.	4	0h ☿ in Perihelion; 5h 49m ☌ ♅ ☾, ♅ 4° 2′ N.;		1○234
Wed.	5	[15h 30m ☌ ♂ ☾, ♂ 3° 19′ N.		♃♃3○4
Thur.	6	3h·6 ☾ in Apogee; 15h ☿ in Perihelion.	3 48	2○134
Fri.	7	19h 22m·5 New Moon.		13○24
Sat.	8			3○124
Sun.	9	9h 53m ☌ ☿ ♄, ☿ 1° 29′ N.	0 37	321○4
Mon.	10			32○41
Tues.	11	2h ☿ Greatest Elong. E. 18° 19′; 15h 30m ☌ ♀ ☾,	21 26	41○32
Wed.	12	[♀ 2° 1′ N.		4○213
Thur.	13	19h 36m ☌ ♄ ☾, ♄ 6° 23′ S.		42○3●
Fri.	14		18 15	♃41○2
Sat.	15	15h 58m·0 Moon's First Quarter.		43○12
Sun.	16	22h ☿ Greatest Hel. Lat. N.		4321○
Mon.	17	15h 43m ☌ ♆ ☾, ♆ 5° 34′ S.; 23h ☿ Stationary.	15 04	432○1
Tues.	18			41○32
Wed.	19	12h ♀ Greatest brilliancy.		○1243
Thur.	20		11 53	2○34●
Fri.	21	0h 18m ♍ enters Aries. Spring begins.		1○34●
Sat.	22	6h 56m·2 Full Moon.		3○124
Sun.	23		8 42	312○4
Mon.	24			32○14
Tues.	25	22h ♀ Greatest Hel. Lat. N.		1○324
Wed.	26		5 31	○1243
Thur.	27	23h ☌ ☿ ♍ Inferior.		♃21○3
Fri.	28			♃4○3●
Sat.	29	7h 57m·7 Moon's Last Quarter; 21h 29m ☌ ♃ ☾,	2 20	43○12
Sun.	30	[♃ 5° 19′ N.		4312○
Mon.	31	14h 35m ☌ ♅ ☾, ♅ 0° 48′ N.	23 09	432○1

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars, ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR APRIL

The Sun.—During April the sun continues its rapid rise above the equator, and the days rapidly increase in length. On the 1st its R.A. is 0h 41m, Decl. 4° 25′ N.; on the 30th the R.A. is 2h 28m, Decl. 14° 40′ N.

On April 6 th there is a partial eclipse of the sun, visible in the north-western part of Canada and in Alaska. See page 48.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 22nd the moon occults 48 *B* Scorpii, mag. 4·9 (see page 8).

Mercury on the 24th reaches its greatest elongation W., 27° 12′ (see opp. page). This is a wide separation from the sun, but this is not the best tlme of the year to see the planet at western elongation. It can probably be seen, however, with an opera glass.

Venus on the 15th is in R.A. 2h 20m, Decl. 21° 16′ N., and crosses the meridian at 0.48 p.m. (M.T.). It is in inferior conjunction with the sun on the 24th, after which it becomes a morning star, separating from the sun rapidly.

Mars on the 15th is in R.A. 22h 58m, Decl. 8° 3′ S., and crosses the meridian at 9.26 a.m. (M.T.). On this date it is 182 millions of miles from the earth. It is now in Aquarius, and can be seen as a morning star, but it is still not very bright.

Jupiter on the 15th is in R.A. 19h 15m, Decl. 22° 16′ S., and crosses the meridian at 5.43 a.m. (M.T.). Its stellar magnitude is − 1·8, somewhat brighter than Sirius, and it is a prominent morning star, in the constellation Sagittarius.

Saturn on the 15th is in R.A. 4h 1m, Decl. 18° 56′ N., and crosses the meridian at 2.29 p.m. (M.T.). Still an evening star, but setting soon after the sun. Its stellar magnitude is 0·3.

Uranus on the 15th is in R.A. 20h 39m, Decl. 19° 2′ S., and crosses the meridian at 7.23 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 40m, Decl. 20° 58′ N., and crosses the meridian at 6.03 p.m. (M.T.).

For the minima of Algol and the configurations of Jupiter's satellites see opposite page.

APRIL

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 3h 0m.
			h m	
Tues.	1			41○2●
Wed.	2	14h·5 ☾ in Apogee; 20h 31m ☌ ♂ ☾, ♂ 1° 34′ N.		4○123
Thur.	3	3h ☿ Stationary; 19h ♆ Stationary.	19 58	421○3
Fri.	4			24○13
Sat.	5	4h 54m ☌ ☿ ☾, ☿ 1° 29′ N.		3○42●
☉Sun.	6	12h 48m·2 New Moon; Partial Eclipse of Sun, vis-	16 47	31○24
Mon.	7	[ible in western Canada; 19h □ ♃ ◍.		32○14
Tues.	8	12h 11m ☌ ♀ ☾, ♀ 4° 1′ N.		1○24●
Wed.	9	9h ☿ in ♉; 10h ☿ Stationary.	13 36	○1234
Thur.	10	5h 41m ☌ ♄ ☾, ♄ 6° 22′ S.		21○34
Fri.	11			2○134
Sat.	12		10 25	31○42
Sun.	13	14h □ ♆ ◍; 22h 18m ☌ ♆ ☾, ♆ 5° 31′ S.		♃34○2
☽Mon.	14	0h 39m·2 Moon's First Quarter.		342○1
Tues.	15		7 14	413○●
Wed.	16			4○132
Thur.	17			412○3
Fri.	18	11h·6 ☾ in Perigee.	4 02	42○13
Sat.	19	14h ☿ in Aphelion.		413○2
☉Sun.	20	16h 32m·7 Full Moon.		34○12
Mon.	21		0 51	324○●
Tues.	22			31○4●
Wed.	23	22h ♂ Greatest Hel. Lat. S.	21 40	○1324
Thur.	24	20h ☌ ♀ ◍ Inferior; 23h ☿ Greatest Elong. W.		12○34
Fri.	25	[27° 12′		2○134
Sat.	26	9h 13m ☌ ♃ ☾, ♃ 5° 9′ N.	18 29	1○324
Sun.	27	23h 24m ☌ ♅ ☾, ♅ 3° 52′ N.		3○124
☾Mon.	28	1h 9m·2 Moon's Last Quarter; 4h □ ♅ ◍.		32○4●
Tues.	29		15 18	312○4
Wed.	30	7h·9 ☾ in Apogee.		4○132

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ◍ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR MAY

The Sun.—On the 1st the sun's R.A. is 2h 32m, Decl. 14° 59′ N.; on the 31st the R.A. is 4h 31m, Decl. 21° 52′ N. The equation of time, 2m 56s on the 1st, rises to 3m 48s on the 15th (a maximum) and then falls to 2m 37s on the 31st.

The Moon.— For its phases and conjunctions with the planets, see opp. page

Mercury during the month continally approaches the sun and the planet thus cannot be well seen.

Venus on the 15th is in R.A. 1h 35m, Decl. 11° 8′ N., and crosses the meridian 10.05 a.m. (M.T.). During the month its augular distance from the sun continually increases, and on the 30th it attains its greatest brilliancy. At this time its stellar magnitude is – 4·2, and its disc, which can be seen in a small telescope, is like a cresent moon of age four days. (See note on Venus for March).

Mars on the 15th is in R.A. 0h 23m, Decl, 0° 59′ N. (*i. e.* near the vernal equinox) and crosses the meridian at 10.52 a.m. (M.T.). On this date its distance from the earth is 170 millions of miles. Visible as a morning star, but not a prominent object. In conjunction with the moon on the 2nd and the 31st. (see opp. page).

Jupiter on 15th is in R.A. 19h 17m, Decl. 22° 16′ S., and crosses the meridian at 3.48 a.m, (M.T.). Its stellar magnitude is – 2·1. A prominent object. On the 15th the planet becomes stationary and begins to retrograde. In conjunction with the moon on the 23rd. (see opp. page).

Saturn on the 29th reaches conjunction with the sun, and so is not visible during the month.

Uranus on the 15th is in R.A. 20h 40m, Decl. 18°59′ S., and crosses the meridian at 5.11 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 42m, Decl. 20° 55′ N., and crosses the meridian at 4.11 p.m. (M.T.).

For the minima of Algol and the configurations of Jupiter's satellites see opposite page.

MAY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 2h 0m.
			h m	
Thur.	1			241○3
Fri.	2	3h 24m ☌ ♂ ☾, ♂ 0° 48′ S.	12 07	42○13
Sat.	3	[1° 26′ N.		41○32
Sun.	4	3h 3m ☌ ☿ ☾, ☿ 4° 49′ S.; 18h 59m ☌ ♀ ☾, ♀		43○12
Mon.	5	16h 24 Stationary.	8 56	4321○
(Tues.	6	3h 24m·3 New Moon.		2432○
Wed.	7	17h 35m ☌ ♄ ☾, ♄ 6° 20′ S.		4○132
Thur.	8	22h ☌ ☿ ♀, ☿ 5° 41′ S.	5 45	1○423
Fri.	9	23h ☿ Greatest Hel. Lat. S.		2○143
Sat.	10			1○234
Sun.	11	4h 19m ☌ ♆ ☾, ♆ 5° 21′ S.	2 34	3○124
Mon.	12	16h ♁ Stationary.		321○4
☽Tues.	13	6h 45m·0 Moon's First Quarter.	23 23	32○14
Wed.	14	0h ♀ Stationary.		○24●●
Thur.	15	20h·6 ☾ in Perigee.		1○243
Fri.	16		20 12	2○413
Sat.	17			41○3●
Sun.	18	10h ♂ in Perihelion.		43○12
Mon.	19		17 01	4312○
(Tues.	20	2h 18m·1 Full Moon; 23h ♀ in ♉.		432○1
Wed.	21			4○2●●
Thur.	22		13 50	24○23
Fri.	23	17h 23m ☌ 24 ☾, 24 4° 56′ N.		42○13
Sat.	24			41○3●
Sun.	25	7h 50m ☌ ♁ ☾, ♁ 3° 38′ N.; 14h 24 in ♉.	10 39	3○412
Mon.	26			312○4
☾Tues.	27	19h 3m·7 Moon's Last Quarter.		32○14
Wed.	28	2h·9 ☾ in Apogee; 23h ☿ in ♌.	7 28	31○24
Thur.	29	8h ☌ ♄ (Sun).		24○234
Fri.	30	22h ♀ Greatest brilliancy.		2○134
Sat.	31	9h 25m ☌ ♂ ☾, ♂ 3° 10′ S.; 13h ☌ ☿ ♄, ☿ 2° 4′ N.	4 17	12○34

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; (Sun) Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; 24 Jupiter; ♄ Saturn; ♁ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; 24 signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR JUNE

The Sun.— The sun's R.A. on the 1st is 4^h 35^m and on the 30th it is 6^h 35^m. During the month the Declination slowly rises from 22° 1′ to 23° 27′ on the 22nd, which is the summer solstice (see opposite page), at which time our days are longest. It then falls to 23° 12′ on the 30th. The equation of time is zero on the 14th; it then rises to 3^m 19^s on the 30th. It is this increase in the equation of time, taken with the decreasing length of the day, which causes the time of sunset to appear constant for several days at the end of June and the beginning of July.

The Moon.— For its phases and conjunctions with the planets, see opposite page.

Mercury is in superior conjunction with the sun on the 1st (see opp. page), and during the month is too close to the sun for observation.

Venus on the 15th is in R.A. 2^h 33^m, Decl. 12° 0′ N., and crosses the meridian at 9 a.m. (M.T.). During the month it continues to separate from the sun and is a prominent morning star. It reaches its greatest elongation early in July. It is in conjunction with the moon on the 30th (see opp. page).

Mars on the 15th is in R.A. 1^h 49^m, Decl. 9° 54′ N., and crosses the meridian at 8.17 a.m. (M.T.). At that time it is just within the constellation Aries and is 157½ millions of miles from the earth. Its stellar magnitude is 1·1 and thus is an easily observed morning star, and as there are no first-magnitude stars in this part of the sky it is quite a prominent object.

Jupiter on the 15th is in R.A. 19^h 7^m, Decl. 22° 37′ S., and crosses the meridian at 1.36 a.m. (M.T.). Its stellar magnitude is − 2·2, and it is still retrograding. It is in conjunction with the moon on the 19th (see opp. page). It is a prominent object all the evening in the south-eastern sky.

Saturn on the 15th is in R.A. 4^h 33^m, Decl. 20° 21′ N., and crosses the meridian at 11.01 a.m. (M.T.). Still too near the sun for observation.

Uranus on the 15th is in R.A. 20^h 39^m, Decl. 19° 7′ S., and crosses the meridian at 3.08 a.m. (M.T.).

Neptune on the 15th is in R.A. 7^h 45^m, Decl. 20° 47′ N., and crosses the meridian at 2.12 p.m. (M.T.).

For the minima of Algol and the configurations of Jupiter's satellites see opposite page.

JUNE

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 0h 30m.
			h m	
Sun.	1	11h 4m ☌ ♀ ☾, ♀ 4° 38′ S.; 18h ☌ ☿ ☉ Superior.		2 1 0 1 4 2
Mon.	2	14h ☿ in Perihelion.		2 3 1 4 0
Tues.	3		1 06	3 4 2 0 1
Wed.	4	7h 24m ☌ ♄ ☾, ♄ 6° 22′ S.; 14h 57m·0 New Moon; 23h		4 3 1 0 2
Thur.	5	[4m ☌ ☿ ☾, ☿ 3° 48′ S.	21 55	4 0 1 3 2
Fri.	6			4 2 0 3 ●
Sat.	7	11h 39m ☌ ♆ ☾, ♆ 5° 9′ S.		4 2 1 0 3
Sun.	8		18 44	4 0 3 1 2
Mon.	9	23h·5 ☾ in Perigee.		4 3 1 0 2
Tues.	10			3 2 0 1 ●
Wed.	11	11h 37m·3 Moon's First Quarter.	15 33	3 1 0 2 4
Thur.	12	21h ☿ Greatest Hel. Lat. N.		0 1 3 2 4
Fri.	13			2 1 0 3 4
Sat.	14		12 22	2 1 2 0 3 4
Sun.	15			0 1 3 2 4
Mon.	16			3 1 0 2 4
Tues.	17		9 10	3 2 0 1 4
Wed.	18	12h 53m·7 Full Moon.		3 1 0 4 ●
Thur.	19	21h 26m ☌ 2 ☾, 2 4° 47′ N.		4 0 3 1 2
Fri.	20		5 59	4 2 1 0 3
Sat.	21	15h 8m ☌ ♅ ☾, ♅ 3° 27′ N.; 20h 9m ☉ enters Cancer,		4 2 0 1 3
Sun.	22	[Summer begins.		4 0 3 2 ●
Mon.	23		2 48	4 3 1 0 2
Tues.	24	5h ☌ ☿ Ψ, ☿ 2° 10′ N.; 9h ♀ in Aphelion; 21h·7 ☾ in		4 3 2 0 1
Wed.	25	[Apogee.	23 37	4 3 1 0 ●
Thur.	26	12h 40m·8 Moon's Last Quarter.		4 0 1 2 ●
Fri.	27			1 2 0 4 3
Sat.	28		20 26	2 0 1 4 3
Sun.	29	12h 4m ☌ ♂ ☾, ♂ 4° 51′ S.		0 2 3 4 ●
Mon.	30	14h 4m ☌ ♀ ☾, ♀ 7° 44′ S.		3 1 0 2 4

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; 2 Jupiter; ♄ Saturn; ♅ Uranus; Ψ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; 2 signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR JULY

The Sun.— During the month the sun's R.A. changes from 6h 39m to 8h 40m and the Decl. from 23° 9′ N. to 18° 22′ N. The earth is farthest from the sun on the 3rd, (see opp. page).

