THE OBSERVER'S HANDBOOK FOR 1921

PUBLISHED BY

The Royal Astronomical Society of Canada

EDITED BY C. A. CHANT.

THIRTEENTH YEAR OF PUBLICATION

TORONTO
198 COLLEGE STREET
PRINTED FOR THE SOCIETY
1921

1921 CALENDAR 1921

JANUARY						
Sun.	2	9	16	23	30	
Mon.	3	10	17	24	31	
Tues.	4	11	18	25	..	
Wed.	5	12	19	26	..	
Thur.	6	13	20	27	..	
Fri.	7	14	21	28	..	
Sat.	1	8	15	22	29	..

FEBRUARY						
Sun.	..	6	13	20	27	
Mon.	..	7	14	21	28	
Tues.	1	8	15	22	....	
Wed.	2	9	16	23	....	
Thur.	3	10	17	24	....	
Fri.	4	11	18	25	..	
Sat.	5	12	19	26	..	

MARCH						
Sun.	..	6	13	20	27	
Mon.	..	7	14	21	28	
Tues.	1	8	15	22	29	
Wed.	2	9	16	23	30	
Thur.	3	10	17	24	31	
Fri.	..	4	11	18	25	..
Sat.	..	5	12	19	26	..

APRIL						
Sun.	3	10	17	24	..	
Mon.	4	11	18	25	..	
Tues.	5	12	19	26	..	
Wed.	6	13	20	27	..	
Thur.	7	14	21	28	..	
Fri.	1	8	15	22	29	..
Sat.	2	9	16	23	30	..

MAY						
Sun.	1	8	15	22	29	
Mon.	2	9	16	23	30	
Tues.	3	10	17	24	31	
Wed.	4	11	18	25	..	
Thur.	5	12	19	26	..	
Fri.	6	13	20	27	..	
Sat.	7	14	21	28	..	

JUNE						
Sun.	..	5	12	19	26	
Mon.	..	6	13	20	27	
Tues.	..	7	14	21	28	
Wed.	1	8	15	22	29	
Thur.	2	9	16	23	30	
Fri.	3	10	17	24	..	
Sat.	4	11	18	25	..	

JULY						
Sun.	3	10	17	24	31	
Mon.	4	11	18	25	....	
Tues.	5	12	19	26	....	
Wed.	6	13	20	27	....	
Thur.	7	14	21	28	....	
Fri.	1	8	15	22	29	....
Sat.	2	9	16	23	30	....

AUGUST						
Sun.	..	7	14	21	28	
Mon.	1	8	15	22	29	
Tues.	2	9	16	23	30	
Wed.	3	10	17	24	31	
Thur.	4	11	18	25	..	
Fri.	5	12	19	26	..	
Sat.	6	13	20	27	..	

SEPTEMBER						
Sun.	..	4	11	18	25	
Mon.	..	5	12	19	26	
Tues.	..	6	13	20	27	
Wed.	..	7	14	21	28	
Thur.	1	8	15	22	29	
Fri.	2	9	16	23	30	
Sat.	3	10	17	24	..	

OCTOBER						
Sun.	2	9	16	23	30	
Mon.	3	10	17	24	31	
Tues.	4	11	18	25	..	
Wed.	5	12	19	26	..	
Thur.	6	13	20	27	..	
Fri.	7	14	21	28	..	
Sat.	1	8	15	22	29	..

NOVEMBER						
Sun.	..	6	13	20	27	
Mon.	..	7	14	21	28	
Tues.	1	8	15	22	29	
Wed.	2	9	16	23	30	
Thur.	3	10	17	24	..	
Fri.	..	4	11	18	25	..
Sat.	..	5	12	19	26	..

DECEMBER						
Sun.	..	4	11	18	25	
Mon.	..	5	12	19	26	
Tues.	..	6	13	20	27	
Wed.	..	7	14	21	28	
Thur.	1	8	15	22	29	
Fri.	..	2	9	16	23	30
Sat.	3	10	17	24	31	

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CONTENTS

PREFACE

The HANDBOOK for 1921 follows the same lines as that for 1920. The chief difference is in the omission of the extended table giving the distance, velocities, and other information regarding certain fixed stars; and the substitution of a fuller account of the planets for the year, with maps of their paths.

