R. K. Young.

THE OBSERVER'S HANDBOOK FOR 1914

PUBLISHED BY

The Royal Astronomical Society of Canada

EDITED BY C. A. CHANT

SIXTH YEAR OF PUBLICATION

TORONTO
198 COLLEGE STREET
PRINTED FOR THE SOCIETY
1914

CALENDAR 1914

JANUARY

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEBRUARY

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

MARCH

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

APRIL

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

MAY

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

JUNE

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

JULY

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

AUGUST

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

SEPTEMBER

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

OCTOBER

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

NOVEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

DECEMBER

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

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CONTENTS

PREFACE

The HANDBOOK for 1914 differs from that for last year chiefly in the addition of the phenomena of Jupiter's Satellites (page 46), though some other additions and corrections have been made which, it is hoped, will render the work more useful.

As in previous years the Editor is indebted to those whose names appear in the body of the book, and also especially to Mr. R. M. Stewart, M.A., of the Dominion Astronomical Observatory, Ottawa, who prepared the "Astronomical Phenomena" on the odd pages from 23 to 45, and the "Phenomena of Jupiter's Satellites."

THE EDITOR.

TORONTO, December, 1913.

ANNIVERSARIES AND FESTIVALS, 1914

New Year's Day	Thur.,	Jan. 1	Pentecost (Whit Sunday)		May 31
Epiphany	Tues.,	Jan. 6	Trinity Sunday		June 7
Septuagesima Sunday		Feb. 8	Corpus Christi	Thur.,	June 11
Quinquagesima (Shrove Sunday)		Feb. 22	St. John Baptist	Wed.,	June 24
Ash Wednesday		Feb. 25	Dominion Day	Wed.,	July 1
St. David	Sun.,	Mch. 1	Labor Day	Mon.,	Sept. 7
St. Patrick	Tues.,	Mch. 17	St. Michael (Michaelmas Day)	Tues.	Sept. 29
Palm Sunday		Apl. 5	All Saints Day	Sun.,	Nov. 1
Good Friday		Apl. 10	First Sunday in Advent		Nov. 29
Easter Sunday		Apl. 12	St. Andrew	Mon.,	Nov. 30
St. George	Thur.,	Apl. 23	Conception Day	Tues.,	Dec. 8
Rogation Sunday		May 17	St. Thomas	Mon.,	Dec. 21
Ascension Day (Holy Thursday)		May 21	Christmas Day	Fri.,	Dec. 25
Victoria Day	Sun.,	May 24			

Thanksgiving Day, usually last Monday in October.
King George V., born June 3, 1865; began to reign May 6, 1910.
Queen Mary, born May 26, 1867.
Prince of Wales, born June 23, 1894.

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.

1914, 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
Thur. Jan. 1	18	44	37	S. 23	3	23	+	3	27·2	18	41	10·2
Tues. " 6	19	6	38	22	34	7		5	45·5	19	0	53·0
Sun. " 11	19	28	28	21	53	45		7	52·1	19	20	35·8
Fri. " 16	19	50	3	21	2	44		9	44·1	19	40	18·6
Wed. " 21	20	11	21	20	1	40		11	19·5	20	0	1·4
Mon. " 26	20	32	20	18	51	12		12	36·4	20	19	44·1
Sat. " 31	20	53	0	17	32	9		13	33·2	20	39	26·9
Thur. Feb. 5	21	13	19	16	5	22		14	9·2	20	59	9·7
Tues. " 10	21	33	17	14	31	41		14	24·6	21	18	52·5
Sun. " 15	21	52	56	12	51	58		14	20·4	21	38	35·3
Fri. " 20	22	12	16	11	7	1		13	58·3	21	58	18·0
Wed. " 25	22	31	21	9	17	42		13	19·9	22	18	0·8
Mon. Mar. 2	22	50	10	7	24	54		12	26·8	22	37	43·6
Sat. " 7	23	8	47	5	29	29		11	20·8	22	57	26·4
Thur. " 12	23	27	13	3	32	18		10	4·3	23	17	9·1
Tues. " 17	23	45	32	S. 1	34	3		8	40·2	23	36	51·9
Sun. " 22	0	3	46	N. 0	24	30		7	11·3	23	56	34·7
Fri. " 27	0	21	58	2	22	37		5	40·2	0	16	17·4
Wed. Apr. 1	0	40	9	4	19	29		4	8·9	0	36	0·2
Mon. " 6	0	58	23	6	14	20		2	39·8	0	55	43·0
Sat. " 11	1	16	41	8	6	27	+	1	15·0	1	15	25·7
Thur. " 16	1	35	6	9	55	13	−	0	2·7	1	35	8·5
Tues. " 21	1	57	24	12	0	19		1	23·5	1	58	47·8
Sun. " 26	2	12	26	13	19	52		2	8·5	2	14	34·1
Fri. May 1	2	31	23	14	54	20		2	53·7	2	34	16·8
Wed. " 6	2	50	34	16	22	36		3	26·0	2	53	59·6
Mon. " 11	3	9	58	17	44	4		3	44·7	3	13	42·4
Sat. " 16	3	29	36	18	58	9		3	48·9	3	33	25·2
Thur. " 21	3	49	30	20	4	16		3	38·5	3	53	8·0
Tues. " 26	4	9	36	21	1	50		3	14·3	4	12	50·8
Sun. " 31	4	29	56	21	50	20		2	38·0	4	32	33·6
Fri. June 5	4	34	1	21	58	54		2	29·4	4	36	30·1
Wed. " 10	5	11	2	22	58	31	−	0	56·8	5	11	59·1
Mon. " 15	5	31	46	23	17	38	+	0	4·1	5	31	41·9
Sat. " 20	5	52	34	23	26	30		1	8·8	5	51	24·7
Thur. " 25	6	13	22	23	25	2		2	14·1	6	11	7·5
Tues. " 30	6	34	7	N. 23	13	15		3	15·6	6	30	50·3

Observe that the sum of the 4th and 5th columns equals the 2nd.

1914. 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
Sun.	July	5	6	54	46	N. 22	51	19	+	4	13·5	6	50	33·1
Fri.	"	10	7	15	17	22	19	28		5	1·4	7	10	15·9
Wed.	"	15	7	35	38	21	38	1		5	39·6	7	29	58·7
Mon.	"	20	7	55	47	20	47	18		6	6·0	7	49	41·5
Sat.	"	25	8	15	43	19	47	49		6	18·8	8	9	24·3
Thur.	"	30	8	35	34	18	44	6		6	16·8	8	29	7·0
Tues.	Aug.	4	8	54	49	17	24	45		5	59·3	8	48	49·8
Sun.	"	9	9	13	59	16	2	21		5	26·5	9	8	32·6
Fri.	"	14	9	32	55	14	33	30		4	39·6	9	28	15·4
Wed.	"	19	9	51	38	12	58	48		3	39·4	9	47	58·2
Mon.	"	24	10	10	8	11	18	55		2	27·0	10	7	40·9
Sat.	"	29	10	28	27	9	34	35	+	1	3·6	10	27	23·7
Thur.	Sept.	3	10	46	37	7	46	29	−	0	29·0	10	47	6·5
Tues.	"	8	11	4	41	5	55	16		2	8·6	11	6	49·2
Sun.	"	13	11	22	40	4	1	32		3	52·5	11	26	32·0
Fri.	"	18	11	40	37	2	5	59		5	38·2	11	46	14·8
Wed.	"	23	11	58	34	N. 0	9	19		7	23·6	12	5	57·6
Mon.	"	28	12	16	34	1	47	41		9	6·4	12	25	40·3
Sat.	Oct.	3	12	34	39	3	44	18		10	44·1	12	45	23·1
Thur.	"	8	12	52	52	5	39	51		12	14·0	13	5	5·9
Tues.	"	13	13	11	15	7	33	36		13	33·3	13	24	48·6
Sun.	"	18	13	29	52	9	24	49		14	39·3	13	44	31·4
Fri.	"	23	13	48	44	11	12	37		15	30·2	14	4	14·2
Wed.	"	28	14	7	52	12	56	10		16	4·5	14	23	57·0
Mon.	Nov.	2	14	27	19	14	34	38		16	20·4	14	43	39·7
Sat.	"	7	14	47	6	16	7	14		16	16·3	15	3	22·5
Thur.	"	12	15	7	14	17	33	7		15	51·1	15	23	5·3
Tues.	"	17	15	27	44	18	51	28		15	4·2	15	42	48·1
Sun.	"	22	15	48	34	20	1	24		13	56·4	16	2	30·9
Fri.	"	27	16	9	45	21	2	9		12	29·1	16	22	13·7
Wed.	Dec.	2	16	31	12	21	53	2		10	43·9	16	41	56·4
Mon.	"	7	16	52	56	22	33	26		8	43·0	17	1	39·2
Sat.	"	12	17	14	53	23	2	50		6	28·9	17	21	22·0
Thur.	"	17	17	37	00	23	20	50		4	5·2	17	41	4·8
Tues	"	22	17	59	11	23	27	8	−	1	36·3	18	0	47·6
Sun.	"	27	18	21	24	23	21	40	+	0	53·1	18	20	30·4

Observe that the sum of the 4th and 5th columns equals the 2nd.

OCCULTATIONS OF STARS BY THE MOON, 1914

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. All stars down to magnitude 4·6 have been included.

Star	Mag.	Date	*Immersion		*Emersion		Position Angle	
							Immersion	Emersion
			h	m	h	m	°	°
q Tauri	4·3	January 7	13	56·0			57	
20 Tauri	4·1	January 7	15	08·1			86	
π Scorpii	3·0	January 20	15	48·6	16	38·6	74	331
δ Capricorni	3.0	April 18	15	43·4	16	13·9	2	308
ρ Leonis	3·8	May 4	4	18·5	4	58·2	175	247
τ Scorpii	2·9	May 10	15	28·0	16	32·3	120	248
γ Capricorni	3·8	May 15	21	05·0	21	43·5	112	181
κGeminorum	3·7	May 28	7	49·8	8	48·8	110	293
λ Aquarii	3·8	June 13	19	29·1	20	40·6	66	220
τ Scorpii	2·9	July 4	9	45·2	10	58·7	118	262
ε Arietis	4·6	July 16	16	28·9	17	17·9	110	190
q Tauri	4·3	July 17			14	54·6		272
20 Tauri	4·1	July 17	14	10·0	15	08·7	78±	238
λ Aquarii	3·8	August 7	11	04·9	12	22·9	54	233
τ Sagittarii	3·5	August 30	8	58·7	10	16·2	82	246
τ Scorpii	2·9	September 24	3	40·0	4	57·0	69	267
α Leonis	1·3	October 14	15	44·6	16	28·6	70	342
λ Aquarii	3·8	October 28	7	13·4	7	48·9	115	165
130 Tauri	4·6	December 3	10	45.6	12	7·1	77	275

*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 and 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			Moosejaw	+ 2		
London	+ 25	St. John,				Moosomin	+ 40		
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 its 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 26	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 44	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 varions 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 45m to 20h 53m, and its Decl. changes from 23° 3′ S. to 17° 32′ S. The equation of time increases from 3m 27s to 13m 33s 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 3 p.m. on January 3.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On January 7 the moon occults *q* Tauri and 20 Tauri and on the 20th π Scorpii (see page 8).

Mercury on January 1 crosses the meridian at 11.04 a.m. M.T. ; at 11.44 on the 15th. It reached greatest elongation W. on Dec. 10, 1913, and is in superior conjunction with the sun on Jan. 25. Its low declination during the month, as well as its nearness to the sun prevents the planet from being well seen.

Venus on the 15th is in R A. 19h 13m, Decl. 22° 56′ S., and crosses the meridian at 11.42 a.m. (M.T.). It is thus near the sun, which it slowly approaches during the month, reaching superior conjunction on February 11.

Mars on the 15th is in R.A. 6h 49m, Decl. 27° 1′ N., and crosses the meridian at 11.09 p.m. (M.T.). The planet is nearest the earth on January 1, at which time the distance is 58 millions of miles, though the opposition to the sun does not occur until the 5th. During the month it is visible all night long and though this is not a very favorable opposition it is a fine object. On January 1 the stellar magnitude is −1·2 ; this gradually falls, until on the 31st it is −0·7. At that time the distance from the earth is 67 millions of miles.

Jupiter on the 15th is in R.A. 20h 3m, Decl. 20° 50′ S., and crosses the meridian at 12.27 p.m. (M.T.). Too near the sun for observations, being in conjunction with it on the 20th.

Saturn on the 15th is in R.A. 4h 42m, Decl. 20° 37′ N., and crosses the meridian at 9.04 p.m. (M.T.). It is well-placed for observations ; its stellar magnitude is 0·0, and the rings are opened out almost to their fullest amount. In conjunction with the moon on the 9th (see opposite page).

Uranus on the 15th is in R.A. 20h 37m, Decl. 19° 9′ S., and crosses the meridian at 1.01 p.m. (M.T.).

Neptune on the 15th is in R.A. 7h 55m, Decl. 20° 21′ N., and crosses the meridian at 12.29 a.m. (M.T.).

For the minima of Algol, (see opposite page).

JANUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites
Thur.	1	1h ♂ nearest ⊕.	5	28	Invisible on account of proximity to sun.
Fri.	2				
Sat.	3	15h ⊕ in Perihelion; 15h·6 ☾ in Apogee.			
☽Sun.	4	8h 9m·1 Moon's First Quarter.	2	17	
Mon.	5	13h ☍ ♂ ☉.			
Tues.	6		23	06	
Wed.	7				
Thur.	8	12h ☿ in Aphelion.			
Fri.	9	4h 40m ☌ ♄ ☾, ♄ 6° 47′ S.	19	55	
Sat.	10				
Sun.	11	8h 48m ☌ ♂ ☾, ♂ 0° 34′ S.			
☹Mon.	12	0h 9m·0 Full Moon; 8h 38m ☌ ♆ ☾, ♆ 4° 27′ S.	16	44	
Tues.	13				
Wed.	14	0h ☌ ☿ ♀, ☿ 1° 4′ S.			
Thur.	15	13h·2 ☾ in Perigee.	13	33	
Fri.	16				
Sat.	17	13h ☍ ♆ ☉.			
☾Sun.	18	19h 29m·8 Moon's Last Quarter.	10	22	
Mon.	19				
Tues.	20	11h ☌ ♃ ☉.			
Wed.	21		7	11	
Thur.	22	9h ☌ ☿ ♃, ☿ 1° 40′ S.			
Fri.	23	[2° 48′ N.			
Sat.	24	[15h 42m ☌ ♃ ☾, ♃ 3° 22′ N.; 15h 54m ☌ ♀ ☾, ♀	4	00	
Sun.	25	3h ☌ ☿ ☉ Superior; 13h ☌ ♀ ♃, ♀ 0° 33′ S.;			
●Mon.	26	1h 34m 1 New Moon; 2h 15m ☌ ☿ ☾, ☿ 1° 14′ N.;			
Tues.	27	[4h 0m ☌ ♅ ☾, ♅ 2° 44′ N; 15h ☌ ♀ ♅, ☿ 1° 32′ S.	0	49	
Wed.	28	3h ☌ ♅ ☉; 21h ☿ Greatest Hel. Lat. S.			
Thus.	29		21	38	
Fri.	30	23h ☌ ♀ ♅, ♀ 0° 30′ S.			
Sat.	31	12h·5 Moon in Apogee.			

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 57m, to 22h 43m, and the Decl. changes from 17° 15′ S. to 8° 10′ S. The equation of time reaches its maximum value 14m 25s on 11th. On the 28th it is 12m 50s. On the 24th there is an annular eclipse of the sun invisible in Canada (see page 50).

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

Mercury reaches greatest elongation, 18° 8′ E., on the 22nd, at which time it crosses the meridian at 1.19 p.m. Though its southern declination is somewhat unfavorable for observations it will probably be possible to see the planet for some days before and after this date.

Venus on the 15th is in R.A. 21h 58m, Decl. 13° 51′ S., and crosses the meridian at 12.20 p.m. (M.T.). It is in superior conjunction with the sun on the 11th, and so is not well placed for observation during the month.

Mars on the 15th is in R.A. 6h 26m, Decl. 26° 53′ N., and crosses the meridian at 8.45 p.m. (M.T.). On that date it is 76½ millions of miles from the earth, and its stellar magnitude is -0·2. Still well placed for observation.

Jupiter on the 15th is in R.A. 20h 33m, Decl. 19° 14′ S., and crosses the meridian at 10.55 a.m. (M.T.). It is a morning star but too near the sun for good observation.

Saturn on the 15th is in R.A. 4h 40m, Decl. 20° 39′ N., and crosses the meridian at 6.59 p.m. (M.T.). Still well seen during the evening. In conjunction with the moon on the 5th, and stationary on the 11th, (see opposite page).

Uranus on the 15th is in R.A. 7h 45m, Decl. 18° 42′ S., and crosses the meridian at 11.06 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 52m, Decl. 20° 31′ N., and crosses the meridian at 10.12 p.m. (M.T.).

For the minima of Algol, and the configurations of Jupiter's satellites see opposite page. For the eclipses, etc., of the satellites see page 46.

FEBRUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 6h.
			h	m	
Sun.	1		18	27	Invisible on account of proximity to sun.
Mon.	2				
☽Tues.	3	5h 32m·6 Moon's First Quarter.			
Wed.	4	2h ♀ in Aphelion.	15	16	
Thur.	5	12h 31m ☌ ♄ ☾, ♄ 6° 50′ S.			
Fri.	6				
Sat.	7	7h 38m ☌ ♂ ☾, ♂ 1° 9′ S.	12	05	
Sun.	8	17h 38m ☌ ♆ ☾, ♆ 4° 31′ S.			
Mon.	9				
☽Tues.	10	12h 34m·7 Full Moon.	8	54	
Wed.	11	15h ☌ ☿ ☉ Superior; 22h ♄ Stationary.			
Thur.	12	8h·5 ☾ in Perigee; 20h ♂ Stationary.			
Fri.	13		5	43	
Sat.	14				
Sun.	15				
Mon.	16	21h ☿ in ☊.	2	31	
☾Tues.	17	4h 23m·0 Moon's Last Quarter.			
Wed.	18		23	20	
Thur.	19				
Fri.	20				
Sat.	21	12h ☿ in Perihelion.	20	09	23○4●
Sun.	22	10h 30m ☌ ♃ ☾, ♃ 2° 56′ N.; 13h ☿ Greatest Elong.			31○24
Mon.	23	[E., 18° 8′; 13h 40m ☌ ♅ ☾, ♅ 2° 39′ N.			3○124
☉Tues.	24	19h 2m·1 New Moon; Annular Eclipse of Sun, invis-	16	58	213○4
Wed.	25	3h 1m ☌ ☿ ☾, ☿ 1° 1′ S. [ible in Canada.			4○13●
Thur.	26	7h ☌ ☿ ☾, ☿ 1° 36′ N.; 13h ♀ Greatest Hel. Lat. S.			41○23
Fri.	27		13	47	42○13
Sat.	28	4h ☾ in Apogee; 15h ☿ Stationary.			♃421○

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 MARCH

The Sun.—On March 1st the sun's R.A. is 22h 46m, and its Decl. 7° 48′ S. It reaches the equator on the 21st (see opposite page) and on the 31st the R.A. is oh 37m, Decl. 3° 56′ N. During the month the equation of time changes from 12m 38s to 4m 27s.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 11th is a partial eclipse of the moon. (See page 50).

Mercury comes into inferior conjunction with the sun on the 10th and by the end of the month has a considerable westerly elongation, crossing the meridian at 10.28 a.m. on the 31st.

Venus on the 15th is in R.A. oh 10m, Decl. 0° 20′ S., and crosses the meridian at 12.40 p.m. (M.T.). Still too near the sun to be well seen.

Mars on the 15th is in R.A. 6h 48m, Decl. 25° 51′ N., and crosses the meridian at 7.17 p.m. (M.T.). On that day it is 99½ millions of miles from the earth. It is still in Gemini and its stellar magnitude is 0·5.

Jupiter on the 15th is in R.A. 20h 58m, Decl. 17° 41′ S., and crosses the meridian at 9.30 a.m. (M.T.). Its stellar magnitude is − 1·6, and it can easily be seen as a morning star. For the configurations of its satellites, see opposite page. For the eclipses, etc., of the satellites, see page 46.

Saturn on the 15th is in R.A. 4h 43m, Decl. 20° 53′ N., and crosses the meridian at 5.14 p.m. (M.T.). It is in quadrature with the sun on the 2nd (see opposite page). Still well seen during the evening, about 5° N.E. of Aldebaran.

Uranus on the 15th is in R.A. 20h 51m, Decl. 18° 19′ S., and crosses the meridian at 9.22 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 50m, Decl. 20° 37′ N., and crosses the meridian at 8.19 p.m. (M.T.).

For the minima of Algol, see opposite page.

MARCH

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 5h.
			h	m	
Sun.	1				♃43○2
Mon.	2	18h □ ♄ ◍.	10	36	43○12
Tues.	3	18h ☿ Greatest Hel. Lat. N.			4321○
Wed.	4	4h ☌ ♃ ♁, ♃ 0° 9′ N.; 21h 39m ☌ ♄ ☾, ♄ 6° 47′ S.			42○31
☽Thur.	5	0h 3m·0 Moon's First Quarter.	7	25	14○23
Fri.	6	8h ☌ ☿, ♀, ☿ 5° 28′ N.; 21h 44m ☌ ♂ ☾, ♂ 1°			♃○143
Sat.	7	[49′ S.			21○34
Sun.	8	3h 6m ☌ ♆ ☾, ♆ 4° 35′ S.	4	14	3○124
Mon.	9				3○24●
Tues.	10	10h ☌ ☿ ◍ Inferior.			321○4
☺Wed.	11	23h 18m·5 Full Moon; Partial Eclipse of the Moon,	1	03	2○314
Thur.	12	17h ·3 ☾ in Perigee. [visible in Canada.			1○234
Fri.	13		21	52	○2143
Sat.	14				214○3
Sun.	15				43○1●
Mon.	16		18	41	43○2●
Tues.	17				4321○
☾Wed.	18	14h 39m·4 Moon's Last Quarter.			42○13
Thur.	19		15	30	41○23
Fri.	20	[☾, ♁ 2° 32′ N.			4○213
Sat.	21	6h 11m ◍ enters Aries, Spring begins; 21h 58m ☌ ♁			421○3
Sun.	22	3h 39m ☌ ♃ ☾, ♃ 2° 26′ N.; 9h ☌ Greatest Hel. Lat.	12	19	3○1●●
Mon.	23	[N.; 20h ☿ Stationary.			31○42
Tues.	24	11h 15m ☌ ☿ ☾, ☿ 1° 8′ N.			♃32○4
Wed.	25		9	08	2○14●
◍Thur.	26	13h 9m·1 New Moon.			1○234
Fri.	27	6h ☿ in ♉; 10h ·5 ☾ in Apogee; 16h 54m ☌ ♀ ☾,			○1234
Sat.	28	[♀ 4° ·16′ S.	5	57	21○34
Sun.	29				32○14
Mon.	30				31○42
Tues.	31		2	46	342○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 40m, Decl. 4° 19′ N.; on the 30th the R.A. is 2h 28m, Decl. 14° 36′ N.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 18th the moon occults the star δ Capricorni (see page 8).

Mercury reaches its greatest elongation west on April 7 (see opposite page). As the planet, however, is west of the sun it is a morning star and this is not a good time of the year to observe it. If it were an evening star the circumstances would be very favorable.

Venus on the 15th is in R.A. 2h 33m, Decl. 14° 40′ N., and crosses the meridian at 1.01 p.m, (M.T.). It is slowly separating from the sun, but is still too close for convenient observation. The moon, which is new on the 25th is in conjunction with Venus on the 27th (see opposite page).

Mars on the 15th is in R.A. 7h 38m, Decl. 23° 47′ N., and crosses the meridian at 6.06 p.m. (M.T.). On this date its distance from the earth is 127 millions of miles and its stellar magnitude is 1·0, —almost a duplicate of Aldebaran. The planet is in quadrature with the sun on the 10th.

Jupiter on the 15th is in R.A. 21h 21m, Decl. 16° 7′ S. and crosses the meridian at 7.50 a.m. (M.T.). Its stellar magnitude is −1·8. It is well seen as a morning star, in the constellation Capricornus. For the configurations of the satellites, see the opposite page, and for the eclipses, etc., of the satellites, see page 46.

Saturn on the 15th is in R.A. 4h 54m, Decl. 21° 17′ N. and crosses the meridian at 3.22 p.m. (M.T.). Though easily visible as an evening star, it sets too early for effective observation.

Uranus on the 15th is in R.A. 20h 55m, Decl. 18° 1′ S., and crosses the meridian at 7.25 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 49m, Decl. 20° 39′ N., and crosses the meridian at 6.17 p.m. (M.T.).

For the minima of Algol, (see opposite page).

APRIL

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 4h.
			h	m	
Wed.	1	7h 30m ☌ ♄ ☾, ♄ 6° 37′ S.			423○●
Thur.	2	[☍ 2° 0′ S.	23	35	41○23
☽Fri.	3	14h 41m·5 Moon's First Quarter; 22h 6m ☌ ♂ ☾,			4○123
Sat.	4	11h 27m ☌ ♆ ☾, ♆ 4° 30′ S.			421○3
Sun.	5		20	24	♃42○1
Mon.	6	6h ♆ Stationary; 11h ☿ in Aphelion.			431○2
Tues.	7	1h ☿ Greatest Elong. W. 27° 46′.			34○21
Wed.	8		17	13	231○●
Thur.	9				♃○234
☺Fri.	10	4h.9 ☾ in Perigee; 8h 28m·2 Full Moon; 23h □ ♂ ☍.			○1234
Sat.	11		14	02	21○34
Sun.	12				2○314
Mon.	13				31○24
Tues.	14		10	50	3○214
Wed.	15				321○4
Thur.	16	2h □ ♆ ☍.			○134●
☾Fri.	17	2h 52m·2 Moon's Last Quarter.	7	39	4○23●
Sat.	18	5h 50m ☌ ♅ ☾, ♅ 2° 20′ N.; 19h 13m ☌ ♃ ☾,			421○3
Sun.	19	[♃ 1° 50′ N.			42○31
Mon.	20		4	28	431○2
Tues.	21	6h ☌ ♂ ♆, ♂ 2° 34′ N.			43○21
Wed.	22				4321○
Thur.	23	9h 32m ☌ ☿ ☾, ☿ 5° 30′ S.; 12h.8 ☾ in Apogee;	1	17	4○1●●
Fri.	24	[20h ♀ in ♌.			4○23●
☍Sat.	25	6h 21m·9 New Moon.	22	06	21○43
Sun.	26	20h ☿ Greatest Hel. Lat. S.			2○134
Mon.	27	1h ♂ in Aphelion; 1h 20m ☌ ♀ ☾, ♀ 4° 52′ N.			31○24
Tues.	28	18h 11m ☌ ♄ ☾, ♄ 6° 22′ S.	18	55	3○124
Wed.	29				321○4
Thur.	30				23○14

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 31m, Decl. 14° 54′ N. ; on the 31st the R.A. is 4h 30m, Decl. 21° 50′ N. The equation of time is 2m 54s on the 1st, rises to 3m 49s on the 15th (a maximum) and then falls to 2m 38s on the 31st.