The Moon.— For its phases and conjunctions with the planets, see opp. page. On the 13th the moon occults π Scorpii, mag. 3·0; on the 21st φ Aquarii, mag. 4·4; and on the 27th it passes over the Pleiades again (see notes for March).

Mercury reaches greatest elongation E. 26° 13′ on the 7th, and should be seen then without difficulty. Soon after sunset examine the western horizon near the sunset point with an opera glass and the planet will probably be seen. Having located it with the glass it will be possible to see it with the naked eye. It will appear like a first magnitude star.

Venus on the 15th is in R.A. 4h 23m, Decl. 18° 27′ N., and crosses the meridian at 8.52 a.m. (M.T.). Its stellar magnitude is − 3·8, and it reaches greatest western elongation on the 3rd (see opposite page). At this time in the telescope it appears like a half-moon. It is in conjunction with Saturn on the 21st and with the moon on the 30th (see opp. page).

Mars on the 15th is in R.A. 3h 13m, Decl. 16° 52′ N., and crosses the meridian at 7.42 a.m. (M.T.). On this date it is 145 millions of miles from the earth. The planet about this time enters the constellation Taurus, and its stellar magnitude is 1·0, equal to that of Aldebaran.

Jupiter on the 15th is in R.A. 18h 51m, Decl. 23° 3′ S., and crosses the meridian at 11.18 p.m. (M.T.). It is in opposition to the sun on the 5th (see opposite page) and during the month is a prominent object all night long. In conjunction with the moon on the 16th, (see opp. page).

Saturn on the 15th is in R.A. 4h 49m, Decl. 20° 50′ N., and crosses the meridian at 9.18 a.m. (M.T.). It is a prominent morning star. In conjunction with Venus on the 21st (see above) and the moon on the 29th.

Uranus on the 15th is in R.A. 20h 34m, Decl. 19° 22′ S., and crosses the meridian at 1.06 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 50m, Decl. 20° 35′ N., and crosses the meridian at 0·18 p.m. (M.T.).

For the minima of Algol and the configurations of Jupiter's satellites see opposite page.

JULY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 23h 30m.
			h m	
Tues.	1	22h 25m ☌ ♄ ☾, ♄ 6° 30′ S.	17 15	3 1 2 ○ 4
Wed.	2			3 ○ 1 2 4
Thur.	3	19h ⊕ in Aphelion; 22h ☿ Greatest Elong. W. 45° 44′.		♃ 1 ○ 3 4
Fri.	4	0h 6m·2 New Moon; 21h 17m ☌ ♆ ☾, ♆ 5° 0′ S.	14 04	2 ○ 4 1 3
Sat.	5	10h ☍ ♃ ☉; 20h 39m ☌ ☿ ☾, ☿ 3° 49′ S.		4 1 ○ 2 3
Sun.	6	8h ☿ in ♉; 18h·8 ☾ in Perigee.		♃ 4 3 ○ 2
Mon.	7	10h ☿ Greatest Elong. E. 26° 13′.	10 53	4 3 2 ○ 1
Tues.	8			4 3 2 1 ○
Wed.	9			4 3 ○ 1 2
Thur.	10	16h 37m·4 Moon's First Quarter.	7 42	4 1 ○ 2 3
Fri.	11			4 2 ○ 1 3
Sat.	12			4 1 ○ 2 3
Sun.	13		4 31	3 ○ 1 4 2
Mon.	14			3 2 ○ 4 ●
Tues.	15	[29m ☌ ♃ ☾, ♃ 4° 47′ N.		3 2 1 ○ 4 ●
Wed.	16	13h ☿ in Aphelion; 20h ☿ Greatest Hel. Lat. S.; 22h	1 20	3 ○ 1 2 4
Thur.	17			1 ○ 2 3 4
Fri.	18	1h 6m·4 Full Moon; 20h ☌ ♆ ☉; 20h 49m ☌ ♅ ☾,	22 09	2 ○ 1 3 4
Sat.	19	[♅ 3° 24′ N.		1 ○ 2 3 4
Sun.	20	13h ☿ Stationary.		♃ ○ 1 4 2
Mon.	21	20h ☌ ☿ ♄, ☿ 1° 18′ S.	18 58	3 2 4 1 ○
Tues.	22	14h·5 ☾ in Apogee.		3 4 2 1 ○
Wed.	23			4 3 ○ 1 2
Thur.	24		15 47	4 1 ○ 2 3
Fri.	25			4 2 ○ 1 3
Sat.	26	4h 58m·7 Moon's Last Quarter.		4 1 ○ 3 ●
Sun.	27		12 36	4 ○ 3 1 2
Mon.	28	10h 12m ☌ ♂ ☾, ♂ 5° 41′ S.		3 4 2 1 ○
Tues.	29	3h ☍ ♅ ☉; 13h 11m ☌ ♄ ☾, ♄ 6° 42′ S.		♃ 3 2 4 ○
Wed.	30	2h 30m ☌ ☿ ☾, ☿ 7° 40′ S.	9 25	3 ○ 1 2 4
Thur.	31			1 ○ 3 2 4

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR AUGUST

The Sun.— During August the sun's R.A. increases from $8^h\ 44^m$ to $10^h\ 37^m$, and the Decl. changes from 18° 7′ to 8° 47′ N. The equation of time falls from $9^m\ 10^s$ on the 1st to $0^m\ 23^s$ on the 31st.

There is a partial eclipse of the sun on the 31st, invisible in Canada (see opposite page and also page 48).

The Moon.— For its phases and conjunctions with the planets, see opposite page. On the 10th the moon occults τ Scorpii, mag. 2·9 (see page 8).

Mercury on the 4th reaches inferior conjunction with the sun; it then rapidly separates from the sun and on the 22nd attains greatest elongation W. 18° 26′.

Venus on the 15th is in R.A. $6^h\ 46^m$, Decl. 21° 24′ N., and crosses the meridian at 9.12 a.m. (M.T.). Its stellar magnitude is − 3·6, and it is still a prominent morning star. On the 29th it is in conjunction with Neptune (see opp. page).

Mars on the 15th is in R.A. $4^h\ 39^m$, Decl. 21° 31′ N., and crosses the meridian at 7.06 a.m. (M.T.). It is now in Taurus a little north-east of Aldebaran, and as its stellar magnitude is 0·8 these two objects will appear like twin red stars. On this date it is 130 millions of miles from the earth.

Jupiter on the 15th is in R.A. $18^h\ 38^m$, Decl. 23° 21′ S., and crosses the meridian at 9.03 p.m. (M.T.). It is still a prominent object, well placed for observation.

Saturn on the 15th is in R.A. $5^h\ 1^m$, Decl. 21° 8′ N., and crosses the meridat 7.29 a.m. (M.T.). Its stellar magnitude is 0·3, and it is a prominent mornimg star. We see the southern side of the rings which are now well opened out.

Uranus on the 15th is in R.A. $20^h\ 29^m$, Decl. 19° 41′ S., and crosses the meridian at 10.55 p.m. (M.T.).

Neptune on the 15th is in R.A. $7^h\ 55^m$, Decl. 20° 24′ N., and crosses the meridian at 10.22 a.m. (M.T.). Neptune is in conjunction with Venus on the 29th (see opp. page)

For the minima of Algol and the configurations of Jupiter's satellites see opposite page.

JULY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 23h 33m.
			h m	
Tues.	1	22h 25m ☌ ♄ ☾, ♄ 6° 30′ S.	17 15	3 1 2 ○ 4
Wed.	2			3 ○ 1 2 4
Thur.	3	19h ⊕ in Aphelion; 22h ☿ Greatest Elong. W. 45° 44′.		♃ 1 ○ 3 4
♋ Fri.	4	0h 6m·2 New Moon; 21h 17m ☌ ♆ ☾, ♆ 5° 0′ S.	14 04	2 ○ 4 1 3
Sat.	5	10h ☍ ♃ ◍; 20h 39m ☌ ☿ ☾, ☿ 3° 49′ S.		4 1 ○ 2 3
Sun.	6	8h ☿ in ♉; 18h·8 ☾ in Perigee.		♃ 4 3 ○ 2
Mon.	7	10h ☿ Greatest Elong. E. 26° 13′.	10 53	4 3 2 ○ 1
Tues.	8			4 3 2 1 ○
Wed.	9			4 3 ○ 1 2
☽ Thur.	10	16h 37m·4 Moon's First Quarter.	7 42	4 1 ○ 2 3
Fri.	11			4 2 ○ 1 3
Sat.	12			4 1 ○ 2 3
Sun.	13		4 31	3 ○ 1 4 2
Mon.	14			3 2 ○ 4 ●
Tues.	15	[29m ☌ ♃ ☾, ♃ 4° 47′ N.		3 2 1 ○ 4
Wed.	16	13h ☿ in Aphelion; 20h ☿ Greatest Hel. Lat. S.; 22h	1 20	3 ○ 1 2 4
Thur.	17			1 ○ 2 3 4
♌ Fri.	18	1h 6m·4 Full Moon; 20h ☌ ♆ ◍; 20h 49m ☌ ♅ ☾,	22 09	2 ○ 1 3 4
Sat.	19	[♅ 3° 24′ N.		1 ○ 2 3 4
Sun.	20	13h ☿ Stationary.		♃ ○ 1 4 2
Mon.	21	20h ☌ ♀ ♄, ♀ 1° 18′ S.	18 58	3 2 4 1 ○
Tues.	22	14h·5 ☾ in Apogee.		3 4 2 1 ○
Wed.	23			4 3 ○ 1 2
Thur.	24		15 47	4 1 ○ 2 3
Fri.	25			4 2 ○ 1 3
☾ Sat.	26	4h 58m·7 Moon's Last Quarter.		4 1 ○ 3 ●
Sun.	27		12 36	4 ○ 3 1 2
Mon.	28	10h 12m ☌ ♂ ☾, ♂ 5° 41′ S.		3 4 2 1 ○
Tues.	29	3h ☍ ♅ ◍; 13h 11m ☌ ♄ ☾, ♄ 6° 42′ S.		♃ 3 2 4 ○
Wed.	30	2h 30m ☌ ♀ ☾, ♀ 7° 40′ S.	9 25	3 ○ 1 2 4
Thur.	31			1 ○ 3 2 4

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ◍ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR AUGUST

The Sun.— During August the sun's R.A. increases from 8h 44m to 10h 37m, and the Decl. changes from 18° 7′ to 8° 47′ N. The equation of time falls from 9m 10s on the 1st to 0m 23s on the 31st.

There is a partial eclipse of the sun on the 31st, invisible in Canada (see opposite page and also page 48).

The Moon.— For its phases and conjunctions with the planets, see opposite page. On the 10th the moon occults τ Scorpii, mag. 2·9 (see page 8).

Mercury on the 4th reaches inferior conjunction with the sun; it then rapidly separates from the sun and on the 22nd attains greatest elongation W. 18° 26′.

Venus on the 15th is in R.A. 6h 46m, Decl. 21° 24′ N., and crosses the meridian at 9.12 a.m. (M.T.). Its stellar magnitude is − 3·6, and it is still a prominent morning star. On the 29th it is in conjunction with Neptune (see opp. page).

Mars on the 15th is in R.A. 4h 39m, Decl. 21° 31′ N., and crosses the meridian at 7.06 a.m. (M.T.). It is now in Taurus a little north-east of Aldebaran, and as its stellar magnitude is 0·8 these two objects will appear like twin red stars. On this date it is 130 millions of miles from the earth.

Jupiter on the 15th is in R.A. 18h 38m, Decl. 23° 21′ S., and crosses the meridian at 9.03 p.m. (M.T.). It is still a prominent object, well placed for observation.

Saturn on the 15th is in R.A. 5h 1m, Decl. 21° 8′ N., and crosses the meridat 7.29 a.m. (M.T.). Its stellar magnitude is 0·3, and it is a prominent mornimg star. We see the southern side of the rings which are now well opened out.

Uranus on the 15th is in R.A. 20h 29m, Decl. 19° 41′ S., and crosses the meridian at 10.55 p.m. (M.T.).

Neptune on the 15th is in R.A. 7h 55m, Decl. 20° 24′ N., and crosses the meridian at 10.22 a.m. (M.T.). Neptune is in conjunction with Venus on the 29th (see opp. page)

For the minima of Algol and the configurations of Jupiter's satellites see opposite page.

AUGUST

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 22h 0m.
			h m	
Fri.	1	8h 44m ☌ ♆ ☾, ♆ 4° 59′ S.		2○134
●Sat.	2	7h 58m·1 New Moon; 9h 19m ☌ ☿ ☾, ☿ 8° 53′ S.	6 14	12○34
Sun.	3	18h·2 ☾ in Perigee.		○3124
Mon.	4	6h ☌ ☿ ◍ Inferior.		2431○4
Tues.	5	22h ☿ Greatest Hel. Lat. S.	3 03	32○14
Wed.	6			3○42●
Thur.	7		23 52	41○2●
☽Fri.	8	23h 3m·0 Moon's First Quarter.		42○13
Sat.	9			412○3
Sun.	10		20 41	4○312
Mon.	11			2431○
Tues.	12	23h 29m ☌ ♃ ☾, ♃ 4° 52′ N.		432○1
Wed.	13	21h ☿ Stationary.	17 30	431○2
Thur.	14			2○4●2
Fri.	15	1h 9m ☌ ♅ ☾, ♅ 3° 27′ N.		2○413
☺Sat.	16	15h 27m·0 Full Moon.	14 19	21○43
Sun.	17			○1324
Mon.	18			31○24
Tues.	19	3h·1 ☾ in Apogee.	11 07	32○14
Wed.	20			31○4●
Thur.	21			3○124
Fri.	22	7h ☿ Greatest Elong. W. 18° 26′.	7 56	2○34●
Sat.	23	[ter; 23h ☿ in ☊.		21○43
☾Sun.	24	12h ☌ ♂, ♄, ♂ 1° 9′ N.; 19h 17m·8 Moon's Last Quar-		4○123
Mon.	25		4 45	413○2
Tues.	26	1h 54m ☌ ♄ ☾, ♄ 6° 53′ S.; 3h 29m ☌ ♂ ☾, ♂ 5° 43′ S.		432○1
Wed.	27			431○●
Thur.	28	18h 43m ☌ ♀ ☾, ♀ 5° 25′ S.; 20h 38m ☌ ♆ ☾, ♆ 5° 0′ S.	1 34	43○12
Fri.	29	13h ☿ in Perihelion; 19h ☌ ♀ ♆, ♀ 0° 18′ S.		42○3●
Sat.	30	12h 49m ☌ ☿ ☾, ☿ 1° 54′ S. [Labrador.	22 23	421○3
●Sun.	31	15h 38m·1 New Moon; Partial Eclipse of Sun, visible in		4○123

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars, ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR SEPTEMBER

The Sun.— The sun's R.A. increases during the month from 10h 40m to 12h 25m. On the 1st the Decl. is 8° 25′, the sun reaches the equator on the 23rd, and on the 30th it is 2° 40′ south. On the 29th is a partial eclipse of the sun, invisible in Canada (see page 48.)

