THE OBSERVER'S HANDBOOK FOR 1917

Published By

The Royal Astronomical Society of Canada

EDITED BY C. A. CHANT

NINTH YEAR OF PUBLICATION

TORONTO
198 COLLEGE STREET
PRINTED FOR THE SOCIETY
1917

CALENDAR 1917

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

In the present HANDBOOK the Ephemeris of the Sun is arranged in, it is hoped, a more useful form. The Editor would be glad to receive any suggestions for making the book more usable for amateurs.

Besides those mentioned in the body of the book, Mr. R. M. Stewart has supplied the phenomena of Jupiter's satellites and Dr. R. K. Young has furnished the times of the minima of Algol. For the latter Hartwig's correction of $1^h\ 30^m$ *earlier* has been applied to Chandler's formula. The Editor would also give his best thanks to Mr. J. P. Henderson, his assistant in astronomy at the University of Toronto.

THE EDITOR.

TORONTO, December, 1916.

ANNIVERSARIES AND FESTIVALS. 1917

New Year's Day	Mon.,	Jan. 1	Pentecost (Whit Sunday)		May 27
Epiphany	Sat.,	Jan. 6	Trinity Sunday		June 3
Septuagesima Sunday		Feb. 4	Corpus Christi	Thur.,	June 7
Quinquagesima (Shrove Sunday)		Feb. 18	St. John Baptist	Sun.,	June 24
Ash Wednesday		Feb. 21	Dominion Day	Sun.,	July 1
St. David	Thurs.	Mch. 1	Labor Day	Mon.,	Sept. 3
St. Patrick	Sat.	Mch. 17	St. Michael (Michaelmas Day)	Sat.,	Sept. 29
Palm Sunday		Apr. 1	All Saints Day	Thurs.,	Nov. 1
Good Friday		Apr. 6	St. Andrew	Fri.,	Nov. 30
Easter Sunday		Apr. 8	First Sunday in Advent		Dec. 2
St. George	Mon.,	Apr. 23	Conception Day	Sat.,	Dec. 8
Rogation Sunday		May 13	St. Thomas Day	Fri.,	Dec. 21
Ascension Day (Holy Thursday)		May 17	Christmas Day	Tues.,	Dec. 25
Victoria Day	Thurs.,	May 24			

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.

1917, EPHEMERIS OF SUN. AT GREENWICH MEAN NOON.

Date	R.A.			Equation of Time		Declination			Date	R.A.			Equation of Time		Declination		
	h	m	s	m	s	°	′	″		h	m	s	m	s	°	′	″
Jan. 1	18	45	50	+ 3	34·5	S. 23	1	57	May 1	2	32	26	– 2	56·1	N. 14	59	15
" 4	18	59	3		4 58·1	22	45	23	" 4	2	43	55		3 16·8	15	52	46
" 7	19	12	13		6 18·0	22	24	46	" 7	2	55	29		3 32·6	16	43	56
" 10	19	25	18		7 33·5	22	0	12	" 10	3	7	8		3 43·3	17	32	36
" 13	19	38	18		8 43·9	21	31	45	" 13	3	18	52		3 48·6	18	18	38
" 16	19	51	13		9 48·8	20	59	33	" 16	3	30	42		3 48·7	19	1	55
" 19	20	4	1		10 47·8	20	23	45	" 19	3	42	37		3 43·5	19	42	19
" 22	20	16	44		11 40·2	19	44	28	" 22	3	54	37		3 33·2	20	19	41
" 25	20	29	19		12 25·7	19	1	53	" 25	4	6	41		3 18·3	20	53	56
" 28	20	41	47		13 4·0	18	16	10	" 28	4	18	50		2 59·0	21	24	56
" 31	20	54	7		13 34·7	17	27	31	" 31	4	31	3	WATCH SLOW	2 35·6	21	52	36
Feb. 3	21	6	20		13 58·0	16	36	6	June 3	4	43	20		2 8·6	22	16	50
" 6	21	18	25		14 13·8	15	42	6	" 6	4	55	40		1 38·4	22	37	36
" 9	21	30	24		14 22·2	14	45	40	" 9	5	8	3		1 5·2	22	54	47
" 12	21	42	15		14 23·7	13	47	2	" 12	5	20	28	–	0 29·6	23	8	22
" 15	21	53	59		14 18·5	12	46	19	" 15	5	32	55	+	0 7·9	23	18	16
" 18	22	5	37		14 6·9	11	43	45	" 18	5	45	24		0 46·7	23	24	29
" 21	22	17	9		13 49·2	10	39	30	" 21	5	57	53		1 26·0	23	26	58
" 24	22	28	35		13 25·6	9	33	46	" 24	6	10	21		2 5·1	23	25	44
" 27	22	39	56		12 56·6	8	26	45	" 27	6	22	49		2 43·3	23	20	48
									" 30	6	35	16		3 19·9	23	12	10
Mar. 2	22	51	11		12 22·4	7	18	38	July 3	6	47	40		3 54·4	22	59	53
" 5	23	2	22		11 43·7	6	9	37	" 6	7	0	1		4 26·2	22	44	0
" 8	23	13	29		11 0·9	4	59	50	" 9	7	12	20		4 54·9	22	24	34
" 11	23	24	33		10 14·7	3	49	27	" 12	7	24	34		5 20·2	22	1	39
" 14	23	35	33		9 25·7	2	38	39	" 15	7	36	46		5 41·5	21	35	19
" 17	23	46	32		8 34·4	1	27	35	" 18	7	48	52		5 58·6	21	5	39
" 20	23	57	29		7 41·6	S. 0	16	25	" 21	8	0	54		6 10·8	20	32	47
" 23	0	8	24		6 47·5	N. 0	54	40	" 24	8	12	51		6 18·0	19	56	48
" 26	0	19	19		5 52·8	2	5	31	" 27	8	24	42		6 19·7	19	17	51
" 29	0	30	14		4 57·9	3	15	56	" 30	8	36	28		6 16·0	18	36	2
Apr. 1	0	41	9		4 3·2	4	25	46	Aug. 2	8	48	9		6 6·6	17	51	29
" 4	0	52	5		3 9·3	5	34	52	" 5	8	59	43		5 51·8	17	4	18
" 7	1	3	2		2 16·7	6	43	6	" 8	9	11	13		5 31·7	16	14	38
" 10	1	14	1		1 26·1	7	50	17	" 11	9	22	38		5 6·5	15	22	36
" 13	1	25	2	+ 0	37·9	8	56	19	" 14	9	33	57		4 36·4	14	28	20
" 16	1	36	7		0 7·3	10	1	1	" 17	9	45	12		4 1·4	13	31	58
" 19	1	47	15		0 49·0	11	4	15	" 20	9	56	22		3 21·8	12	33	41
" 22	1	58	26		1 27·0	12	5	50	" 23	10	7	28		2 37·9	11	33	37
" 25	2	9	42		2 1·0	13	5	38	" 26	10	18	29		1 49·9	10	31	55
" 28	2	21	2		2 30·8	N. 14	3	29	" 29	10	29	27	+	0 58·1	N. 9	28	43

WATCH FAST — WATCH SLOW — WATCH FAST — WATCH SLOW

1917, EPHEMERIS OF SUN. AT GREENWICH MEAN NOON.

Date	R.A.	Equation of Time	Declination	Date	R.A.	Equation of Time	Declination
	h m s	m s	° ′ ″		h m s	m s	° ′ ″
Sept. 1	10 40 22	+ 0 3·1	N. 8 24 11	Nov. 3	14 32 20	− 16 22·0	S. 14 58 43
" 4	10 51 14	− 0 54·7	7 18 25	" 6	14 44 12	16 18·7	15 54 5
" 7	11 2 3	1 54·6	6 11 34	" 9	14 56 13	16 7·8	16 47 5
" 10	11 12 51	2 56·2	5 3 47	" 12	15 8 21	15 49·2	17 37 32
" 13	11 23 38	3 58·8	3 55 12	" 15	15 20 37	15 22·8	18 25 14
" 16	11 34 25	5 2·1	2 46 0	" 18	15 33 1	14 48·8	19 10 0
" 19	11 45 11	6 5·7	1 36 18	" 21	15 45 32	14 7·5	19 51 41
" 22	11 55 57	7 8·9	N. 0 26 18	" 24	15 58 10	13 19·2	20 30 5
" 25	12 6 44	8 11·4	S. 0 43 52	" 27	16 10 55	12 24·1	21 5 4
" 28	12 17 33	9 12·7	1 54 2	" 30	16 23 46	11 22·5	21 36 30
Oct. 1	12 28 23	10 12·0	3 4 3	Dec. 3	16 36 43	10 14·8	22 4 13
" 4	12 39 16	11 8·8	4 13 48	" 6	16 49 46	9 1·6	22 28 7
" 7	12 50 12	12 2·4	5 23 6	" 9	17 2 54	7 43·4	22 48 4
" 10	13 1 12	12 52·2	6 31 48	" 12	17 16 6	6 21·0	23 3 59
" 13	13 12 16	13 37·7	7 39 44	" 15	17 29 22	4 55·3	23 15 47
" 16	13 23 25	14 18·5	8 46 44	" 18	17 42 39	3 27·3	23 23 24
" 19	13 34 39	14 54·1	9 52 35	" 21	17 55 58	1 57·9	23 26 48
" 22	13 45 59	15 24·2	10 57 8	" 24	18 9 18	− 0 28·2	23 25 57
" 25	13 57 24	15 48·5	12 0 12	" 27	18 22 37	+ 1 0·9	23 20 53
" 28	14 8 56	16 6·5	13 1 35	" 30	18 35 54	+ 2 28·8	S 23 11 36
" 31	14 20 34	− 16 17·8	S. 14 1 9				

WATCH SLOW

To obtain the Sidereal Time or R.A. of Mean Sun, subtract the Equation of Time from the Right Ascension.

In the Equation of Time the sign + means that the watch is faster than the sun, − that it is slower; to obtain Local Mean Time, in the former case add the equation of time to, in the latter case subtract it from, apparent or sun-dial time.

OCCULTATION OF STARS BY THE MOON, 1917

PREPARED BY R. M. MOTHERWELL

The following predictions were prepared for Ottawa by the graphic method of W. F. Rigge and include all stars down to magnitude 4·5. Observers should bear in mind that the predictions were made only for Ottawa and that the times will vary according to the latitude and longitude of the observer.

It will be noticed that some occultations occurring in the day-time are given, the observation of which may prove interesting. Attention is also directed to the fact that the hours are numbered astronomically, that is, beginning at noon.

Date	Star	Mag.	*Immersion		*Emersion		Position Angle	
							Immer.	Emer.
			h	m	h	m	°	°
January 7	δ Geminorum	3·5	14	38·6	15	45·4	98	316
January 18	α Scorpii	1·2	23	05·9	23	42·6	130	234
April 2	o Leonis	3·8	10	12·7	11	23·7	151	278
April 10	σ Scorpii	3·1	15	02·1	16	22·1	105	268
April 16	θ Aquarii	4·3	18	26·4	19	17·9	102	195
May 27	o Leonis	3·8	00	17·6	01	26·1	102	304
November 2	μGeminorum	3·2	19	35·2	21	33·2	130	261
December 27	μGeminorum	3·2	13	20·3	14	22·3	141	248

*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 parts of Canada. The times are given in Mean Solar Time, and in the table on page following this, are given corrections to change 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 various places, see pages 8 and 9

NOVEMBER

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

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

DECEMBER

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

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

THE SKY FOR JANUARY

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	20h 19m	18h 0m	20h 29m	1h 40m	7h 58m	21h 24m	8h 24m
Decl.	17° 13′ S.	22° 52′ S.	20° 9′ S.	9° 8′ N.	20° 54′ N.	15° 59′ S.	19° 6′ N.
Transit	12·40	10·23	12·52	18·01	0·22	13·46	0·48

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—During January the sun's R.A. increases from 18h 46m to 20h 54m and its Decl. changes from 23° 2′ to 17° 28′ S. The equation of time (see page 6) increases from 3m 34s to 13m 35s, and on account of 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 (see page 10). The earth is nearest the sun on the 2nd at 7 a.m. E.S.T. On the 23rd there is an eclipse of the sun visible in Europe and Siberia, but invisible in Canada (see page 53).

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 8th there is a total eclipse of the moon, visible in Canada (see page 53). On the morning of the 8th the moon occults δ Geminorum and on the morning of the 19th, α Scorpii (see page 8).

Mercury attains greatest elongation 19° 22′ E. on the 2nd. This is not a very desirable time of the year to observe an eastern elongation, as the planet is so far south of the equator, but if the day is good and the horizon is clear the planet may be seen during the first week of the month. Immediately after sunset examine the sky above a point on the horizon about 14° south of the point where the sun has set. Field glasses will probably be necessary to locate it at first, but when once found it should be visible to the naked eye. Stellar magnitude — 0.4 on January 1, — 0.1 on January 6.

Venus on the 15th crosses the meridian at 10.23 (see above table) and is easily observed as a morning star. About 9/10 of its disc is illuminated and during the entire month its stellar magnitude is — 3.4.

Mars on the 15th is 218 millions of miles from the earth and sets too soon after the sun for convenient observation.

Jupiter on the 15th crosses the meridian at 6.01 p.m., and being fairly far north in the sky forms a prominent object for the first half of the night. Stellar magnitude — 2.0. On the opposite page are given the configurations of its satellites; on page 46, their eclipses, etc.

Saturn on the 15th is on the meridian at 22 minutes after midnight (see above table) and is visible all night long. It is in opposition to the sun on the 17th (see opp. page). It began to retrograde on Nov. 11, 1916, and will continue to do so until March 25. It is in Gemini, nearly on the line drawn from Castor through Pollux. Stellar magnitude — 0.1.

The positions of Uranus and Neptune are given in the above table. By referring to Maps IV. and II. of the Constellations their positions with respect to the stars can be obtained.

For the minima of Algol, see next page.

JANUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at 21h
			h	m	
Mon.	1	16h 47m ☌ ♃ ☾, ♃ 6° 58′ S.			41○32
Tues.	2	22h ☿ Greatest Elong. E. 19° 22′			43○12
Wed.	3	7h ⊕ in Perihelion.	8	27	432○1
Thur.	4				♃432○
Fri.	5				4○312
Sat.	6		5	16	1○243
Sun.	7	12h ☿ in ☊. [Full Moon.			2○143
♉Mon.	8	☾ Total Eclipse visible in Canada, (see p. 53); 2h 42m			1○234
Tues.	9	0h 4m ☌ ♄ (☾, ♄ 0° 58′ N.; 12h 31m ☌ ♆ ☾, ♆ 1°	2	05	3○124
Wed.	10	[6′ N.; 16h ☿ Stationary.			321○4
Thur.	11		22	54	♃32○4
Fri.	12	3h ☿ in Perihelion.			3○24●
Sat.	13	20h ☌ ☿ ♂, ☿ 3° 5′ N.			1○243
Sun.	14		19	43	2○413
Mon.	15				41○3●
☾Tues.	16	6h 42m·1 Moon's Last Quarter.			43○12
Wed.	17	4h □ ♃ ☉; 14h ☍ ♄ ☉.	16	31	4321○
Thur.	18				432○1
Fri.	19	1h ☌ ☿ ☉ Inferior.			43○2●
Sat.	20		13	20	41○23
Sun.	21	10h 51m ☌ ♀ ☾, ♀ 1° 26′ N. [13′ N.			42○13
Mon.	22	10h ☿ Greatest Hel. Lat. N.; 12h 28m ☌ ☿ ☾, ☿ 3°			14○3●
♊Tues.	23	♋ Ecl. invisible in Canada; 2h 40m New Moon; 17h	10	09	3○412
Wed.	24	5h 39m ☌ ♅ ☾, ♅ 3° 30′ S. [34m ☌ ♂ ☾, ♂ 3°			312○4
Thur.	25	[13′ S.; 20h ☍ ♆ ☉.			32○14
Fri.	26	19h ♂ Greatest Hel. Lat. S.	6	58	3:○24
Sat.	27				♃○234
Sun.	28	4h ♀ in ♉. [Quarter.			2○134
☽Mon.	29	3h 17m ☌ ♃ ☾, ♃ 6° 45′ S.; 20h 1m·5 Moon's First	3	47	12○34
Tues.	30	11h ☿ Stationary; 16h ☌ ☿ ♀, ☿ 2° 53′ N.			♃○142
Wed.	31				♃314○

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

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	20h 10m	20h 46m	22h 7m	1h 55m	7h 48m	21h 31m	8h 20m
Decl.	20° 8′ S.	18° 48′ S.	12° 46′ S.	10° 39′ N.	21° 24′ N.	15° 26′ S.	19° 18′ N.
Transit	10·31	11·06	12·27	16·14	22·06	11·50	22·38

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—During February the sun's R.A. increases from 20h 58m to 22h 44m and the Decl. changes from 17° 11′ to 8° 4′ S. The equation of time reaches its maximum value 14m 24s on the 11th (see page 6).

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

Mercury attains greatest elongation 26° 3′ W. on the 12th. This is a considerable distance from the sun but the planet is far south of the equator and it will not be favorably placed for observation. It will rise about that date nearly 20° south of where the sun rises but it will be low in the sky.

Venus is approaching too near to the sun and is too far south for convenient observation this month.

Mars on the 15th is 220 million miles from the earth, nearly as far as it will be in the part of its orbit remote from the earth. On the 28th it is in conjunction with the sun.

Jupiter crosses the meridian about 4 hours after the sun, is of stellar magnitude — 1.8, and so is a bright evening star. Being nearly 11° north of the equator, it is well placed for observation for the first part of the evening. The configuration of its satellites are given on the opposite page; their eclipses, etc., on page 46.