The Moon.—For its phases and conjunctions with the planets, see opposite page. It occults ρ Leonis on the 4th, τ Scorpii on the 10th, γ Capricorni on the 15th and κ Geminorum on the 28th (see page 8).

Mercury reaches superior conjunction with the sun on the 17th and is too close to the sun to be well seen during the month.

Venus on the 15th is in R.A. 5h 3m, Decl. 23° 43′ N., and crosses the meridian at 1.34 p.m, (M.T.). It is slowly separating from the sun, and at the end of the month sets about 2h after the sun. At that time its stellar magnitude − 3·3, or almost five times as bright as Sirius, and it is easily seen as an evening star. It is in conjunction with Saturn on the 16th (see opposite page).

Mars on the 15th is in R.A. 8h 39m, Decl. 20° 13′ N., and crosses the meridian at 5.09 p.m. (M.T.). On this date its distance from the sun is 154½ millions of miles and its stellar magnitude has fallen to 1·4. It is then in Cancer, not far east of Præsepe.

Jupiter on the 15th is in R.A. 21h 35m, Decl. 15° 6′ S. and crosses the meridian at 6.06 a.m. (M.T.). Its stellar magnitude is − 1·9, and it is a prominent morning star. It is in quadrature with the sun on the 12th (see opposite page). For the configurations of its satellites, see the opposite page, and for the eclipses, etc., of the satellites, see page 46.

Saturn on the 15th is in R.A. 5h 8m, Decl. 21° 42′ N. and crosses the meridian at 1.38 p.m. (M.T.). It is thus too near the sun to be well observed.

Uranus on the 15th is in R.A. 20h 57m, Decl. 17° 56′ S., and crosses the meridian at 5.28 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 51m, Decl. 20° 36′ N., and crosses the meridian at 4.20 p.m. (M.T.).

For the minima of Algol, (see opposite page).

MAY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 3h.
			h	m	
Fri.	1	18h 24m ☌ ♆, ☾, ♆ 4° 17′ S.	15	44	1○234
Sat.	2	3h 42m ☌ ♂ ☾, ♂ 1° 36′ S.; 14h □ ♅ ☉.			♃☾ 143
☽Sun.	3	1h 29m·0 Moon's First Quarter.			2○413
Mon.	4		12	33	413○2
Tues.	5				43○12
Wed.	6				4321○
Thur.	7		9	22	423○1
Fri.	8	14h·7 ☾ in Perigee.			41○32
☺Sat.	9	16h 30m·8 Full Moon.			4○213
Sun.	10		6	11	42○3●
Mon.	11				♃1○2●
Tues.	12	7h □ ♃ ☉.			3○142
Wed.	13		3	00	312○4
Thur.	14				23○14
Fri.	15	14h 4m ☌ ♅ ☾, ♅ 2° 3′ N.; 20h ☌ in ☊.	23	49	1○324
☾Sat.	16	8h 50m ☌ ♃ ☾, ♃ 1° 13′ N.; 9h ☌ ☿ ♄, ☿ 2° 10′N.;			○2134
Sun.	17	3h ♅ Stationary; 5h ☌ ☿ ☉ Superior. [17h 12m·1			21○34
Mon.	18	[Moon's Last Quarter.	20	38	♃1○34●
Tues.	19				3○142
Wed.	20	11h ☿ in Perihelion; 23h·2 ☾ in Apogee.			♃312○
Thur.	21		17	27	432○1
Fri.	22				41○32
Sat.	23				4○123
●Sun.	24	21h 34m·8 New Moon.	14	16	421○3
Mon.	25	20h 7m ☌ ☿ ☾, ☿ 3° 27′ S.			4○13●
Tues.	26	6h 5m ☌ ♄ ☾, ♄ 6° 9′ S.			43○2●
Wed.	27	4h 2m ☌ ♀ ☾, ♀ 3° 21′ S.; 11h ♀ in Perihelion.	11	05	3412○
Thus.	28	15h ☌ ☿ ♄, ☿ 3° 2′ N.			324○1
Fri.	29	0h 56m ☌ ♆ ☾, ♆ 4° 1′ S.]			1○324
Sat.	30	12h 16m ☌ ♂ ☾, ♂ 0° 42′ S.; 18h ☿ Greatest Hel.	7	54	○1234
Sun.	31	[Lat. N.			21○34

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 JUNE

The Sun.—The sun's R.A. on 1st is 4h 34m, and on the 30th it is 6h 34m. During the month the declination slowly rises from 21° 59′ on the 1st to 23° 27′ on the 22nd, which is the summer solstice, at which time our days are longest. It then falls to 23° 13′ on the 30th. The equation of time is zero on the 15th; it then rises to 3m 17s 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 (stated in mean time) to appear constant for several days at the end of June and the beginning of July. (See pages 15 and 16).

The Moon.—For its phases and conjunctions with the planets, see opposite page. On June 13th it occults λ Aquarii. (See page 8).

Mercury attains greatest elongation east on the 19th. Its angular separation from the sun is then 24° 52′ (see opposite page), and this should be a comparatively good time to observe it. Immediately after sunset examine the sky above the sunset point with an opera glass. The planet will appear like a star of the first magnitude (stellar mag., 0·5, the same as Procyon). When once located by means of the glass it will likely be possible to see it with the naked eye.

Venus on the 15th is in R.A. 7h 47m, Decl. 23° 0′ N., and crosses the meridian at 2.15 p.m. (M.T.). Its stellar magnitude is then − 3·4, and it is well seen as an evening star. It is in close conjunction with the moon on the 26th. (See opposite page.)

Mars on the 15th is in R.A. 9h 46m, Decl. 14° 47′ N., and crosses the meridian at 4.14 p.m. (M.T.). At this time its distance from the earth is 176½ millions of miles, and its stellar magnitude is 1·7. It is in Leo, and on the 23rd it is about ¼° S. of Regulus. The planet is visible still as an evening star.

Jupiter on the 15th is in R.A. 21h 40m, Decl. 14° 51′ S., and crosses the meridian at 4.09 p.m. (M.T.). A prominent morning star. For the configurations of the satellites, see next page, and for the eclipses, etc., of the satellites, see page 46.

Saturn on the 15th is in R.A. 5h 25m, Decl. 22° 3′ N., and crosses the meridian at 11.54 a.m. (M.T.). It is thus too near the sun for observation.

Uranus on the 15th is in R.A. 20h 56m, Decl. 18° 2′ S., and crosses the meridian at 3.25 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 54m, Decl. 20° 27′ N., and crosses the meridian at 2.22 p.m. (M.T.).

For the minima of Algol, see opposite page.

JUNE

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 2h.
			h	m	
☽Mon.	1	9h 3m·0 Moon's First Quarter.			2○134
Tues.	2		4	43	3○24●
Wed.	3				♃♃3○4
Thur.	4				32○14
Fri.	5	18h ·0 ☾ in Perigee.	1	32	1○24●
Sat.	6				4○123
Sun.	7		22	21	421○3
☽Mon.	8	oh 18m·3 Full Moon.			42○13
Tues.	9				431○2
Wed.	10		19	09	♃43○2
Thur.	11	15h ♃ Stationary; 22h 33m ☌ ♅ ☾, ♅ 1h 48′ N.			432○1
Fri.	12	19h 32 ☌ ♃ ☾, ♃ 0° 43′ N.			41○2●
Sat.	13	9h ☌ ♄ ☍.	15	58	4○123
Sun.	14				12○3●
☾Mon.	15	9h 20m·0 Moon's Last Quarter.			2○143
Tues.	16	21h ☌ ☿ ♆, ☿ 2° 14′ N.	12	47	13○24
Wed.	17	15h ·9 ☾ in Apogee.			3○124
Thur.	18	8h ☿ Greatest Hel. Lat. N.			32○4●
Fri.	19	2h ☿ Greatest Elong. E. 24° 52′.	9	36	31○4●
Sat.	20				○1324
Sun.	21	(☌ ♄ ☾, ♄ 6° 1′ S.			12○43
Mon.	22	1h 55m ☉ enters Cancer, Summer begins; 19h 24m	6	25	2○413
☉Tues.	23	5h ☿ in ♋; 10h 33m·2 New Moon.			♃41○2
Wed.	24	[3° 49′ S.; 17h ☌ ☿ ♆, ☿ 0° 10′ S.			43○12
Thur.	25	8h 10m ☌ ☿ ☾, ☿ 3° 55′ S.; 8h 29m ☌ ♆ ☾, ♆	3	14	432○●
Fri.	26	4h 8m ☌ ♀ ☾, ♀ 0° 46′ S.			431○●
Sat.	27	22h 58m ☌ ♂ ☾, ♂ 0° 36′ N.			4○132
Sun.	28		00	3	412○3
Mon.	29				42○13
☽Tues.	30	14h 24m·5 Moon's First Quarter.			♃41○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 JULY

The Sun.—During the month the sun's R.A. changes from 6h 38m to 8h 39m and the Decl. from 23° 10′ to 18° 26′ N. The earth is farthest from the sun on July 2, (see opposite page).

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 4th it occults τ Scorpii, on the 16th ε Arietis, on the 17th q Tauri and 20 Tauri (see page 8).

Mercury comes to inferior conjunction with the sun on the 16th, and so is too near the sun for observation during the month.

Venus on the 15th is in R A. 10h 10m, Decl. 12° 56′ N., and crosses the meridian at 2.40 p.m, (M.T.). It is slowly separating from the sun and can be well seen as an evening star. Its stellar magnitude is − 3·5, and 78 per cent. of its disc is illuminated. It is in conjunction with the moon on the 26th. (See opposite page).

Mars on the 15th is in R.A. 10h 53m, Decl. 8° 8′ N., and crosses the meridian at 3.23 p.m. (M.T.). At this time its distance from the earth is 195½ millions of miles. It is still in Leo, but is no longer an interesting object for the amateur.

Jupiter on the 15th is in R.A. 21h 33m, Decl. 15° 30′ S. and crosses the meridian at 2.05 a.m. (M.T.). It rises at about 9 o'clock and so can be observed in the late evening. It is about 2½° N.W. of δ Capricorni. Its stellar magnitude is − 2·3. The planet has a close conjunction with the moon on the 10th. For the configurations of the Satellites, see the opposite page, and for the eclipses of the Satellites, see page 46.

Saturn on the 15th is in R.A. 5h 41m, Decl. 22° 15′ N. and crosses the meridian at 10.12 a.m. (M.T.). It is thus a morning star, but it is too close to the sun for effective observation.

Uranus on the 15th is in R.A. 20h 52 m, Decl. 18° 17′ S., and crosses the meridian at 1.24 a.m. (M.T.).

Neptune on the 15th is in R.A. 7h 59m, Decl. 20° 15′ N., and crosses the meridian at 12.29 p.m. (M.T.).

For the minima of Algol, (see opposite page).

JULY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 1h.
			h	m	
Wed.	1				3○412
Thur.	2	9h ☿ Stationary; 19h ⊕ in Aphelion.			321○4
Fri.	3	2h ·7 ☾ in Perigee; 11h ☿ in Aphelion.	17	41	32○14
Sat.	4				☾324●
Sun.	5				♃1○34
Mon.	6		14	30	2○134
Tues.	7	8h 59m·8 Full Moon.			1○234
Wed.	8	5h ☌ ☿ ♆, ☿ 3° 21′ S.			3○124
Thur.	9	6h 27m ☌ ♁ ☾, ♁ 1° 42′ N.	11	19	♃321○
Fri.	10	2h 14m ☌ ♃ ☾, ♃ 0° 32′ N.			342○1
Sat.	11				4○32●
Sun.	12		8	08	41○23
Mon.	13				42○13
Tues.	14				41○23
☾Wed.	15	2h 31m·9 Moon's Last Quarter; 10h ·1 ☾ in Apogee.	4	57	43○12
Thur.	16	13h ☌ ☿ ☍ Inferior.			3412○
Fri.	17				324○1
Sat.	18		1	46	1○42●
Sun.	19				♃○234
Mon.	20	9h 43m ☌ ♄ ☾, ♄ 5° 59′ S.	22	35	2○134
Tues.	21	9h ☌♆ ☍. [43′ S.; 21h 38m·4 New Moon.			1○34●
●Wed.	22	2h 46m ☌ ☿ ☾, ☿ 8° 37′ S.; 17h 50m ☌ ♆ ☾. ♆ 3°			3○124
Thur.	23	19h ☿ Greatest Hel. Lat. S.	19	24	312○4
Fri.	24				32○14
Sat.	25				1○42●
Sun.	26	1h 24m ☌ ♀ ☾, ♀ 1° 52′ N.; 11h 32m ☌ ♂ ☾, ♂	16	13	4○123
Mon.	27	0h ☿ Stationary. [2° 7′ N.			42○13
Tues.	28	7h ·0 ☾ in Perigee.			412○3
☽Wed.	29	18h 51m·0 Moon's First Quarter.	13	02	43○12
Thur.	30				4312○
Fri.	31				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 satellites 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 43m to 10h 36 m, and the Decl. changes from 18° 11′ to 8° 52′ N. The equation of time falls from 6m 12s on the 1st to 0m 26s on the 31st.