The Moon.— For its phases and conjunctions with the planets, see opposite page. There is a total eclipse of the Moon on the 15th (see page 48).

Mercury on the 16th reaches superior conjunction with the sun, after which it is an evening star; not well placed for observation.

Venus on the 15th is in R.A. 9h 17m, Decl. 16° 5′ N., and crosses the meridian at 9·41 a.m. (M.T.). Its stellar magnitude is − 3·5, and it is still a prominent morning star. In close conjunction with the moon on the 27th, (see opposite page). On the 25th the planet passes 16′ to the north of Regulus.

Mars on the 15th is in R.A. 5h 59m, Decl. 23° 23′ N., and crosses the meridian at 6.25 a.m. (M.T.). At this time it is 113 millions of miles from the earth. During the month it passes from Taurus into Gemini. Its stellar magnitude is 0·6, and it is thus a prominent morning star.

Jupiter on the 15th is in R.A. 18h 36m, Decl. 23° 26′ S., and crosses the meridian at 6.59 p.m. (M.T.). Its stellar magnitude is − 2·0, and it is still a prominent evening object in Sagittarius. It is stationary on the 4th (see opp. page) after which its motion is eastward again.

Saturn on the 15th is in R.A. 5h 8m, Decl. 21° 15′ N., and crosses the meridian at 5·34 a.m. (M.T.). Its stellar magnitude is 0·2, and it is still a prominent object, not far from β Tauri. Stationary on the 30th, at which time it begins its retrograde motion.

Uranus on the 15th is in R.A. 20h 26m, Decl. 19° 54′ S., and crosses the meridian at 8.49 p.m. (M.T.).

Neptune on the 15th is in R.A. 7h 59m, Decl. 20° 12′ N., and crosses the meridian at 8.35 a.m. (M.T.).

For the minima of Algol and the configuration of Jupiter's satellites see opposite page.

AUGUST

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol h m	Configuration of Jupiter's Satellites at 22h cm.
Fri.	1	8h 44m ☌ ♆ ☾, ♆ 4° 59′ S.		2○134
(●)Sat.	2	7h 58m·1 New Moon; 9h 19m ☌ ☿ ☾, ☿ 8° 53′ S.	6 14	12○34
Sun.	3	18h·2 ☾ in Perigee.		○3124
Mon.	4	6h ☌ ☿ (●) Inferior.		2|31○4
Tues.	5	22h ☿ Greatest Hel. Lat. S.	3 03	32○14
Wed.	6			3○42●
Thur.	7		23 52	41○2●
(☽)Fri.	8	23h 3m·0 Moon's First Quarter.		42○13
Sat.	9			412○3
Sun.	10		20 41	4○312
Mon.	11			2|431○
Tues.	12	23h 29m ☌ ♃ ☾, ♃ 4° 52′ N.		432○1
Wed.	13	21h ☿ Stationary.	17 30	431○2
Thur.	14			2|4○2●
Fri.	15	1h 9m ☌ ♅ ☾, ♅ 3° 27′ N.		2○413
(♌)Sat.	16	15h 27m·0 Full Moon.	14 19	21○43
Sun.	17			○1324
Mon.	18			31○24
Tues.	19	3h·1 ☾ in Apogee.	11 07	32○14
Wed.	20			31○4●
Thur.	21			3○124
Fri.	22	7h ☿ Greatest Elong. W. 18° 26′.	7 56	2○34●
Sat.	23	[ter; 23h ☿ in ♌.		21○43
(☾)Sun.	24	12h ☌ ♂, ♄, ♂ 1° 9′ N.; 19h 17m·8 Moon's Last Quar-		4○123
Mon.	25		4 45	413○2
Tues.	26	1h 54m ☌ ♄ ☾, ♄ 6° 53′ S.; 3h 29m ☌ ♂ ☾, ♂ 5° 43′ S.		432○1
Wed.	27			431○●
Thur.	28	18h 43m ☌ ♀ ☾, ♀ 5° 25′ S.; 20h 38m ☌ ♆ ☾, ♆ 5° 0′ S.	1 34	43○12
Fri.	29	13h ☿ in Perihelion; 19h ☌ ♀ ♆, ♀ 0° 18′ S.		42○3●
Sat.	30	12h 49m ☌ ☿ ☾, ☿ 1° 54′ S. [Labrador.	22 23	421○3
(●)Sun.	31	15h 38m·1 New Moon; Partial Eclipse of Sun, visible in		4○123

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; (●) Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars, ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; 2| signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR SEPTEMBER

The Sun.—The sun's R.A. increases during the month from 10h 40m to 12h 25m. On the 1st the Decl. is 8° 25′, the sun reaches the equator on the 23rd, and on the 30th it is 2° 40′ south. On the 29th is a partial eclipse of the sun, invisible in Canada (see page 48.)

The Moon.—For its phases and conjunctions with the planets, see opposite page. There is a total eclipse of the Moon on the 15th (see page 48).

Mercury on the 16th reaches superior conjunction with the sun, after which it is an evening star; not well placed for observation.

Venus on the 15th is in R.A. 9h 17m, Decl. 16° 5′ N., and crosses the meridian at 9·41 a.m. (M.T.). Its stellar magnitude is − 3·5, and it is still a prominent morning star. In close conjunction with the moon on the 27th, (see opposite page). On the 25th the planet passes 16′ to the north of Regulus.

Mars on the 15th is in R.A. 5h 59m, Decl. 23° 23′ N., and crosses the meridian at 6.25 a.m. (M.T.). At this time it is 113 millions of miles from the earth. During the month it passes from Taurus into Gemini. Its stellar magnitude is 0·6, and it is thus a prominent morning star.

Jupiter on the 15th is in R.A. 18h 36m, Decl. 23° 26′ S., and crosses the meridian at 6.59 p.m. (M.T.). Its stellar magnitude is − 2·0, and it is still a prominent evening object in Sagittarius. It is stationary on the 4th (see opp. page) after which its motion is eastward again.

Saturn on the 15th is in R.A. 5h 8m, Decl. 21° 15′ N., and crosses the meridian at 5·34 a.m. (M.T.). Its stellar magnitude is 0·2, and it is still a prominent object, not far from β Tauri. Stationary on the 30th, at which time it begins its retrograde motion.

Uranus on the 15th is in R.A. 20h 26m, Decl. 19° 54′ S., and crosses the meridian at 8.49 p.m. (M.T.).

Neptune on the 15th is in R.A. 7h 59m, Decl. 20° 12′ N., and crosses the meridian at 8.35 a.m. (M.T.).

For the minima of Algol and the configuration of Jupiter's satellites see opposite page.

SEPTEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 21h 0m.
			h m	
Mon.	1	2h·1 ☾ in Perigee.		13○2●
Tues.	2		19 12	32○14
Wed.	3			312○4
Thur.	4	9h ♃ Stationary.		3○124
Fri.	5		16 01	♃1○34
Sat.	6			♃2○34
☽Sun.	7	8h 5m·7 Moon's First Quarter.		○234●
Mon.	8	20h ☿ Greatest Hel. Lat. N.	12 50	1○324
Tues.	9	3h 46m ☌ ♃ ☾, ♃ 4° 56′ N.		324○1
Wed.	10	23h □ ♄ ☍.		3412○
Thur.	11	3h ☿ in ☊; 5h 13m ☌ ♅ ☾, ♅ 3° 35′ N.	9 39	43○12
Fri.	12			♃41○3
Sat.	13			42○13
Sun.	14	[Eclipse of the Moon, partially visible in Canada.	6 28	4○23●
☺Mon.	15	7h·3 ☾ in Apogee; 7h 45m·9 Full Moon; Total		41○32
Tues.	16	10h ☌ ☿ ☍ Superior.		432○1
Wed.	17		3 17	3124○
Thur.	18	6h ♂ in ☊.		3○142
Fri.	19			1○24●
Sat.	20		0 06	2○134
Sun.	21			1○34●
Mon.	22	11h 2m ☌ ♄ ☾, ♄ 6° 59′ S.	20 55	♃○324
☾Tues.	23	7h 30m·0 Moon's Last Quarter; 10h 53m ☍ enters		32○14
Wed.	24	[Libra; Autumn begins; 15h 22m ☌ ☌ ☾, ☌ 5° 6′ S.		321○4
Thur.	25	7h 7m ☌ ♆ ☾, ♆ 5° 0′ S.	17 44	3○412
Fri.	26			14○2●
Sat.	27	15h 34m ☌ ♀ ☾, ♀ 1° 20′ S.		42○13
Sun.	28	[Eclipse of Sun, visible in north-western Canada.	14 33	41○3●
☍Mon.	29	13h·2 ☾ in Perigee; 23h 56m·8 New Moon; Partial		♃4○32
Tues.	30	19h ♄ Stationary; 20h 2m ☌ ☿ ☾, ☿ 2° 35′ N.		432○●

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars, ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR OCTOBER

The Sun.—During October the sun's R.A. increases from 12h 28m to 14h 20m and the Decl. changes from 3° 3′ to 14° 0′ S. The equation of time rises from 10m 11s on the 1st to 16m 17s on the 31st, to be subtracted from apparent time.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 5th the moon occults W Sagittarii, mag. 4·3; on the 11th, φ Aquarii, mag. 4·4; and on the 17th it passes before the Pleiades for the third time during the year (see page 8).

Mercury gradually increases its E. elongation during the month, and on the 1st of November will reach a maximum 23° 34′ from the sun. However its declination then is 23° S., and so it is not well placed for observation.

Venus on 15th is in R.A. 11h 36m, Decl. 4° 7′ N., and crosses the meridian at 10.02 a.m. (M.T.). Its stellar magnitude is − 3·4, and it is still a prominent morning star.

Mars on the 15th is in R.A. 7h 4m, Decl. 23° 21′ N., and crosses the meridain at 5.31 a.m. (M.T.) At that time its distance from the earth is 94½ millions of miles and its stellar magnitude is 0·2, equal to Capella. At the end of the month it is almost directly south from Pollux. It is a prominent object during the late evening.

Jupiter on 15th is in R.A. 18h 46m, Decl. 23° 18′ S., and crosses the meridian at 5.12 p.m. (M.T.). Its stellar magnitude is − 1·8, and it can still be well seen during the evening.

Saturn on the 15th is in R.A. 5h 8m, Decl. 21° 12′ N., and crosses the meridian at 3.36 a.m. The planet's stellar magnitude is 0·0, the same as Arcturus, and it is well placed for observation in the late evening.

Uranus on the 15th is in R.A. 20h 24m, Decl. 19° 58′ S., and crosses the meridian at 6.50 p.m. (M.T.).

Neptune on the 15th is in R.A. 8h 1m, Decl. 20° 6′ N., and crosses the meridian at 6.28 a.m. (M.T.).

For the minima of Algol and the configurations of Jupiter's satellites see opposite page.

OCTOBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 19h 30m.
			h m	
Wed.	1		11 22	4321☾
Thur.	2	7h ☿ in ♉; 10h □ ♂ ◍; 21h □ ♃ ◍.		43☾12
Fri.	3			413☾2
Sat.	4		8 11	2☾13●
Sun.	5			12☾43
☽Mon.	6	13h 21m ☌ ♃ ☾, ♃ 4° 51′ N.; 20h 46m·2 Moon's		☾1324
Tues.	7	[First Quarter.	5 00	♃31☾4
Wed.	8	10h 37m ☌ ♅ ☾, ♅ 3° 35′ N.		♃32☾4
Thur.	9			3☾124
Fri.	10		1 49	13☾24
Sat.	11			2☾134
Sun.	12	10h·5 ☾ in Apogee; 13h ☿ in Aphelion.	22 38	12☾43
Mon.	13	20h ♅ Stationary.		4☾123
Tues.	14	17h ♀ in Perihelion.		♃41☾2
☺Wed.	15	1h 6m·9 Full Moon.	19 27	♃432☾
Thur.	16			43☾●●
Fri.	17			431☾2
Sat.	18		16 15	42☾13
Sun.	19	16h 18m ☌ ♄ ☾, ♄ 6° 56′ S.		412☾3
Mon.	20			4☾123
Tues.	21	20h 7m ☌ ♂ ☾, ♂ 3° 55′ S.	13 04	1☾342
☾Wed.	22	0h □ ♆ ◍; 14h 54m ☌ ♆ ☾, ♆ 4° 53′ S.; 17h 53m·0		32☾14
Thur.	23	[Moon's Last Quarter.		3☾4●●
Fri.	24		9 53	31☾24
Sat.	25			2☾14●
Sun.	26			21☾34
Mon.	27	12h □ ♅ ◍; 15h 31m ☌ ♀ ☾, ♀ 3° 18′ N.; 22h·9	6 42	☾1234
Tues.	28	[☾ in Perigee.		1☾324
◍Wed.	29	9h 29m·2 New Moon.		23☾41
Thur.	30		3 31	3412☾
Fri.	31	3h 18m ☌ ☿ ☾, ☿ 2° 2′ N.; 20h ♆ Stationary.		♃43☾2

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars, ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ☾ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR NOVEMBER

The Sun.—The sun's R.A. during the month increases from 14h 24m to 16h 24m, and the Decl. changes from 14° 20′ to 21° 36′ S. The equation of time rises to a maximum on the 3rd, at which time its value is 16m 21s. The true sun crosses the meridian this much earlier than the mean sun.

The Moon.—For its phases and conjunctions with the planets, see opposite page.

Mercury reaches greatest elongation E. 23° 34′ on the 1st (see note on Mercury for last month); and on the 23rd comes to inferior conjunction with the sun.