Saturn crosses the meridian about 2 hours before midnight and is therefore visible nearly all night. It is of stellar magnitude 0, somewhat brighter than either Castor or Pollux. It is still retrograding and it is interesting to compare its position among the stars (Map II.) with its position last month.

The positions of *Uranus* and *Neptune* are given in the above table. See note for last month. The former is in conjunction with the sun on the 8th (see opp. page).

The minima of Algol are given on the opposite page.

FEBRUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at 20h 30m
			h	m	
Thur.	1		0	36	342○1
Fri.	2	17h ☌ ♂, ♂ 0° 26′ S.			431○2
Sat.	3		21	25	4○132
Sun.	4				42○3●
Mon.	5	1h 46m ☌ ♄ ☾, ♄ 0° 48′ N.; 17h 9m ☌ ♆ ☾, ♆ 1°			421○3
♉ Tues.	6	22h 28m·4 Full Moon. ⌈2′ N.	18	14	4○312
Wed.	7				431○2
Thur	8	19h ☌ ♁ ☉.			324○1
Fri.	9		15	03	31○4●
Sat.	10				○124●
Sun.	11				21○34
Mon.	12	4h ☿ Greatest Elong. W. 26° 3′.	11	52	21○34
Tues.	13				○1324
☾ Wed.	14	20h 53m·2 Moon's Last Quarter; 21h ☿ in ♍.			31○24
Thur.	15		8	41	32○14
Fri.	16				31○4●
Sat.	17				4○12●
Sun.	18				
Mon.	19	19h 49m ☌ ☿ ☾, ☿ 2° 20′ S. ⌈☌ ♁ ☾, ♁ 3° 38′ S.	5	30	421○3
Tues.	20	11h 19m ☌ ♀ ☾, ♀ 3° 25′ S.; 12h ♂ in Perihelion; 19h 45m			24203
♋ Wed.	21	13h 9m New Moon; 18h 52m ☌ ♂ ☾, ♂ 5° 10′ S.	2	18	4○132
Thur.	22				431○2
Fri.	23		23	07	432○1
Sat.	24	17h ☌ ♀ ♁, ♀ 0° 23′ S.			43○12
Sun.	25	3h ☿ in Aphelion; 19h 6m ☌ ♃ ☾, ♃ 6° 21′ S.			124○3
Mon.	26		19	56	2○143
Tues.	27				○234●
☽ Wed.	28	11h 43m·7 Moon's First Quarter; 17h ☌ ♂ ☉.			31○24

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

THE SKY FOR MARCH

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	22h 55m	23h 2m	23h 29m	2h 15m	7h 43m	21h 37m	8h 18m
Decl.	9° 17′ S.	7° 44′ S.	4° 20′ S.	12° 32′ N	21° 39′ N	14° 57′ S.	19° 26′ N.
Transit	11·26	11·32	11·59	14·44	20·10	10·07	20·46

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—On March 1st the sun's R.A. is 22h 47m and its Decl. is 7° 41′ S. It reaches the equator on the 20th (see opposite page), and on the 31st its R.A. is 0h 38m, its Decl. 4° 3′ N. During the month the equation of time decreases from 12m 34s to 4m 21s (see page 6).

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

Mercury during the month is in that portion of its orbit farther from the earth, reaching superior conjunction with the sun on the 29th. It is therefore not well placed for observation.

Venus is also in that part of its orbit distant from the earth and rises only half-an-hour before the sun. It is therefore unfavorably placed for observation.

Mars on the 15th is 221 million miles from the earth. Although past conjunction with the sun, it is still receding from us, because both it and the earth are travelling toward aphelion, or the points in their respective orbits most remote from the sun. Of course the planet is unfavorably placed for observation.

Jupiter is still about 2¾ hrs. after the sun and is a bright evening star. Stellar magnitude — 1.7, about the same as Sirius. For the configuration of its satellites, see next page; and for their eclipses, etc., see page 46.

Saturn is visible practically all night, being on the meridian on the 15th at 8.10 p.m. (see above table). It ceases to retrograde on the 25th (see opp. page).

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

The minima of Algol are given on the next page.

MARCH

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight

			Minima of Algol		Configuration of Jupiter's Satellites at 20h
			h	m	
Thur.	1		16	45	32○14
Fri.	2	9h ☌ ☿ ♅, ☿ 1° 12′ S.			312○4
Sat.	3	18h ☿ in Aphelion.			3○124
Sun.	4	4h 49m ☌ ♄ ☾, ♄ 0° 47′ N.; 22h 10m ☌ ♆ ☾, ♆	13	34	♃1○34
Mon.	5	[1° 3′ N.			2○143
Tues.	6				41○23
Wed.	7		10	23	♃43○2
☉Thur.	8	16h 58m Full Moon.			432○1
Fri.	9				4312○
Sat.	10		7	12	43○12
Sun.	11				41○23
Mon.	12				42○13
Tues	13		4	01	41○3●
Wed.	14				4○312
Thur.	15				32○4●
☾Fri.	16	7h 33m·1 Moon's Last Quarter.	0	50	321○4
Sat.	17	11h ☿ Greatest Hel. Lat. S.			3○124
Sun.	18	17h ☌ ☿ ♀, ☿ 0° 43′ S.	21	39	1○234
Mon.	19				2○134
Tues.	20	8h 24m ☌ ♅ ☾, ♅ 3° 52′ S,; 23h 38m ☉ enters Aries,			1○34●
Wed.	21	[Spring commences.	18	28	○1324
☉Thur.	22	12h 12m ☌ ♀ ☾, ♀ 6° 40′ S.; 16h 27m ☌ ☿ ☾, ☿ 7° 13′			32○4●
Fri.	23	[S.; 19h 11m ☌ ♂ ☾, ♂ 6° 12′ S.; 23h 5m New Moon.			3241○
Sat.	24	3h ☌ ☿ ♂, ☿ 0° 56′ S.	15	16	43○12
Sun.	25	14h 26m ☌ ♃ ☾, ♃ 5° 51′ S.; 19h ♄ Stationary.			41○2●
Mon.	26	1h ☿ Greatest Hel. Lat. S.			42○13
Tues.	27		12	05	412○3
Wed.	28				4○132
Thur.	29	12h ☌ ☿ ☉ Superior.			4321○
☽Fri.	30	5h 36m·4 Moon's First Quarter.	8	54	♃324○
Sat.	31	3h ☌ ♀ ♂, ♀ 0° 39′ S.; 11h 11m ☌ ♄ ☾, ♄ 1° 1′ N.			3○412

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 APIRL

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	2h 35m	1h 24m	0h 57m	2h 42m	7h 44m	21h 42m	8h 17m
Decl.	17° 2′ N.	7° 29′ N.	5° 22′ N.	14° 47′ N.	21° 38′ N.	14° 32′ S.	19° 30′ N.
Transit	13·03	11·51	11·25	13·09	18·10	8·10	18·43

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—During April the sun continues its rapid rise above the equator and the days rapidly increase in length. The sun's R.A. increases from 0h 41m on the 1st to 2h 29m on the 30th, and its Decl. from 4° 26′ to 14° 41′ N. For equation of time, see page 6.

The Moon.—For its phases and conjunctions with the planets, see opposite page. The moon occults *o* Leonis on the 2nd, σ Scorpii on the morning of the 11th and θ Aquarii on the morning of the 16th (see page 8).

Mercury attains greatest elongation 20° 22′ E. on the 24th. Although not so far from the sun as it sometimes is, this is the best time of the year to observe an eastern elongation as the planet is almost directly above the setting sun. Immediately after sunset examine the sky above the point where the sun has disappeared. If convenient, use a field glass but if the horizon is clear there should be no difficulty in picking the planet up with the naked eye. The planet should be visible for some days before and a few days after the 24th. Its stellar magnitude is 0, about as bright as Capella. Its conjunction with Jupiter on the 16th (see opp. page) will add to its interest this month.

Venus is in conjunction with the sun on the 26th and hence is not well placed for observation during the month. After the date given it will be an evening star.

Mars on the 15th is over 221 million miles from the earth, and is too near the sun in the sky for observation.

Jupiter crosses the meridian about an hour after the sun and can still be seen as an evening star for a short time after sunset. Beginning with the 23rd the phenomena of the satellites are not given on account of the planet's nearness to the sun.

Saturn, as seen in the above table, is on the meridian on the 15th at 6.10 p.m., and so is visible during the first half of the night.

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

The minima of Algol are given on the next page.

APRIL

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at 19h 45m
			h	m	
Sun.	1	4h 33m ☌ ♆ ☾, ♆ 1° 15′ N.			13○24
Mon.	2		5	43	2○134
Tues.	3				12○34
Wed.	4				○1324
Thur.	5	12h ☿ in ☊.	2	32	2413○4
Fri.	6				32○14
(26)Sat.	7	8h 48m·8 Full Moon.	23	21	3○24●
Sun.	8				31○42
Mon.	9				42○13
Tues.	10	2h ☿ in Perihelion.	20	10	421○3
Wed.	11				4○123
Thur.	12	19h ♆ Stationary.			413○2
Fri.	13		16	59	432○1
☾Sat.	14	8h □ ♄ (☉); 15h 12m Moon's Last Quarter.			431○●
Sun.	15				431○2
Mon.	16	14h ☌ ☿ 24, ☿ 3° 0′ N.; 18h 2m ☌ ♅ ☾, ♅ 4° 11′ S.	13	48	42○13
Tues.	17				21○43
Wed.	18				○1243
Thur.	19		10	37	1○324
Fri.	20	9h ☿ Greatest Hel. Lat. N.; 17h 29m ☌ ♂ ☾, ♂ 6° 5′ S.			32○14
(27)Sat.	21	9h 1m·3 New Moon; 10h 47m ☌ ♀ ☾, ♀ 6° 14′ S.			31○4●
Sun.	22	10h 54m ☌ 24 ☾, 24 5° 22′ S.; 15h □ ♆ (☉); 23h 15m	7	26	243○24
Mon.	23	⌈☌ ☿ ☾, ☿ 1° 16′ S.			
Tues.	24	15h ☿ Greatest Elong. E. 20° 22′.			
Wed.	25				
Thur.	26	3h ☌ ♀ (☉) Superior.	4	14	
Fri.	27	21h 13m ☌ ♄ ☾, ♄ 1° 24′ N.			
Sat.	28	12h 35m ☌ ♆ ☾, ♆ 1° 32′ N.	1	03	
☽Sun.	29	0h 22m Moon's First Quarter.			
Mon.	30		21	52	

Invisible on account of proximity to sun.

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

THE SKY FOR MAY

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	3h 36m	3h 48m	2h 23m	3h 10m	7h 52m	21h 45m	8h 18m
Decl.	18° 53′ N.	19° 44′ N.	13° 45′ N.	16° 51′ N.	21° 20′ N.	14° 19′ S.	19° 26′ N.
Transit	12·05	12·18	10·52	11·39	16·20	6·14	16·46

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—On the 1st the sun's R.A. is 2h 32m, Decl. 14° 59′ N; on the 31st its R.A. is 4h 31m, Decl. 21° 53′. The equation of time is 2m 56s on the 1st, rises to a maximum 3m 49s on the 15th and then falls to 2m 36s on the 31st. See page 6.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 27th the moon occults *o* Leonis (see page 8).

Mercury is in conjunction with the sun on the 16th, and hence is unsuitably placed for observation during the month.

Venus is an evening star and is separating from the sun but it will not be conveniently located for observation before the latter part of June.

Mars on the 15th is 220 million miles from the earth and hence is comparatively faint. Besides, it is only about an hour from the sun and so is not suitably placed for observation.

Jupiter is now too close to the sun for convenient observation.

Saturn crosses the meridian on the 15th at 4.20 p.m. and is still well seen as an evening star. Stellar magnitude +0.5, the same as Procyon.

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

The minima of Algol are given on the next page.

MAY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at
			h	m	
Tues.	1				
Wed.	2				
Thur.	3		18	41	
Fri.	4				
Sat.	5	21h ☌ ♀ ♃, ♀ 0° 16′ N.; 22h ☿ Stationary.			
☉ Sun.	6	21h 43m·3 Full Moon.	15	30	
Mon.	7				
Tues.	8				
Wed.	9	6h ☌ ♃ ☉.	12	19	
Thur.	10				
Fri.	11				
Sat.	12	[Moon's Last Quarter.	9	08	
☾ Sun.	13	13h ☌ ☿ ♀, ☿ 0° 25′ N.; 20h ☿ in ♉; 20h 47m·9			
Mon.	14	0h 54m ☌ ♅ ☾, ♅ 4° 29′ S.; 21h □ ♅ ☉.			
Tues.	15		5	57	
Wed.	16	15h ☌ ☿ ☉ Inferior.			
Thur.	17				
Fri.	18		2	46	
Sat.	19	13h 46m ☌ ♂ ☾, ♂ 5° 2′S. [19h 46m·8 New Moon.			
☉ Sun.	20	6h 43m ☌ ♃ ☾, ♃ 4° 55′ S.; 11h 11m ☌ ☿ ☾, ☿ 5° 50′ S.;	23	35	
Mon.	21	7h ♀ in ♌; 9h 57m ☌ ♀ ☾, ♀ 2° 56′ S.			
Tues.	22				
Wed.	23		20	24	
Thur.	24	2h ☿ in Aphelion; 16h ☌ ☿ ♃, ☿ 2° 6′ S.			
Fri.	25	9h 55m ☌ ♄ ☾, ♄ 1° 49′ N.; 21h 43m ☌ Ψ ☾, Ψ 1°			
Sat.	26	[47′ N.	17	13	
Sun.	27				
☽ Mon.	28	18h 33m·5 Moon's First Quarter; 21h ☿ Stationary.			
Tues.	29	6h ♅ Stationary.	14	01	
Wed.	30				
Thur.	31				

Invisible on account of proximity to sun.

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; ♃ Jupiter; ♄ Saturn; ♅ Uranus; Ψ 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

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	3h 57m	6h 32m	3h 53m	3h 39m	8h 5m	21h 45m	8h 21m
Decl.	17° 16′ N.	24° 12′ N.	20° 10′ N.	18° 40′ N.	20° 45′ N.	14° 21′ S.	19° 16′ N.
Transit	10·25	12·59	10·20	10·06	14·31	4·12	14·48

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—The sun's R.A. on the 1st is 4h 35m, and on the 30th it is 6h 35m. During the month its declination slowly rises from 22° 1′ N. on the 1st to 23° 27′ on the 21st, the summer solstice, when our days are longest. It then falls to 23° 12′ by the 30th. The equation of time reaches zero on the 14th, and rises to 3m 20s on the 30th (see page 6). The increase in the equation of time, taken with the decreasing length of the day, 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 table on pages 15 and 16). On the 19th there is a partial eclipse of the sun visible in the Canadian North West (see page 53).

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

Mercury is a morning star all month and attains greatest elongation 23° 32′ W. on the 11th, but although farther from the sun than in April it is about 7° south of the ecliptic and is not nearly so favorably situated for observation. Rising, as it does, nearly 20° south of the sunrise point, it is not nearly so high in the sky at the time the sun "extinguishes" the stars. But for some days about the 11th it should be easily picked up with field glasses over a clear horizon.

Venus is still separating from the sun but is only an hour behind it on the 15th. It will not be conveniently situated for observation as an evening star until about the end of the month.

Mars on the 15th is 217 million miles from the earth and hence is comparatively faint. However it crosses the meridian 2 hours before the sun and so can be seen as a morning star. From the above table its position in Taurus can be found on Map II. of the Constellations. It is in conjunction with Jupiter on the 8th.

Jupiter on the 15th crosses the meridian at 10.06 a.m. (see above table) and so can be observed as a morning star. The configurations of the satellites are given on the opposite page, and their eclipses, etc., on page 46.

Saturn is about 2½ hours after the sun and can be still seen as an evening star.

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

The minima of Algol are given on the opposite page.

JUNE

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at 3h 45m
			h	m	
Fri.	1		10	50	
Sat.	2				423○1
Sun.	3				4321○
Mon	4		7	39	43○12
♋Tues.	5	8h 6m·7 Full Moon; 19h ☌ ☿ ♂, ☿ 3° 50′ S.			431○2
Wed.	6				2442○3
Thur.	7		4	28	4○13●
Fri.	8	7h ☌ ♂ 2, ♂ 0° 41′ N.; 21h ☌ ☿ 2, ☿ 3° 3′ S.			1○423
Sat.	9				2○314
Sun.	10	6h 41m ☌ ♁ ☾, ♁ 4° 40′ S.	1	17	321○4
Mon.	11	18h ☌ ☿ ♂, ☿ 3° 31′ S.; 19h ☿ Greatest Elong.			3○124
☾Tues.	12	1h 38m·5 Moon's Last Quarter. [W. 23° 32′	22	06	31○24
Wed.	13	11h ☿ Greatest Hel. Lat. S.			2○134
Thur.	14				2○134
Fri.	15		18	55	1○423
Sat.	16	[23′ S.; 12h 40m ☌ ☿ ☾, ☿ 6° 1′ S.			42○31
Sun.	17	0h 51m ☌ 2 ☾, 2 4° 30′ S.; 8h 51m ☌ ♂ ☾, ♂ 3°			4321○
Mon.	18	[Canada, (see p. 53)	15	44	43○21
♍Tues.	19	8h 2m·2 New Moon; ☉ Partial Eclipse visible in N.W.			431○2
Wed.	20	15h 34m ☌ ♀ ☾, ♀ 1° 25′ N.			42○31
Thur.	21	19h 14m ☉ enters Cancer, Summer commences; 23h 49m	12	33	42○3●
Fri.	22	7h 2m ☌ Ψ ☾, Ψ 1° 56′ N. [☌ ♄ ☾, ♄ 2° 12′ N.			41○23
Sat.	23	4h ♂ in ♌.			24○13
Sun.	24	2h ♀ in Perihelion.	9	22	231○4
Mon.	25				3○214
Tues.	26				31○24
☽Wed.	27	11h 8m·4 Moon's First Quarter.	6	11	2○14●
Thur.	28				21○34
Fri.	29				2○234
Sat.	30		2	59	○1234

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

THE SKY FOR JULY

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	7h 52m	9h 7m	5h 23m	4h 5m	8h 20m	21h 42m	8h 26m
Decl.	22° 40′ N.	18° 10′ N.	23° 26′ N.	19° 59′ N.	20° 0′ N.	14° 37′ S.	19° 3′ N.
Transit	12·22	13·36	9·51	8·34	12·48	2·12	12·54

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—During the month the sun's R.A. changes from 6h 39m to 8h 40m, and its Decl. 23° 8′ to 18° 21′ N. The earth is farthest from the sun on the 3rd (see opposite page). On the 18th there is a partial eclipse of the sun invisible in Canada (see page 53).