There is a total eclipse of the sun on the 21st, visible in the eastern part of Canada as a partial eclipse (see opposite page and also page 50).

The Moon.—For its phases and conjunctions with the planets, see opposite page. The moon occults λ Aquarii on the 7th and τ Sagittarii on the 30th (see page 8).

Mercury reaches greatest elongation W. on the 5th. The angular distance between the planet and the sun, however, is only 19° 14′ and hence it will not be easy to observe the planet. It reaches superior conjunction with the sun on the 30th.

Venus on the 15th is in R.A. 12h 19m, Decl. 2° 14′ S., snd crosses the meridian at 2.47 p.m, (M.T.). On the 15th 64 per cent. of the disc is illuminated and the stellar magnitude is −3·7. It is in conjunction with Mars on the 5th at which time the two planets are only 10′ apart.

Mars on the 15th is in R.A. 12h 3m, Decl. 0° 17′ N., and crosses the meridian at 2.31 p.m. On this date it is 210½ millions of miles from the earth.

Jupiter on the 15th is in R.A. 21h 18m, Decl. 16° 47′ S. and crosses the meridian at 11.48 p.m. (M.T.). It is in opposition to the sun on the 10th (see opposite page). Its stellar magnitude is now −2·4 and it is visible all night. For the configurations of the Satellites see the opposite page and for the eclipses, etc., of the Satellites see page 46.

Saturn on the 15th is in R.A. 5h 56m, Decl. 22° 19′ N. and crosses the meridian at 8.25 a.m. (M.T.). It is now well seen as a morning star. It is just on the boundary between Taurus and Gemini.

Uranus on the 15th is in R.A. 20h 47m, Decl. 18° 38′ S., and crosses the meridian at 11.13 p.m. (M.T.).

Neptune on the 15th is in R.A. 8h 4m, Decl. 20° 2′ N., and crosses the meridian at 10.31 a.m. (M.T.).

For the minima of Algol, (see opposite page).

AUGUST

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 0h.
			h	m	
Sat.	1		9	51	4 1 3 ○ 2
Sun.	2	14h ☌ ♅ ☉.			4 ○ 1 2 3
Mon.	3	[♀ 0° 10′ S.			2 ○ 3 ● ●
Tues.	4	[♅ 1° 45′ N.; 19h 40m·7 Full Moon; 21h ☌ ♀ ☾,	6	40	2 1 ○ 4 3
Wed.	5	8h ☿ Greatest Elong. W., 19° 14′; 12h 57m ☌ ♅ ☾,			3 ○ 1 2 4
Thur.	6	4h 58m ☌ ♃ ☾, ♃ 0° 40′ N.			♃ 3 1 ○ 4
Fri.	7		3	29	3 2 ○ 1 4
Sat.	8				3 1 ○ 2 4
Sun.	9				○ 1 3 2 4
Mon.	10	16h ☍ ♃ ☉.	0	17	2 1 ○ 4 3
Tues.	11	20h ☿ in ♌.			♃ 2 ○ 4 3
Wed.	12	4h·8 ☾ in Apogee.	21	06	♃ 4 ○ 1 2
☾Thur.	13	9h ♀ in ♍; 19h 56m·0 Moon's Last Quarter.			4 3 1 ○ 2
Fri.	14				4 3 2 ○ 1
Sat.	15		17	55	4 3 1 ○ 2
Sun.	16	10h ☿ in Perihelion; 23h 58m ☌ ♄ ☾, ♄ 5° 58′ S.			4 ○ 3 1 2
Mon.	17				4 2 1 ○ 3
Tues.	18		14	44	4 2 ○ 1 3
Wed.	19	4h 44m ☌ ♆ ☾, ♆ 3° 41′ S.			4 ○ 3 2 ●
Thur.	20	12h 40m ☌ ☿ ☾, ☿ 0° 20′ S.			3 1 ○ 2 4
☉Fri.	21	7h 26m·5 New Moon; Total Eclipse of the Sun, visible	11	33	3 2 ○ 1 4
Sat.	22	[as a Partial Eclipse in Eastern Canada.			3 1 ○ 4 ●
Sun.	23	[16h 48m ☌ ♀ ☾, ♀ 2° 48′ N.			○ 3 1 2 4
Mon.	24	1h·5 ☾ in Perigee; 1h 46m ☌ ♂ ☾, ♂ 3° 32′ N.;	8	22	1 2 ○ 3 4
Tues.	25				2 ○ 1 3 4
Wed.	26	17h ☿ Greatest Hel. Lat. N.			○ 3 2 4 ●
☽Thur.	27	23h 52m·5 Moon's First Quarter.	5	11	3 1 ○ 2 4
Fri.	28				3 2 4 ○ 1
Sat.	29				4 3 1 ○ ●
Sun.	30	13h ☌ ☿ ☉ Superior.	2	00	4 ○ 3 1 2
Mon.	31				4 1 2 ○ 3

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 39m to 12h 24m. On the 1st the Decl. is 8° 30′, the sun reaches the equator on the 23rd and on the 30th it is 2° 34′ S.

The Moon.—For the phases of the moon and its conjunctions with the planets, see opposite page. On Sept. 24 it occults τ Scorpii. (See page 8). There is a partial eclipse of the moon on Sept. 4th (see page 50).

Mercury during the month slowly separates from the sun, but at no time is it well placed for observation. On the 30th it crosses the meridian at 1.07 p.m. (M.T.).

Venus on the 15th is in R.A. 14h 19m, Decl. 16° 53′ S., and crosses the meridian at 2.45 p.m. (M.T.). It reaches greatest eastern elongation on the 18th (see opposite page) and is well seen as an evening star. At this time one half of the disc is visible, and its stellar magnitude is −4·0.

Mars on the 15th is in R.A. 13h 17m, Decl. 7° 52′ S., and crosses the meridian at 1.42 p.m. (M.T.). On this date it is 221 millions of miles from the earth.

Jupiter on the 15th is in R.A. 21h 5m, Decl. 17° 48′ S., and crosses the meridian at 9.28 p.m. (M.T.). It is in excellent position for observation. The configurations of the satellites are given on the opposite page, and their eclipses, etc., are found on page 46.

Saturn on the 15th is in R.A. 6h 7m, Decl. 22° 18′ N., and crosses the meridian at 6.33 a.m. (M.T.). The rings are now opened out almost to their greatest extent and the planet is well seen as a morning star. It is in quadrature with the sun on the 25th (see opposite page).

Uranus on the 15th is in R.A. 20h 43m, Decl. 18° 53′ S., and crosses the meridian at 9.07 p.m. (M.T.).

Neptune on the 15th is in R.A. 8h 7m, Decl. 19° 50′ N., and crosses the meridian at 8.34 a.m. (M.T.).

For the minima of Algol, see opposite page.

SEPTEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 22h 30m.
			h	m	
Tues.	1	17h 55m ☌ ♅ ☾, ♅ 1° 52′ N.	22	49	41○23
Wed.	2	5h 39m ☌ ♃ ☾, ♃ 0° 58′ N.			43○12
Thur.	3	[partially visible in Western Canada.			342○●
Fri.	4	9h 1m·2 Full Moon; Partial Eclipse of the Moon,	19	38	3214○
Sat.	5				○142●
Sun.	6				♃1○34
Mon.	7		16	27	2○134
Tues.	8	22h ·7 ☾ in Apogee.			1○234
Wed.	9				3○124
Thur.	10		13	16	32○4●
Fri.	11				321○4
Sat.	12	12h 48m·3 Moon's Last Quarter.			3○142
Sun.	13	12h 32m ☌ ♄ ☾, ♄ 5° 54′ S.	10	05	14○23
Mon.	14				42○13
Tues.	15	15h 59m ☌ ♆, ☾, ♆ 3° 37′ S.			41○23
Wed.	16	19h in ♀ Aphelion.	6	54	43○12
Thur.	17				4321○
Fri.	18	7h ♀ Greatest Elong. E., 46° 27′.			♃4320
Sat.	19	4h ☿ in ♍; 16h 33m·3 New Moon.	3	43	43○12
Sun.	20	23h 7m ☌ ☿ ☾, ☿ 3° 23′ N.			41○23
Mon.	21	1h ·5 ☾ in Perigee; 17h 27m ☌ ♂ ☾, ♂ 4° 32′ N.			2○413
Tues.	22		0	32	1○43●
Wed.	23	0h 45m ☌ ♀ ☾, ♀ 1° 30′ N.; 16h 34′ Sun enters			3○124
Thur.	24	[Libra, Autumn begins.	21	21	321○4
Fri.	25	17h □ ♄ ☉.			♃32○4
Sat.	26	7h 3m·0 Moon's First Quarter.			3○24●
Sun.	27		18	10	1○234
Mon.	28	22h 19m ☌ ♅ ☾, ♅ 1° 53′ N.			2○143
Tues.	29	7h 38m ☌ ♃ ☾, ♃ 1° 6′ N.; 10h ☿ in Aphelion.			1○43●
Wed.	30		14	59	♃4○12

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 satellites 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 27m to 14h 20m and the Decl. changes from 2° 58′ to 13° 56′ S. The equation of time rises from 10m 6s to 16m 16s, to be subtracted from apparent time.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 14th the moon occults α Leonis (Regulus), and on the 28th λ Aquarii. (See page 8).

Mercury on the 15th reaches its greatest elongation east, 24° 52′ (see opposite page). This, however, is not a very satisfactory time of the year to observe an eastern elongation as the planet is too near the horizon. From the predictions given on the opposite page it will also be noticed that during the month Mercury is twice in conjunction with Mars, a rather odd happening.

Venus on the 15th is in R.A. 16h 3m, Decl. 26° 2′ S., and crosses the meridian at 2.30 p.m. (M.T.). On the 21st it has a close conjunction with the moon, and on the 23rd it attains its greatest brilliancy. At this time one-fourth of the disc is seen illuminated and the stellar magnitude of the planet is − 4·3. The conjunction of the 21st should be a beautiful sight. Venus in a small telescope will appear like a moon four days old.

Mars on the 15th is in R.A. 14h 34m, Decl. 15° 13′ S., and crosses the meridian at 1.01 p.m. (M.T.). On that date it is 226½ millions of miles from the earth.

Jupiter on the 15th is in R.A. 21h 1m, Decl. −18° 1′ S., and crosses the meridian at 7.27 p.m. (M.T.). It is well placed for observation still. Its stellar magnitude is − 2·1. For the configurations of the satellites, see next page, and for their eclipses, etc., see page 46.

Saturn on the 15th is in R.A. 6h 1cm, Decl. 22° 16′ N., and crosses the meridian at 4.37 a.m. (M.T.). It is thus a prominent morning star still.

Uranus on the 15th is in R.A. 20h 41m, Decl. 19° 0′ S., and crosses the meridian at 7.07 p.m. (M.T.).

Neptune on the 15th is in R.A. 8h 10m, Decl. 19° 43′ N., and crosses the meridian at 6.34 a.m. (M.T.).

For the minima of Algol, see opposite page.

OCTOBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 21h.
			h	m	
Thur.	1				4312○
Fri.	2				432○1
Sat.	3		11	48	431○2
☉Sun.	4	0h 58m·9 Full Moon.			♃4○32
Mon.	5				42○13
Tues.	6	0h ♂ in ♉; 3h ☌ ☿ ♂, ☿ 2° 11′ S.; 12h·1 ☾ in	8	36	4123
Wed.	7	[Apogee.			4○312
Thur.	8				♃31○●
Fri.	9	5h ♀ Greatest Hel. Lat. S.; 8h ♃ Stationary.	5	25	32○14
Sat.	10	21h 46m ☌ ♄ ☾, ♄ 5° 45′ S.			31○24
Sun.	11				♃○24◐
☾Mon.	12	4h 33m·1 Moon's Last Quarter.	2	14	2○34●
Tues.	13	1h 51m ☌ ♆, ☾, ♆ 3° 27′ S.			21○34
Wed.	14		23	03	○1324
Thur.	15	7h ♄ Stationary; 11h ☿ Greatest Elong. E., 24° 52′.			31○24
Fri.	16				♃32○1
Sat.	17		19	52	341○●
Sun.	18	7h ♅ Stationary. [Greatest Hel. Lat. S.			4○12●
●Mon.	19	1h 33m·5 New Moon; 10h·8 ☾ in Perigee; 19h ☿			42○3●
Tues.	20	10h 30m ☌ ☍ ☾, ☍ 4° 55′ N.; 18h 37m ☌ ☿ ☾.	16	41	421○3
Wed.	21	21h 2m ☌ ☿ ☾, ☿ 0° 24′ S. [☿ 1° 55′ N.			4○132
Thur.	22				413○2
Fri.	23	7h ♀ Greatest brilliancy.	13	30	342○1
Sat.	24	12h □ ♆ ◍.			314○●
☽Sun.	25	17h 44m·0 Moon's First Quarter.			3○142
Mon.	26	4h 2m ☌ ♅ ☾, ♅ 1° 43′ N.; 14h 8m ☋ ♃ ☾, ♃0°	10	19	21○34
Tues.	27	9h ☿ Stationary. [56′ N			♃2○34
Wed.	28				○1234
Thus	29		7	08	13○24
Fri.	30	11h ☌ ☿ ☍, ☿ 2° 14′ S.			32○14
Sat.	31	20h □ ♅ ◍.			312○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 NOVEMBER

The Sun.—The sun's R.A. during the month increases from 14h 23m, to 16h 23m, and the Decl. changes from 14° 15′ to 21°34′ S. The equation of time rises to a maximum on the 4th, 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 on the 6th crosses the face of the sun (see opposite page and also page 50). During the first half of the present century these transits occur as follows: Nov. 12, 1907; Nov. 6, 1914; May 7, 1924; Nov. 8, 1927; May 10, 1937; Nov. 12, 1940. To observe the transit a small telescope is required. The planet reaches greatest elongation W. on the 23rd.