Venus on the 15th is in R.A. 13h 59m, Decl. 10° 32′ S., and crosses the meridian at 10.23 a.m. (M.T.). Its stellar magnitude is − 3·4, and it is still a prominent morning star, but slowly closing in on the sun.

Mars on the 15th is in R.A. 7h 44m, Decl. 23° 10′ N., and crosses the meridian at 4.09 a.m. (M.T.). On the 27th it is stationary and begins to retrograde; at that time it is on the boundary between Gemini and Cancer. On the 15th the distance of the planet from the earth is 75 millions of miles and its stellar magnitude is − 0.3. A prominent object during the late evening.

Jupiter on the 15th is in R.A. 19h 7m, Decl. 22° 52′ S., and crosses the meridian at 3.30 p.m. (M.T.). On account of its low declination it is not well seen. In conjunction with the moon on the 3rd and 30th (see opp. page).

Saturn on the 15th is in R.A. 5h 2m, Decl. 21° 1′ N., and crosses the meridian at 1.28 a.m. (M.T.). The planet is nearly on a straight line from α to β Tauri, its stellar magnitude − 0·2, and it should be well seen all night.

Uranus on the 15th is in R.A. 20h 36m, Decl. 19° 51′ S., and crosses the meridian at 4.49 p.m. (M.T.).

Neptune on the 15th is in R.A. 8h 1m, Decl. 20° 6′ N., and crosses the meridian at 4.26 a.m. (M.T.).

For the minima of Algol and the configuration of Jupiter's satellites see opposite page.

NOVEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 18h 30m.
			h m	
Sat.	1	21h ☿ Greatest Hel. Lat. S.; 23h ☿ Greatest		42O1●
Sun.	2	[Elong. E. 23° 34′.	0 20	421O3
Mon.	3	4h 17m ☌ ♃ ☾, ♃ 4° 35′ N.		4O123
Tues.	4	18h 32m ☌ ♅ ☾, ♅ 3° 26′ N.	21 09	41O32
☽Wed.	5	13h 34m·4 Moon's First Quarter; 14h ♀ Greatest		423O1
Thur.	6	[Hel. Lat. N.		3412O
Fri.	7		17 58	3O12●
Sat.	8	22h·9 ☾ in Apogee.		♃3O4●
Sun.	9			21O34
Mon.	10		14 47	O2134
Tues.	11			1O234
Wed.	12	18h ☿ Stationary.		23O14
☺Thur.	13	18h 11m·4 Full Moon.	11 36	321O4
Fri.	14			3C124
Sat.	15	19h 24m ☌ ♄ ☾, ♄ 6° 49′ S.		♃31O2
Sun.	16		8 25	421C3
Mon.	17			4O13●
Tues.	18	14h 6m ☌ ♂ ☾, ♂ 2° 23′ S.; 20h 21m ☌ ♆ ☾,		41O23
Wed.	19	[♆ 4° 40′ S.	5 14	423O1
Thur.	20	22h ☿ in ☊.		4321O
☾Fri.	21	2h 56m·5 Moon's Last Quarter.		43O12
Sat.	22		2 03	431O2
Sun.	23	1h ☌ ☿ ☍ Inferior.		♃24O3
Mon.	24		22 52	O43●●
Tues.	25	oh·6 ☾ in Perigee; 12h ☿ in Perihelion.		1O234
Wed.	26	14h 33m ☌ ♀ ☾, ♀ 5° 41′ N.		2O314
☍Thur.	27	6h 32m ☌ ☿ ☾, ☿ 6° 43′ N.; 7h ♂ Stationary;	19 41	321O4
Fri.	28	[20h 41m·2 New Moon.		3O124
Sat.	29			31O24
Sun.	30	23h 5m ☌ ♃ ☾, ♃ 4° 12′ N.	16 30	2O134

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars, ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle O represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE SKY FOR DECEMBER

The Sun.—During December the sun's R.A. increases from 16h 28m to 18h 40m. On the 1st the Decl. is 21° 46′ S.; this slowly changes until it becomes 23° 27′ on the 22nd; and by the 31st it has come back to 23° 8′. The winter solstice is at 5.35 a.m. (E. S. T.) on the 22nd. (See opp. page).

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 5th the moon occults φ Aquarii, mag. 4·4 (see page 8).

Mercury reaches greatest elongation W. 21° 2′, on the 10th. Its low declination, however, renders it not an easy object to observe.

Venus on 15th is in R.A. 16h 29m, Decl. 21° 9′ S., and crosses the meridian at 10.55 a.m. (M.T.). It is too near the sun for good observations.

Mars on the 15th is in R.A. 7h 38m, Decl. 24° 48′ N., and crosses the meridian at 2.06 a.m. (M.T.). On the 31st it crosses the meridian at 0.40 a.m. (M.T.). On the 15th its distance from the earth is 60½ millions of miles. This decreases until the two bodies are nearest on the 1st January, 1914. The distance then is 48 millions of miles. The planet can now be seen all night long, and its stellar magnitude is − 1·2. This opposition is not a very favorable one; in 1907 Mars approached within 38 millions of miles.

Jupiter on 15th is in R.A. 19h 33m, Decl. 22° 4′ S., and crosses the meridian at 1.58 p.m. (M.T.). Too near the sun for observations.

Saturn on the 15th is in R.A. 4h 51m, Decl. 20° 47′ N., and crosses the meridian at 11.15 p.m. It is well placed for observations; its stellar magnitude is − 0·2; and it is about 5° N.E. from Aldebaran.

Uranus on the 15th is in R.A. 20h 31m, Decl. 19° 34′ S., and crosses the meridian at 2.52 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 59m, Decl. 20° 11′ N., and crosses the meridian at 2.28 a.m. (M.T.).

For the minima of Algol and the configurations of Jupiter's satellites see opposite page.

DECEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol	Configuration of Jupiter's Satellites at 18h 0m.
			h m	
Mon.	1			2○43●
Tues.	2	5h 1m ☌ ♅ ☾, ♅ 3° 9′ N.; 10h ☿ Stationary;		14○23
Wed.	3	[14h ☌ ☿ ♀, ☿ 1° 35′ N.	13 19	♃4○31
Thur.	4	[Lat. N.		4321○
☽Fri.	5	9h 58m·7 Moon's First Quarter; 21h ☿ Greatest Hel.		43○21
Sat.	6	18h·1 ☾ in Apogee.	10 08	431○2
Sun.	7	4h ☍ ♄ ☉.		42○1●
Mon.	8			421○3
Tues.	9		6 57	♃4○23
Wed.	10	21h ☿ Greatest Elong. W. 21° 2′		4○213
Thur.	11			231○4
Fri.	12	22h 58m ☌ ♄ ☾, ♄ 6° 45′ S.	3 46	3○214
☹Sat.	13	10h 0m·3 Full Moon.		31○24
Sun.	14			2○14●
Mon.	15	16h 57m ☌ ♂ ☾, ♂ 0° 59′ S.	0 35	21○34
Tues.	16	1h 36m ☌ ♆ ☾, ♆ 4° 29′ S.		○1234
Wed.	17		21 23	○234●
Thur.	18			231○4
Fri.	19			34○1●
☾Sat.	20	11h 15m·6 Moon's Last Quarter.	18 12	
Sun.	21	9h·4 ☾ in Perigee.		
Mon.	22	5h 35m ☉ enters Capricornus. Winter begins.		
Tues.	23		15 01	
Wed.	24			
Thur.	25	[☿ 5° 13′ N.		
Fri.	26	3h 23m ☌ ☿ ☾, ☿ 5° 26′ N.; 12h 57m ☌ ☿ ☾,	11 50	
●Sat.	27	9h 58m·7 New Moon.		
Sun.	28	19h 32m ☌ ♃ ☾, ♃ 3° 46′ N.		
Mon.	29	6h ☿ in ♉; 16h 45m ☌ ♅ ☾, ♅ 2° 53′ N.	8 39	
Tues.	30			
Wed.	31	16h ♀ in ♉.		

Invisible on account of proximity to sun.

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; ♃ Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; ♃ signifies that the satellite is on the disc; ● signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN

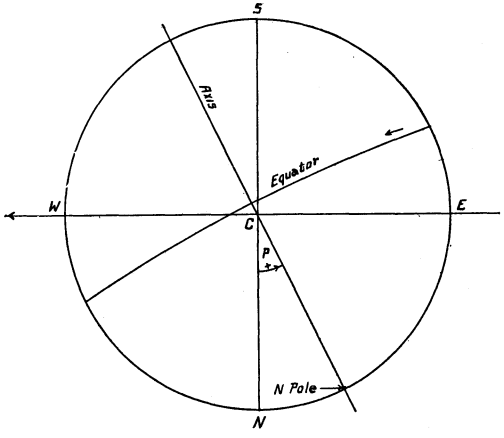
By R. E. Delury

In the ephemeris for Physical Observations of the Sun, P is the position angle of the N end of the Sun's axis measured E from N point of the disc, *i. e.*, in direction $N\ E\ S\ W$ around the edge of the disc. P will therefore be positive when the N point of the Sun's axis is E of the N point of the disc and negative when it is W of this point.

"*Lat.*" is the heliographical latitude of the centre of the Sun's disc, *i. e.*, the angle measured on the surface of the Sun in a direction N of the Sun's equator. "*Lat.*" will therefore be positive when the centre of the Sun's disc is N of the Sun's equator and negative when the centre of the disc is S of it.

"*Long.*" is the heliographical longitude of the centre of the Sun's disc referred to the meridian which passed through the ascending node on January 1, 1854, Greenwich mean noon, as zero meridian.

In preparing this ephemeris it has been assumed that the inclination of the Sun's axis to the ecliptic is 82°·75, the longitude of the ascending node for 1913·0 is 74°·54 and the period of the Sun's sidereal rotation is 25·38 days (according to Carrington).



The accompanying Figure shows the relative positions of various points for a selected time, October 9, 12:00 noon, "Eastern" Time, *i. e.*, 5:00 Greenwich Mean Time, when $P = +\ 26°{\cdot}42$, "*Lat.*" $= +\ 6°{\cdot}20$, and "*Long.*" $= 255°{\cdot}85$. In the Figure, $N\ E\ S$ and W are the North, East, South and West points on the disc of the Sun. These are determined on an image of the Sun by allowing it to drift from East to West tangentially to a line which will therefore give the "*East and West*" line thus fixing the diameters, $E\ W$ parallel to it, and $N\ S$ perpendicular to it. The axis is shown making an angle of 26°·42 with $N\ S$ and having the *North Pole* on the positive side of it, *i. e.*, eastward from N or in direction, $N\ E\ S\ W$; and the equator is shown intersecting the edge of the disc at points the same angle from E and W, and passing S of the centre of the disc, C which is at "*Lat.*", $+\ 6°{\cdot}20$ and "*Long.*", 255°·85.

If the ephemeris is to be used frequently it will be found very convenient to have the values plotted on a large scale on section-paper so that the angles for any particlar hour may be read off quickly.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN*

Greenwich Mean Noon		P	Lat.	Long.	Greenwich Mean Noon		P	Lat.	Long.
		°	°	°			°	°	°
Jan.	1	+ 2·01	− 3·17	6·20	July	5	− 0·91	+ 3·43	84·40
	6	− 0·43	3·73	300·35		10	+ 1·38	3·95	18·23
	11	2·85	4·27	234·51		15	3·63	4·44	312·06
	16	5·22	4·77	168·67		20	5·84	4·90	245·90
	21	7·53	5·24	102·84		25	7·99	5·33	179·75
	26	9·75	5·66	37·00		30	10·06	5·72	113·61
	31	− 11·88	− 6·04	331·17	Aug.	4	+ 12·06	+ 6·07	47·49
Feb.	5	13·89	6·37	265·34		9	13·95	6·38	341·38
	10	15·78	6·65	199·51		14	15·74	6·65	275·28
	15	17·54	6·88	133·67		19	17·42	6·87	209·19
	20	19·15	7·06	67·82		24	18·97	7·03	143·12
	25	20·62	7·17	1·97		29	20·40	7·16	77·06
Mar.	2	− 21·93	− 7·24	296·11	Sept.	3	+ 21·69	+ 7·23	11·02
	7	23·08	7·25	230·23		8	22·84	7·25	304·99
	12	24·07	7·20	164·35		13	23·84	7·22	238·97
	17	24·89	7·10	98·44		18	24·68	7·13	172·96
	22	25·54	6·94	32·52		23	25·37	6·99	106·96
	27	26·02	6·73	326·58		28	25·89	6·80	40·98
Apr.	1	− 26·31	− 6·48	260·62	Oct.	3	+ 26·24	+ 6·56	335·00
	6	26·43	6·17	194·64		8	26·42	6·27	269·04
	11	26·37	5·83	128·65		13	26·41	5·93	203·08
	16	26·12	5·44	62·63		18	26·21	5·55	137·12
	21	25·69	5·01	356·59		23	25·82	5·13	71·18
	26	25·07	4·55	290·53		28	25·24	4·66	5·24
May	1	− 24·27	− 4·05	224·45	Nov.	2	+ 24·45	+ 4·16	299·31
	6	23·28	3·53	158·36		7	23·48	3·63	233·39
	11	22·12	2·99	92·25		12	22·30	3·06	167·47
	16	20·80	2·42	26·12		17	20·94	2·48	101·55
	21	19·32	1·84	319·98		22	19·39	1·87	35·65
	26	17·68	1·25	253·82		27	17·66	1·24	329·75
	31	− 15·90	− 0 65	187·66	Dec.	2	+ 15·77	+ 0·61	263·86
June	5	13·99	− 0·05	121·49		7	13·74	− 0·03	197·97
	10	11·97	+ 0·56	55·31		12	11·58	0·67	132·09
	15	9·86	1·16	349·13		17	9·31	1·31	66·21
	20	7·68	1·75	282·94		22	6·96	1·93	0·35
	25	5·44	2·32	216·75		27	4·56	2·54	294·49
	30	− 3·17	+ 2·89	150·57		31	+ 2·12	− 3·14	228·64

*Taken from *The Nautical Almanac.*

ECLIPSES IN 1913

There will be five eclipses in 1913, three of the Sun and two of the Moon.

I. A Total Eclipse of the Moon, March 21, 1913, partly visible in eastern Canada, the Moon setting eclipsed. In western Canada the entire eclipse will be visible.

		d	h	m
Moon enters shadow	March	21	17	12·6
Total eclipse begins	"	21	18	10·9
Middle of the eclipse	"	21	18	57·6
Total eclipse ends	"	21	19	44·4
Moon leaves shadow	"	21	20	42·6

Magnitude of the eclipse = 1·575 (Moon's diameter = 1·0).

II. A Partial Eclipse of the Sun, April 5–6, 1913, visible in British Columbia, Alberta, Athabaska and Peace River Districts, and the Yukon. At Edmonton the eclipse begins about noon and ends about one o'clock. At Vancouver it begins and ends about fifteen minutes earlier.