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 4th there is a total eclipse of the moon which is invisible in Canada (see page 53).

Mercury is in conjunction with the sun on the 12th and is not well placed for observation during the month.

Venus during this month is seen as an evening star, of stellar magnitude —3.3. It sets about 1½ hrs. after the sun. During this and succeeding months, although Venus may be some considerable distance from the sun, it will not be as high in the sky as it would have been had its western elongation occurred in the spring. This depends on the angle that the ecliptic (along which the sun appears to travel and the planets approximately) assumes at the horizon, whether it rises almost directly upward from the horizon or tends to slope downward towards the south.

Mars on the 15th is 212 million miles from the earth and, though not prominent, can be seen as a morning star in the easterly portion of Taurus. Its position amongst the stars can be found from the table given above.

Jupiter on the 15th is on the meridian at 8.34 a.m. and hence can be seen as a morning star from about 2 a.m. onwards. At that time it is about midway between Aldebaran and the Pleiades. Stellar magnitude —1.7, slightly brighter than Sirius. For the configurations of its satellites, see opposite page; for their eclipses, etc., see page 46.

Saturn is now too close to the sun to be well seen as an evening star. On the 15th it is on the meridian at 12.48 p.m.

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

For the minima of Algol, see opposite page.

JULY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at 3h 15m
			h	m	
Sun.	1				231○4
Mon.	2	11h ☿ in ☊.	23	48	3○241
Tues.	3	15h ⊕ in Aphelion.			314○2
♋Wed.	4	16h 40m·5 Full Moon; ☾ Total eclipse invisible in			423○1
Thur.	5	[Canada; 19h ☌ ☿ ♄, ☿ 1° 4′ N.	20	37	421○3
Fri.	6	18h ☌ ☿ Ψ, ☿ 1° 43′ N.			4○123
Sat.	7	1h ☿ in Perihelion; 13h 14m ☌ ♅ ☾, ♅ 4° 41′ S.			4○23●
Sun.	8		17	26	4213○
Mon.	9				43○1●
Tues.	10				341○2
☾Wed.	11	7h 11m·9 Moon's Last Quarter.	14	15	32○41
Thur	12	11h ☌ ☿ ☉ Superior.			21○34
Fri.	13				○1234
Sat.	14	16h 53m ☌ ♃ ☾, ♃ 4° 5′ S.	11	04	○234●
Sun.	15	19h ☿ Greatest Hel. Lat. N.			♃♃2○4
Mon.	16	3h 41m ☌ ♂ ☾, ♂ 1° 26′ S. [Canada.			32○14
Tues.	17	8h ☿ Greatest Hel. Lat. N. [tial eclipse invisible in	7	53	31○24
♎Wed.	18	16h ☌ ☿ ♄, ☿ 1° 25′ N.; 22h 0m·1 New Moon; ☉ Par-			32○14
Thur.	19	5h ☌ ☿ Ψ, ☿ 2° 3′ N.; 13h 48m ☌ ♄ ☾, ♄ 2° 33′ N.;			21○43
Fri.	20	[15h 52m ☌ Ψ ☾, Ψ 2° 1′ N.; 18h 9m ☌ ☿ ☾, ☿	4	42	4○213
Sat.	21	4h 52m ☌ ♀ ☾, ♀ 5° 23′ N. [4° 11′ N.			41○23
Sun.	22				♃42○3
Mon.	23		1	31	432○1
Tues.	24				431○2
Wed.	25		22	20	♃43○1
Thur.	26				421○3
☽Fri.	27	1h 40m·4 Moon's First Quarter; 16h ☌ ♄ ☉.			4○213
Sat.	28	2h ☌ Ψ ☉.	19	09	1○423
Sun.	29				2○134
Mon.	30	8h ☌ ♄ Ψ, ♄ 0° 39′ N.			32○4●
Tues.	31		15	57	31○24

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

THE SKY FOR AUGUST

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	11h 15m	11h 31m	6h 53m	4h 26m	8h 36m	21h 37m	8h 30m
Decl.	3° 52′ N.	4° 25′ N.	23° 31′ N.	20° 51′ N.	19° 5′ N.	15° 0′ S.	18° 47′ N.
Transit	13·42	13·58	9·20	6·53	11·02	0·05	10·57

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—During August the sun's R.A. increases from 8h 44m to 10h 37m, and the Decl. changes from 18° 7′ to 8° 46′ N. The equation of time falls from 6m 10s on the 1st to 0m 22s on the 31st. For fuller details, see page 7.

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

Mercury attains greatest elongation 27° 23′ E. on the 23rd, but again it is on that part of the ecliptic which slopes to the south from the sunset point. The planet, also, is about 4° south of the ecliptic and although, as seen from the earth, it is almost as far separated from the sun as it ever is, it is low down in the sky at sunset. It should however be easily picked up with field glasses where there is a clear horizon. It will be above a point on the horizon about 30° south of the sunset point. It is in conjunction with the moon on the 20th, about 3½° north of it (see opposite page).

Venus will be nearly 2 hours behind the sun on the 15th. It is increasing in brightness, at the same time remaining visible farther into the night (see note for July). On the 20th it is in conjunction with the moon. On that evening the sight of the moon, about 3 days old, with Mercury about 7 moon-diameters to the north, and Venus about as far north of Mercury will be watched with great interest.

Mars on the 15th is 202 million miles from the earth. It is then in the middle of the constellation Gemini, and rises about 3 hours before the sun.

Jupiter on the 15th is on the meridian at 6.53 a.m. (see above table) and hence can be seen as a bright morning star from about 1 a.m. Stellar magnitude, —1.8. For the configurations of its satellites, see opposite page; for their eclipses, etc., see page 46.

Saturn is now about an hour before the sun and hence is seen as a morning star, though not yet very conveniently.

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

For the minima of Algol, see opposite page.

AUGUST

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at 2h 30m
			h	m	
Wed.	1				3○214
Thur.	2				21○4●
♈Fri.	3	0h 10m·9 Full Moon; 21h 20m ☌ ♅ ☾, ♅ 4° 34′ S.	12	46	○134●
Sat.	4				1○243
Sun.	5				2○413
Mon	6		9	35	4231○
Tues.	7				24○32
Wed.	8				43○12
☾Thur.	9	14h 56m·4 Moon's Last Quarter; 19h ☿ in ♍.	6	24	4213○
Fri	10				4○13●
Sat.	11	5h 51m ☌ ♃ ☾, ♃ 3° 39′ S.			41○23
Sun.	12		3	13	42○13
Mon.	13	23h ☌ ☌ ☾, ☌ 0° 42′ N.			2413○
Tues.	14	23h ☍ ♅ ☉.			3○142
Wed.	15		0	02	3○24●
Thur.	16	0h 3m ☌ Ψ☾, Ψ 2° 7′ N.; 3h 18m ☌ ♄ ☾, ♄ 2° 55′ N.			231○4
♌Fri.	17	13h 21m·0 New Moon.	20	51	2○134
Sat.	18				1○234
Sun.	19				24○134
Mon.	20	1h ☿ in Aphelion; 4h 21m ☌ ☿ ☾, ☿ 3° 36′ N.;	17	40	213○4
Tues.	21	[14h 52m ☌ ♀ ☾, ♀ 6° 33′ N.			3○124
Wed.	22				34○2●
Thur.	23	0h ☿ Greatest Elong. E. 27° 23′.	14	29	4231○
Fri.	24				42○13
☽Sat.	25	14h 8m·2 Moon's First Quarter.			41○23
Sun.	26		11	18	4○213
Mon.	27				421○3
Tues.	28				43○21
Wed.	29		8	07	34:○2
Thur.	30				24○324
Fri.	31	5h 28m ☌ ♅ ☾, ♅ 4° 30′ S.			2○134

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☉ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; ♃ Jupiter; ♄ Saturn; ♅ Uranus; Ψ 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

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	11h 51m	13h 46m	8h 18m	4h 39m	8h 51m	21h 33m	8h 34m
Decl.	3° 7′ S.	11° 19′ S.	20° 43′ N.	21° 15′ N.	18° 11′ N.	15° 21′ S.	18° 32′ N.
Transit	12·13	14·11	8·42	5·04	9·16	21·55	8·59

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—The sun's R.A. increases during the month from 10h 40m to 12h 25m. On the 1st its Decl. is 8° 24′ N. The sun reaches the equator on the 23rd (the autumn equinox), and on the 30th its Decl. is 2° 41′ S. For fuller details see page 7.

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

Mercury is in conjunction with the sun on the 18th and too near the sun all month to be observed conveniently.

Venus will be a prominent evening star all month. Its stellar magnitude is now —3.5 and increasing (see note for July).

Mars is getting near to us at the rate of about half-a-million miles a day. On the 15th it is 188 million miles away and (as will be found by the above table and Map II.) in the constellation Cancer. It can be seen as a morning star from about 1.30 a.m. It is in conjunction with Saturn on Oct. 1.

Jupiter on the 15th crosses the meridian at 5.04 a.m. and, rising about 7 hours before this, can be seen the latter half of the night. Stellar magnitude, — 2.0. For the configurations of its satellites, see opposite page; for their eclipses, etc., page 46.

Saturn is now nearly 3 hours before the sun and is well seen as a morning star, in Cancer. See note on Mars.

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

For the minima of Algol, see opposite page.

SEPTEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at 2h 0m
			h	m	
(24)Sat.	1	7h 28m·5 Full Moon.	4	56	1○234
Sun.	2				○2134
Mon.	3	5h □ ♃ ☉.			21○34
Tues.	4		1	44	3○14●
Wed.	5	3h ☿ Stationary.			31○24
Thur.	6		22	33	32○14
Fri.	7	18h 47m ☌ ♃ ☾, ♃ 3° 14′ S.			2○34●
(☾Sat.	8	2h 5m·2 Moon's Last Quarter.			41○23
Sun.	9	10h ☿ Greatest Hel. Lat. S.; 21h ♀ in ♉.	19	22	4○123
Mon.	10				421○3
Tues.	11	18h 53m ☌ ♂ ☾, ♂ 2° 55′ N.			43○1●
Wed.	12	7h 54m ☌ ♆ ☾, ♆ 2° 18′ N.; 16h 12m ☌ ♄ ☾, ♄ 3° 22′ N.	16	11	431○2
Thur.	13				432○1
Fri.	14				42○●●
Sat.	15		13	00	♃4○23
(☉Sun.	16	5h 27m·5 New Moon; 16h 7m ☌ ☿ ☾, ☿ 1° 31′ N.			4○123
Mon.	17				21○34
Tues.	18	19h ☌ ☿ ☉ Inferior.	9	49	32○14
Wed.	19	17h 30m ☌ ♀ ☾, ♀ 4° 5′ N.			31○24
Thur.	20				♃3○14
Fri.	21		6	38	213○4
Sat.	22	5h ☌ ♂ ♆, ♂ 1° 18′ N.			○1234
Sun.	23	10h 1m Sun enters Libra, Autumn commences.			○1243
(☽Mon.	24	0h 41m·4 Moon's First Quarter.	3	27	21○43
Tues.	25				423○1
Wed.	26				431○2
Thur.	27	3h ☿ Stationary; 15h 14m ☌ ♅ ☾, ♅ 4° 33′ S.	0	16	43○21
Fri.	28	10h ☿ in ♌.			4231○
Sat.	29		21	05	4○213
(24)Sun.	30	12h ♃ Stationary; 15h 31m·1 Full Moon.			4○23●

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

THE SKY FOR OCTOBER

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	12h 34m	16h 7m	9h 31m	4h 39m	9h 2m	21h 30m	8h 37m
Decl.	1° 34′ S.	22° 58′ S.	16° 10′ N.	21° 13′ N.	17° 29′ N.	15° 34′ S.	18° 23′ N.
Transit	11·01	14·33	7·57	3·06	7·29	19·54	7·03

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—The sun's R.A. increases during October from 12h 28m to 14h 21m, and the Decl. changes from 3° 4′ to 14° 1′ S. The equation of time rises from 10m 12s to 16m 18s, to be subtracted from apparent time. For fuller details see page 7.

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

Mercury attains greatest elongation west on the 4th. Being near its perihelion its apparent distance from the sun is only 17° 56′. Although 1½° north of the ecliptic, it is not very high above the horizon, but as this is a favorable season to observe a western elongation a sharp eye will probably see the planet. Examine the sky above a point on the horizon about 7° south of the sunrise point. (See notes for April and June).

Venus is gradually increasing in brightness and although comparatively low in the sky is a prominent evening star (see note for July).

Mars on the 15th is 170 million miles from the earth and is of stellar magnitude + 1.5, not quite as bright as Pollux. On October 30 Mars is in conjunction with Regulus, being about 1° 10′ north. Well seen as a morning star. See note on Saturn.

Jupiter on the 15th is on the meridian at 3.06 a.m., and consequently can be seen most of the night. Stellar magitude —2.2. For the configurations of its satellites, see opposite page; for their eclipses, etc., see page 46.

Saturn is now about 4½ hours before the sun and is well seen as a morning star of apparent magnitude + 0.6. On the 1st Mars is in conjunction with Saturn, being 40′ north (see opposite page).

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

The minima of Algol are given on the opposite page.

OCTOBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol h	Minima of Algol m	Configuration of Jupiter's Satellites at 1h 15m
Mon.	1	7h ☌ ♂ ♄, ♂ 0° 40′ N.			421○3
Tues.	2		17	54	423○1
Wed.	3	1h ☿ in Perihelion.			31○42
Thur.	4	11h ☿ Greatest Elong. W. 17° 56′.			3○214
Fri.	5	4h 27m ☌ ♃ ☾, ♃ 2° 57′ S.	14	42	231○4
Sat.	6				○134●
☾Sun.	7	17h 14m·3 Moon's Last Quarter			1○234
Mon	8		11	31	♃2○34
Tues.	9	15h 54m ☌ ♆ ☾, ♆ 2c 36′ N.			2○314
Wed.	10	4h 25m ☌ ♄ ☾, ♄ 3° 52′ N.; 14h 36m ☌ ♂ ☾, ♂			31○24
Thur.	11	[5° 2′ N.	8	20	3○421
Fri	12				4231○
Sat.	13	8h ☿ Greatest Hel. Lat. N.			4○31●
Sun.	14	11h ♀ in Aphelion; 23h 37m ☌ ☿ ☾, ☿ 7° 33′ N.	5	09	41○23
●Mon.	15	21h 41m New Moon.			42○13
Tues.	16				42○13
Wed.	17		1	58	431○2
Thur.	18				34○12
Fri.	19	14h 57m ☌ ♀ ☾, ♀ 0° 8′ S.	22	47	3214○
Sat.	20				2○314
Sun.	21				1○234
Mon.	22		19	36	♃1○134
☽Tues.	23	9h 37m·7 Moon's First Quarter.			2○34●
Wed.	24	22h 32m ☌ ♅ ☾, ♅ 4° 44′ S.			31○24
Thur.	25		16	25	3○124
Fri.	26				321○4
Sat.	27				2○314
Sun.	28		13	14	14○23
Mon.	29				4○213
○Tues.	30	1h 19m·2 Full Moon; 11h ♅ Stationary; 21h □ ♆ ☍.			421○3
Wed.	31		10	03	♃43○2

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

THE SKY FOR NOVEMBER

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	15h 48m	18h 41m	10h 37m	4h 27m	9h 8m	21h 30m	8h 38m
Decl.	21° 2′ S.	26° 10′ S.	10° 40′ N.	20° 48′ N.	17° 9′ N.	15° 32′ S.	18° 20′ N.
Transit	12·12	15·05	7·01	0·52	5·33	17·52	5·02

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—The sun's R.A. during the month increases from 14h 24m to 16h 24m, and the Decl. changes from 14° 21′ to 21° 36′ S. The equation of time rises to a maximum on the 3rd, at which time it is 16m 22s. The true sun crosses the meridian this much earlier than the mean sun (see page 7).

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the morning of the 3rd the moon occults μ Geminorum (see page 8).

Mercury is too near the sun for convenient observation during the month.

Venus is now 3 hours behind the sun and its position is constantly improving. Its stellar magnitude is —4.0 towards the end of the month. The fraction of the disc which appears to us illuminated is decreasing, but because the planet is approaching us the whole of the disc is increasing in apparent size and the illuminated portion is thereby increasing in apparent size faster than it is decreasing owing to change of phase. See also note for July. It reaches greatest elongation E. on the 30th.