As in the last issue, the brief descriptions of the constellations and the star maps are not included, since fuller information is available in a better form and at a reasonable price in many publications, such as: Young's *Uranography* (price 72c.), Upton's *Star Atlas* ($3.00) and McKready's *Beginner's Star Book* (about $3.50.)

To those mentioned in the body of the book; to Mr. J. P. Henderson of the Dominion Observatory, Ottawa; and especially to Messrs. J. H. Horning, B.A., and J. A. Pearce, B.A., thanks are due for their assistance.

THE EDITOR.

TORONTO, December 1920.

ANNIVERSARIES AND FESTIVALS, 1921

New Year's Day	Sat.,	Jan. 1	Pentecost (Whit Sunday)		May 15
Epiphany	Thur.,	Jan. 6	Trinity Sunday		May 22
Septuagesima Sunday		Jan. 23	Victoria Day	Tues.,	May 24
Quinquagesima (Shrove Sunday)		Feb. 6	Corpus Christi	Thurs.,	May 26
Ash Wednesday		Feb. 9	St. John Baptist	Thurs.,	June 24
St. David	Tues.,	Mar. 1	Dominion Day	Fri.,	July 1
St. Patrick	Thurs.,	Mar. 17	Labor Day	Mon.,	Sept. 5
Palm Sunday		Mar. 20	St. Michael (Michaelmas Day)	Thurs.,	Sept. 29
Good Friday		Mar. 25	All Saints Day	Tues.,	Nov. 1
Easter Sunday		Mar. 27	First Sunday in Advent		Nov. 27
St. George	Sat.,	Apr. 23	St. Andrew	Wed.,	Nov. 30
Rogation Sunday		May 1	Conception Day	Thurs.,	Dec. 8
Ascension Day (Holy Thursday)		May 5	St. Thomas Day	Wed.,	Dec. 21
			Christmas Day	Sun.,	Dec. 25

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.

In the Configurations of Jupiter's Satellites (pages 29, 31, etc.), O represents the disc of the planet, d 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.

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.

1921, 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 56	+ 3 33.6	S 23 1 38	Apr. 3	0 48 32	+ 3 26.3	N 5 12 32
" 4	18 59 10	4 57.4	22 45 2	" 6	0 59 29	FAST 2 33.7	6 21 5
" 7	19 12 20	6 17.7	22 24 22	" 9	1 10 28	1 42.9	7 28 40
" 10	19 25 25	FAST 7 33.7	21 59 44	" 12	1 21 29	0 54.3	8 35 6
" 13	19 38 26	8 44.6	21 31 14	" 15	1 32 32	+ 0 8.2	9 40 14
" 16	19 51 21	9 49.6	20 59 1	" 18	1 43 39	− 0 34.9	10 43 55
" 19	20 4 9	WATCH 10 48.3	20 23 11	" 21	1 54 49	SLOW 1 14.6	11 46 1
" 22	20 16 51	11 40.2	19 43 55	" 24	2 6 3	1 50.4	12 46 21
" 25	20 29 25	12 25.1	19 1 21	" 27	2 17 21	2 22.0	13 44 50
" 28	20 41 53	13 2.9	18 15 39	" 30	2 28 44	2 48.9	14 41 16
" 31	20 54 13	13 33.6	17 26 58				
				May 3	2 40 11	3 10.9	15 35 33
Feb. 3	21 6 26	13 57.0	16 35 30	" 6	2 51 44	WATCH 3 27.8	16 27 30
" 6	21 18 32	14 13.2	15 41 27	" 9	3 3 22	3 39.7	17 17 1
" 9	21 30 31	14 22.2	14 44 58	" 12	3 15 5	3 46.4	18 3 55
" 12	21 42 22	14 24.1	13 46 16	" 15	3 26 53	3 48.1	18 48 6
" 15	21 54 7	14 18.9	12 45 33	" 18	3 38 46	SLOW 3 45.0	19 29 25
" 18	22 5 44	FAST 14 7.1	11 43 0	" 21	3 50 43	3 36.9	20 7 45
" 21	22 17 16	13 48.9	10 38 47	" 24	4 2 46	3 24.0	20 43 0
" 24	22 28 41	13 24.8	9 33 6	" 27	4 14 53	3 6.4	21 15 3
" 27	22 40 2	12 55.4	8 26 6	" 30	4 27 5	2 44.4	21 43 48
Mar. 1	22 47 33	12 33.1	7 40 48	June 2	4 39 21	WATCH 2 18.3	23 9 10
" 4	22 58 45	11 56.0	6 32 2	" 5	4 51 40	1 48.5	22 31 3
" 7	23 9 54	11 14.9	5 22 27	" 8	5 4 2	1 15.7	22 49 25
" 10	23 20 59	10 30.3	4 12 12	" 11	5 16 27	0 40.5	23 4 10
" 13	23 32 1	9 42.5	3 1 30	" 14	5 28 54	+ 0 3.6	23 15 16
" 16	23 43 0	8 52.2	1 50 30	" 17	5 41 22	0 34.4	23 22 40
" 19	23 53 57	7 59.7	S 0 39 22	" 20	5 53 50	1 13.1	23 26 22
" 22	0 4 53	7 5.6	N 0 31 42	" 23	6 6 18	FAST 1 51.8	23 26 21
" 25	0 15 47	6 10.6	1 42 45	" 26	6 18 46	2 30.1	23 22 37
" 28	0 26 42	5 15.3	2 53 7	" 29	6 31 13	3 7.3	23 15 11
" 31	0 37 36	4 20.4	4 3 9				