Magnitude of greatest eclipse = 0·424 (Sun's diameter = 1·0).

III. A Partial Eclipse of the Sun, August 31, 1913, visible in Newfoundland and Labrador for a short time about four o'clock.

Magnitude of greatest eclipse = 0·151 (Sun's diameter = 1·0).

IV. A Total Eclipse of the Moon, September 14, 1913. The Moon sets in eastern Canada as the eclipse begins, so that in western Canada the eclipse is visible during the greater part of totality.

		d	h	m
Moon enters shadows	September	14	17	52·5
Total eclipse begins	"	14	19	1·0
Middle of the eclipse	"	14	19	48·1
Total eclipse ends	"	14	20	35·2
Moon leaves shadow	"	14	21	43·6

Magnitude of the eclipse = 1·435 (Moon's diameter = 1·0).

V. A Partial Eclipse of the Sun, September 29, 1913, visible only in South Africa, Madagascar and the Indian Ocean.

Magnitude of greatest eclipse =0·825 (Sun's diameter = 1·0).

(All times given are Eastern Standard Astronomical Time).

COMETS OF 1912

By R. M. Motherwell

The first half of the year 1912 was remarkable for the scarcity of comets. Brooks', Quenisset's and Schaumasse's comets, all discovered in 1911, were visible during the early part of the year and Wolf's periodic comet due at perihelion in February, 1912, was sighted in 1911. Not until September 8, however, were there any further discoveries. On that date Gale of Sydney, Australia, discovered a comet in the constellation Centaurus. It was then too far south to be seen by northern observers but its rapid motion northward soon brought it into view. It was barely visible to the naked eye in September, at which time it was nearest to the earth ; and after passing perihelion on October 4 it became fainter until it was soon beyond the reach of the smaller telescopes. Photographs of the spectrum were taken at Yerkes Observatory by Professor Parkhurst and showed only the "normal" comet spectrum. Direct photographs by Professor Barnard revealed nothing striking in the tail, which was about 4° long in the early part of October.

The second comet of 1912 was discovered by Schaumasse at Nice on October 18, and and an independent discovery was made on October 20 by Dr. Brooks, of Geneva, N. Y. The comet was then visible in a small telescope and moving southeast. A determination of the elements revealed a marked similarity to those of Tuttle's comet (1858i) and further observations proved that Tuttle's comet and comet *b*1912 were the same. Tuttle's comet was first discovered by Méchain in 1790 and then in 1858 by Tuttle. It was also observed in 1871, 1885 and 1899, its period being 13·66 years.

The third comet of 1912 was discovered by Borrelly, of Marseilles, on November 2. It was visible in a small telescope but had reached the points of nearest approach to the earth and sun and was then rapidly moving in a direction nearly opposite to that of the earth's motion. Consequently, it rapidly decreased in brightness and was soon beyond all but the largest telescopes.

Photographs by Professor Barnard on November 4 and 6, showed a small head with a faint tail over a degree long,

Borrelly's comet, 1905ii, was due at perihelion in March 1912, but the perturbations caused by the planets shortened its period so that it was observed in 1911, passing perihelion in December of that year.

Barnard's comet, 1892v, was due at perihelion in the summer but was not observed, its position being less favorable than in 1905-06.

Biela's comet was also due, but all that could be expected was a view of some portions in the form of meteors toward the end of the year. This comet was discovered in 1772 and was observed again in 1805, 1826, 1832, 1845 and 1852, but since then it has not been seen. During its period of visibility in 1845 it was observed to separate into two parts and in 1852 these parts were much more widely separated. It failed to appear in 1866 and 1872, but in the latter year the coincidence of the radiant point of the Andromedes with that of a stream following in the orbit of Biela's comet was observed and the conclusion now seems to be that Biela's comet no longer exists as a concrete body.

METEORS AND SHOOTING STARS

On almost any clear night any one observing the sky for a few minutes will see one or more shooting stars. They are particularly numerous during the autumn months, and on account of the rotation of the earth are better seen during the early morning hours than in the evening.

At certain times there are striking displays, located in particular portions of the sky. These are considered to be due to *meteor swarms*. The principal ones are given in the following table.

Name of Shower	Duration	Greatest Display	Radiant Point R.A.	Decl.
			h m	°
Quadrantids	Dec. 28-Jan. 4	Jan. 2	15 20	+ 52
Lyrids	April 16-22	April 20	18 0	+ 32
η Aquarids	April 30-May 6	May 6	22 31	− 2
δ Aquarids	July 23-Aug. 25	July 28	22 38	− 12
Perseids	July 8-Aug. 22	Aug. 10	3 4	+ 57
Orionids	Oct. 9-29	Oct. 18	6 8	+ 16
Leonids	Nov. 9-17	Nov. 13	10 0	+ 23
Andromedes	Nov. 25-30	Nov. 27	1 41	+ 44
Geminids	Dec. 1-14	Dec. 10	7 12	+ 33

Of these the chief ones are the Perseids, the Leonids and the Andromedes.

The Perseids furnish an annual display of considerable strength, and are perhaps, the best known of all. The swarm appears to have an orbit identical with that of the great Comet 1862 III., the period of which is 120 years.

The Leonids follow in the orbit of Tempel's Comet of 1866, of period 33 years.

The Andromedes are thought to be remnants of Biela's Comet. They were especially numerous in 1872, 1885, 1898, but in recent years have not been so prominent.

For interesting information regarding this subject (and almost any other subject in which the amateur is interested) reference may be made to *Telescopic Work for Starlight Evenings* by W. F. Denning.

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

Name	Mean Distance from Sun		Sidereal Period		Mean Diam't'r Miles	Mass	Density	Volume	Axial Rotation
	⊕ = 1	Millions of Miles	Mean Solar Days	Years		⊕ = 1	Water = 1	⊕ = 1	
☿ Mercury...	0.387	36.0	87.97	0.24	3030	0.476	4.7(?)	0.056	88^{d}
♀ Venus.....	0.723	67.2	224.70	0.62	7700	0.82	4.94	0.92	225^{d}
⊕ Earth.....	1.000	92.9	365.26	1.00	7917.6	1.00	5.55	1.00	$23^{h}\ 56^{m}\ 4^{s}$
♂ Mars.....	1.524	141.5	686.95	1.88	4230	0.108	3.92	0.152	$24^{h}\ 37^{m}\ 23^{s}$
♃ Jupiter....	5.203	483.3	4332.58	11.86	86500	317.7	1.32	1300	$9^{h}\ 55^{m} \pm$
♄ Saturn.....	9.539	886.0	10759.2	29.46	73000	94.8	0.72	760	$10^{h}\ 14^{m} \pm$
♅ Uranus....	19.183	1781.9	30686.8	84.02	31900	14.6	1.22	65	?
♆ Neptune...	30.055	2971.6	60181.1	164.78	34800	17.0	1.11	85	?
☉ Sun.....	....	....	....	.....	866400	332000	1.39	1300000	$25^{d}\ 7^{h}\ 48^{m} \pm$
☾ Moon.....	From ⊕ 238,840 mls		27.32	0.75	2163	1/81.5	3.39	0.020	$27^{d}\ 7^{h}\ 43^{m}$

SATELLITES OF THE SOLAR SYSTEM

Name	Stellar Magnitude.	Mean Distance in Miles	Sidereal Period d. h. m. s.	Discoverer	Date
THE EARTH					
The Moon..	..	238,840	27 7 43 11		
MARS					
1. Phobos.....	14	5,850	7 39 15	Asaph Hall....	Aug. 17, 1877
2. Deimos....	13	14,650	1 6 17 54	Asaph Hall....	Aug. 11, 1877
JUPITER					
5. (Nameless).	13	112,500	11 57 23	Barnard.....	Sept. 9, 1892
1. Io.....	6½	261,000	1 18 27 33	Galileo.....	Jan. 7, 1610
2. Europa....	6½	415,000	3 13 13 42	Galileo.....	Jan. 8, 1610
3. Ganymede .	6	664,000	7 3 42 33	Galileo.....	Jan. 7, 1610
4. Callisto....	7	1,167,000	16 16 32 11	Galileo.....	Jan. 7, 1610
6. (Nameless).	14	7,000,000	250 d.	Perrine.....	Dec. 1904
7. (Nameless).	16	7,300,000	265 d.	Perrine.....	Jan. 1905
8. (Nameless).	17	15,600,000	789 d.	Melotte.....	Jan. 1908
SATURN					
1. Mimas.....	15	117,000	22 37 6	W. Herschel...	July 18, 1789
2. Enceladus..	14	157,000	1 8 53 7	W. Herschel...	Aug. 29, 1789
3. Tethys.....	11	186,000	1 21 18 26	J. D. Cassini...	Mar. 21, 1684
4. Dione.....	11	238,000	2 17 41 9	J. D. Cassini...	Mar. 21, 1684
5. Rhea.....	10	332,000	4 12 25 12	J. D. Cassini...	Dec. 23, 1672
6. Titan.....	9	771,000	15 22 41 23	Huygens.....	Mar. 25, 1655
7. Hyperion...	16	934,000	21 6 39 27	G. P. Bond....	Sept. 16, 1848
8. Iapetus....	11	2,225,000	79 7 54 17	J. D. Cassini...	Oct. 25, 1671
9. Phoebe.....	17	8,000,000	546.5 d.	W.H.Pickering	1898
10. Themis.....	17	906,000	20 20 24 0	W.H.Pickering	1905
URANUS					
1. Ariel.....	15	120,000	2 12 29 21	Lassell.....	Oct. 24, 1851
2. Umbriel....	16	167,000	4 3 27 37	Lassell.....	Oct. 24, 1851
3. Titania.....	13	273,000	8 16 56 29	W. Herschel...	Jan 11, 1787
4. Oberon.....	14	365,000	13 11 7 6	W. Herschel...	Jan. 11, 1787
NEPTUNE					
1. (Nameless).	13	221,500	5 21 2 44	Lassell.....	Oct. 10, 1846

THE CONSTELLATIONS

The accompanying maps, which contain the stars down to the fourth magnitude, are intended primarily for beginners ; but as the right ascension and declination lines are drawn in, the position of any other object, (such as a comet, a planet or a fainter star) if its R.A. and Decl. are known, can be located with respect to the brighter stars.

The constellations are arranged according to months. Those given for any month are on the meridian at approximately 9 p.m. on the 15th of that month ; but, of course, these constellations can be seen in the same position during the month before or that after by looking two hours later or earlier, respectively.

The double-stars and other objects given below are suitable for a small telescope (say, of aperture 3 inches) or sometimes for an opera glass.

For the positions of the sun and the planets consult pages 22, 24, 26, etc.

JANUARY

Camelopardalis (The Giraffe) is a large circumpolar constellation, north of Auriga and Perseus and extending almost to the pole by a long lane which constitutes the neck and head of the animal. The constellation contains no stars brighter than the fourth magnitude.

Auriga (The Charioteer) may readily be recognised by Capella, its brightest star, which crosses the meridian not far from the zenith at 9 p.m. on January 24. Capella, Vega and Arcturus are the three brightest stars of the northern hemisphere, each being approximately of magnitude 0·2. Sirius, which is slightly south of the celestial equator, and which is the brightest star in the entire sky, is the only other star visible in our latitudes which rivals these three. In the mythological drawing of this constellation the charioteer holds in his left arm a goat (Capella) and two kids, represented by the three faint stars 4° or 5° S. W. of Capella. The south-western half of the constellation is traversed by the Milky Way and contains many fine star clusters.

Capella is 30 light years distant and is receding from us at the rate of 21 miles per second.

Clusters. (1) M. 37; R.A. 5h 44m, Decl. 32° 31′, nearly on the line from θ Aurigæ to ζ Tauri. A fine cluster, resolvable into about 500 stars from the tenth to the fourteenth magnitude. "Even in smaller instruments extremely beautiful, one of the finest of its class. Gaze at it well and long."—*Webb.* (2) M. 38, R.A. 5h 21m, Decl. 35° 47′. A fine cluster described by Admiral Smyth as "an oblique cross, with a pair of large stars in each arm, and a conspicuous one in the centre, the whole followed by a bright individual of the seventh magnitude." The whole region is very beautiful.

Taurus (The Bull), directly S. W. of Auriga. It is most easily recognised by the little dipper-shaped group called the Pleiades, which crosses the meridian about 9 p.m. on January 1. In this group six stars are easily visible, but on a dark night a good eye will see nine. It is a beautiful sight in an opera glass, and with a 3-inch telescope 100 stars are visible. Aldebaran, the brightest star, of a ruddy color, is at one end of a group of stars forming a V and well-known as the Hyades. The only other conspicuous star is β or Nath, to the N. E. of Aldebaran and almost south of Capella: it is of the second magnitude. The brightest of the Pleiades is called Alcyone.

Nebula. M. 1, R.A. 5h 27m, Decl. 21° 56′, about 1° west and a little north of ζ, the so-called Crab Nebula. Its accidental discovery by Messier when following a comet in 1758 led to the formation of his catalogue of nebulæ, in which it is number one.

Orion, which is named from a giant of mythological history is one of the few constellations really suggesting the figure of the object it is supposed to represent. It is also the most beautiful and brilliant constellation of all, being studded with stars of the first, second and third magnitudes. The three stars of second magnitude in a close row form the belt; the upper one of these is on the celestial equator. From these depend three others, known as the Sword of Orion; the centre one, θ, appears slightly hazy to a good eye; when examined with a telescope it is seen to be quadruple, and to be surrounded by a nebula, the Great Nebula of Orion. The left knee of the giant is marked by Rigel, of the first magnitude, the right knee by κ, of the second; the two shoulders by Betelgeuse and Bellatrix, of the first and second magnitudes respectively; the head is a small triangle formed by one star of the fourth and two of the fifth magnitude.

Double Stars. (1) β (Rigel), mags. 1 and 8; distance 9″·1; both white; the brilliancy of the primary renders the companion more difficult. (2) δ (the

westernmost star in the belt), mags. 2 and 7; distance 53″. (3) ζ (the easterly star of the belt), triple; mags. 2, 6, 9; distances 2″·2, 57″; colors, yellow, purplish, grey. (4) ι, triple; mags. $3\frac{1}{2}$, $8\frac{1}{2}$, 11; the lowest star in the sword, just below the nebula. (5) θ, multiple, the trapezium situated in the densest part of the great nebula; mags. 6, 7, $7\frac{1}{2}$, 8. (6) σ, triple, a beautiful star of the fourth magnitude. In most ordinary telescopes it presents an appearance described by Sir Wm. Herschel as "a double-treble star, or two sets of treble stars almost similarly situated." In larger instruments both sets are seen to be quadruple.

Nebula. M. 42; the finest in the sky. The fainter portions extend over an immense space; shown by photography to cover a large part of the constellation.