Mars on the 15th is 146 million miles from us and its stellar magnitude is + 1.3. It is on the meridian at 7.01 a.m. and so can be seen during the last half of the night.

Jupiter is in opposition to the sun on the 29th and so can be observed almost the whole night. Stellar magnitude —2.4. For the configurations of the satellites, see opposite page; for their eclipses, etc., see page 46.

Saturn is now about 6½ hours before the sun and is well seen during the last half of the night. Stellar magnitude + 0.5. It begins to retrograde on the 26th (see opp. page).

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

The minima of Algol are given on the opposite page.

NOVEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at 0h 15m
			h	m	
Thur.	1	11h 25m ☌ ♃ ☾, ♃ 2° 55′ S.			43○12
Fri.	2				4321○
Sat.	3	13h ☌ ☿ ☉ Superior.			
Sun.	4		6	52	42○1●
Mon.	5	17h ♀ Greatest Hel. Lat. S.; 19h ☿ in ♍.			41○23
☾Tues.	6	0h 16m ☌ ♆ ☾, ♆ 2° 53′ N.; 12h 3m·5 Moon's Last			○4213
Wed.	7	[Quarter; 15h 32m ☌ ♄ ☾, ♄ 4° 19′ N.; 23h □ ♄ ☉.	3	41	21○34
Thur.	8	8h 37m ☌ ♂ ☾, ♂ 6° 46′ N.			3○14●
Fri.	9	20h ♆ Stationary.			3○24●
Sat.	10		0	29	321○4
Sun.	11				23○14
Mon.	12	15h □ ♅ ☉.	21	18	1○234
Tues	13				○2143
●Wed.	14	13h 28m·5 New Moon.			21○43
Thur.	15	3h 50m ☌ ☿ ☾, ☿ 1° 48′ N.	18	07	43○1●
Fri.	16	0h ☿ in Aphelion.			43○2●
Sat.	17				4321○
Sun.	18	9h 46m ☌ ♀ ☾, ♀ 4° 4′ S.	14	56	423○1
Mon.	19				41○23
Tues.	20				4○123
☽Wed.	21	4h 43m ☌ ♅ ☾, ♅ 4° 56′ S.; 17h 28m·8 Moon's First	11	45	421○3
Thur.	22	[Quarter.			♃42○1
Fri.	23				31○42
Sat.	24		8	34	♃32○4
Sun.	25				23○14
Mon.	26	11h ♄ Stationary.			1○234
Tues.	27		5	23	○1234
○Wed.	28	13h 41m·3 Full Moon; 15h 30m ☌ ♃ ☾, ♃ 3° 7′ S.			21○34
Thur.	29	1h ☍ ♃ ☉.			2○314
Fri.	30	3h ♀ Greatest Elong. E. 47° 18′.	2	12	31○24
					♃34○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 DECEMBER

POSITION OF PLANETS ON THE 15TH.

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R. A.	18h 58m	20h 49m	11h 31m	4h 10m	9h 8m	21h 33m	8h 36m
Decl.	24° 45′ S.	19° 51′ S.	5° 44′ N.	20° 11′ N.	17° 18′ N.	15° 17′ S.	18° 26′ N.
Transit	13·24	15·15	5·56	22·33	3·34	15·58	3·03

The position is given for Greenwich Mean Noon. The time of transit is in Local Mean Time, hours numbering from midnight.

The Sun.—During December the sun's R.A. increases from 16h 28m to 18h 40m. On the 1st the Decl. is 21° 46′ S.; this slowly changes and it becomes 23° 27′ on the 22nd (the winter solstice, see next page), and by the 31st it has come back to 23° 8′. On the 14th there is an annular eclipse of the sun invisible in Canada (see page 53). For equation of time see page 7.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 28th there is a total eclipse of the moon visible in Canada (see page 53). On the morning of the 28th the moon occults μ Geminorum (see page 8).

Mercury attains greatest elongation 20° 20′ E. on the 17th. Its apparent distance from the sun is comparatively small, and it is also about 5° south of the ecliptic, but because the ecliptic in the west at sunset does not slope downwards towards the horizon so decidedly at this time of the year as it does early in the fall, it is not so unfavorable a time to observe an eastern elongation. For some days on both sides of the above date the planet should be seen without difficulty with field glasses in a clear horizon. Look between 15° and 20° south of where the sun has set. Having once located the planet with the glasses, it can probably be seen with the naked eye.

Venus has much improved its position for observation (see note for July) and is much higher in the sky. It is now 3¼ hours after the sun and has stellar magnitude —4.4. It is nearing greatest brilliancy as an evening star. On the 17th it is in conjunction with the moon.

Mars on the 15th is 121 million miles from the earth and has stellar magnitude + 0.9. It is 6 hours before the sun and is well seen as a morning star. During the month it passes from Leo into Virgo.

Jupiter is still visible almost the entire night, being on the meridian, on the 15th, at 10.33 p.m. Its stellar magnitude is —2.4. For the configurations of its satellites, see next page; for their eclipses, etc., see page 46.

Saturn on the 15th is on the meridian at 3.34 a.m. and hence is visible from about 9 o'clock on through the night. Its stellar magnitude is + 0.4 and it continues to retrograde during the month.

The positions of *Uranus* and *Neptune* are given in the above table. See note for January.

The minima of Algol are given on the opposite page.

DECEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configuration of Jupiter's Satellites at 23h 15m
			h	m	
Sat.	1				
Sun.	2		23	01	41○23
Mon.	3	8h 39m ☌ ♆ ☾, ♆ 3° 2′ N.			4○123
Tues.	4	0h 42m ☌ ♄ ☾, ♄ 4° 36′ N.			421○3
Wed.	5		19	50	42○31
☾Thur.	6	9h ☿ Greatest Hel. Lat. S.; 9h 13m·8 Moon's Last			431○2
Fri.	7	[Quarter; 22h 37m ☌ ♂ ☾, ♂ 8° 0′ N.			34○21
Sat.	8		16	39	3241○
Sun.	9				2|4○34●
Mon.	10				○1234
Tues.	11	23h □ ♂ ☍.	13	27	12○34
Wed.	12				2○134
Thur.	13				31○24
☍Fri.	14	☍ Ann. eclipse invis. in Canada; 4h 17m·3 New Moon.	10	16	3○214
Sat.	15	18h 42m ☌ ☿ ☾, ☿ 3° 4′ S.			321○4
Sun.	16				2|4○●●
Mon.	17	1h ☿ Greatest Elong. E. 20° 20′; 20h 1m ☌ ♀ ☾,	7	05	4○123
Tues.	18	11h 47m ☌ ♅ ☾, ♅ 5° 5′ S. [♀ 5° 30′ S.			412○3
Wed.	19				42○13
Thur.	20		3	54	413○2
☽Fri.	21	1h 7m·3 Moon's First Quarter.			43○12
Sat.	22	4h 46m Sun enters Capricornus, Winter commences.			4321○
Sun.	23		0	43	432○1
Mon.	24	18h ☿ Stationary.			4○23●
Tues.	25	7h ♂ Greatest Hel. Lat. N.; 9h ☿ in ♌; 17h 46m	21	32	12○43
Wed.	26	[☌ 2|4 ☾, 2|4 3° 20′ S.			2○134
Thur.	27				13○24
♌Fri.	28	☾ Total eclipse visible in Canada (see p. 53); 4h 51m·6	18	21	3○124
Sat.	29	[Full Moon			321○4
Sun.	30	0h ☿ in Perihelion; 16h 13m ☌ ♆ ☾, ♆ 3° 0′ N.			23○14
Mon.	31	3h ☌ ♀ ♅, ♀ 0° 35′ N.; 7h 4m ☌ ♄ ☾, ♄ 4° 37′ N.;	15	10	1○324
		[24h ♀ in ♌.			2|1○43

Key to Symbols.—☌ Conjunction; ☍ Opposition; □ Quadrature; ☊ Ascending Node; ☋ Descending Node; ☍ Sun; ☿ Mercury; ♀ Venus; ⊕ Earth; ♂ Mars; 2|4 Jupiter; ♄ Saturn; ♅ Uranus; ♆ Neptune. For Jupiter's satellites the circle ○ represents the disc of the planet; 2|4 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.

JANUARY

d	h	m	s			d	h	m	s		
1	18	06	46	II	ER	15	23	21	12	II	ER
3	0	34	03	I	TI	16	17	41	21	III	SI
	21	52	37	I	OD		19	20	07	III	Se
4	19	02	23	I	TI	17	18	29	28	II	Se
	20	20	27	I	SI	18	22	51	48	I	TI
	21	11	42	I	Te	19	20	11	13	I	OD
	22	28	59	I	Se		23	42	49	I	ER
5	18	03	59	III	OD	20	18	40	45	I	SI
	19	51	20	I	ER		19	30	29	I	Te
	20	03	51	III	OR		20	49	17	I	Se
	23	33	24	III	ED	21	18	11	46	I	ER
6	21	20	22	II	TI	22	20	42	35	II	OD
	23	55	38	II	Te		23	19	35	II	OR
7	0	01	42	II	SI		23	26	02	II	ED
8	18	05	58	II	OR	23	18	08	13	III	Te
	18	11	09	II	ED		21	43	32	III	SI
	20	43	53	II	ER		23	21	53	III	Se
10	23	46	53	I	OD	24	18	29	26	II	Te
11	20	56	32	I	TI		18	36	11	II	SI
	22	16	05	I	SI		21	06	59	II	Se
	23	05	59	I	Te	26	22	07	52	I	OD
12	0	24	36	I	Se	27	19	17	23	I	TI
	18	15	35	I	OD		20	36	28	I	SI
	21	47	05	I	ER		21	27	12	I	Te
	21	59	49	III	OD		22	45	03	I	Se
13	0	02	01	III	OR	28	20	07	26	I	ER
	17	34	47	I	Te	29	23	22	23	II	OD
	18	53	34	I	Se	30	20	13	06	III	TI
	23	56	18	II	TI		22	16	22	III	Te
15	18	04	59	II	OD	31	18	34	35	II	TI
	20	41	39	II	OR		21	10	16	II	Te
	20	48	31	II	ED		21	13	44	II	SI

FEBRUARY

2	17	55	20	II	ER	17	18	44	29	III	OD
3	21	14	54	I	TI		20	51	46	III	OR
	22	32	12	I	SI	18	18	17	05	II	Se
4	18	34	58	I	OD	19	19	42	12	I	TI
	22	03	03	I	ER		20	52	34	I	SI
5	17	54	24	I	Te		21	52	35	I	Te
	19	09	48	I	Se	20	20	22	55	I	ER
7	21	16	58	II	TI	23	20	56	42	II	OD
9	20	33	09	II	ER	25	18	23	40	II	SI
10	19	45	24	III	ED		18	44	19	II	Te
	21	25	58	III	ER		20	53	49	II	Se
11	20	33	31	I	OD	26	21	42	10	I	TI
12	18	56	50	I	SI	27	19	02	37	I	OD
	19	53	07	I	Te	28	18	22	51	I	Te
	21	05	39	I	Se		19	26	23	I	Se
13	18	27	27	I	ER		19	32	20	III	Se
16	18	10	32	II	OD						

MARCH

4	18	55	19	II	TI	14	20	14	06	I	TI
	21	00	17	II	SI		21	08	34	I	SI
	21	30	44	II	Te	15	20	37	39	I	ER
6	21	03	05	I	OD	20	18	48	04	II	OD
7	19	12	55	I	SI	22	19	35	34	I	OD
	19	46	07	III	Te	23	18	57	04	I	Te
	20	23	40	I	Te		19	42	38	I	Se
	21	22	13	I	Se	25	19	56	30	III	ED
8	18	42	28	I	ER	29	19	18	33	II	Te
13	20	24	10	II	ER	30	19	28	33	I	SI

APRIL

5	19	33	09	II	TI	15	19	34	37	I	Te
12	19	43	33	III	Se						

JUNE

d	h	m	s			d	h	m	s		
13	3	37	42	I	SI	27	3	14	50	III	OD
14	3	34	56	I	OR	29	2	45	17	I	TI
23	3	36	51	II	Se	30	3	42	39	II	SI

JULY

2	2	58	02	II	OR	22	2	18	01	III	SI
6	3	50	21	I	SI		3	14	19	I	TI
14	2	53	16	I	ED		4	01	25	III	Se
15	2	22	43	I	Se	23	2	33	20	I	OR
	2	27	24	III	TI	25	3	02	00	II	TI
	3	24	54	I	Te		3	13	18	II	Se
16	3	53	48	II	ED	29	4	01	58	I	SI
18	2	46	08	II	Te	30	1	09	21	I	ED
22	2	07	42	I	SI	31	1	51	27	I	Te

AUGUST

1	3	19	47	II	SI	19	0	16	14	II	Se
2	0	59	13	III	OD		0	28	20	II	TI
	2	51	05	III	OR		2	55	17	II	Te
3	3	24	17	II	OR		23	42	05	III	TI
6	3	03	08	I	ED	20	1	30	16	III	Te
7	0	24	42	I	SI	21	4	12	42	I	SI
	1	39	45	I	TI	22	1	19	14	I	ED
	2	33	40	I	Se	23	0	01	05	I	TI
	3	48	45	I	Te		0	49	57	I	Se
8	0	58	03	I	OR		2	09	43	I	Te
9	1	51	52	III	ER	26	0	23	07	II	SI
10	1	00	30	II	ED		2	51	37	II	Se
	3	31	05	II	ER		3	06	49	II	TI
	3	37	05	II	OD	27	0	04	02	III	Se
12	0	15	28	II	Te		3	47	17	III	TI
14	2	18	45	I	SI	28	0	43	12	II	OR
	3	36	27	I	TI	29	3	12	50	I	ED
	4	27	37	I	Se	30	0	35	01	I	SI
15	2	54	35	I	OR		1	55	45	I	TI
16	0	14	15	I	Te		2	43	46	I	Se
	4	03	35	III	ED		4	04	16	I	Te
17	3	36	21	II	ED	31	1	13	46	I	OR

SEPTEMBER

2	2	58	36	II	SI	18	3	15	37	II	ED
3	2	16	35	III	SI	19	23	56	29	II	Se
	4	04	56	III	Se	20	0	06	53	II	TI
4	0	35	32	II	ER		2	32	57	II	Te
	0	50	40	II	OD	21	0	00	18	III	ED
	3	18	26	II	OR		1	53	43	III	ER
6	2	28	48	I	SI		3	22	49	I	ED
	3	49	25	I	TI	22	0	44	37	I	SI
	4	37	33	I	Se		2	01	15	I	TI
	23	22	59	III	OR		2	53	30	I	Se
	23	35	06	I	ED		4	09	37	I	Te
7	3	07	28	I	OR	23	1	19	25	I	OR
	23	06	02	I	Se		22	37	13	I	Te
8	0	26	08	I	Te	27	0	03	23	II	SI
11	0	40	33	II	ED		2	32	35	II	Se
	3	10	42	II	ER		2	36	30	II	TI
	3	24	07	II	OD		5	02	30	II	Te
13	0	01	12	II	Te	28	4	00	32	III	ED
	4	22	31	I	SI		5	16	46	I	ED
14	1	28	53	III	OD	29	0	04	08	II	OR
	1	28	56	I	ED		2	38	13	I	SI
	3	17	28	III	OR		3	51	19	I	TI
	5	00	09	I	OR		4	47	13	I	Se
	22	50	59	I	SI		23	45	11	I	ED
15	0	10	03	I	TI	30	3	09	38	I	OR
	0	59	46	I	Se		21	06	36	I	SI
	2	18	26	I	Te		22	18	38	I	TI
	23	28	05	I	OR		23	15	38	I	Se

OCTOBER

d	h	m	s		
1	0	27	02	I	Te
	21	37	05	I	OR
	23	11	09	III	TI
2	0	55	19	III	Te
4	2	39	25	II	SI
	5	03	54	II	TI
	5	08	54	II	Se
5	21	42	45	II	EL
6	2	29	00	II	OR
	4	31	48	I	SI
7	1	39	13	I	ED
	4	58	44	I	OR
	20	43	07	II	Te
	23	00	11	I	SI
8	0	07	16	I	TI
	1	09	22	I	Se
	2	15	44	I	Te
	22	13	12	III	SI
	23	25	54	I	OR
9	0	07	08	III	Se
	2	49	37	III	TI
	4	33	02	III	Te
	20	42	44	I	Te
11	5	15	36	II	SI
13	0	17	30	II	ED
	4	51	32	II	OR
14	3	33	20	I	ED
	20	41	02	II	TI
	21	04	02	II	Se
	23	07	09	II	Te
15	0	53	47	I	SI
	1	54	45	I	TI
	3	03	09	I	Se
	4	03	18	I	Te
	22	01	56	I	ED
16	1	13	17	I	OR
	2	12	18	III	SI
	4	07	27	III	Se
	20	21	27	I	TI
	21	31	36	I	Se
	22	30	02	I	Te

d	h	m	s		
19	19	55	24	III	OD
	21	40	09	III	OR
20	2	52	10	II	ED
21	5	27	32	I	ED
22	1	29	03	II	Te
	2	47	25	I	SI
	3	41	09	I	TI
	4	56	58	I	Se
	5	49	48	I	Te
	23	56	10	I	ED
23	3	00	16	I	OR
	20	21	01	II	OR
	21	15	49	I	SI
	22	07	35	I	TI
	23	25	26	I	Se
24	0	16	16	I	Te
	21	26	44	I	OR
26	19	58	26	III	ED
	21	57	11	III	ER
	23	22	02	III	OD
27	1	06	12	III	OR
	5	26	48	II	ED
28	23	47	18	II	SI
29	1	22	26	II	TI
	2	17	54	II	Se
	3	48	55	II	Te
	4	41	06	I	SI
	5	26	33	I	TI
30	1	50	31	I	ED
	4	45	58	I	OR
	22	38	10	II	OR
	23	09	32	I	SI
	23	52	45	I	TI
31	1	19	20	I	Se
	2	01	34	I	Te
	20	19	05	I	EL
	23	12	13	I	OR