Venus on the 15th is in R A. 16h 34m, Decl. 26° 26′ S., and crosses the meridian at 12.59 p.m, (M.T.). During the month it quickly closes in on the sun and comes to inferior conjunction on the 27th. After this it becomes a morning star and separates from the sun as rapidly as it approached it.

Mars on the 15th is in R.A. 16h 3m, Decl. 21° 9′ S., and crosses the meridian at 12.28 p.m. (M.T.). On this date it is 228 millions of miles from the earth.

Jupiter on the 15th is in R.A. 21h 10m, Decl. 17° 21′ S., and crosses the meridian at 5.34 p.m. (M.T.). It is still well seen as an evening star. Its stellar magnitude is −1·9. For the configurations of the satellites see next page and for the eclipses, etc., of the satellites, see page 46.

Saturn on the 15th is in R.A. 6h 6m, Decl. 22° 16′ N. and crosses the meridian at 2.33 a.m. (M.T.). It rises at about 7 p.m. and so can be seen in the evening. The rings are wide open now, the southern face being visible. The stellar magnitude of the planet is −0·1, and it is about 15° S.W. of Castor and Pollux.

Uranus on the 15th is in R.A. 20h 42m, Decl. 18° 53′ S., and crosses the meridian at 5.06 p.m. (M.T.).

Neptune on the 15th is in R.A. 8h 10m, Decl. 19° 42′ N., and crosses the meridian at 4.44 a.m. (M.T.).

For the minima of Algol, (see opposite page).

NOVEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 20h.
			h	m	
Sun.	1				3○142
Mon.	2	14h·8 ☾ in Apogee; 18h 48·6m Full Moon.			142○3
Tues.	3	8h ♆ Stationary.			42○13
Wed.	4		0	46	4○23●
Thur.	5				♃41○2
Fri.	6	20h □ ♃ ☉.	21	35	432○1
Sat.	7	3h 3m☌ ♄ ☾, ♄ 5° 34′ S.; 4h ♀ Stationary; 7h ☌ ☿			4312○
Sun.	8	[☉ Inferior; Transit of Mercury, partially visible in Canada; 19h ☿ in ☊.			43○12
Mon.	9	9h 10m ☌ ♆ ☾, ♆ 3° 11′ S.	18	24	♃41○3
Tues.	10	18h 36m·8 Moon's Last Quarter.			2○13●
Wed.	11				○243●
Thur.	12	9h ☿ in Perihelion.	15	13	1○324
Fri.	13				32○14
Sat.	14				321○4
Sun.	15	[☾ in Perigee.	12	02	3○124
Mon.	16	4h ☿ Stationary; 11h 20m ☌ ☿ ☾, ☿ 7° 11′ N.; 22h·9			1○24●
Tues.	17	11h 1m·9 New Moon.			2○134
Wed.	18	4h 57m ☌ ☌ ☾, ☌ 4° 38′ N.; 11h 12m ☌ ♀ ☾, ♀ 1°	8	51	1○43●
Thur.	19	[7′ N.			♃4○32
Fri.	20				432○1
Sat.	21	17h ☌ ♀ ☌, ♀ 2° 45′ S. [Lat. N.	5	40	4321○
Sun.	22	12h 43m ☌ ♅ ☾, ♅ 1° 25′ N.; 16h ☿ Greatest Hel.			43○12
Mon.	23	2h 39m ☌ ♃ ☾, ♃ 0° 28′ N.; 21h ☿ Greatest Elong.			41○32
Tues.	24	8h 38m·7 Moon's First Quarter. [W., 19° 52′.	2	29	42○13
Wed.	25				41○3●
Thur.	26		23	18	4○132
Fri.	27	12h ☌ ♀ ☉ Inferior.			32○4●
Sat.	28				321○4
Sun.	29	17h·6 ☾ in Apogee.	20	07	3○124
Mon.	30				1○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 DECEMBER

The Sun.—During December the sun's R.A. increases from 16h 27m to 18h 39m. On the 1st the Decl. is 21° 44′ S.; this slowly changes until it becomes 23° 27′ on the 22nd; and by the 31st it has come back to 23° 9′. The winter solstice is at 11.23 a.m. (E.S.T.) on the 22nd (see opposite page).

The Moon.—For its phases and conjunctions with the planets, see opposite page. On December 3 it occults 136 Tauri (see page 8).

Mercury during the month continually approaches the sun.

Venus on the 15th is in R.A. 15h 42m, Decl. 17° 11′ S., and crosses the meridian at 10.08 p m. (M.T.). The planet is well seen as a morning star. It is rapidly increasing in brightness attaining a stellar magnitude of −4·4 on the 31st. Maximum brilliancy occurs on January 2, 1915.

Mars on the 15th is in R.A. 17h 38m, Decl. 24° 2′ S., and crosses the meridian at 12.05 p.m. (M.T.). On this date it is 227 millions of miles from the earth. It reaches conjunction with the sun on December 24, 0h (E.S.T.).

Jupiter on the 15th is in R.A. 21h 28m, Decl. 15° 57′ S., and crosses the meridian at 3.54 p.m. (M.T.). As it sets at about 9 p.m., it is not very suitably placed for observations. For the configurations of the satellites consult next page and for the eclipses, etc., of the satellites, see page 46.

Saturn on the 15th is in R.A. 5h 57m, Decl. 22° 17′ N., and crosses the meridian at 12.26 a.m. (M.T.). It is in opposition to the sun on the 21st and so is visible all night long. Its stellar magnitude is −0·3 and it is a beautiful object to observe.

Uranus on the 15th is in R.A. 20h 47m, Decl. 18° 37′ S., and crosses the meridian at 3.13 p.m. (M.T.).

Neptune on the 15th is in R.A. 8h 8m, Decl. 19° 48′ N., and crosses the meridian at 2.53 a.m. (M.T.).

For the minima of Algol, see next page.

DECEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minimum of Algol		Configuration of Jupiter's Satellites at 19h.
			h	m	
Tues.	1				2○134
☽Wed.	2	13h 20m·6 Full Moon.	16	55	12○34
Thur.	3				○1324
Fri.	4	5h 44m ☌ ♄ ☾, ♄ 5° 29′ S. ; 12h ☿ in ☊.			2431○4
Sat.	5		13	44	2432○4
Sun.	6	14h 19m ☌ ♆ ☾, ♆ 2° 58′ S.			34○12
Mon.	7	10h ☌ ☿ ☿, ☿ 0° 21′ N.			413○2
Tues	8		10	33	42○13
Wed.	9				412○3
☾Thur.	10	6h 31m·7 Moon's Last Quarter.			4○123
Fri.	11		7	22	413○2
Sat.	12				432○1
Sun.	13				34○●●
Mon.	14		4	11	31○42
Tues.	15	4h 50m ☌ ☿ ☾, ☿ 7° 36′ N. ; 9h ·2 ☾ in Perigee.			2○134
●Wed.	16	3h ☿ in ♉ ; 3h 22m ☌ ☿ ☾, ☿ 4° 56′ N. ; 21h 35m·1			21○34
Thur.	17	0h 57m ☌ ♂ ☾, ♂ 3° 47′ N. ; 1h ☿ [New Moon.	1	00	○1234
Fri.	18	[Stationary.			241○24
Sat.	19		21	49	32○14
Sun.	20	0h 25m ☌ ♁ ☾, ♁ 1° 6′ N. ; 20h 32m ☌ ♃ ☾, ♃			3○4●●
Mon.	21	8h ☍ ♄ ☉. [0° 12′ S.			31○24
Tues.	22	11h 23m Sun enters Capricornus, Winter begins.	18	38	2○413
Wed.	23				421○3
☽Thur.	24	0h ☌ ♁ ☰ ; 4h 24m·8 Moon's First Quarter.			4○123
Fri.	25		15	27	41○32
Sat.	26	9h ☿ in Aphelion.			432○1
Sun.	27	7h ·7 ☾ in Apogee.			4312○
Mon.	28		12	16	2431○2
Tues.	29				42○1●
Wed.	30				241○3
Thur	31	8h 21 ☌ ♄ ☾, ♄ 5° 31′ S.	9	05	○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.

PHENOMENA OF JUPITER'S SATELLITES

E = eclipse, O = occultation, T = transit, S = shadow, D = disappearance, R = re-appearance, I = ingress, e = egress. The numbers in the fifth column denote the satellites.
Eastern Standard Time, Hours numbering from Midnight.

FEBRUARY

d	h	m	s			d	h	m	s		
28	6	6	6	I	ED						

MARCH

6	5	37		II	Se	13	5	18		II	SI
9	5	34		I	OR	31	5	27		I	SI

APRIL

8	4	16		IV	OR	23	2	34	57	II	ED
	4	33	21	I	ED	24	2	49	42	I	ED
9	4	9		I	Se	25	2	33		II	Te
16	3	42		I	SI		3	43		I	Te
	4	57		I	TI	30	3	51	36	III	ER
17	4	28		I	OR						

MAY

2	2	18		II	TI	18	1	48		III	Se
	2	30		II	Se		2	33		I	Se
	3	17		I	TI		3	33		III	TI
	4	18		I	Se		3	54		I	Te
3	2	50		I	OR	20	4	0		IV	Te
7	4	19	8	III	ED	25	2	5		III	SI
9	2	11		II	SI	25	2	6		I	SI
	3	51		I	SI		2	6	59	II	ED
11	2	01		I	Te		3	26		I	TI
	2	32		II	OR	26	3	0		I	OR
	3	18		III	Te	27	2	21		II	Te
17	3	0	8	I	ED	29	1	14		III	OR
18	1	34		I	TI						

JUNE

1	3	59		I	SI	17	23	33	22	I	ED
2	1	16	36	I	ED	18	2	59		I	OR
3	0	48		I	Se		23	5	25	II	ED
	1	56		II	TI	19	0	10		I	Te
	2	5		I	Te	20	23	2		II	Te
	2	16		II	Se	22	3	20		IV	Se
4	23	20		II	OR	23	2	3		III	Te
5	1	20		III	OD	24	4	8		I	SI
9	3	10	40	I	ED	25	1	27	32	I	ED
10	0	21		I	SI		23	37		I	TI
10	1	34		I	TI	26	0	57		I	Se
	1	56		II	SI		1	39	28	II	ED
	2	41		I	Se		1	58		I	Te
	3	54		I	Te		23	14		I	OR
12	0	16	49	III	ED	27	22	29		II	TI
	1	46		II	OR		23	25		II	Se
	3	50	12	III	ER	28	1	26		II	Te
13	23	50		IV	OD	30	1	45		III	Se
17	2	14		I	SI		1	52		III	TI
	3	23		I	TI						

JULY

d	h	m	s			d	h	m	s		
2	3	21	47	I	ED	18	1	39	04	I	ED
3	0	30		I	SI		2	17		III	OR
	1	24		I	TI		22	46		I	SI
	2	50		I	Se		23	20		I	TI
	3	44		I	Te	19	1	07		I	Se
	4	13	41	II	ED		1	40		I	Te
4	1	1		I	OR		22	58		I	OR
	23	6		II	SI	20	22	40	00	II	ED
5	0	50		II	TI	21	2	34		II	OR
	2	2		II	Se	22	20	34		II	Se
	3	47		II	Te		21	32		II	Te
6	22	1		II	OR	25	0	17	12	III	ED
7	2	1		III	SI		3	33	35	I	ED
9	0	4		IV	TI	26	0	40		I	SI
10	2	24		I	SI		1	04		I	TI
	3	9		I	TI		3	01		I	Se
	22	55		III	OR		3	24		I	Te
	23	44	38	I	ED		22	02	15	I	ED
11	2	47		I	OR	27	0	42		I	OR
	23	13		I	Se		21	29		I	Se
	23	56		I	Te		21	50		I	Te
12	1	43		II	SI	28	1	14	54	II	ED
	3	10		II	TI	29	20	15		II	SI
14	0	18		II	OR		20	51		II	TI
17	1	11	49	IV	ED		23	11		II	Se
	4	18		I	SI		23	48		II	Te

AUGUST

1	4	17	26	III	ED	11	1	17		I	Te
2	2	34		I	SI		1	18		I	Se
	2	48		I	TI		20	16		I	OD
	23	56	54	I	ED		21	55		III	TI
3	2	00		IV	OR		22	03		III	SI
	2	26		I	OR		22	36		I	OR
	21	03		I	SI	12	1	37		III	Te
	21	14		I	TI		1	45		III	Se
	23	24		I	Se		19	43		I	Te
	23	34		I	Te		19	47		I	Se
4	20	52		I	OR	13	1	21		II	TI
	21	45		III	Se		1	28		II	SI
	22	21		III	Te	14	22	34	13	II	ER
5	22	52		II	SI	17	3	34		I	OD
	23	06		II	TI	18	0	41		I	TI
6	1	48		II	Se		0	52		I	SI
	2	02		II	Te		3	01		I	Te
7	20	10		II	OR		3	13		I	Se
9	4	29		I	SI		22	00		I	OD
	4	31		I	TI	19	0	31	00	I	ER
10	1	50		I	OD		1	10		III	TI
	4	10		I	OR		2	03		III	SI
	22	57		I	TI		21	27		I	Te
	22	58		I	SI		21	41		I	Se