FEBRUARY

Canis Major (The Great Dog), lies to the south-east of Orion. It is marked by Sirius, the Dog Star, which is by far the brightest of the fixed stars, forming a magnitude by itself. It is at a distance of about nine light-years; hence it must be of stupendous magnitude and brilliancy. From irregularities in its proper motion it was shown that it must have a dark companion revolving about it. This was confirmed by Alvan Clark's discovery in 1862 of a companion of the tenth magnitude. The period of revolution is about fifty years, the companion having about one-half the mass of Sirius, and about equal to that of our sun. About five or six degrees west of Sirius is β, of the second magnitude; further to the south are δ and ϵ, of the second magnitude, and two other stars of the third, all in the same constellation.

Cluster. M. 41, 4° S. of Sirius; a fine group with a red star near the centre.

Canis Minor (The Lessor Dog) is to the east of Orion and slightly higher. The name of its brightest star, Procyon, signifies "Before the Dog," being given to it because it rises shortly before Sirius; it forms an equilateral triangle with Sirius and Betelgeuse. From the proper motion of Procyon it was shown theoretically by Bessel that it must, like Sirius, have a companion revolving around it. This companion was discovered at the Lick Observatory by Professor Schaeberle in 1896, very nearly in the predicted position.

Gemini (The Twins) is the third sign and the fourth constellation of the zodiac. It derives its name from the Twin Stars, Castor and Pollux, of the first magnitude; they are separated by about four and a half degrees, and lie to the south-east of Capella, and some distance directly to the north of Procyon.

Castor is a double star, the components revolving about one another in about 1000 years. Some distance to the south-west is γ, of the second magnitude; the constellation also includes several third and fourth magnitude stars.

Double Stars. (1) α (Castor), mags. $2\frac{1}{2}$, $3\frac{1}{2}$; distance $5''{\cdot}5$. A beautiful object in a small telescope. The larger of the pair has been shown to be a spectroscopic binary of period about 3 days. (2) δ, about half-way between β and γ, and just south of the ecliptic. Mags. 3 and 8; distance $7''$. (3) μ, mags, 3, 11; distance $80''$.

MARCH

Lynx, a modern constellation just east of Auriga. It contains no stars above magnitude 4.

Double Star. ρ Lyncis, R. A. $9^h\ 11^m$; Decl. $37°\ 21'$; mags. 4 and $7\frac{1}{2}$; distance $2''{\cdot}9$; white and lilac.

Cancer (The Crab), sonth of rhe Lynx and east of Gemini. This does not contain any star brighter than the fourth magnitude.

Double Star. ι, R.A. $8^h\ 40^m$, Decl. $29°$: mags. 4, $6\frac{1}{2}$; distance $30'$; orange and blue.

Cluster. Præsepe ("Beehive") a well-known coarse cluster, easily recognised by the naked eye and resolvable by an opera glass. The line from Castor to Pollux produced about $12°$ passes near it.

APRIL

Ursa Major (The Great Bear). This is the most familiar of the circumpolar constellations and in our latitudes is always above the horizon. In April it is above the pole. The best known feature is the "Big Dipper," but this is but a small part of the constellation. The stars α and β are known as the "Pointers" because a line from β through α, and produced about five times the distance between them passes near the Pole Star.

Double Stars. (1) ζ (Mizar, at the bend in the handle). Near it is a little star Alcor, the "rider on his horse," easily observed by the naked eye. Mizar in a small telescope is seen to be double. Mags. 3 and 5; distance $14''{\cdot}5$. The large star of this pair is also a spectroscopic binary—the first one discovered. (2) ξ, R.A. $11^h\ 13^m$, Decl. $32°\ 6'$; mags. 4 and 5; distance about $3''$ (rapidly changing). A binary having a period of 61 years. Discovered by Sir W. Herschel in 1780. The first binary whose orbit was computed.

Nebulæ. M. 81 and M. 82. R.A. $9^h\ 45^m$, Decl. $69°\ 44'$. Two nebulæ about half a degree apart, one pretty bright.

Leo (The Lion). East of Cancer. Regulus, its brightest star, is of the first magnitude, and it is on the ecliptic. The well-known configuration "The Sickle," in which Regulus is at the end of the handle, is easily recognisable.

Double Stars. (1) γ, the third star in the Sickle. Mags. 2, $3\frac{1}{2}$; distance 3″·4; a binary with a period of about 400 years. (2) ι (about 5° S. W. from β); mags. 4 and 7; distance 2″·5; yellow and bluish.

MAY

Canes Venatici (The Hunting Dogs). With these dogs Boötes pursues the Great Bear around the pole. Most of the stars are small but α (which is known as Cor Caroli — the heart of Charles II. of England) is of magnitude $2\frac{1}{2}$.

Double Star. α (Cor Caroli); mags. 3 and 5; distance 20″; white.

Nebulæ. (1) M. 51; R.A. 13h 25m, Decl. 47° 49′. Faint in small telescopes, but the wonderful spiral, in modern photographs. (2) M. 3; about 12° N. W. from Arcturus; a bright cluster, discovered in 1895 to be variable.

Coma Berenices (The Hair of Berenice). A little constellation, containing many 5 and 6 mag. stars.

Virgo (The Virgin), east of Leo and south of Coma Berenices. Its brightest star is α or Spica, mag. $1\frac{1}{2}$, a fine white star forming with Denebola (β Leonis) and Arcturus an almost equilateral triangle.

Double Stars. (1) γ; mags. 3 and 8; distance 6″·2; a binary with period 185 years. Yellowish. (2) θ (two-fifths of the way from Spica to δ, just north of ecliptic); mags. $4\frac{1}{2}$, 9, 10.

JUNE

Ursa Minor (The Lesser Bear). This small constellation is, of course, always high above the horizon, and it has the high distinction of containing our Pole Star. This star is of the second magnitude and is easily located by means of the Pointers of the "Big Dipper." There are seven stars forming the "Little Dipper," the Pole Star being at the end of the handle. The stars β and γ are known as the "Guardians of the Pole."

Double Star. Polaris has a companion; mag. $9\frac{1}{2}$; distance 18″·6.

Boötes (The Herdsman). A fine and large constellation, extending from the celestial equator to within 30° of the pole. Its principal star Arcturus may be easily located by prolonging the sweep of the handle of the Dipper. It is second only to

Sirius in brilliancy and has been seen *with the naked eye* 24m before sunset. Its distance is about 140 light-years. The spectroscope shows that it is approaching us at the rate of 4 miles a second, but its velocity at right angles to the line drawn from the star to us is probably 250 miles a second. Arcturus, Spica and Denebola form a great triangle, as already remarked.

Double Stars. (1) ϵ, mags. 3 and 6; distance 3″·1; orange and greenish blue. (2) ζ (about 9° S. E. from Arcturus); mags. 3·5, 4; distance 0″·8; requires a good 4-inch telescope to separate this.

Corona Borealis (Northern Crown) is a pretty half-circle of stars about 20° N. E. of Arcturus. Its principal star, Alphecca, is of the second magnitude. It was in this constellation that a *Nova* of the second magnitude suddenly appeared on May 10, 1866. In a short time it faded to the ninth magnitude, in which condition it still remains. Its position is 1½° S. E. of ϵ, the most easterly star in the semi-circle.

Libra (The Balance). This is a large but inconspicuous constellation, there being no stars of the first or second magnitude and only two, α and β, of the third. The star δ is a remarkable variable, usually being of the 4½ or 5 magnitude, but at times running down nearly two magnitudes.

JULY

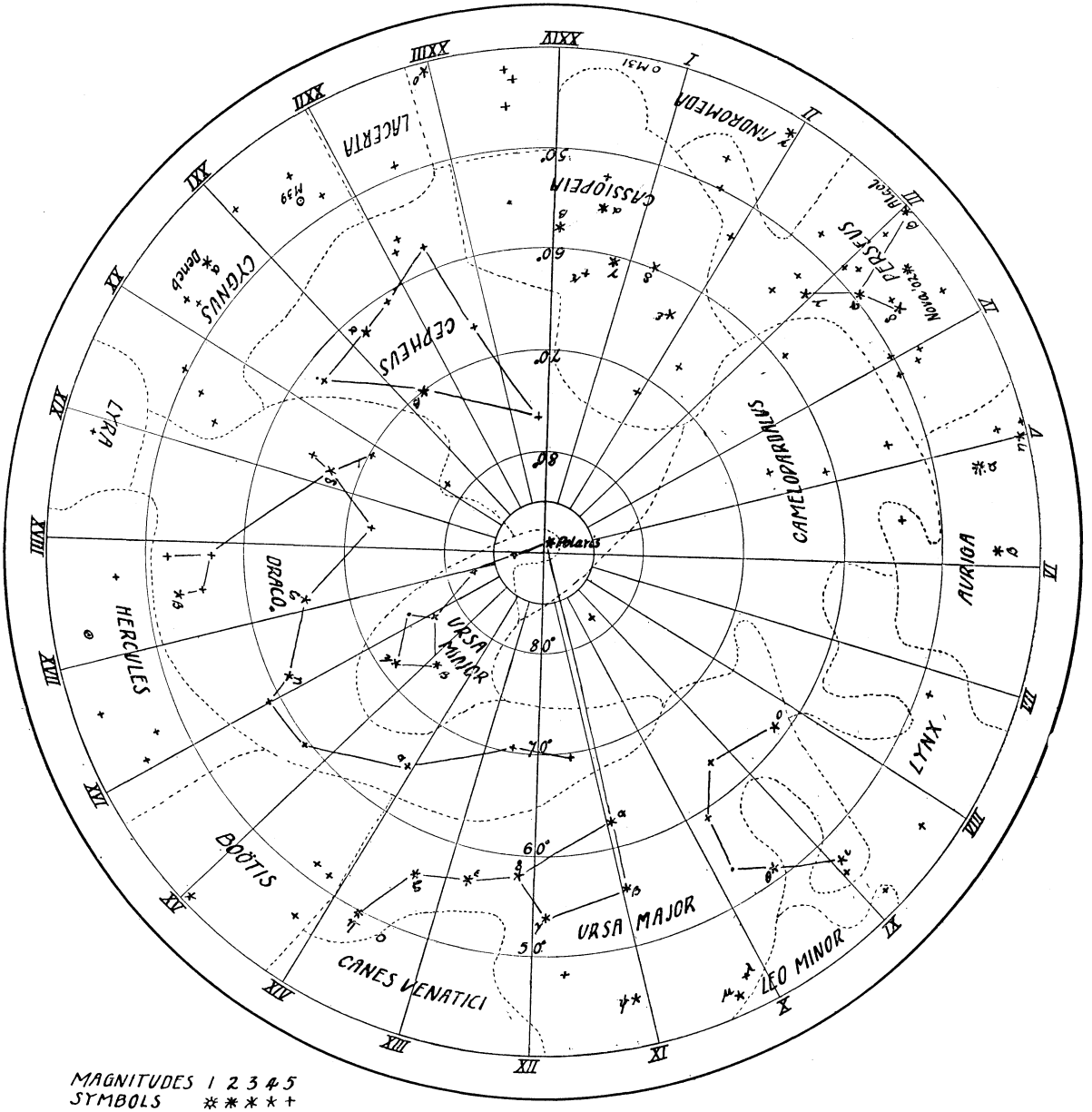
Hercules, a large constellation, is bounded on the north by Draco and on the south by Ophiuchus, and extends east and west nearly from Arcturus to Vega. It has no very conspicuous stars, but contains many good telescopic objects. It is interesting as marking that part of the heavens towards which the solar system is at present travelling.

Double Stars. (1) α, mags. 3 and 6; distance 4″·5; colors, yellow and intense blue; one of the finest objects in the heavens. (2) ζ, at the S. W. corner of the "Keystone" (see Map); mags. 3, 6½; distance 1″·5 (1905); a binary of period 34 years. (3) ρ, (2½° east of π); mags. 4 and 5; distance 4″; white, emerald green (4) δ, mags. 3 and 8; distance 18″; white, light blue.

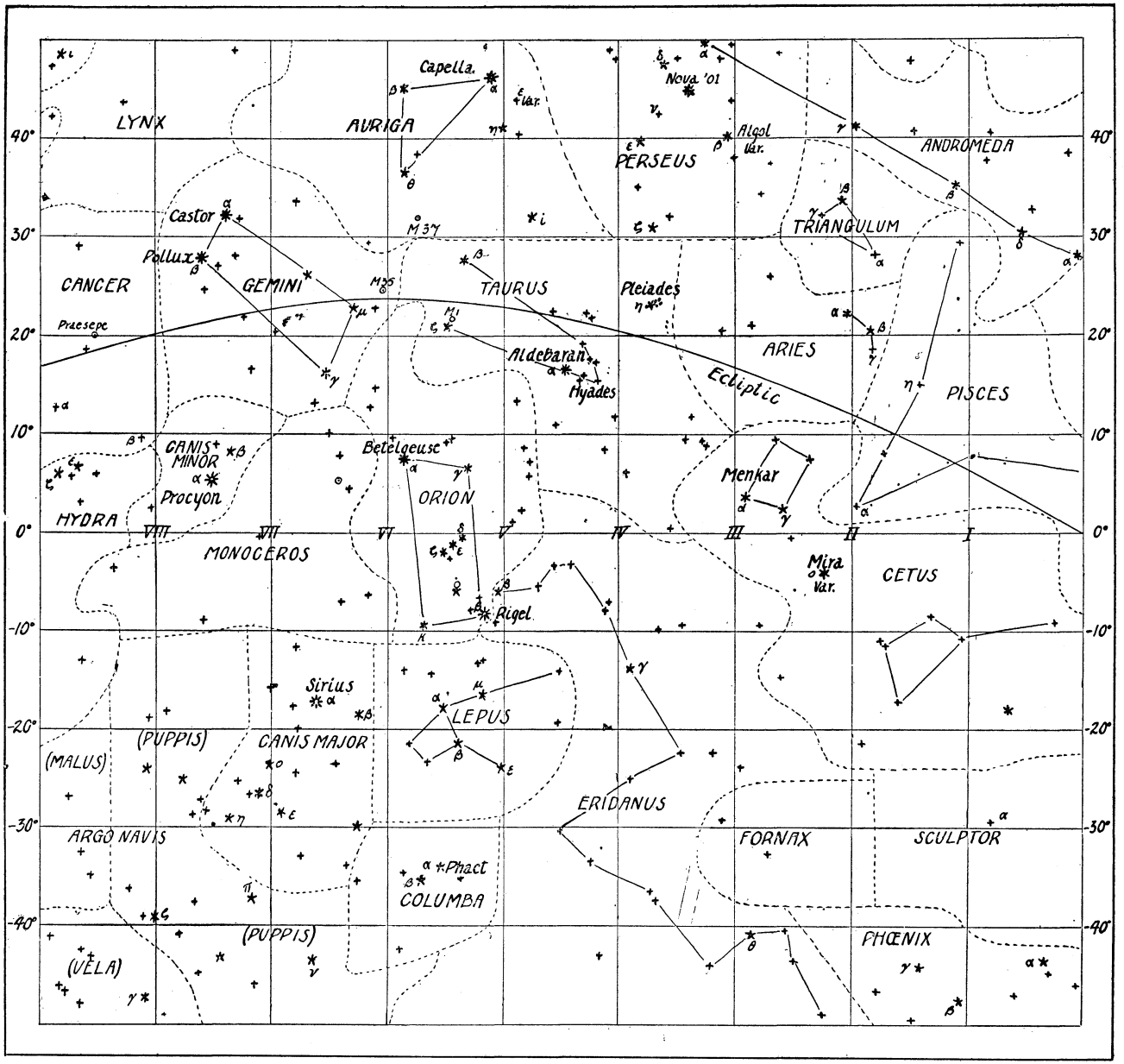
Clusters. (1) M. 13, R.A. 16h 37m, Decl. 36° 41′. The finest of all the clusters, containing 25,000 stars. (2) M. 92, R.A. 17h 13m, Decl. 43° 16′. Fine but not equal to M. 13.