NOVEMBER

d	h	m	s		
1	19	47	48	I	Se
	20	27	45	I	Te
2	23	58	07	III	ED
3	1	58	00	III	ER
	2	44	56	III	OD
	4	28	51	III	OR
5	2	24	14	II	SI
	3	40	17	II	TI
	4	55	08	II	Se
	6	07	02	II	Te
6	3	44	59	I	ED
	21	18	44	II	ED
7	0	53	36	II	OR
	1	03	21	I	SI
	1	37	06	I	TI
	3	13	19	I	Se
	3	46	03	I	Te
	22	13	35	I	ED
8	0	56	56	I	OR
	19	15	05	II	Te
	19	31	48	I	SI
	20	03	04	I	TI
	21	41	48	I	Se
	22	12	02	I	Te
9	19	23	04	I	OR
10	3	58	07	III	ED
	5	59	07	III	ER
	6	04	27	III	OD

d	h	m	s		
12	5	01	24	II	SI
	5	56	38	II	TI
13	5	39	35	I	ED
	18	10	44	III	SI
	19	55	49	III	TI
	20	11	03	III	Se
	21	38	21	II	Te
	23	53	24	II	ED
14	2	57	17	I	SI
	3	07	41	II	OR
	3	20	49	I	TI
	5	07	24	I	Se
	5	29	53	I	Te
15	0	08	13	I	ED
	2	41	03	I	OR
	18	19	38	II	SI
	19	03	54	II	TI
	20	50	55	II	Se
	21	25	46	I	SI
	21	31	09	II	Te
	21	46	39	I	TI
	23	35	54	I	Se
	23	55	44	I	Te
16	18	36	57	I	ED
	21	07	04	I	OR
17	18	04	29	I	Se
	18	21	37	I	Te
20	22	10	09	III	SI

NOVEMBER—*(Continued)*

d	h	m	s		
20	23	10	51	III	TI
21	0	11	44	III	Se
	0	54	12	III	Te
	2	23	06	II	ED
	4	51	21	I	SI
	5	04	05	I	TI
	5	20	53	II	OR
22	2	02	59	I	ED
	4	24	49	I	OR
	20	57	09	II	SI
	21	18	49	II	TI
	23	19	52	I	SI
	23	28	39	II	Se
	23	29	52	I	TI
	23	46	27	II	Te
23	1	30	08	I	Se
	1	39	04	I	Te
	20	31	45	I	ED
	22	50	47	I	OR
24	17	48	27	I	SI
	17	55	40	I	TI
	18	27	18	II	OR

d	h	m	s		
24	19	58	44	I	Se
	20	04	53	I	Te
25	17	16	38	I	OK
28	2	09	48	III	SI
	2	24	42	III	TI
	4	09	17	III	Te
	4	12	36	III	Se
	5	02	53	II	ED
	6	45	34	I	SI
	6	47	14	I	TI
29	3	57	53	I	ED
	6	09	18	I	ER
	23	33	24	II	TI
	23	34	54	II	SI
30	1	13	00	I	TI
	1	14	08	I	SI
	2	01	27	II	Te
	2	06	32	II	Se
	3	22	17	I	Te
	3	24	29	I	Se
	22	24	04	I	OD

DECEMBER

1	0	38	08	I	ER
	18	04	09	III	ER
	18	13	14	II	OD
	19	38	49	I	TI
	19	42	45	I	SI
	20	50	26	II	ER
	21	48	07	I	Te
	21	53	05	I	Se
2	19	06	50	I	ER
5	5	38	21	III	TI
	6	09	33	III	SI
6	5	41	49	I	OD
7	1	48	14	II	TI
	2	12	51	II	SI
	2	56	19	I	TI
	3	08	32	I	SI
	4	16	44	II	Te
	4	44	33	II	Se
	5	05	40	I	Te
	5	18	54	I	Se
8	0	07	53	I	OD
	2	33	16	I	ER
	19	05	17	III	OD
	20	25	57	II	OD
	21	22	14	I	TI
	21	37	10	I	SI
	22	05	19	III	ER
	23	25	25	II	ER
	23	31	34	I	Te
	23	47	32	I	Se
9	18	33	49	I	OD
	21	02	01	I	ER
10	17	25	09	II	Te
	17	57	32	I	Te
	18	04	06	II	Se
	18	16	10	I	Se
14	4	03	53	II	TI
	4	40	06	I	TI
	4	50	57	II	SI
	5	03	04	I	SI
15	1	52	09	I	OD
	4	28	33	I	ER
	22	20	51	III	OD
	22	39	31	II	OD
	23	06	10	I	TI
	23	31	43	I	SI
16	1	15	33	I	Te
	1	42	03	I	Se

d	h	m	s		
16	2	00	32	II	ER
	2	06	35	III	ER
	20	18	15	I	OD
	22	57	19	I	ER
17	17	12	39	II	TI
	17	32	17	I	TI
	18	00	23	I	SI
	18	10	34	II	SI
	19	41	40	I	Te
	19	41	51	II	Te
	20	10	42	I	Se
	20	42	15	II	Se
18	17	26	13	I	ER
22	3	37	08	I	OD
23	0	50	52	I	TI
	0	54	24	II	OD
	1	26	23	I	SI
	1	39	15	III	OD
	3	00	16	I	Te
	3	32	59	III	OR
	3	36	40	I	Se
	4	00	03	III	ED
	4	35	48	II	ER
	22	03	26	I	OD
24	0	52	44	I	ER
	19	17	12	I	TI
	19	30	26	II	TI
	19	55	05	I	SI
	20	48	52	II	SI
	21	26	36	I	Te
	22	00	04	II	Te
	22	05	20	I	Se
	23	20	29	II	Se
25	19	21	40	I	ER
26	17	23	52	III	Te
	17	53	29	II	ER
	18	10	49	III	SI
	20	18	14	III	Se
30	2	36	31	I	TI
	3	11	01	II	OD
	3	21	10	I	SI
	23	49	35	I	OD
31	2	48	16	I	ER
	21	03	07	I	TI
	21	49	53	I	SI
	21	50	09	II	TI
	23	12	31	I	Te
	23	27	15	II	SI

EPHEMERIS FOR PHYSICAL OBSERVATIONS OF THE SUN

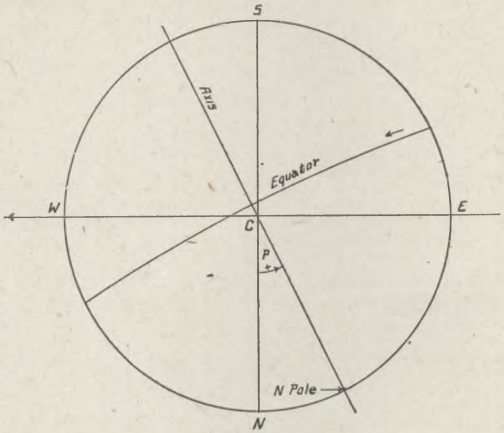
By Ralph E. DeLury

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

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

"Long." is the heliographical longitude of the centre of the Sun's disc referred to the meridian which passed through the ascending node of the Sun's equator on the ecliptic, 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 1917.0 is 74°.602 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 $P = +\ 26°.41$, *"Lat."* $= +\ 6°.19$ and *"Long."* $= 49°.66$. 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 $+\ 26°.41$ 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 C of the disc, which is at *"Lat."* $+\ 6°.19$ and *"Long."* $49°.66$.

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	+ 1·99	− 3·16	162·77	July	5	− 0·88	+ 3·42	240·96
	6	− 0·44	3·73	96·92		10	+ 1·39	3·94	174·79
	11	2·86	4·27	31·07		15	3·64	4·43	108·62
	16	5·23	4·77	325·24		20	5·85	4·90	42·47
	21	7·54	5·24	259·40		25	8·00	5·32	336·32
	26	9·76	5·66	193·57		30	10·07	5·72	270·18
	31	− 11·89	− 6·04	127·74	Aug.	4	+ 12·06	+ 6·07	204·06
Feb.	5	13·90	6·37	61·90		9	13·96	6·38	137·94
	10	15·79	6·65	356·07		14	15·75	6·64	71·84
	15	17·54	6·88	290·23		19	17·42	6·85	5·76
	20	19·15	7·05	224·39		24	18·98	7·04	299·69
	25	20·62	7·17	158·54		29	20·40	7·16	233·63
Mar.	2	− 21·93	− 7·24	92·67	Sept.	3	+ 21·69	+ 7·23	167·58
	7	23·08	7·25	26·80		8	22·84	7·25	101·55
	12	24·07	7·20	320·91		13	23·84	7·22	35·53
	17	24·89	7·10	255·00		18	24·68	7·13	329·53
	22	25·54	6·94	189·08		23	25·37	6·99	263·53
	27	26·01	6·74	123·15		28	25·89	6·80	197·55
Apr.	1	− 26·31	− 6·48	57·19	Oct.	3	+ 26·24	+ 6·56	131·57
	6	26·43	6·18	351·21		8	26·41	6·27	65·60
	11	26·36	5·83	285·21		13	26·40	5·94	359·64
	16	26·11	5·44	219·19		18	26·20	5·55	293·69
	21	25·68	5·01	153·16		23	25·81	5·13	227·75
	26	25·06	4·55	87·10		28	25·23	4·66	161·81
May	1	− 24·26	− 4·06	21·02	Nov.	2	+ 24·45	+ 4·16	95·88
	6	23·28	3·53	314·93		7	23·47	3·63	29·95
	11	22·13	2·99	248·81		12	22·29	3·07	324·04
	16	20·80	2·42	182·69		17	20·93	2·48	258·12
	21	19·31	1·84	116·55		22	19·38	1·87	192·22
	26	17·67	1·25	50·39		27	17·65	1·25	126·32
	31	− 15·88	− 0·65	344·23	Dec.	2	+ 15·76	+ 0·61	60·42
June	5	13·98	− 0·05	278·06		7	13·73	− 0·03	354·53
	10	11·96	+ 0·55	211·88		12	11·56	0·67	288·65
	15	9·85	1·15	145·69		17	9·30	1·29	222·78
	20	7·66	1·74	79·51		22	6·95	1·93	156·92
	25	5·43	2·32	13·33		27	4·55	2·54	91·05
	30	− 3·16	+ 2·88	307·14		32	+ 2·11	3·13	25·20

*Taken from *The Nautical Almanac*.

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
$\alpha\ \beta$ Perseids	July-Aug.-Sept.	Aug. 16	3	12	+	43
Perseids	July 8-Aug. 25	Aug. 11-12	3	4	+	57
Draconis	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	Oct. 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't'r Miles	Mass	Density	Volume	Axial Rotation
	⊕ = 1	Millions of Miles	Mean Solar Days	Years		⊕ = 1	Water = 1	⊕ = 1	
☿ Mercury...	0.387	36.0	87.97	0.24	3030	0.0476	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	$9^h\ 55^m$ ±
♄ Saturn.....	9.539	886.0	10759.2	29.46	73000	94.8	0.72	760	$10^h\ 14^m$ ±
♅ Uranus....	19.183	1781.9	30686.8	84.02	31900	14.6	1.22	65	$10^h\ 45^m$ ±
♆ Neptune...	30.055	2971.6	60181.1	164.78	34800	17.0	1.11	85	?
☉ Sun.....	....	....	....	....	866400	332000	1.39	1300000	$25^d\ 7^h\ 48^m$ ±
☾ 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	266·00 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
9. (Nameless).	19	18,900,000	3 years	Nicholson.....	July 1914
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

ECLIPSES IN 1917

PREPARED BY R. M. MOTHERWELL

In the year 1917 there will be seven eclipses, four of the Sun and three of the Moon.

I. A Total Eclipse of the Moon, Jan. 7, 1917, the beginning visible in central and western Europe, northwestern Africa, North and South America, and the central and eastern portions of the Pacific Ocean: the ending visible in North America, northwestern South America, northern and northeastern Asia and eastern Australia.

Moon enters shadow	Jan.	7d	12h	50.4m (= Jan. 8, 0h 50.4m a.m. E. S. T.)
Total eclipse begins	"	7	14	0.4
Middle of the eclipse	"	7	14	44.6
Total eclipse ends	"	7	15	28.8
Moon leaves shadow	"	7	16	38.6

Magnitude of the eclipse = 1.369 (Moon's diameter = 1.00).

II. A Partial Eclipse of the Sun, Jan. 22, 1917, invisible in Canada but visible in central and eastern Europe, western Asia and northern Africa.

Magnitude of greatest eclipse = 0.725 (Sun's diameter = 1.0).

III. A Partial Eclipse of the Sun, June 18, 1917, visible in western and northwestern Canada, Alaska, Arctic Ocean, Siberia and northwestern Russia-in-Europe.

Magnitude of greatest eclipse = 0.473 (Sun's diameter = 1.0).

IV. A Total Eclipse of the Moon, July 4, 1917, invisible in Canada but visible in Asia except in northeastern portion, Australia, Africa, Europe except the northwestern portions, and the south Atlantic Ocean; the ending visible generally in western Australia, southwestern Asia, Europe, Africa and South America.

Moon enters shadow	July	4d	2h	52.2m (= July 4, 2h 52.2m p.m. E. S. T.)
Total eclipse begins	"	4	3	50.6
Middle of the eclipse	"	4	4	38.9
Total eclipse ends	"	4	5	27.2
Moon leaves shadow	"	4	6	25.4

Magnitude of the eclipse = 1.625 (Moon's diameter = 1.0).

V. A Partial Eclipse of the Sun, July 18, 1917, invisible in Canada.

Magnitude of greatest eclipse = 0.086 (Sun's diameter = 1.0).

VI. An Annular Eclipse of the Sun, December 13, 1917, invisible in Canada but visible as a partial eclipse in the Antarctic Ocean, southwestern Australia and the southern extremity of South America, the central line of Annulus passing across the South Pole.

VII. A Total Eclipse of the Moon, December 27, 1917, visible in Canada; the beginning visible in North and South America, the Pacific Ocean and the extreme northeastern portion of Asia; the ending visible in North America, the Pacific Ocean, eastern Asia and Australia.

Moon enters shadow	Dec.	27d	15h	5.1m (=Dec. 28, 3h 5.1m a.m.,E.S.T.)
Total eclipse begins	"	27	16	38.1
Middle of the eclipse	"	27	16	46.3
Total eclipse ends	"	27	16	54.6
Moon leaves shadow	"	27	18	27.4

Magnitude of the eclipse = 1.011 (Moon's diameter = 1.0).

(Eastern Standard Astronomical Time is used throughout.)

DOUBLE STARS

Even with telescopes of small aperture it is possible to resolve a comparatively large number of double stars, and hence this kind of observation has much interest for the amateur. It permits one, also, to determine the optical value of the instrument he employs, as the power to separate the images is directly proportional to the diameter of the objective.

The usual test of excellence is that an objective of one-inch diameter should be able to separate star images at a distance of 4″·56 between their centres. This power should vary according to the following table:—

Diam. of Objective	1 in.	2 in.	3 in.	4 in.	5 in.	6 in.	10 in.	20 in.	40 in.
Limiting distance between stars	4″·56	2″·28	1″·52	1″·14	0″·91	0″·76	0″·45	0″·23	0″·11

In choosing a double-star for testing a telescope care should be taken that a binary, with varying distance between the components, be not selected.

I. THE MOST LUMINOUS PAIRS

Star	Mags.	Dist. ″	Star	Mags.	Dist. ″
Mizar....	2.4, 4.0	14.5	γ Leonis....	2.5, 4.0	3.0
Castor...	2.5, 3.0	5.6	β Scorpii...	2.5, 5.5	13.0
γ Virginis.	3.0, 3.2	5.0	θ Serpentis.	4.4, 6.0	21.0
γ Arietis...	4.2, 4.5	8.9	44i Boötis....	5.0, 6.0	4.8
ζ Aquarii..	3.5, 4.4	3.5	π Boötis....	4.3, 6.0	6.0

II. THE FINEST COLORED PAIRS

Star	Magnitudes	Distance ″	Colors
γ Andromedæ..	2.2, 5.5	10	Orange, Green.
α CanumVenat.	3.2, 5.7	20	Golden, Lilac.
β Cygni.....	3.3, 5.5	34	Golden, Sapphire.
ε Boötis.....	2.4, 6.5	2.9	Golden, Sapphire.
95 Herculis.....	5.5, 5.8	6	Golden, Azure.
α Herculis.....	4, 5.5	4.7	Ruby, Emerald.
γ Delphini.....	3.4, 5	11	Golden, Bluish Green.
32 Eridani.....	4.7, 7	6.7	Topaz, Bright Green.
ε Hydræ.....	3.5, 7.5	3.5	Yellow, Blue.
ζ Lyræ.....	4.5, 5.5	44	Yellow, Green.
ι Cancri.....	4.5, 5	30	Pale Orange, Blue.
o Cygni.....	4.3, 7.5, 5.5	337.8, 106.8	Yellow, Blue.
24 Coma Beren..	5.6, 7	21	Orange, Lilac.
o Cephei.....	5.4, 8	2.5	Golden, Azure.
94 Aquarii.....	5.5, 7.5	11	Rose, Greenish.
39 Ophiuchi.....	5.7, 7.5	12	Yellow, Blue.
41 Aquarii.....	5.8, 8.5	4.8	Yellow Topaz, Blue.
2 Canum Venat	6, 9	11	Golden, Azure
52 Cygni.....	4.6, 9	7	Orange, Blue.
55 Piscium.....	6, 9	6	Orange, Blue.
κ Geminorum..	3.8, 9	9	Orange, Blue.
ρ Orionis.....	5.1, 9	6.8	Orange, Blue.
54 Hydræ.....	5.2, 8	9	Yellow, Violet.
η Persei.....	4.2, 8.5	28	Yellow, Blue.
ϕ Draconis.....	4.8, 6	31	Yellow, Lilac.
o Draconis.....	4.7, 8.5	32	Golden, Lilac.
η Cassiopeiæ...	4.7, 7	5.7	Golden, Purple.
23 Orionis.....	5.4, 7	32	White, Blue.
δ Herculis.....	3.6, 8	18	White, Violet.
o Capricorni...	6.3, 7	22	Bluish.
17 Virginis.....	6.5, 7	20	Rose.
ξ Boötis.....	4.5, 6.5	4.2	Reddish Yellow.