PHENOMENA OF JUPITER'S SATELLITES—*(Continued)*

AUGUST—*(Continued)*

d	h	m	s			d	h	m	s		
21	21	41		II	OD	26	23	11		I	Te
22	1	10	13	II	ER		23	36		I	Se
	19	53	08	III	ER	27	20	54	40	I	ER
23	19	40		II	Te		23	10		IV	SI
	20	20		II	Se		23	55		IV	Te
25	2	25		I	TI	28	23	57		II	OD
	2	47		I	SI	29	23	54	12	III	ER
	23	44		I	OD	30	19	00		II	TI
	2	25	53	I	ER		20	01		II	SI
26	20	51		I	TI		21	56		II	Te
	21	16		I	SI		22	57		II	Se

SEPTEMBER

2	1	29		I	OD	13	23	30		II	TI
	22	36		I	TI	14	1	14		II	SI
	23	10		I	SI	15	22	18	09	II	ER
3	0	56		I	Te	16	21	50		III	Se
	1	31		I	Se	17	23	28		I	OD
	19	55		I	OD	18	20	35		I	TI
	22	49	40	I	ER		21	30		I	SI
4	19	23		I	Te		22	56		I	Te
	20	00		I	Se		23	50		I	Se
5	1	40		IV	OD	19	21	08	38	I	ER
	21	40		III	OD	21	21	43		IV	OR
6	21	17		II	TI	22	20	03		II	OD
	22	38		II	SI	23	21	51		III	Te
7	0	13		II	Te		22	10		III	SI
	1	34		II	Se	24	18	05		II	Te
8	19	41	14	II	ER		20	05		II	Se
10	0	22		I	TI	25	1	16		I	OD
	1	06		I	SI		22	24		I	TI
	21	41		I	OD		23	25		I	SI
11	0	44	44	I	ER	26	0	44		I	Te
	19	34		I	SI		19	43		I	OD
	21	09		I	Te		23	03	51	I	ER
	21	55		I	Se	27	19	11		I	Te
12	19	13	29	I	ER		20	14		I	Se
13	1	04		III	OD	29	22	26		II	OD
	22	19		IV	Se	30	21	43		III	TI

OCTOBER

1	17	34		II	TI	8	22	22		II	SI
	19	46		II	SI		22	55		II	Te
	20	30		II	Te	10	19	29	36	II	ER
	22	43		II	Se		23	23		I	OD
3	0	13		I	TI	11	19	09		III	OR
	21	33		I	OD	11	20	29	00	III	ED
4	18	40		I	TI		20	32		I	TI
	19	49		I	SI		21	45		I	SI
	19	59	13	III	ER		22	52		I	Te
	21	01		I	Te	12	0	00	31	III	ER
	22	10		I	Se		0	05		I	Se
5	19	27	57	I	ER		21	23	14	I	ER
8	19	59		II	TI	13	18	34		I	Se
	20	02	10	IV	ED	15	22	28		II	TI

OCTOBER—*(Continued)*

d	h	m	s			d	h	m	s		
16	22	38		IV	Te	25	18	55	17	IV	ER
17	22	07	32	II	ER		23	05		III	OD
18	19	14		III	OD	26	16	53		II	SI
	22	24		I	TI		17	12		II	Te
	22	56		III	OR		19	49		II	Se
	23	41		I	SI		21	36		I	OD
19	17	13		II	Se	27	18	46		I	TI
	19	43		I	OD		20	06		I	SI
	23	18	33	I	ER		21	06		I	Te
20	18	10		I	SI		22	26		I	Se
20	19	12		I	Te	28	19	42	42	I	ER
	20	30		I	Se	29	18	18		III	SI
22	17	56		III	Se		21	58		III	Se
24	19	11		II	OD	31	21	46		II	OD

NOVEMBER

2	16	50		II	TI	10	20	00	25	III	ER
	19	29		II	SI	18	16	24		II	OD
	19	46		II	Te		21	52		I	OD
3	20	41		I	TI	19	18	23		IV	SI
	22	01		I	SI		19	03		I	TI
4	16	42	39	II	ER		20	22		I	SI
	18	00		I	OD		21	24		I	Te
	21	38	01	I	ER	20	16	55		II	Se
5	18	50		I	Se		19	57	27	I	ER
	20	36		III	Te	23	19	01		III	OR
	22	20		III	SI		20	38	56	III	ED
9	19	26		II	TI	25	19	07		II	OD
	22	05		II	SI	26	21	01		I	TI
	22	22		II	Te	27	16	35		II	SI
10	19	50		IV	OD		17	01		II	Te
11	19	21	04	II	ER		18	19		I	OD
	19	55		I	OD		19	31		II	Se
12	18	26		I	SI		19	38		IV	OR
	19	26		I	Te	28	17	52		I	Te
	20	46		I	Se		19	07		I	Se
	20	57		III	TI	30	19	32		III	OD
13	18	02	11	I	ER						

DECEMBER

4	16	47		II	TI	12	19	30		I	TI
	18	06		III	Se		20	38		I	SI
	19	10		II	SI	13	19	15	16	II	ER
	19	43		II	Te		20	11	50	I	ER
	20	17		I	OD	14	17	27		I	Se
5	17	30		I	TI	18	18	11		III	TI
	18	43		I	SI	20	18	46		I	OD
	19	50		I	Te	21	18	21		I	Te
	21	03		I	Se		19	23		I	Se
6	16	36	37	II	ER	28	18	02		I	TI
6	17	29		IV	Se		18	59		I	SI
	18	16	42	I	ER	29	17	21		II	Te
11	17	31		III	Te		18	30	43	I	ER
	18	30		III	SI	31	19	40	55	IV	ER
	19	30		II	TI						

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN.

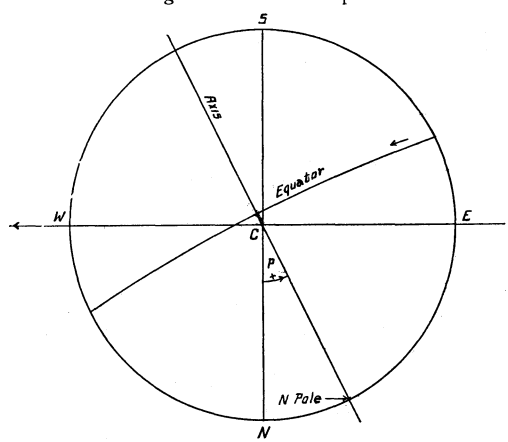
By Ralph E. De Lury.

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 end 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 ths 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°·750, the longitude of the ascending node for 1914·0 is 74°·560 and the period of the Sun's sidereal rotation is 25·38 days (according to the deductions of Carrington from his sun-spot measurements).



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 $P = + 26°{\cdot}41$, "*Lat.*" $= + 6°{\cdot}21$, and "*Long.*" $= 115°{\cdot}51$. In the Figure, $N\ E\ S\ W$ are the North, South, East and West points on the disc of the Sun. These points are determined on an image of the Sun by allowing it to drift due to the Earth's rotation, 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 $+ 26°{\cdot}41$ with $N\ S$ and having the *North Pole* on the positive side of it, *i. e.*, eastward from N; 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.*" $+ 6°{\cdot}21$ and "*Long.*" $115°{\cdot}51$.

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 particular hour may be read off quickly, care being taken to use the hour corresponding to Greenwich Mean Noon, *e. g.* in "Eastern" Time, 7 a.m.

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN*

Greenwich Mean Noon		*P*	Lat.	Long	Greenwich Mean Noon		*P*	Lat.	Long.
		°	°	°			°	°	°
Jan.	1	+ 2·12	− 3·14	228·64	July	5	− 1·00	+ 3·40	306·85
	6	− 0·31	3·70	162·79		10	+ 1·27	3·92	240·67
	11	2·73	4·24	96·94		15	3·52	4·41	174·50
	16	5·11	4·75	31·10		20	5·73	4·88	108·35
	21	7·42	5·21	325·27		25	7·89	5·31	42·20
	26	9·65	5·64	259·44		30	9·97	5·70	336·06
	31	− 11·78	− 6·02	193·61	Aug.	4	+ 11·96	+ 6·05	269·94
Feb.	5	13·80	6·36	127·78		9	13·86	6·37	203·83
	10	15·69	6·64	61·94		14	15·66	6·63	137·73
	15	17·45	6·87	356·10		19	17·34	6·86	71·64
	20	19·08	7·05	290·26		24	18·90	7·03	5·57
	25	20·55	7·17	224·41		29	20·33	7·15	299·51
Mar.	2	− 21·87	− 7·24	158·54	Sept.	3	+ 21·63	+ 7·23	233·47
	7	23·03	7·25	92·67		8	22·79	7·25	167·43
	12	24·02	7·20	26·78		13	23·79	7·22	101·41
	17	24·85	7·10	320·88		18	24·65	7·14	35·40
	22	25·51	6·95	254·96		23	25·34	7·00	329·41
	27	26·00	6·75	189·02		28	25·87	6·81	263·42
Apr.	1	− 26·30	− 6·49	123·07	Oct.	3	+ 26·23	+ 6·58	197·44
	6	26·43	6·19	57·09		8	26·41	6·29	131·47
	11	26·37	5·85	351·09		13	26·41	5·95	65·51
	16	26·14	5·46	285·07		18	26·22	5·57	359·56
	21	25·71	5·03	219·03		23	25·84	5·15	293·62
	26	25·11	4·57	152·98		28	25·27	4·69	227·68
May	1	− 24·32	− 4·08	86·90	Nov.	2	+ 24·50	+ 4·19	161·75
	6	23·34	3·56	20·81		7	23·53	3·65	95·82
	11	22·20	3·01	314·69		12	22·37	3·09	29·90
	16	20·88	2·45	248·57		17	21·01	2·51	323·99
	21	19·39	1·87	182·43		22	19.47	1·90	258·09
	26	17·76	1·28	116·27		27	17·75	1·28	192·19
	31	− 15·97	− 0·68	50·11	Dec.	2	+ 15·87	+ 0·64	126·29
June	5	14·08	− 0·08	343·94		7	13·84	− 0·00	60·40
	10	12·07	+ 0·53	277·76		12	11·69	− 0·64	354·52
	15	9·97	1·13	211·58		17	9·42	1·27	288·65
	20	7·79	1·72	145·39		22	7·08	1·90	222·78
	25	5·55	2·30	79·21		27	4·68	2·51	156·92
	30	− 3·28	+ 2·86	13·03		32	+ 2·25	− 3·11	91·07

*Taken from *The Nautical Almanac*.

ECLIPSES IN 1914 AND TRANSIT OF MERCURY

PREPARED BY R. M. MOTHERWELL

There will be four eclipses in 1914, two of the Sun and two of the Moon.

I. An Annular Eclipse of the Sun, February 24, 1914, invisible in Canada but visible in the southern part of the Pacific and Indian Oceans, the southern extremity of South America and the Antarctic Ocean.

II. A Partial Eclipse of the Moon, March 11, 1914, the beginning visible in Europe, Africa, North and South America ; the ending visible in western Europe, western Africa, North and South America and the central and eastern portions of the Pacific Ocean.

		d	h	m
Moon enters shadow	March	11	9	41·8
Middle of the eclipse	"	11	11	12·9
Moon leaves shadow	"	11	12	44·0

Magnitude of the eclipse = 0·916 (Moon's diameter = 1·0).

III. A Total Eclipse of the Sun, August 20–21, 1914, visible as a partial eclipse in Canada as far west as Brandon where it ends at sunrise. The path of totality extends from a point west of Prince Albert Land across Greenland, Norway, Sweden, Gulf of Finland, southwestern Russia, Black Sea, Asiatic, Turkey, Persia and ends in the northwest part of India near Cutch Island.

IV. A Partial Eclipse of the Moon, September 3, 1914, the beginning visible in western North America, the Pacific Ocean, eastern Asia, Australia, and Oceanica ; the ending visible in the central and western portions of the Pacific Ocean, Asia, Australia, the Indian Ocean and the extreme east of Africa.

		d	h	m
Moon enters shadow	September	3	19	16·3
Middle of the eclipse	"	3	20	54·7
Moon leaves shadow	"	3	22	33·1

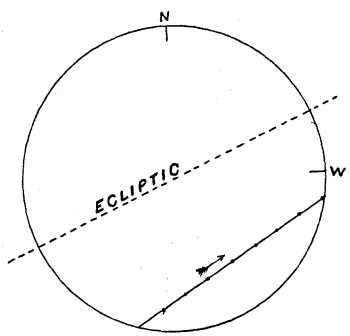
Magnitude of the eclipse = 0·864 (Moon's diameter = 1·0).

There is also a transit of mercury over the Sun's Disc on November 7, 1914. The ingress will be visible generally in western Australia, central and western Asia, Europe, Africa and part of South America but not in any part of Canada. The egress will be visible in southwest Europe, Africa, South America and in Canada as far west as Moosejaw where egress occurs within a few minutes of sunrise.

The following times of the four contacts for Ottawa, Toronto and Winnipeg were computed from the formulæ given in the *American Ephemeris*, for 1914.

	Ottawa			Toronto			Winnipeg		
	h	m	s	h	m	s	h	m	s
Ingress external	16	58	02	16	58	00	16	57	58
Ingress internal	17	00	15	17	00	14	17	00	12
Egress internal	21	07	28	21	07	32	21	07	36
Egress external	21	09	43	21	09	46	21	09	49

(All times are Eastern Standard Astronomical Time, hours numbering from noon).



Path of Mercury across the Sun's Disc, November 7, 1914. The dots show positions at half-hour intervals. (From Todd's *New Astronomy*).