Ophiuchus (The Serpent-Bearer) is south of Hercules, and though occupying a considerable space in the sky, is not a very conspicuous constellation. The highest part of this constellation is marked by the star α, of the second magnitude, about

NORTH POLAR CONSTELLATIONS

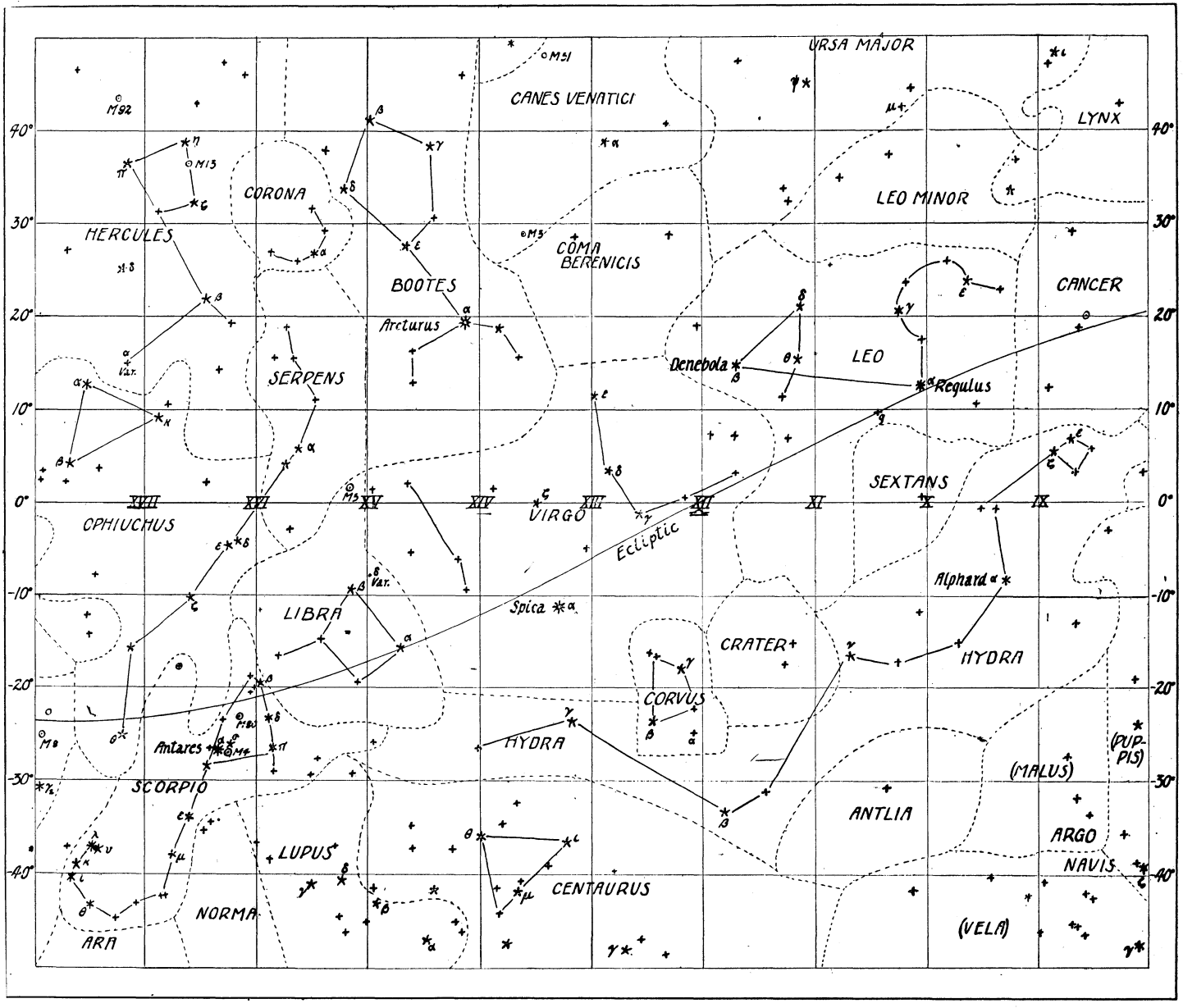


CONSTELLATIONS, 0h to 9h



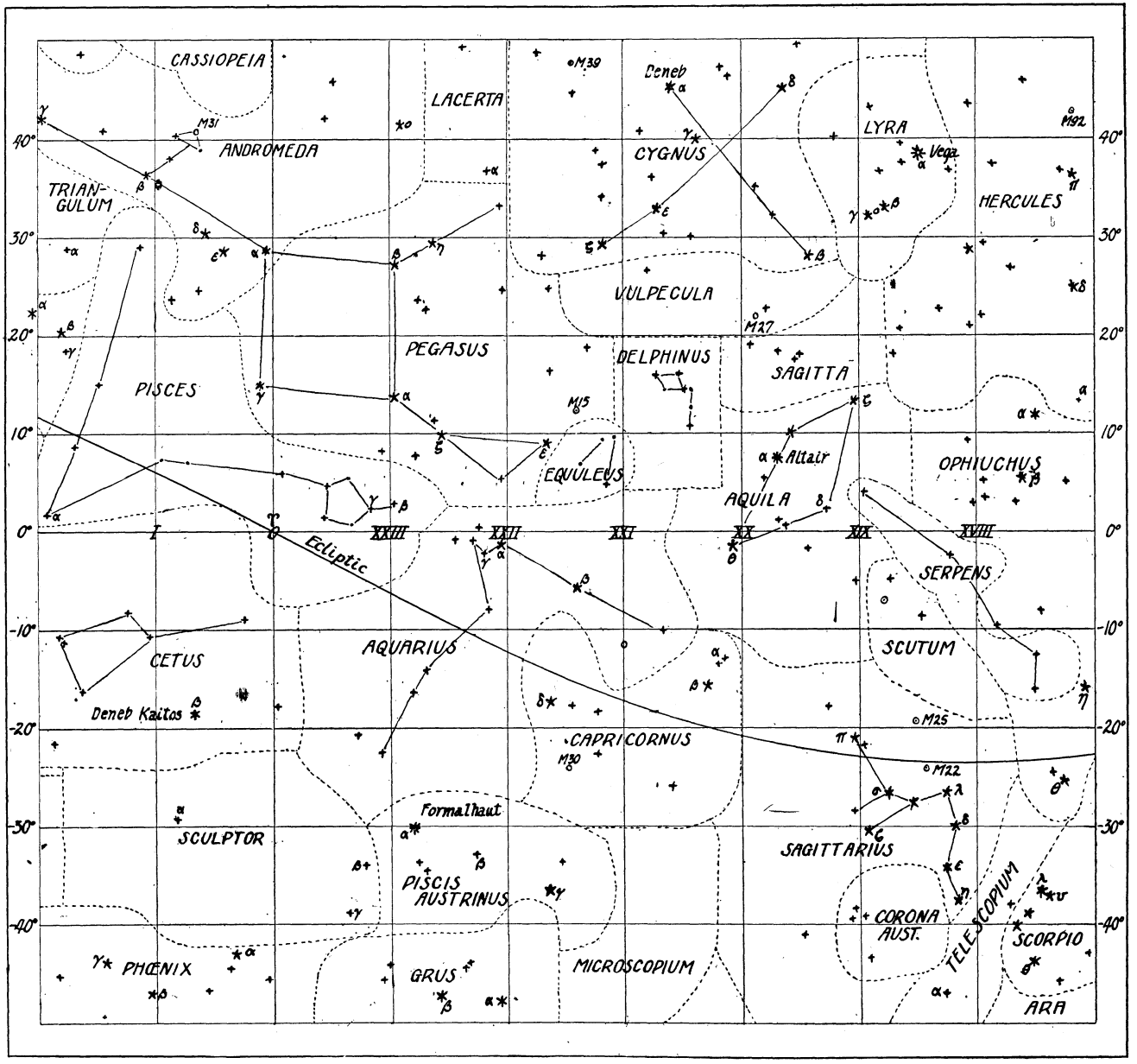
MAGNITUDES 0 1 2 3 4 Nebula Cluster
SYMBOLS ✱ ✱ ✱ ✱ + ○ ⊙

CONSTELLATIONS, 8h to 18h



MAGNITUDES 0 1 2 3 4 Nebula Cluster
SYMBOLS ✲ ✲ ✲ ✲ + ○ ⊙

CONSTELLATIONS, 17h to 24h



MAGNITUDES 0 1 2 3 4 Nebula Cluster
SYMBOLS ✲ ✲ ✲ ✲ + ○ ⊙

half-way between Antares and Vega, and forming with Vega and Altair a nearly equilateral triangle.

Serpens (The Serpent) is a divided constellation, the principal part being to the north-west of Ophiuchus ; with one corner to the south-east of the latter. The ancients probably considered it to consist of a trail of stars stretching across, or, perhaps, coiled around, Ophiuchus, whence arose the name of the latter. It contains no stars brighter than the third magnitude.

Double Stars. (1) λ Ophiuchi, R.A. 16h 28m, Decl. 2° 20′ N.; mags. 4 and 6; distance 1″·2. (2) 70 Ophiuchi, R.A. 18h 1m, Decl. 2° 32′ N.; mags. 4½, 6; distance (1905) 2″; a well.known binary of period 93 years. (3) δ Serpentis, R.A. 15h 30m, Decl. 10° 51′; mags. 4 and 5; distnnce 4″. (4) θ Serpentis, R.A. 18h 51m, Decl. 4° 4′ N.; mags. 4 and 4½; distance 21″; yellowish and white; a fine wide pair.

Cluster. M. 23, R.A. 17h 50m, Decl. 19° 0′ S.; a fine low-pewer field.

Scorpio (The Scorpion), south of Ophiuchus, the ninth constellation of the zodiac, is of irregular shape. It is only by virtue of two long projections to the north that it is ranked as a zodiac constellation at all, as nearly all the stars belonging to it are some distance south of the ecliptic. The sun spends only nine days out of twenty-five in Scorpio, the other sixteen being occupied in passing through Ophiuchus, which, however, is not counted among the zodiac constellations. Scorpio's principal star is Antares, of the first magnitude, color a decided red. Viewed through the telescope Antares' color appears interspersed with intermittent flashes of green, which is explained by the presence of a close green companion. Under ordinary atmospheric conditions this companion can not be separated from the rays of Antares itself.

Double Stars. (1) α, mags. 1 and 7; distance 3″·5 (see above). (2) β, triple; mags. 2, 4, 10; distances 13″, 0″·9. (3) ν (2° E. of β), quadruple; mags. 4, 5, 7, 8.

Clusters. (1) M. 80, half-way between α and β; a very fine cluster. (2) M. 4, 1½° W. of α; not so fine as the preceding.

AUGUST

Draco (The Dragon), a very large and winding constellation, is in the neighborhood of the pole. Draco contains several second magnitude stars between Vega and the pole, and extends westward in a wide curve around Ursa Minor. The star α, of

magnitude 3½, 4700 years ago was the pole-star, being much nearer to the pole than Polaris now is.

Lyra (The Lyre), though a small constellation, contains several fairly bright stars. The principal of these is Vega, which rank second or third in the heavens in brightness. Vega is of a brilliant bluish-white color and cannot fail to be easily identified. It crosses the meridian at 9 p.m. on August 15, when it is only a few degrees south of the zenith. This star is always visible in our latitudes at some hour of the night throughout the year. Twelve thousand years from now it will be the pole star, though not so near the pole as Polaris now is.

Double Stars. (1) Vega has a companion, of mag. 11, 48″ from it. (2) β has three small stars near it, a pretty object with low power. (3) ϵ, the well-known "double-double," about 2° east of Vega. Visible in an opera glass as a double and to some with the naked eye. Each is again double; mags. 5, 6, 5, 5.

Nebula. M. 57, the Ring Nebula; between β and γ, one-third of the way from β.

Sagittarius (The Archer), the tenth constellation of the zodiac, passes low in the south when Vega is on the meridian. It contains a group of seven fairly bright stars, about 30° to the east of Antares and at about the same altitude. The sun passes through Sagittarius in December and January.

Clusters. (1) M. 22 (3° N. W. of λ). (2) M. 25 (7° N. and 1° E. of λ); visible to naked eye. (3) The Trifid Nebula, R.A. $17^h\ 55^m$, Decl. 23° 2′ S., a well-known and beautiful object.

SEPTEMBER

Cygnus (The Swan) is marked by five stars forming a conspicuous cross in the heavens, which may, without unduly stretching the imagination, be likened to the outline of a flying swan. It is in the Milky Way, which here begins to separate into two streams, and contains telescopic fields of great magnificence. Its brightest star α, sometimes known as Arided or Deneb, crosses the meridian two hours and five minutes after Vega and a few degrees higher, almost exactly in the zenith; it is between the first and second magnitudes, but has no appreciable parallax or proper motion, being, therefore, at an immense distance, and possibly surpassing Vega or even Sirius in size; it is approaching us at the rate of about forty miles per second. About 15° east of α there suddenly appeared, in 1876, a Nova of the 3rd magnitude, which later faded irregularly to the 14th magnitude.

Double Stars. (1) β, mags. $3\frac{1}{2}$, 7; distance 35″; orange and blue; the finest of colored pairs for a small telescope. (2) 61 Cygni, at one corner of a parallelogram, of which α, γ and ε form the other corners; mags. $5\frac{1}{2}$, 6; distance 22″; our *second nearest* neighbor, its distance having been first determined by Bessel in 1838.

Clusters. The Milky Way in Cygnus affords fine views for a low power.

Vulpecula (The Fox) and **Sagitta** (The Arrow) are two small constellations immediately south of Cygnus, between it and Aquila. Neither of them contains any bright stars, but as both are traversed by the Galaxy the telescopic fields are good. Vulpecula, in particular, contains one of the prettiest of telescopic objects, the well-known Dumb-Bell Nebula. M. 27, R. A. 19^h 54^m, Decl. 22° 23′.