The colors given above are according to Flammarion. For slight variations and also for a much longer list consult Webb's "Celestial Objects."

A SHORT LIST OF VARIABLE STARS

PREPARED BY THE LATE J. MILLER BARR.

The brighter of the following stars can be found on the star maps in this volume; for the others a good star-atlas will be required. The times of maxima and minima are given in *Popular Astronomy* (monthly) and in the "Companion" to the *Observatory*.

NAME	LIMITING MAGS.	PERIOD	CLASS	DISCOVERER
		d. h. m.		
U Cephei	7.0– 9.2	2 11 49.6	V.	W. Ceraski.....1880
o Ceti	1.7– 9.5	331.7	II.	Fabricius.....1596
ρ Persei	3.4– 4.2	Irr.	III.	Schmidt.....1854
6.1904 Cephei	8.6– 9.1	32.3	V.	Blajko.....1904
β Persei (Algol)	2.1– 3.2	2 20 48.9	V.	Montanari.....1669
λ Tauri	3.3– 4.2	3 22 52.2	V.	Baxendell.....1848
W Eridani	8.1–<12.5	369	II.	Fleming.....1898
RW Tauri	8–11	2 18 27.2	V.	Fleming.....1905
R Leporis	6–8 ?	436.1	II.	Schmidt.....1855
α Orionis	1– 1.4	Irr.	III.	J. Herschel.....1840
U Orionis	5.8–12.3	375	II.	Gore.....1885
η Geminorum	3.2– 4.2	231.4	III.	Schmidt.....1865
T Monocerotis	5.7– 6.8	27.0	IV.	Gould.....1871
ζ Geminorum	3.8– 4.3	10 3 41.5	IV.	Schmidt.....1847
R Geminorum	6.6–13.3	370.2	II.	Hind.....1848
R Canis Maj	5.7– 6.3	1 3 15.8	V.	Sawyer.....1887
S Cancri	8.0–10.2	9 11 37.8	V.	Hind.....1848
S Antliæ	6.3– 6.8	0 7 46.8	IV.	Paul.....1888
W Ursæ Maj	7.9– 8.6	0 4 0.2	V.?	Müller & Kempf..1903
R Leonis	4.6–10.5	312.8	II.	Koch.....1782
R Hydræ	3.5– 9.7	425.1	II.	Montanari.....1670
δ Libræ	5.0– 6.2	2 7 51.4	V.	Schmidt 1859
α Herculis	3.1– 3.9	Irr.	III.	W. Herschel.....1795
U Ophiuchi	6.0– 6.7	0 20 7.7	V.	Gould.....1871
X Sagittarii	4.4– 5.4	7 0 17.1	IV.	Schmidt.....1866
R Scuti	4.8– 7.8	Irr.	III.	Pigott.....1795
β Lyræ	3.4– 4.1	12 21 59.2	IV.	Goodricke.....1784
χ Cygni	4.5–13.5	406.0	II.	Kirch.....1686
η Aquilæ	3.7– 4.5	7 4 14.0	IV.	Pigott.....1784
S Sagittæ	5.5– 6.1	8 9 11.8	IV.	Gore.....1885
14.1904 Cygni	10.7–11.6	0 3 14.2	IV.	Ceraski.....1904
Y Cygni	7.1– 7.9	1 11 57.5	V.	Chandler.....1886
δ Cephei	3.7– 4.6	5 8 47.7	IV.	Goodricke.....1784
U Pegasi	9.3– 9.9	0 8 59.7	IV.	Chandler.....1894

Several attempts have been made to classify the variable stars; but a scientific system of classification, in harmony with the chief deductions of theory as well as the facts of observation, is still wanting. The best

known system is that formulated by Professor E. C. Pickering in 1880, and reproduced (with slight additions) in his "Provisional Catalogue of Variable Stars" (1903). This includes five classes, two of which are subdivided, as follows:—

		EXAMPLES
I.	New or temporary stars	Nova, 1572.
II.	Variables of long period:	
	a. Ordinary stars of this class	*o* Ceti.
	b. Stars subject to "occasional sudden and irregular outbursts of light which gradually diminishes"	U Geminorum.
III.	"Variables of small range or irregular variation, according to laws as yet unknown"	α Orionis.
IV.	Variables of short period:	
	a. "Ordinary" cases	δ Cephei.
	b. Stars with "minima successively bright and faint"	β Lyraæ.
V.	Stars of the Algol type	β Persei.

THE STARS

THEIR DISTANCES, VELOCITIES, SPECTRAL TYPES, ETC.

PREPARED BY W. E. HARPER.

The accompanying table contains the chief known facts regarding 276 stars and 13 nebulæ. The first 256 stars are those listed as brighter than 3.51 visual magnitude in Harvard *Annals*, Vol. L. The remaining number range in magnitude from 5 to 8.6, and they and the nebulæ are given here on account of their exceptionally high radial velocities.

In the case of visual double stars, the most important of which are preceded by a ‖, the magnitude of the components combined is given. The spectral type is also taken from the publication just named. (For a brief outline of the system of notation Campbell's *Stellar Motions*, p. 31, may be consulted.) The proper motion is from Boss's *Preliminary General Catalogue*, μ being the annual motion in R. A. and μ' that in Decl. The parallax is taken from many sources, principally Kapteyn's compilations. Those in brackets are least trustworthy. To obtain the distance in light-years, divide the number given in the column into 3.26, this being the number of light-years corresponding to a parallax of 1″. For example, the parallax of α Andromeda is ″.06; its distance is therefore $3.26 \div .06 = 54$ light-years. Where the parallax is negative, it indicates that the star is farther away than the faint comparison stars used. The radial velocities are taken from various Lick Observatory *Bulletins*, and the first decimal place is given only when the velocities are fairly well determined. A * placed after the velocity indicates that the star is a spectroscopic binary, and the velocity of the system is given. About 80 of these appear. The masses are given relative to the sun. These can be determined only for visual binaries or for spectroscopic binaries which show spectra of both components. In the latter case there is also uncertainty due to lack of knowledge of the inclination of the orbital plane to the line of sight.

Star	R.A. 1900	Decl. 1900	Mag.	Type	Proper Motion		Parallax	Rad. Vel. km./sec.	Mass
					μ	μ'			
	h m	° ′			s	″	″		
α Andromedæ	0 3	+28 32	2·2	A	+·010	−·16	(·06)	−13·0*	
β Cassiopeiæ	4	+58 36	2·4	F5	+·068	−·18	·074	+12·8	
τ Pegasi	8	+14 38	2·9	B2	000	−·01		+6·5*	
β Hydri	20	−77 49	2·9	G	+·702	+·32	·143	+22·8	
α Phœnicis	21	−42 51	2·4	K	+·018	−·40		+76 *	
δ Andromedæ	34	+30 19	3·5	K	+·011	−·09		+5 *	
α Cassiopeiæ	35	+55 59	2·2-2·8	K	+·006	−·03	(·04)	−3·8	
β Ceti	39	−18 32	2·2	K	+·016	+·04		+14·6	
‖γ Cassiopeiæ	51	+60 11	2·2	Bp	+·004	00	(·01)	+3 *	
β Phœnicis	1 2	−47 15	3·4	K	−·004	−·01		−0·5	
β Andromedæ	4	+35 5	2·4	Ma	+·015	−·11	(·07)	+2 *	
δ Cassiopeiæ	19	+59 43	2·8	A5	+·040	−·05	(·01)	+9·0	
‖α Ursæ Majoris	23	+88 46	2·1	F8	+·138	00	·047	−17 *	
γ Phœnicis	24	−43 50	3·4	K5	−·003	−·22		*	
α Eridani	34	−57 45	0·6	B5	+·011	−·03	·051		
ϵ Cassiopeiæ	47	+63 11	3·4	B5	+·006	−·02		−9	
β Arietis	49	+20 19	2·7	A5	+·007	−·11		−1·0*	
α Hydri	56	−62 3	3·0	F	+·036	+·04		−5	
‖γ Andromedæ	58	+41 51	2·2	Kp	+·004	−.05	·007	−10·7	
α Arietis	2 2	+22 59	2·2	K2	+·014	−·15	·088	−14·0	
β Trianguli	4	+34 31	3·1	A5	+·012	−·05		−2 *	
ο Ceti	14	−3 26	1·7-9·6	Md	000	−·24	·142	+62·3	
‖θ Eridani	54	−40 42	3 0	A2	−·006	+·02		*	
α Ceti	57	+3 42	2·8	Ma	−·001	−·08		−25·1	
γ Persei	58	+53 7	3·1	Gp	000	−·01		+2 *	
ρ Persei	59	+38 27	3·4-4·2	Mb	+·012	−·11	·087	+28·6	
β Persei	3 2	+40 34	2·1-3·2	B8	+·001	00	·029	+4·1*	
α Persei	17	+49 30	1·9	F5	+·003	−·03	(·09)	−2·2	
δ Persei	36	+47 28	3·1	B5	+·003	−·03			
‖η Tauri	41	+23 48	3·0	B5	+·001	−·05		+15	
ζ Persei	48	+31 35	2·9	B1	+·001	−·02		+20·4	
γ Hydri	49	−74 33	3·2	Ma	+·011	−·12		+16	
‖ϵ Persei	51	+39 43	3·0	B	+·002	−·03		*	
γ Eridani	53	−13 47	3·2	K5	+·005	−·11		+62·5	
λ Tauri	55	+12 12	3·3-4·2	B3	000	−·01		+10 *	
α Reticuli	4 13	−62 43	3·4	G5	+·005	+·06		+35·4	
α Tauri	30	+16 18	1·1	K5	+·005	−·19	·073	+55·1	
α Doradus	32	−55 15	3·5	Ap	+·006	00		+26·0	
π^3Orionis	44	+6 47	3·3	F8	+·032	+·02		+25·0	
ι Aurigæ	50	+33 0	2·9	K2	+·001	−·03		+18·0	
ϵ Aurigæ	55	+43 41	3·4-4·1	F5p	000	−·01		−9 *	
η Aurigæ	5 0	+41 6	3·3	B3	+·003	−·08		+3	
ϵ Leporis	1	−22 30	3·3	K5	+·002	−·07		+1·1	
β Eridani	3	−5 13	2·9	A2	−·006	−·08		−15·0	

Star	R.A. 1900	Decl. 1900	Mag.	Type	Proper Motion μ	Proper Motion μ'	Parallax	Rad. vel. km./sec.	Mass
	h m	° ′			s	″	″		
μ Leporis	5 8	−16 19	3·3	Ap	+·003	−·03		+28·0	
‖α Aurigæ	9	+45 54	0·2	G	+·008	−·43	·066	+30·2*	2·0
‖β Orionis	10	−8 19	0·3	B8p	000	00	·007	+22·6*	
‖η Orionis	19	−2 29	3·4	B1	000	00		+35·5*	21·8 / sin³ i
γ Orionis	20	+6 16	1·7	B2	000	−·02	−·003	+18	
β Tauri	20	+28 31	1·8	B8	+·002	−·18	(·06)	+11	
β Leporis	24	−20 50	3·0	G	000	−·09		−13·7	
‖δ Orionis	27	−0 22	2·4	B	000	00		+23·1*	
α Leporis	28	−17 54	2·7	F	000	00		+24·9	
‖ι Orionis	31	−5 59	2·9	Oe5	000	00		+21·3*	
ϵ Orionis	31	−1 16	1·8	B	000	00		+24·5*	
ζ Tauri	32	+21 5	3·0	B3	000	−·03		+16·4*	
‖ζ Orionis	36	−2 0	1·8	B	000	−·01		+2·0	
α Columbæ	36	−34 8	2·8	B5p	000	−·04			
κ Orionis	43	−9 42	2·2	B	000	00		+2·2	
β Columbæ	47	−35 48	3·2	K	+·004	+·39		+89·2	
α Orionis	50	+7 23	1·0–1·4	Ma	+·002	+·01	·030	+21 *	
β Aurigæ	52	+44 56	2·1	Ap	−·004	00	·014	−18·1*	4·4 / sin³ i
‖θ Aurigæ	53	+37 12	2·7	Ap	+·004	−·09		+28·5*	
‖η Geminorum	6 9	+22 32	3·2–4·2	Ma	−·004	−·02	·044	*	
ζ Canis Majoris	17	−30 1	3·1	B3	+·001	00		+24 *	
μ Geminorum	17	+22 34	3·2	Ma	+·004	−·11		+54·6	
β Canis Majoris	18	−17 54	2·0	B1	000	00		+33·7*	
α Carinæ	22	−52 38	−0·9	F	+·002	+·01	·007	+20·8	
γ Geminorum	32	+16 29	1·9	A	+·003	−·05		−11·0*	
ν Puppis	35	−43 6	3·2	B8	000	−·02		+26 *	
ϵ Geminorum	38	+25 14	3·2	G5	000	−·02		+9·6	
ξ Geminorum	40	+13 0	3·4	F5	−·008	−·20		+27	
‖α Canis Majoris	41	−16 35	−1·6	A	−·037	−1·21	·376	−7·4*	3·4
α Pictoris	47	−61 50	3·3	A5	−·011	+·26			
τ Puppis	47	−50 30	2·8	K	+·003	−·09		+37 *	
‖ϵ Canis Majoris	55	−28 50	1·6	B1	000	00		+29·2	
ζ Geminorum	58	+20 43	3·7–4·3	G	000	−·01		+6·8*	
o^2 Canis Majoris	59	−23 41	3·1	B5p	000	−·01		+49 *	
δ Canis Majoris	7 4	−26 14	2·0	F8p	000	00		+35·5*	
L^2 Puppis	10	−44 29	3·4–6·2	Md	+·009	+·32			
π Puppis	14	−36 55	2·7	K5	−·001	00		+16·4	
β Canis Minoris	22	+8 29	3·1	B8	−·003	−·04			
σ Puppis	26	−43 6	3·3	K5	−·006	+·18			
‖α Geminorum	28	+32 6	1·6	A	−·014	−·11	·069	{−1·0* +6·2	4·8 ±
‖α Canis Minoris	34	+5 29	0·5	F5	−·047	−1·03	·324	−0·5*	1·3
β Geminorum	39	+28 16	1·2	K	−·047	−·06	·064	+3·9	
ξ Puppis	45	−24 37	3·5	G	000	00		+4·2	
ζ Puppis	8 0	−39 43	2·3	Od	−·003	+·01			
ρ Puppis	3	−24 1	2·0	F5	−·006	+·04		+4·6*	