Date	R.A.		Equation of Time		Declination		Date	R.A.		Equation of Time		Declination	
	h m s			m s	° ′ ″			h m s			m s	° ′ ″	
July 2	6 43 38		+	3 42.8	N 23 4 4		Oct. 3	12 35 46		−	10 49.5	S 3 51 21	
" 5	6 56 1			4 16.1	22 49 20		" 6	12 46 41			11 43.8	5 0 49	
" 8	7 8 21			4 46.4	22 31 1		" 9	12 57 40	SLOW		12 34.7	6 9 44	
" 11	7 20 38			5 13.1	22 9 13		" 12	13 8 42			13 21.9	7 17 54	
" 14	7 32 50			5 35.6	21 43 59		" 15	13 19 49			14 4.6	8 25 10	
" 17	7 44 58	FAST		5 53.7	21 15 25		" 18	13 31 1	WATCH		14 42.5	9 31 21	
" 20	7 57 1			6 7.1	20 43 37		" 21	13 42 18			15 14.8	10 36 19	
" 23	8 8 59			6 15.5	20 8 40		" 24	13 53 42			15 41.0	11 39 52	
" 26	8 20 52			6 18.8	19 30 41		" 27	14 5 11			16 0.8	12 41 50	
" 29	8 32 39			6 16.9	18 49 46		" 30	14 16 48			16 13.8	13 42 2	
Aug. 1	8 44 22			6 9.8	18 6 4		Nov. 2	14 28 32			16 19.8	14 40 17	
" 4	8 55 59			5 57.3	17 19 41		" 5	14 40 23			16 18.7	15 36 23	
" 7	9 7 31			5 39.4	16 30 47		" 8	14 52 21			16 10.2	16 30 10	
" 10	9 18 57			5 16.1	15 39 30		" 11	15 4 26			15 54.3	17 21 26	
" 13	9 30 18			4 47.4	14 45 57		" 14	15 16 39			15 31.0	18 10 0	
" 16	9 41 34			4 13.6	13 50 18		" 17	15 29 0			15 0.0	18 55 42	
" 19	9 52 45	WATCH		3 35.1	12 52 40		" 20	15 41 28			14 21.5	19 38 23	
" 22	10 3 52			2 52.2	11 53 12		" 23	15 54 4	SLOW		13 35.5	20 17 51	
" 25	10 14 55			2 5.3	10 52 1		" 26	16 6 47			12 42.2	20 53 58	
" 28	10 25 54			1 14.9	9 49 17		" 29	16 19 36			11 42.2	21 26 34	
" 31	10 36 50		+	0 21.3	8 45 7								
Sept. 3	10 47 43		−	0 35.1	7 39 42		Dec. 2	16 32 32			10 35.9	21 55 30	
" 6	10 58 34			1 33.9	6 33 9		" 5	16 45 34			9 24.1	22 20 39	
" 9	11 9 23			2 34.8	5 25 40		" 8	16 58 40	WATCH		8 7.5	22 41 53	
" 12	11 20 10	SLOW		3 37.3	4 17 21		" 11	17 11 51			6 46.8	22 59 7	
" 15	11 30 56			4 40.8	3 8 23		" 14	17 25 4			5 22.7	23 12 14	
" 18	11 41 42			5 44.7	1 58 53		" 17	17 38 21			3 55.9	23 21 13	
" 21	11 52 28	WATCH		6 48.4	N 0 49 0		" 20	17 51 39			2 27.3	23 25 59	
" 24	12 3 15			7 51.4	S 0 21 7		" 23	18 4 58		−	0 57.6	23 26 30	
" 27	12 14 3			8 52.8	1 31 19		" 26	18 18 18		+	0 32.2	23 22 48	
" 30	12 24 53			9 52.4	2 41 27		" 29	18 31 36			2 1.1	23 14 52	