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. 9	Jan. 3	15	20	+ 53
Aurigids	Feb. 7-23	Feb. 10	5	0	+ 41
Lyrids	April 16-22	April 21	18	4	+ 33
η Aquarids	April 29-May 8	May 4-6	22	32	− 2
Herculids	May 13-29	May 24	16	36	+ 30
Scorpiids	May-June-July	June 4	16	48	− 21
Sagittids	June-July	July 28	20	12	+ 24
Capricornids	July-Aug.	July 22	20	20	− 12
δ Aquarids	July 18-Aug. 12	July 28-31	22	36	− 11
α-β Perseids	July-Aug.-Sept.	Aug. 16	3	12	+ 43
Perseids	July 8-Aug. 25	Aug. 11.12	3	4	+ 57
Draconids	Aug. 18-25	Aug. 23	19	24	+ 61
ε Perseids	Aug.-Sept.	Sept. 15	4	8	+ 35
Arietids	Aug.-Sept.-Oct.	Sept. 21	2	4	+ 19
	Sept.-Oct.	Oct. 15	2	4	+ 9
Orionids	October 9-29	Oct. 19	6	8	+ 15
μ Ursids Maj.	Oct.-Nov.-Dec.	Nov. 16-25	10	16	+ 41
Taurids	November	Nov. 21	4	12	+ 23
Leonids	Nov. 9-20	Nov. 14-15	10	0	+ 23
Andromedes	Nov. 20-30	Nov. 20-23	1	40	+ 43
Geminids	Dec. 1-14	Dec. 11	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.

The above table was prepared for the HANDBOOK by Mr. W. F. Denning, F.R.A.S., of Bristol, England; and for further interesting information regarding this subject (and almost any other subject in which the amateur is interested) reference may be made to his *Telescopic Work for Starlight Evenings*.

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

Name	Mean Distance from Sun		Sidereal Period		Mean Diam'tr 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	0.0476	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	1309	$9^{h}\ 55^{m} \pm$
♄ Saturn.....	9.539	886.0	10759.2	29.46	73000	94.8	0.72	760	$10^{h}\ 45^{m} \pm$
♅ 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	0.075	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	7,372,000	265·00 d.	Perrine	Dec. 1904
7. (Nameless).	16	7,567,900	276·67 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 fifth 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 foot 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. 9h 11m; Decl. 37° 21′; mags. 4 and $7\frac{1}{2}$; distance $2''{\cdot}9$; white and lilac.

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

Double Star. ι, R.A. 8h 40m, 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. 11h 13m, 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. 9h 45m, 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 γ); 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* 24^{m} 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

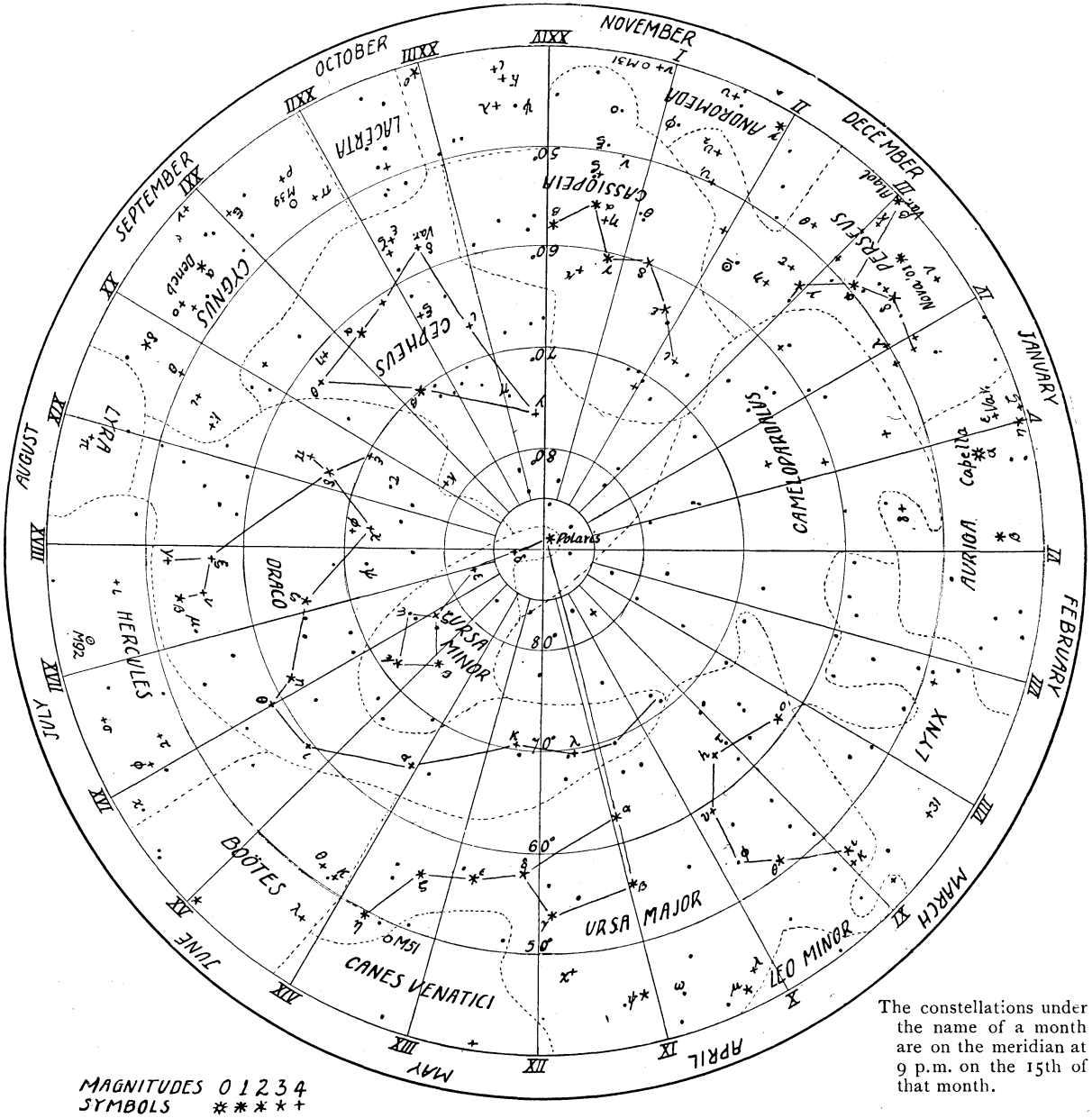
Hercules, a large constellation, is bounded on the north by Draco and on the south by Ophiuchus, and extends east and west nearly from Arcturus to Vega. It has no very conspicuous stars, but contains many good telescopic objects. It is interesting as marking that part of the heavens towards which the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

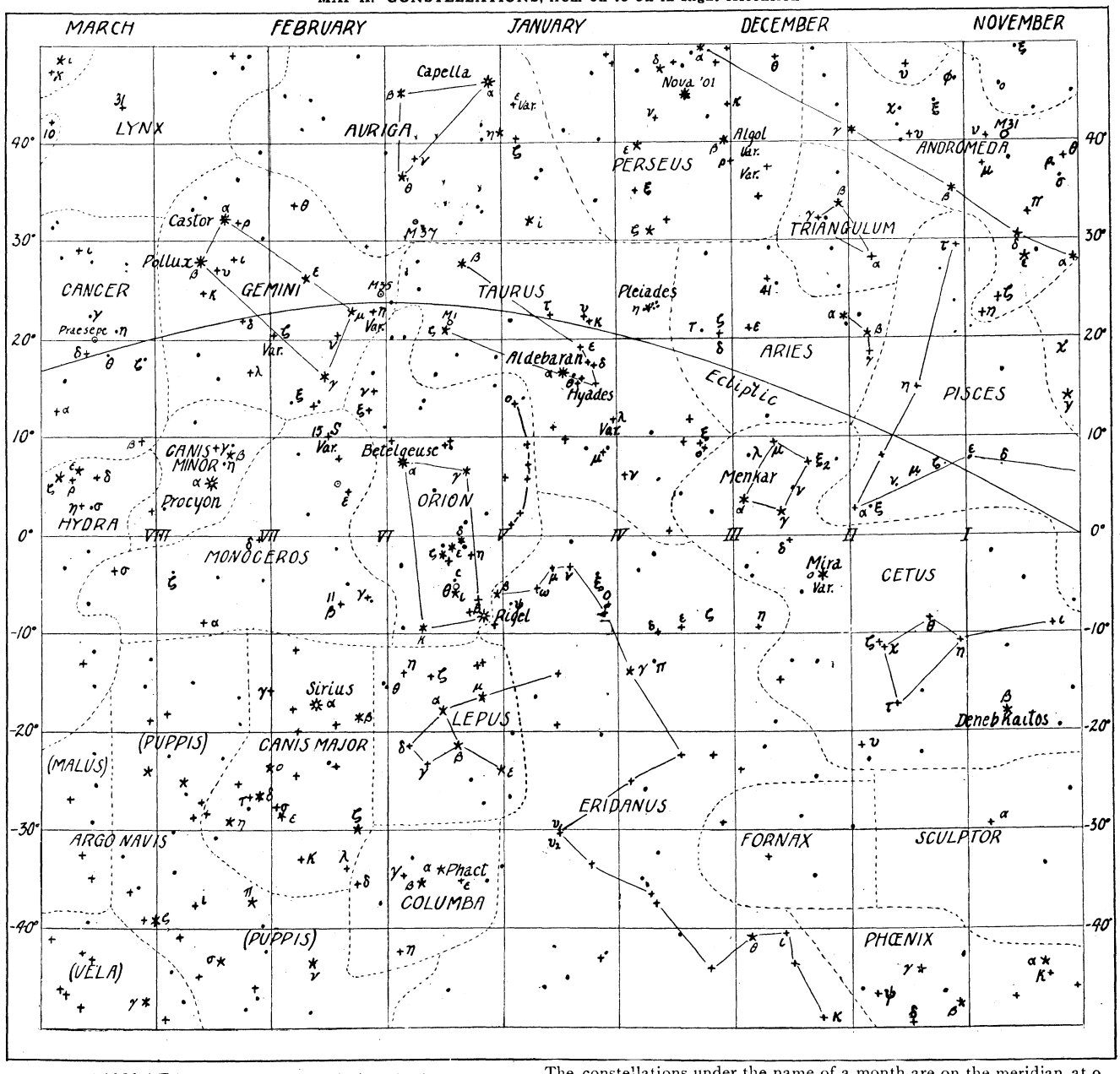
MAP I.--NORTH POLAR CONSTELLATIONS



MAGNITUDES 0 1 2 3 4
SYMBOLS * * * * +

The constellations under the name of a month are on the meridian at 9 p.m. on the 15th of that month.

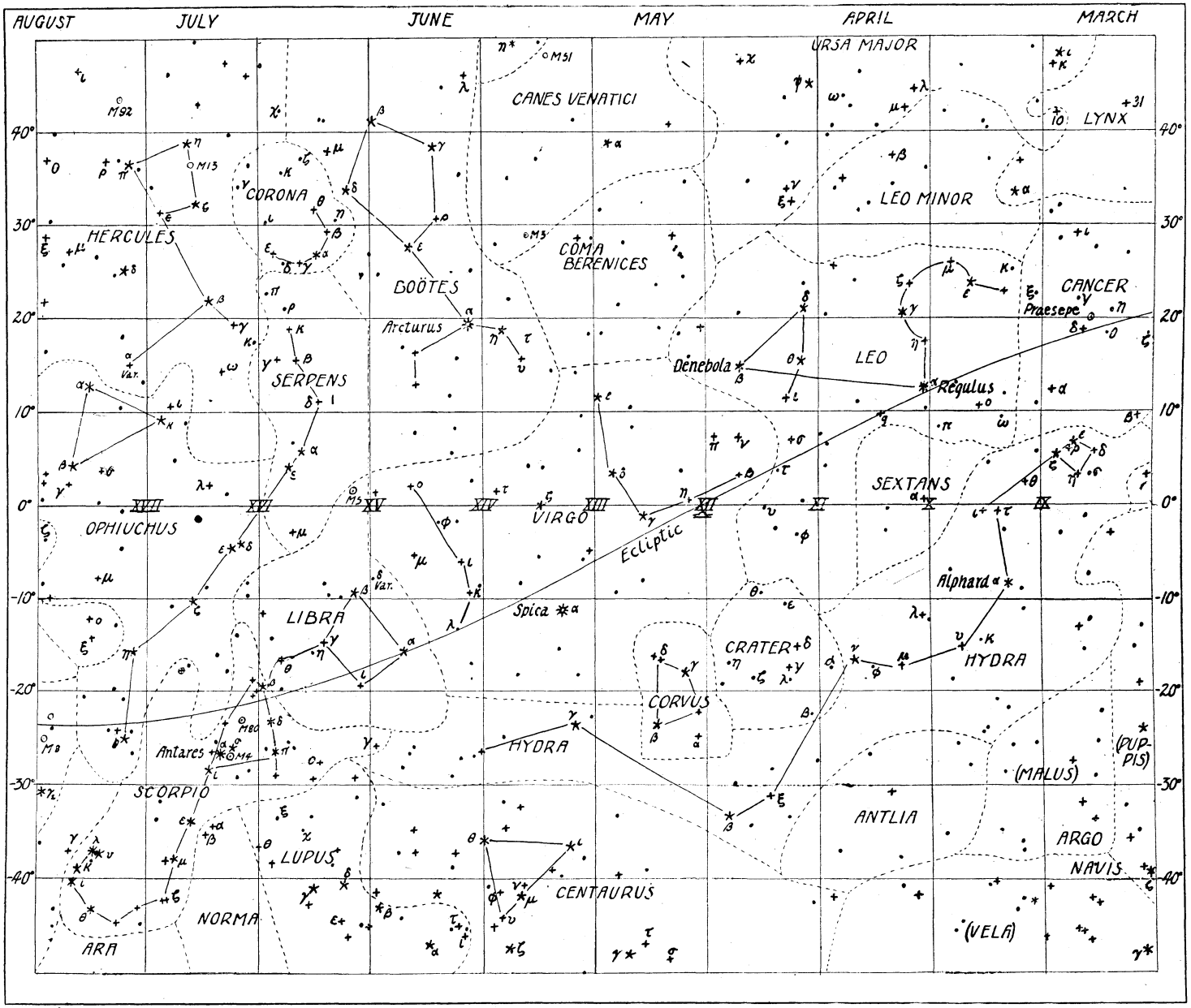
MAP II.--CONSTELLATIONS, from 0h to 9h in Right Ascension



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

The constellations under the name of a month are on the meridian at 9 p.m. on the 15th of that month.