Delphinus (The Dolphin), otherwise known as Job's Coffin, is another small constellation to the immediate north-east of Aquila, containing a little group of five stars of the third magnitude.

Double Star γ (at the N. E. angle of quadrilateral); mags. 4 and 7; distance 11″·3.

Aquila (The Eagle) is on the meridian about nine o'clock at the beginning of September, being then about half-way from the horizon to the zenith. It is conspicuously marked by Altair, a fine star of the first magnitude, which crosses the meridian seventy minutes after Vega. Though Aquila is a large constellation it contains only three other moderately bright stars, all of the third magnitude.

OCTOBER

Cepheus, one of the polar constellations, extends northward to the pole between Draco and Cassiopeia, and southward as far as Cygnus. Though a large constellation, it contains only three stars of the third magnitude and four of the fourth; however, it atones for this by the comparatively large number of interesting double and variable stars, several of the latter being of quite short period.

Double Stars. (1) β, mags. 3 and 8; distance 14″. (2) δ, mags. 3·7 to 5 (larger star variable) and 7; distance 41″.

Pegasus, the winged horse of Grecian mythology, lies S. E. of Cygnus; three bright stars in it form with Alpherat, in Andromeda, a large and conspicuous figure known as the Square of Pegasus, each side of the square being about 14° in length.

The boundaries of the constellation extend a considerable distance to the west and south-west, taking in the bright star ϵ, which lies west and a little south of the star in the right-hand lower corner of the square.

Aquarius (The Waterman), a large and irregularly shaped constellation, lies to the east and north of Capricornus. It is the eleventh sign and twelfth constellation of the zodiac, and is occupied by the sun from the middle of February till the middle of March; it contains seven third magnitude and eight fourth magnitude stars. It is not conspicuous, but if attentively examined the stars in the south-eastern part of it will be found to have a trend downwards, which, doubtless, gave occasion to the idea of water flowing from a jar.

Piscis Australis (The Southern Fish), which is not to be confounded with the zodiac constellation of Pisces, lies to the south of Aquarius and Capricornus. Its brightest star, Fomalhaut, is the most southerly of the first magnitude stars visible in these latitudes; it is on the meridian at nine o'clock on the 20th of October, when it is only about 15° above the southern horizon.

Capricornus (The Goat), the eleventh constellation of the zodiac, contains four stars of the third magnitude and four of the fourth. It may be readily recognised by two stars pointing directly to Altair, which pass the meridian twenty-seven minutes after it, about 20° lower.

Double Stars. (1) α, mags. 3 and 4; distance 6′ 13″; use a very low power. 2) β, mags. $3\frac{1}{2}$ and 7; distance 3′ 25″.

NOVEMBER

Cassiopeia, one of the two bright circumpolar constellations, is named from a queen of Grecian mythology; and sometimes known by the name of *The Lady in her Chair.* During November it is on the meridian. directly above the pole and opposite the Dipper, about nine o'clock. The constellation is very easily recognised by five bright stars arranged in a zigzag figure like a wide inverted W, which in certain positions is said to resemble the outline of a chair. Lying as it does, in the galaxy, it contains many fine telescopic fields.

Double Star. η, about half-way between α and γ, a little off the line; mags. 4 and $7\frac{1}{2}$; distance 5″·5; orange and purple.

Andromeda is directly to the south of Cassiopeia, and passes the meridian slightly south of the zenith. Its brightest star Alpherat, passes the meridian at the same time as the most westerly of the five bright stars in Cassiopeia, β passes the meridian an hour after Alpherat, and about 7° nearer to the zenith.

Double Stars. (1) γ, mags. 3 and 5; distance 11″; orange and greenish-blue; very fine. (2) π (2° N. and a little W. of δ); mags. 4 and 9; distance 36″; white and blue.

Nebula. M. 31; the Great Nebula, visible to the naked eye; prolong the line from β to μ its own length beyond μ.

Pisces (The Fishes), is to the southeast and east of Pegasus and south of Andromeda. It is the first constellation of the zodiac; although containing quite a large number of stars, none of them are brighter than the fourth magnitude, and it is a quite inconspicuous constellation.

Double Star. α, mags. 4 and 5½; distance 3″.

Cetus (The Whale), is a fairly large constellation lying to the southeast of Pisces. It contains two stars, α and β, of the second magnitude, and eight of the third. β may be indentified by prolonging the eastern side of the Square of Pegasus about two and a half times its own length to the south: α lies about 40° towards the northeast. About one-third of the way from α to β, in a direct line between them, lies Mira (The Wonderful), a variable star, having a perion of about eleven months; at its maximum brilliancy this star is somewhat brighter than the second magnitude, though it does not attain this degree of brightness in every period; its miniumum is about the ninth magnitude.

Double Star. γ, mags. 3½, 7; distance 2″·5; yellow and blue.

DECEMBER

Perseus, named after a hero of Grecian mythology, lies to the east of Andromeda. Its brightest star, α, is known by the name of Mirfak; it is of the second magnitude, and crosses the meridian slightly north of the zenith at nine o'clock (local time) on December 26. About ten degrees a little west of south from it is Algol (The Demon), the best known variable star in the heavens. Ordinarily of the second magnitude, but once in every period of two days and nearly twenty-one hours it is partially

eclipsed by a companion which revolves around it ; the eclipse occupies eight or ten hours, during about half an hour of which the star is only of the fourth magnitude. It is easily located by noting that it is a little less than half way from the Pleiades to Cassiopeia. Another interesting feature of this constellation is the double cluster, lying about half way between Mirfak and Cassiopeia.

Double Star. ε, mags. $3\frac{1}{2}$ and 9 ; distance 8″·4.

Aries (The Ram), lies immediately to the north-east of Pisces. Its brightest star α, otherwise known as Hamal, is of the second magnitude ; it is situated directly east from the centre of the Square of Pegasus, at a distance of about double the diameter of the latter ; near it, to the south-west, is β, of the third magnitude ; the constellation contains no other stars brighter than the fifth magnitude.

Triangulum (The Triangle), is a small constellation marked by a right-angled triangle of three stars of the third magnitude. The centre of the triangle lies about ten degrees directly north of Hamal.

RECENT PROGRESS IN ASTRONOMY

By W. E. Harper

INTRODUCTION

As this is the first time an article on the above subject appears in the HANDBOOK, the aim will be to cover in a brief way the progress made since the JOURNAL was started some five years ago, paying particular attention to the most recent items. The foundation laid, a more concise statement of yearly progress can be given in future issues if this feature is retained.

STELLAR INVESTIGATION

Proper Motion. Boss' catalogue of the proper motion of 6188 stars, issued in 1910, is perhaps the most important publication bearing on this branch of old astronomy. From his data the apex of the sun's way is placed at R. A. 270°·5, Decl. + 34°·3.

Star Position. The problem of determining star positions by photography was suggested two or three years ago by Turner who has since been conducting experiments along this line. Schlesinger at Allegheny has been making experiments on the stability of piers, so essential for this research, and his results to date show that apparently a small movement takes place, but more data are necessary to determine its magnitude and character.

Radial Velocities. The radial velocities of 1073 stars published by Campbell in 1910 lead to most important results. The apex of the sun's way is given by R. A. 272°·0, Decl. + 27·5, in close agreement with that of Boss and others observers. The velocity of the solar system through space was found to be 17·8 km. per sec. Furthermore many new binary systems were revealed.

Spectroscopic Binaries. On January 1, 1905, 136 spectro-

scopic binary systems were known to exist, and of these less than 20 had orbital elements determined. On January 1, 1910, 306 binary systems were known, about 70 of whose orbits were determined. Since that date to the present, about 113 new binaries have been discovered ; 12 new orbits have been determined here and about the same number elsewhere. Thus out of over 400 known, less than 100 have elements assigned them.

H and K Lines. An interesting by-product of the work is that the H and K lines of calcium in certian stars give different velocities to that of the other lines in general.

In the case of those binaries whose periods are determind it is found that :—

(1) the period is a function of the spectral type, the period increasing with approach to solar type.

(2) the eccentricity increases with increase of period.

Double Stars. In 1907 Burnham's monumental catalogue of 13,665 double stars was issued. Since then measures upon those whose orbits are incomplete have appeared from time to time, as well as lists of new doubles by Aitken and others.

Eclipsing Variables. The problem of determining orbital elements for eclipsing variables has been undertaken by Russell. He shows under what conditions and to what degree the problem is determinate and develops tables and formulæ.

Parallax. The method of obtaining stellar parallaxes by photography has been recently introduced and has reached its highest development in the plates made by Schlesinger at the Yerkes Observatory. Very accurate results are given for 25 stars. An interesting by-product was that third magnitude helium stars were equally distant with ninth magnitude stars of other types,— a conclusion reached independently by other observers.

Kapteyn and Weersma collected from various reliable sources values of the parallax of 352 stars, adopted mean values, and used these as a basis for investigation of the distribution of the stars in space.

Star Distances and Types. A statistical method of determining the distances of the stars from the combination of the proper motions by Boss and the radial velocities by Campbell already alluded to, showed that :

(1) Stars of different magnitudes are more thoroughly mixed than has hitherto been supposed.

(2) When classified according to type, their distance away depends on the type. The order outward from the solar system is as follows: solar stars and those approaching that type 100 light-years ; late solar as well as hydrogen type 250 light-years, while the early type helium stars are 500 light-years distant.

Star Drifts. The motion of the solar system through space towards Vega causes all the stars to appear to move in an opposite direction. Such a motion of the stars, made up not of motions all in the one direction, but of motions in all directions with a preponderance in one direction, is called a drift of the stars ; and there is thus a drift of the stars towards a point in the Southern Hemisphere nearly opposite Vega.

About five or six years ago Kapteyn, from an examination of the proper motions of the Bradley stars came to the conclusion that there is not one drift of the stars, that due to the solar motion, but two drifts, moving in different directions. This conclusion has been confirmed by various observers since. Allowing for the solar motion we find that these two drifts are moving, one towards the point, R. A. 94°, Decl. + 12° about 8° northeast of α Orionis, and the other in the opposite direction exactly as if we were in the midst of two sidereal systems interpenetrating one another.

We should expect that the radial velocities of stars in these two directions would be greater than in a direction at right angles, and this is exactly as Campbell found it from the 1073 velocities referred to.

Star Streams. Besides the two drifts we have smaller groups of stars in different regions of the sky, having a motion approximately in the same direction and of the same velocity. Such groups are called star streams. It was long ago pointed out that the stars of the Dipper formed such a stream, because their proper motion were in the same direction and of approximately the same magnitude.

Taurus Stream. Another star stream has recently been found by Boss in the constellation Taurus. Thirty-nine stars forming a roughly globular cluster 15° in diameter are moving with a velocity of 40 km. per sec. towards a point in the north-eastern part of Orion. They are 130 light-years distant.

Orion Stream. By selecting from Boss' catalogue all the stars of early type (Orion type) Kapteyn found (in 1910) two streams of stars of this type in distinct regions of the sky, The first region extends from R. A. 12^h to 18^h and from Decl. 0° to − 60°; the second from R. A. $2^h\ 50^m$ to $4^h\ 30^m$ and from Decl. 0° to + 55°. Those in the first division move in the same direction with the same velocity, while those in the second also move as a single system though in a different direction and with a different velocity.

Nova. A new star in Gemini was discovered last spring, which was visible to the naked eye for a short time and gradually faded. Its spectrum, characteristic of novæ, underwent marked changes, the continuous spectrum becoming weaker and emission bands stronger and more defined as the star faded.

COMETS AND METEORS

The connection supposed to exist between comets and meteors seems to be supported by certain meteors in Aquarii whose orbits were detrmined by Olivier at the time of Halley's comet and were found to be almost identical with that of the comet.

SOLAR RESEARCH

In 1905, at Oxford, the International Union for Co-operation in Solar Research, which was organized at the St. Louis Exhibition, realizing that Rowland's system of wave-lengths was unsuitable for refined work — there being errors in the absolute value of 1 in 30,000, as well as systematic errors due to the inherent errors in the grating itself — decided to adopt standards for the wave-lengths of certain lines in the arc spectrum. In 1907, at Meudon, the red cadimum line was selected as the primary standard and it was decided to obtain secondary standards by the interferometer method. In 1910, at Mt. Wilson, the mean values of three independent observers for 49 lines of iron between λ4282 and λ6494 were adopted as secondary standards.

Sun Spots. Another important result reported at the Mt. Wilson meeting was the work on the Constitution of the Sun Spots carried out at the Mt. Wilson Solar Observatory, where it was shown conclusively, first, that sun spots are at a lower temperatur ethan the photosphere and, second, that many are surrounded by a magnetic field. This, coupled with the discovery of radial motions in and around them by Evershed, were the most important features of the Sun Spot Committee's work.

Solar Rotation. A committee on the spectroscopic determination of the Solar Rotation was organized and the work divided among several observatories for the purpose of determining the velocity and law of variation with latitude, and of confirming or otherwise the results of Adams, showing a difference of velocity for different elements.

Solar Constant. The determination of the value of the solar constant as nearly 2 calories and of the existence of small variations in its value by Abbot was the most important work recorded by the Committee on Solar Radiation.

GEOPHYSICS

In the department of Geophysics the greatest advance in the past few years has been made in the science of seismology from which we are now receiving direct evidence of the constitution of the interior of the earth. The old idea of a fluid interior is shown to be untenable on account of the transmission through it of transverse or distortional waves. Seismographs have been greatly improved in sensitiveness and efficiency, so that good records can now be read to the individual second of time, which is essential for the intercomparison and study of seismograms from different stations, of the same quake.

Interesting observations are now going on at a number of stations distributed around the world for elucidating the anamoly found in the bodily tides of the earth, that the earth is more compressible in a north-south than in an east-west direction.

Pulsations known as microseisms, sent through the crust of the earth hundreds of miles, by the action of sea-waves beating on the shore, are also undergoing investigation.

The completion of the 60-inch reflector and other telescopes at Mt. Wilson — the equipment of the laboratory in connection therewith, for correlating the results, and the recent installation of the 30-inch refractor at Allegheny Observatory, are epoch marking events in the astronomical world.

The perfection of the selenium photometer by Stebbins is also an outstanding feature. Instead of working to tenths, we can now as correctly measure hundredths of a magnitude.

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THE

ROYAL ASTRONOMICAL SOCIETY

OF CANADA

The Meetings of the Royal Astronomical Society of Canada are now held in Toronto, Ottawa, Peterborough, Hamilton, Guelph, Regina, and Winnipeg.

Membership fee, $2.00 per year, which includes the Society's *Journal* (bi-monthly) and *Handbook*.

Copies of this *Handbook* can be obtained for 25 cents each from the Society's Librarian, 198 College St., Toronto.

For further information address J. R. Collins, Secretary, at the same address.