Star	R.A. 1900	Decl. 1900	Mag.	Type	Proper Motion		Parallax	Rad. Vel. km./sec.	Mass
					μ	μ'			
	h m	° ′			s	″	″		
‖γ Velorum	8 6	−47 3	2·2	Oap	000	·00			
ϵ Carinæ	20	−59 11	1·7	Kp	−·004	+·01		+12	
o Urs. Majoris	22	+61 3	3·5	G	−·017	−·11	·087	+19·4	
‖ϵ Hydræ	41	+6 47	3·5	F8	−·013	−·05	(·25)	+37 *	3·3
δ Velorum	42	−54 20	2·0	A	+·003	−·09			
ζ Hydræ	50	+6 20	3·3	K	−·007	+·01		+23·1	
ι Urs. Majoris	52	+48 26	3·1	A5	−·044	−·25	·061	+6·0	
λ Velorum	9 4	−43 2	2·2	K5	−·002	00		+19·2	
β Carinæ	12	−69 18	1·8	A	−·031	+·10		−14·0	
ι Carinæ	14	−58 51	2·2	F	−·003	00		+13·3	
α Lyncis	15	+34 49	3·3	K5	−·018	+·01	−·057	+38·6	
κ Velorum	19	−54 35	2·6	B3	−·002	00		+21·9*	
α Hydræ	23	−8 14	2·2	K2	−·001	+·03		−3·5	
θ Urs. Majoris	26	+52 8	3·3	F8	−·103	−·55	·092	+15·7	
N Velorum	28	−56 36	3·0	K5	−·005	00		−13·5	
ϵ Leonis	40	+24 14	3·1	Gp	−·003	−·02		+5·0	
‖υ Carinæ	45	−64 36	3·1	F	−·003	+·01		+13·8	
α Leonis	10 3	+12 27	1·3	B8	−·017	00	·033		
q Carinæ	14	−60 50	3·4	K5	−·006	−·01		+8·3	
‖γ Leonis	14	+20 21	2·3	K	+·022	−·18	−·035	−35	
μ Urs. Majoris	16	+42 0	3·2	K5	−·007	+·02	·051	*	
θ Carinæ	39	−63 52	3·0	B	−·003	+·01		+16	
η Carinæ	41	−59 10	1·0–7·4	Pec.	000	00			
μ Velorum	42	−48 54	2·8	G5	+·005	−·06		+7·4	
ν Hydræ	45	−15 40	3·3	K	+·006	+·19		−1·1	
β Urs. Majoris	56	+56 55	2·4	A	+·010	+·03	(·08)	−16·8*	
α Urs. Maj.	58	+62 17	2·0	K	−·017	−·07		*	
ψ Urs. Majoris	11 4	+45 2	3·2	K	−·006	−·04		−3·4	
δ Leonis	9	+21 4	2·6	A2	+·011	−·14			
θ Leonis	9	+15 59	3·4	A	−·004	−·09		+7·7	
λ Centauri	31	−62 28	3·3	B9	−·006	−·02		+11	
β Leonis	44	+15 8	2·2	A2	−·034	−·12	·129	−4·0	
γ Urs. Majoris	49	+54 15	2·5	A	+·011	00		−9	
δ Centauri	12 3	−50 10	2·9	B3p	−·004	−·02			
ϵ Corvi	5	−22 4	3·2	K	−·005	+·01		+4·8	
δ Crucis	10	−58 12	3·1	B3	−·006	−·02		+25	
δ Urs. Majoris	10	+57 35	3·4	A2	+·014	00			
γ Corvi	11	−16 59	2·8	B8	−·011	+·01		−7 *	
α Crucis	21	−62 33	1·0	B1	−·007	−·02	·055	+7	
‖δ Corvi	25	−15 58	3·1	A	−·014	−·14			
γ Crucis	26	−56 33	1·5	Mb	+·002	−·27		+22	
β Corvi	29	−22 51	2·8	G5	000	−·06		−7·1	
α Muscæ	31	−68 35	2·9	B3	−·006	−·02		+13·5	
γ Centauri	36	−48 24	2·4	A	−·020	−·02		−7·0	
‖γ Virginis	36	−0 54	2·9	F	−·038	00	·058	−20·0	

Star	R.A. 1900	Decl. 1900	Mag.	Type	Proper Motion		Parallax	Rad. vel. km./sec.	Mass
					μ	μ'			
	h m	° ′			s	″	″		
β Muscæ	12 40	−67 34	3·3	B3	−·005	−·03			
β Crucis	42	−59 9	1·5	B1	−·006	−·03	·008	+13	
ϵ Urs. Majoris	50	+56 30	1·7	Ap	+·014	−·01	(·08)	−10·0*	
α Can. Venat.	51	+38 51	2·8	Ap	−·020	+·04		−2·0	
ϵ Virginis.	57	+11 30	3·0	K	−·018	+·02		−13·2	
γ Hydræ	13 13	−22 39	3·3	G5	+·005	−·05		−5·6	
ι Centauri	15	−36 11	2·9	A2	−·028	−·09		+2·0	
ζ Urs. Majoris	20	+55 27	2·2	A	+·016	−·04	·033	−10·0* −12·5	
α Virginis	20	−10 38	1·2	B2	−·003	−·04	−·012	+1·6	15·4 / sin³ i
ζ Virginis	30	−0 5	3·4	A2	−·019	+·03			
ϵ Centauri	34	−52 57	2·6	B1	−·003	−·03		+6	
η Urs. Majoris	44	+49 49	1·9	B3	−·012	−·02	(−·05)	−6	
μ Centauri	44	−41 59	3·3	B2p	−·002	−·02		+12·6	
ζ Centauri	49	−46 48	3·1	B2p	−·006	−·05			
η Boötis	50	+18 54	2·8	G	−·004	−·37		−0·2*	
β Centauri	57	−59 53	0·9	B1	−·004	−·03	·037	+12	
τ Hydræ	14 1	−26 12	3·5	K	+·003	−·16		+27·3	
θ Centauri	1	−35 53	2·3	K	−·044	−·53		+1·5	
α Boötis	11	+19 42	0·2	K	−·078	−2·00	·075	−3·9	
γ Boötis	28	+38 45	3·0	F	−·010	+·14		−35	
η Centauri	29	−41 43	2·6	B3p	−·003	−·04		0	
α Centauri	33	−60 25	0·0	G K5	−·487	+·73	·759	−22·2	·1·9
α Circini	34	−64 32	3·4	F	−·031	−·24			
α Lupi	35	−46 58	2·9	B2	−·002	−·03		+8 *	
ϵ Boötis	41	+27 30	2·6	K	−·004	+·01		−16·4	
α^2 Libræ	45	−15 38	2·9	A2	−·007	−·08		*	
β Urs. Minoris	51	+74 34	2·2	K5	−·007	00	(·02)	+17·2	
β Lupi	52	−42 44	2·8	B2p	−·004	−·05		0 *	
κ Centauri	53	−41 42	3·4	B3	−·002	−·03		+10	
σ Libræ	58	−24 53	3·4	Mb	−·006	−·06		−3·5	
ζ Lupi	15 5	−51 43	3·5	K	−·012	−·07		−9·4	
γ T Australis	10	−68 19	3·1	A	−·011	−·02			
β Libræ	12	−9 1	2·7	B8	−·007	−·03			
δ Lupi	15	−40 17	3·4	B2	−·001	−·03			
γ Urs. Minoris	21	+72 11	3·1	A2	−·003	+·01	(·04)	−8	
ι Draconis	23	+59 19	3·5	A	−·001	+·01		−10·0	
γ Lupi	28	−40 50	3·0	B3	−·001	−·04			
α Cor. Borealis	30	+27 3	2·3	A	+·009	−·10	(−·04)	+0·4*	
α Serpentis	39	+6 44	2·8	K	+·009	+·04		+3·4	
β T Australis	46	−63 7	3·0	F	−·030	−·39			

Star	R.A. 1900	Decl. 1900	Mag.	Type	Proper Motion		Parallax	Rad. Vel. km./sec.	Mass
					μ	μ'			
	h m	° ′			s	″	″		
π Scorpii	15 53	−25 50	3·0	B2p	−·001	−·04			*
δ Scorpii	54	−22 20	2·5	B	−·001	−·04			*
‖β Scorpii	1 0	−19 32	2·8	B1	−·002	−·03			*
δ Ophiuchi	9	− 3 26	3·0	Ma	−·003	−·15			−19·5
ϵ Ophiuchi	13	− 4 27	3·3	K	+·005	+·03			− 9·2
‖σ Scorpii	15	−25 21	3·1	B1	−·001	−·03			*
‖η Draconis	23	+61 44	2·9	G5	−·002	+·06			−14·0
‖α Scorpii	23	−26 12	1·2	Map	000	−·03	·029	− 3	*
β Herculis	26	+21 42	2·8	K	−·008	−·02			−25·5*
τ Scorpii	30	−28 1	2·9	B	−·001	−·04			+ 1·5
ζ Ophiuchi	32	−10 22	2·7	B	+·001	+·02			
‖ζ Herculis	38	+31 47	3·0	G	−·036	+·38	·142	−70	*
α T Australis	38	−68 51	1·9	K2	+·003	−·03		− 3·6	
ϵ Scorpii	44	−34 7	2·4	K	−·050	−·26		− 2·2	
μ' Scorpii	45	−37 53	3·1	B3p	−·001	−·03			*
ζ Aræ	50	−55 50	3·1	Ma	−·003	−·04		− 6·6	
κ Ophiuchi	53	+ 9 32	3·4	K	−·020	−·01		−55·9	
‖η Ophiuchi	17 5	−15 36	2·6	A	+·002	+·09		− 1·0	
η Scorpii	5	−43 6	3·4	F2	+·002	−·29		−28	
ζ Draconis	8	+65 50	3·2	B5	−·002	+·02		−14·7	
‖α Herculis	10	+14 30	3·1–3·9	Mb	−·001	+·03		−32·2	
δ Herculis	11	+24 57	3·2	A	−·002	−·16	(·05)		
π Herculis	12	+36 55	3·4	K2	−·002	00	(·11)	−25·6	
θ Ophiuchi	16	−24 54	3·4	B3	000	−·03		− 0·9	
β Aræ	17	−55 26	2·8	K2	−·002	−·03		− 1·2	
υ Scorpii	24	−37 13	2·8	B3	000	−·04		+17	*
α Aræ	24	−49 48	3·0	B3p	−·003	−·08		+ 2	*
λ Scorpii	27	−37 2	1·7	B2	000	−·04		+ 3	
β Draconis	28	+52 23	3·0	G	−·002	+·01		−20·5	
θ Scorpii	30	−42 56	2·0	F	000	−·01		+ 5	
α Ophiuchi	30	+12 38	2·1	A5	+·008	−·24	·074		*
κ Scorpii	36	−38 58	2·5	B2	−·001	−·03			
β Ophiuchi	39	+ 4 37	2·9	K	−·003	+·15		−11·8	
ι' Scorpii	41	−40 5	3·1	F5p	000	00			
‖μ Herculis	43	+27 47	3·5	G5	−·024	−·75	·106	−15·6	
G Scorpii	43	−37 1	3·2	K2	+·005	+·02		+24·5	
ν Ophiuchi	54	− 9 46	3·5	K	−·001	−·12		+12·9	
γ Draconis	54	+51 30	2·4	K5	−·001	−·03	·107	−27·0	
γ Sagittarii	59	−30 26	3·1	K				+22	*
η Sagittarii	18 11	−36 48	3·2	Mb	−·012	−·17		0·0	
δ Sagittarii	15	−29 52	2·8	K	+·003	−·04		−20·2*	

Star	R.A. 1900	Decl. 1900	Mag.	Type	Proper Motion μ	Proper Motion μ'	Parallax	Rad. Vel. km./sec.	Mass
	h m	o ′			s	″	″		
η Serpentis	18 16	− 2 55	3·4	K	− ·038	− ·70		+ 9·5	
ϵ Sagittarii	18	− 34 26	2·0	A	− ·004	− ·13		− 11·0	
λ Sagittarii	22	− 25 29	2·9	K	− ·004	− ·19		− 43·1	
‖α Lyræ	34	+ 38 41	0·1	A	+ ·017	+ ·28	·094	− 13·8	
Φ Sagittarii	39	− 27 6	3·3	B8	+ ·004	00			*
‖β Lyræ	46	+ 33 15	3·4–4·1	B2p	000	− ·01		− 7·8*	30·6
σ Sagittarii	49	− 26 25	2·1	B3	+ ·001	− ·07		− 1	
γ Lyræ	55	+ 32 33	3·3	A	000	− ·01		− 20	*
‖ζ Sagittarii	56	− 30 1	2·7	A2	− ·002	00		+ 26·0	
τ Sagittarii	19 1	− 27 49	3·4	K	− ·004	− ·26			*
ζ Aquilæ	1	+ 13 43	3·0	A	− ·001	− ·10			
π Sagittarii	4	− 21 11	3·0	F2	000	− ·04		− 10·5*	
δ Draconis	13	+ 67 29	3·2	K	+ ·017	+ ·09		+ 25·6	
δ Aquilæ	21	+ 2 55	3·4	F	+ ·017	+ ·08			
‖β Cygni	27	+ 27 45	3·1	Kp	000	− ·01	− ·021	− 24	*
γ Aquilæ	42	+ 10 22	2·8	K2	+ ·001	00		− 1·9	
‖δ Cygni	42	+ 44 53	3·0	A	+ ·005	+ ·04			
α Aquilæ	46	+ 8 36	0·9	A5	+ ·036	+ ·38	·238	− 33·0	
θ Aquilæ	20 6	− 1 7	3·4	A	+ ·002	00		− 28·0*	0·6 / sin³ i
‖β Capricorni	15	− 15 6	3·2	Gp	+ ·002	00		− 18·8*	
α Pavonis	18	− 57 3	2·1	B3	000	− ·09		+ 2·0*	
γ Cygni	19	+ 39 56	2·3	F8p	000	00	− ·106	− 5·1	
α Indi	31	− 47 38	3·2	K	+ ·004	+ ·06		− 1·7	
α Cygni	38	+ 44 55	1·3	A2	000	00	− ·004	− 4·0	
ϵ Cygni	42	+ 33 36	2·6	K	+ ·020	+ ·32	− ·182	− 10	*
ζ Cygni	21 9	+ 29 49	3·4	K	000	− ·06		+ 17	*
α Cephei	16	+ 62 10	2·6	A5	+ ·022	+ ·05			
β Aquarii	26	− 6 1	3·1	G	+ ·001	− ·01		+ 6·9	
β Cephei	27	+ 70 7	3·3	B1	+ ·002	00		− 5	*
ϵ Pegasi	39	+ 9 25	2·5	K	+ ·002	00		+ 5·0	
δ Capricorni	42	− 16 35	3·0	A5	+ ·018	− ·30			*
γ Gruis	48	− 37 50	3·2	A	+ ·009	− ·02		− 3·0	
α Aquarii	22 1	− 0 48	3·2	G	+ ·001	− ·01		+ 7·5	
α Gruis	2	− 47 27	2·2	B5	+ ·012	− ·16	·024		
α Tucanæ	12	− 60 45	2·9	K2	− ·011	− ·03		+ 41	*
β Gruis	37	− 47 24	2·2	Mb	+ ·012	− ·02		+ 1·2	
η Pegasi	38	+ 29 42	3·1	G	+ ·001	− ·04		+ 4·3*	
α P Australis	52	− 30 9	1·3	A3	+ ·025	− ·17	·138	+ 6·7	
β Pegasi	59	+ 27 32	2·2–2·4	Mb	+ ·014	+ ·13		+ 8·4	
α Pegasi	59	+ 14 40	2·6	A	+ ·004	− ·04			*
γ Cephei	23 35	+ 77 4	3·4	K	− ·018	+ ·16		− 42·2	

SOME LARGE RADIAL VELOCITIES

Star	R.A. 1900	Decl. 1900	Mag.	Type	Annual Motion	Parallax	Rad. Vel. km./sec.	Mass
	h m	° ′			″	″		
Groom. 211	0 56	+44 55	7·0	G4	·10		− 71	
μ Cassiopeiæ	1 2	+54 26	5·3	G5	3·8	0·11	− 97	
Lalande 1966	1 3	+61 1	8·5	F3		0·08	− 325	
Lalande 4855	2 33	+30 28	7·2	G			− 120	
Lalande 5761	3 3	+26 0	8·0	F			− 153	
W. B. 3h·617	3 35	− 3 32	7·2	F5	·78		+ 114	
T Tauri	4 16	+19 18	var.				+ 86	
Groombridge 864	4 35	+41 58	7·3	G			+ 101	
C. Z. 5h·243	5 8	−44 59	8·3	G-K	8·7	0·32	+ 242	
A.G.C. 7195	5 59	−26 17	5·2	G			+ 185	
Lalande 15290	7 48	+30 54	8·2	G			− 242	
Boss 2847	9 47	+ 2 55	5·9	A2	·20		+ 96	
Groombridge 1830	11 47	+38 26	6·5	G-K	7·0	0·10	− 97	
11 Libræ	14 45	− 1 53	5·0	K			+ 83	
AOe 14320	15 5	−15 54	9·2	Go	3·76		+ 290	
Lalande 28607	15 38	−10 39	7·3	A			− 170	
Boss 4188	16 22	− 7 22	5·4	Ma p	·18		+ 97	
W. B. 17h·514	17 30	+ 6 4	8·6	F1	·58		− 148	
ω Pavonis	18 49	−60 20	5·1	K			+ 184	
ν^2 Sagittarii	18 49	−22 47	5·0	K			− 106	
31 *b* Aquilæ	19 21	+11 45	5·2	G			− 96	
Boss 4976	19 24	+28 24	4·6	K5	·17		− 87	
Lalande 37120-1	19 30	+33 0	6·6	G			− 162	
A.G.C. 27600	20 5	−36 21	5·3	K5			− 132	
AOe 20452	20 18	−21 40	8·1	Go p	1·21		− 179	
NEBULÆ								
N.G.C. 224 (Andromeda)	0 37	+40 43		G			− 330	
N.G.C. 1644	1 6	−73 44					+ 158	
N.G.C. 1068	2 38	− 0 26					+ 765 } + 1100 }	
N.G.C. 1714	4 52	−67 06					+ 301	
N.G.C. 1743	4 55	−69 21					+ 254	
N.G.C 2070	5 39	−69 09					+ 276	
N.G.C. 2111	5 53	−69 33					+ 268	
N.G.C. 4565	12 31	+26 32						
N.G.C. 4594 (Virgo)	12 35	−11 3					1000	
N.G.C. 5866	15 4	+56 9						
N.G.C. 5873	15 6	−37 43					− 136	
N.G.C. 6644	18 26	− 25 12					+ 191	
N.G.C. 6732	18 28	−22 43					− 148	
One in Lesser Magellanic							+ 160	
Four in Greater Magellanic							+ 275	

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.