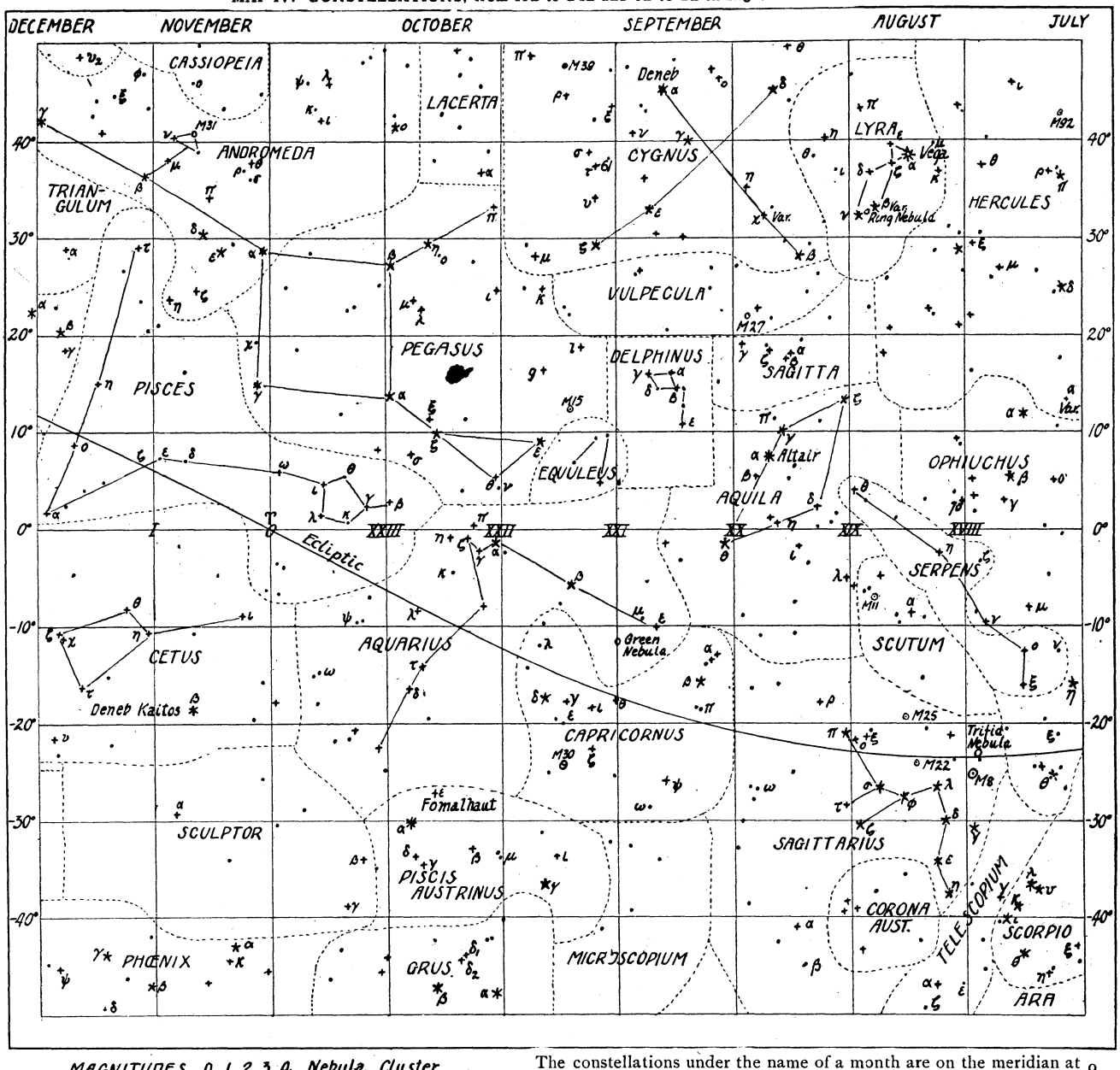
MAP III.-- CONSTELLATIONS, from 8h to 18h in Right Ascension



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

The constellations under the name of a month are on the meridian at 9 p.m. on the 15th of that month.

MAP IV.--CONSTELLATIONS, from 17h to 24h and 0h to 2h in Right Ascension



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

The constellations under the name of a month are on the meridian at p.m. on the 15th of that month.

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 fiue 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 identified 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 period 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 minimum 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 $8''{\cdot}4$.

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.

COMETS OF 1913

By R. M. Motherwell

At the beginning of the year 1913 there were three of the 1912 comets still visible. Comet 1912*a* was invisible to the naked eye and decreasing in brightness; 1912*b* was a faint object circumpolar in the southern sky; 1912*c* was visible only in large telescopes. During 1913 five other comets have been observed, three hitherto unknown and two periodic comets whose periods had been determined during previous visits to the vicinity of the sun.

COMET 1913*a*

Comet 1913*a* was discovered by Schaumasse at Nice on May 7. It was then visible in a small telescope and was at no time a conspicuous object. It reached its maximum brilliancy in June.

COMET 1913*b*

Rev. J. H. Metcalf discovered comet 1913*b* on September 1 at South Hero, Vermont. Its nearest approach to the earth was during the first week of October but it showed no unusual activity and proved to be a rather uninteresting comet.

COMET 1913*c*

Most comets are considered remarkable according to their brightness and internal activity but comet 1913*c*, although a very faint object, has excited considerable interest among astronomers. It was discovered photographically by Neujmin at Simeis, Crimea, on September 3, and had more the appearance of a tenth magnitude star than of a comet. Subsequent observations, however, revealed a stellar nucleus with a faint nebulosity surrounding it. Elliptic elements with a period of about 17 years seemed to satisfy the observed positions fairly well, the motion being direct at an angle of about twenty degrees to the earth's orbit. It was decreasing in brightness at the time of discovery and was soon beyond the reach of all small telescopes.

COMET 1913*d*

The fourth comet discovered in 1913 proved to be Westphal's periodic comet, first discovered by Westphal at Göttingen, June 27, 1852. It was then visible to the naked eye for some time in October and was observed telescopically for nearly six months. It was first observed on its present return by Delavan about the twenty-fifth of September and it reached its nearest point to the earth early in October. Up to that time it had been only a telescopic object and as its perihelion came much later than in 1852 it was not at any time so favorably situated for observation. However, it should be within reach of large telescopes during the winter of 1913-14.

COMET 1913*e*

Comet 1913*e* was discovered by Zinner about October twenty-first and a determination of its orbital elements showed it to be identical with Giacobini's comet (1900iii). It is a faint comet with a period of 6·46 years.

RECENT PROGRESS IN ASTONOMY

By W. E. Harper

During the past year the writer has not had the best chance to keep in touch with the progress in astronomy as recorded in the astronomical journals from time to time but the following notes will summarize some of the more important advances.

STELLAR INVESTIGATION

Proper Motions. An investigation by Van Maanen of 162 stars in the neighborhood of the Orion nebula showed that their proper motions were so small that it was impossible to detect any community of motion in and near the nebula.

Slight discordances in the position of the apex of the sun's way as given by determinations involving G-type stars from that given when other types were used led Benjamin Boss to further investigate the subject. While the results are by no means conclusive there would seem to be a slight drift of the G-type stars as a class towards $\alpha = 273°$, $\delta = -5°$, whereas the apex is situated approximately at $\alpha = 270°$, $\delta = +34°$.

A study of five hundred and thirteen stars fainter than the eighth magnitude by Comstock gives material for a number of deductions among which may be noted

(1) Contrary to general opinion 75 per cent of stars between 7th and 13th magnitude yield sensible proper motions.

(2) The mean proper motion in the plane of the Milky Way is about half that in high galactic latitudes.

(3) The determination of the apex of the solar motion is in substantial agreement with other determinations made from brighter stars.

(4) Faint stars are less remote and more intermingled with the bright stars than heretofore inferred from photometric data.

Star Positions. Mention was made last year of Schlesinger's work in this regard. The telescope of 10-inch aperture and 100-inch focus is mounted upon a pier in the basement and plates of the region surrounding the pole are being made. Russell presents in *N., M.* Vol. LXXIII a method of treatment for these plates.

Considerable has been written regarding irregular refraction and its effect upon measurement of star positions. From plates made at Yerkes and Mt. Wilson of trails of the Pleiades group Schlesinger confirms the slow period oscillation detected by Nusl and Fric. In addition to the rapid oscillations known to observers as unsteady seeing, oscillations of one minute of time and of double amplitude about one second of arc are recorded. Such work is valuable in freeing observations of star positions from error.

Spectroscopic Work. From time to time during the past year there have appeared orbits of spectroscopic binaries by various observers. While a considerable number of new binaries also has been discovered the past year the number is necessarily becoming fewer as the attack is made upon the fainter stars and those whose variability of radial motion is not so marked.

Campbell in L. O. B. 229 publishes a catalogue of 915 stars of classses F, G, K, and M, whose radial velocities seem to be substantially constant, or whose approximate systematic velocities may be estimated. Most of these velocities were obtained from the Mt. Hamilton plates.

Wolf has obtained the bright lines in the spectrum of the

Andromeda nebula in addition to the solar type and Slipher has obtained from the G-type spectrum a velocity of approach of 300 km. per sec.

With the 60-inch reflector seven stars in the Perseus cluster of B and A types, whose lines were sharp, were found to have a common motion of approach of some 40 km. per sec.

Classification of Spectra. At the Solar Union in Bonn, notwithstanding the fact that the consensus of opinion favored the Draper classification, it was decided that the time was not ripe yet for the adoption of a universal and permanent classification.

Double Stars. The list is growing rapidly, new ones being announced from time to time. Two lists of 100 each are given by Aitken in *L. O. B.* bulletins.

Eclipsing Variables. In the September number of the *Astrophysical Journal*, Shapley summarizes the orbits of 87 eclipsing variables. He divides them into four series; 28 variables well observed, such that further work will not materially change the solutions; 25, the orbits of which are susceptible of more or less improvement; 16, for which the observational data is meagre and 18 by Nijland unclassified as to accuracy.

Parallax. From the Yerkes observatory contributions to astronomy come the parallaxes of a dozen or so stars which have been determined by Slocum and Mitchell using the photographic method, and a very high order of accuracy has been reached.

SOLAR RESEARCH

This branch may best be summarized by reference to the Solar Union which met at Bonn the past summer.

Wave Lengths. At Mt. Wilson in 1910 the secondary standards were adopted. It was believed then that a final set of standards was within sight but investigations have shown that

the wave lengths of many of the iron lines vary slightly with conditions in the arc, hence the necessity of defining the kind of arc to be employed. A standard arc was adopted at this meeting.

Solar Rotation. In this work different observers have obtained results differing systematically from each other by as much as 10 per cent, and discrepancies have been found in the results obtained by different observers from measurements of the same photographs. Before proceeding further investigations of these sources of error are to be made by determining the velocity at the equator in as many different ways as possible.

Sun Spots. Spots observed during the recent minimum did not differ, so far as could be determined with instruments of moderate precision, from those observed at maximum. The work will be continued so as to embrace a complete cycle of 11 years. Through the co-operation of several observatories a catalogue of lines affected in sun-spots is being prepared through photographs of sun-spot spectra.

The Sun a Magnet. Hale has done an important piece of work on the general magnetic field of the sun as revealed by the Zeeman effect on the absorption lines. The sun-spot minimum was favorable to this work and by methods similar to those employed in measuring the field surrounding sun-spots he has shown that there is a general magnetic effect, minute but measurable.

GEOPHYSICS

The new science seismology is forging ahead with unabated vigor. New stations are being established, and old ones are installing more modern and more sensitive instruments. The seismograms are slowly being unravelled and the theory of the

propagation of the different kind of waves through the earth is being extended and amplified. Of national earthquake stations supplied with the highest type of seismographs, Russia at present leads the world. Microseisms, whose presence on seismograms has been noted at many stations including Ottawa, have now been definitely associated with meteorological phenomena, being due to areas of low barometer with steep gradients on the ocean near the coast line, and consequent storm and waves, sending tremors through the earth to record themselves even hundreds of miles from the sea. To correlate the periods of the waves and of the microseisms the Dominion Observatory has installed the first instrument — christened Undagraph — on the broad waters of the Atlantic, near Halifax. The Dominion Observatory is taking part in the international investigation of the deformation of the earth by the moon and more particularly in the anomalies connected therewith. The mysteries of terrestrial magnetism still await solution, but progress is slowly advancing, especially in correlating solar activity with magnetic phenomena upon the earth.

The existence of a magma layer at about 120 km. beneath the earth's surface is receiving confirmation from different lines of research.

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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.

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