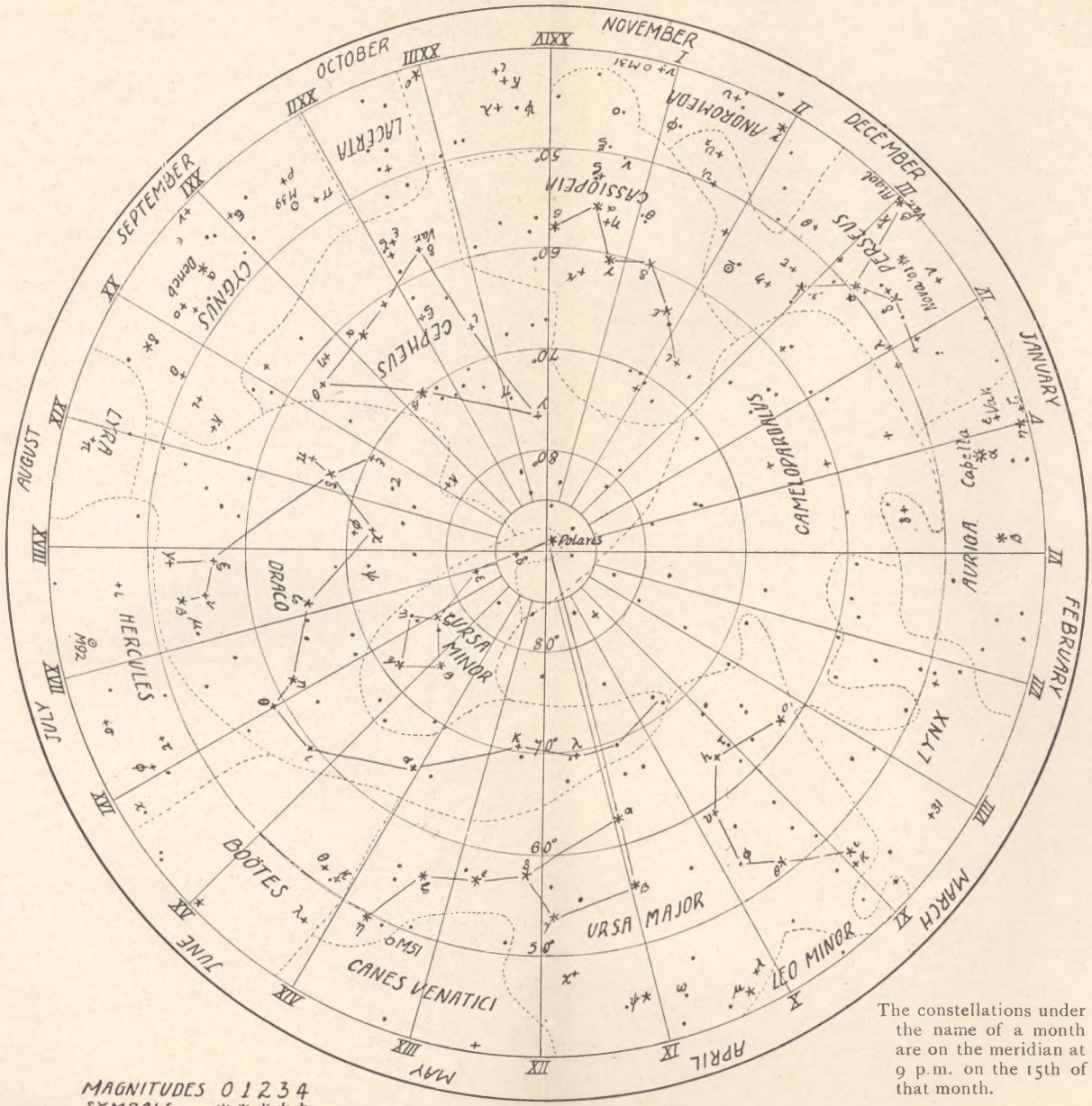
For the positions of the sun and the planets consult pages 22, 24, 26, etc.

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.

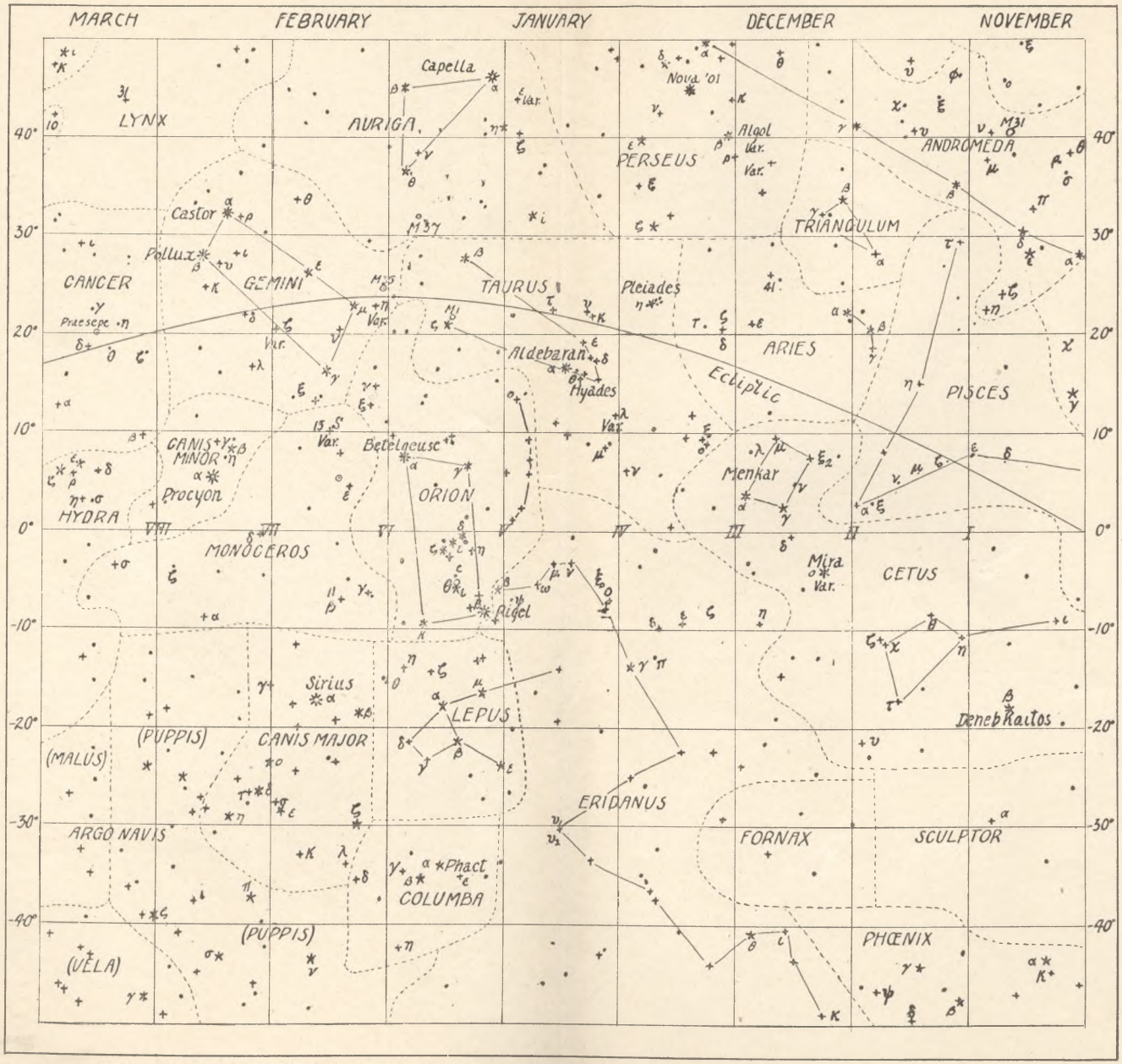
Auriga (The Charioteer) may readily be recognised by Capella, its brightest star, which crosses the meridian not far from the zenith at 9 p.m. on January 24. Capella, Vega and Arcturus are the three brightest stars of the northern hemisphere, each being approximately of magnitude 0·2. Sirius, which is 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.

MAP I. –NORTH POLAR CONSTELLATIONS



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

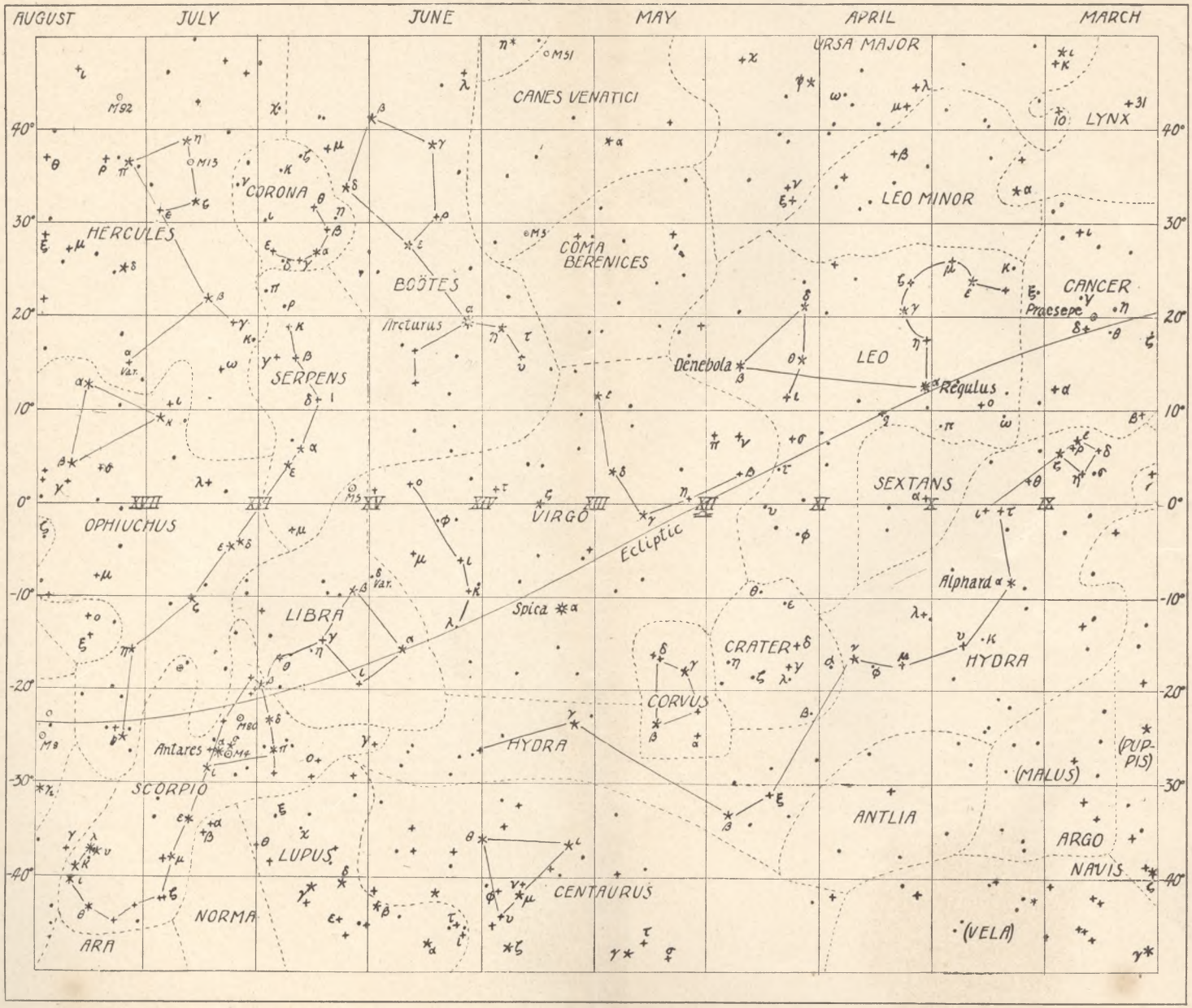
MAP II. —CONSTELLATIONS, from 0h to 9h in Right Ascension



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.

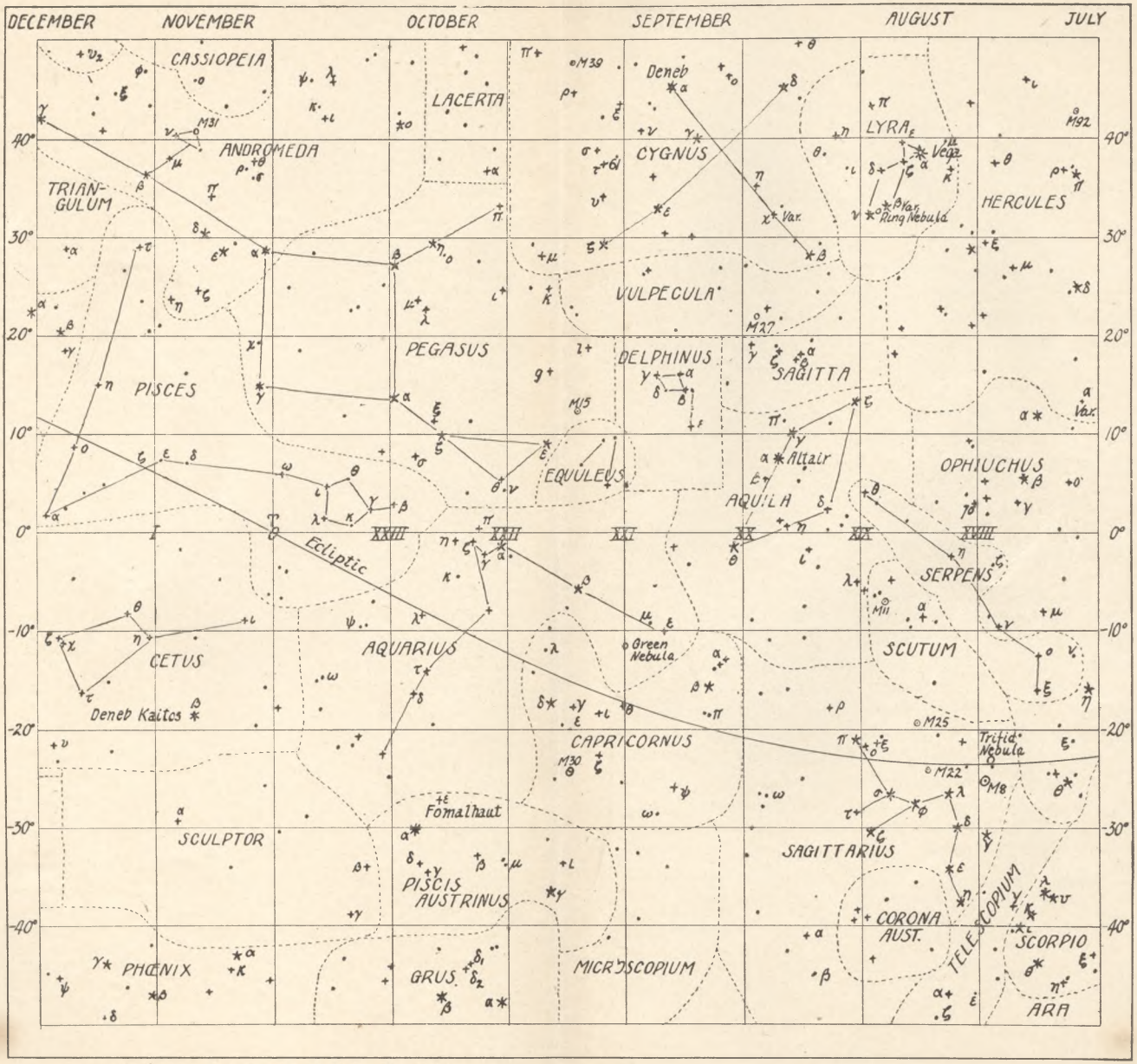
MAP III.—CONSTELLATIONS, from 8h to 18h in Right Ascension



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 9 p.m. on the 15th of that month.

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. $9^h\ 11^m$; 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. $8^h\ 40^m$, Decl. $29°$: mags. 4, $6\frac{1}{2}$; distance $30'$; orange and blue.

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

APRIL

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

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

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

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

Double Stars. (1) γ, the third star in the Sickle. Mags. 2, $3\frac{1}{2}$; distance $3''{\cdot}4$; a binary with a period of about 400 years. (2) ι (about 5° S. W. from β); mags. 4 and 7; distance $2''{\cdot}5$; 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 $6''{\cdot}2$; 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 $18''{\cdot}6$.

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

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

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

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

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

JULY

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

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

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

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

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; distance 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-power field.

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

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

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

AUGUST

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

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

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

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

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

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

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

SEPTEMBER

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

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

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

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

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

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

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

OCTOBER

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

Double Stars. (1) ζ, 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″·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 1916

By R. M. Motherwell

Three of the comets of 1915 were still visible at the beginning of 1916. None, however, were conspicuous. 1915*d* was visible only in large telescopes and 1915*a* while visible in small telescopes in January faded away very rapidly during February. 1915*e* proved to be faint but interesting. It was discovered by Taylor at Good Hope on December 2 and was then visible in a small telescope. Nothing unusual was observed until February 19, 1916, when Barnard saw a double nucleus, the magnitudes of the components being 14 and 15. These nuclei separated as the comet receded and the southern one which was the brighter at first faded rapidly and had disappeared from view by March 24, 1916.

The first discovery in 1916 was by Neujmin, at Simeis, on Feb. 24, when he observed a comet of about the eleventh magnitude. Its perihelion was about March 4 and its date of nearest approach to the Earth was close to the date of discovery. It had a period of about 5 years.

Comet 1916*b* was discovered by Wolf, at Heidelberg, in the latter part of April. It promises to be an interesting comet as its geocentric distance at date of discovery was greater than that of any other comet at discovery. As it does not reach perihelion until June, 1917, it will probably become a naked-eye comet. During the early summer of 1917 it will be visible in the mornings in the constellation of Pegasus.

The third comet of the year was discovered by Rev. J. H. Metcalf, at Winchester, on November 21. It is a very faint object with starlike appearance.

Encke's comet was photographed on September 22 by Wolf less than two months after aphelion.

Comet 1889V, Brooks, is due at perhelion in February, 1918, but as it has been growing fainter since its disruption in 1889 it may not be visible.

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