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, 1921

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 4.6. 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.
1920			h m	h m	°	°
Jan. 4	νScorpii	3.9	16 50.3	.....	114	...
Mar. 14	δTauri	3.9	.....	23 09.7	...	255
Mar. 14	68Tauri	4.3	23 44.5	0 07.5	6	331
Apr. 11	δTauri	3.9	6 01.9	6 47.9	136	221
Apr. 11	68Tauri	4.3	7 17.2	8 02.7	46	312
Apr. 14	λGeminorum	3.6	3 54.4	5 10.9	93	284
Apr. 27	ρSagittarii .	4.0	16 49.5	17 44.0	29	206
July 18	ρSagittarii	4.0	15 04.3	.....	107	...
July 29	δTauri	3.9	16 31.8	17 34.1	49	287
Aug. 29	λGeminorum	3.6	1 13.4	1 49.4	52	334
Oct. 22	λGeminorum	3.6	12 30.8	13 26.8	62	303
Nov. 18	λGeminorum	3.6	20 30.4	20 54.4	37	347
Nov. 20	αCancri	4.3	11 55.0	12 55.5	91	292
Dec. 2	ρSagittarii	4.0	2 30.5	3 52.0	92	245
Dec. 10	oPiscium	4.5	5 35.9	6 50.9	77	237
Dec. 18	αCancri	4.3	20 42.3	.....	52	...

*Eastern Standard Time the hours numbering 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-town	+13	Port Arthur	+57	Brandon	+40	Calgary	+36
Brantford	+21	Fredericton	+26	Victoria	+13	Indian Head	− 5	Edmonton	+34
Chatham	+29	Montreal	− 6			Kamloops	+ 2	Prince Albert	+ 4
Goderich	+27	Ottawa	+ 3			Kenora	+18	Saskatoon	+ 6
Guelph	+21	Parry Sound	+20			Medicine Hat	+22		
Halifax	+14	Quebec	− 15			Moosejaw	+ 2		
Hamilton	+20	Sherbrooke	− 12			Moosomin	+40		
Kingston	+ 6	St. John, N.B.	+24			Nelson	− 11		
London	+ 25	Sydney	+ 1			Portage La Prairie	+33		
Orillia	+18	Three Rivers	− 10			Regina	− 2		
Owen Sound	+24					Vancouver	+12		
Peterboro	+13					Winnipeg	+28		
Port Hope	+14								
Stratford	+24								
Toronto	+18								
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 PLANETS DURING 1921

In the following notes on the Planets a general account of the phenomena connected with their motions is given. Fuller details will be found on the pages headed *The Sky for the Month* (pages 28, 30...).

MERCURY ☿

Mercury's apparent separation from the sun is never great, and consequently it is comparatively seldom seen with the naked eye; but when near its greatest elongation it is easily visible as a star of the first magnitude. It can often be seen for about a fortnight at its elongations, but some of these occasions are much more favourable than others. For instance, on February 15 the planet is 18° east of the sun, while on Oct. 7, it is 25° east. Yet the former is the better time to look for the planet, since then it is *higher above the horizon* after the sun has set. In general, the planet can best be seen at an eastern elongation (that is, as an evening star) during late winter and spring and at a western elongation (that is, as morning star) in the autumn.

By a reference to the *Planetary Phenomena* (pages 31, 39, 49) it will be seen that maximum eastern elongations occur on Feb. 15 and June 10, near which dates the planet should be well seen as an evening star; a favourable western elongation occurs on Nov. 16, when it should be a good morning star. The planet can probably be seen at the other elongations too, but those named are **especially favourable.**

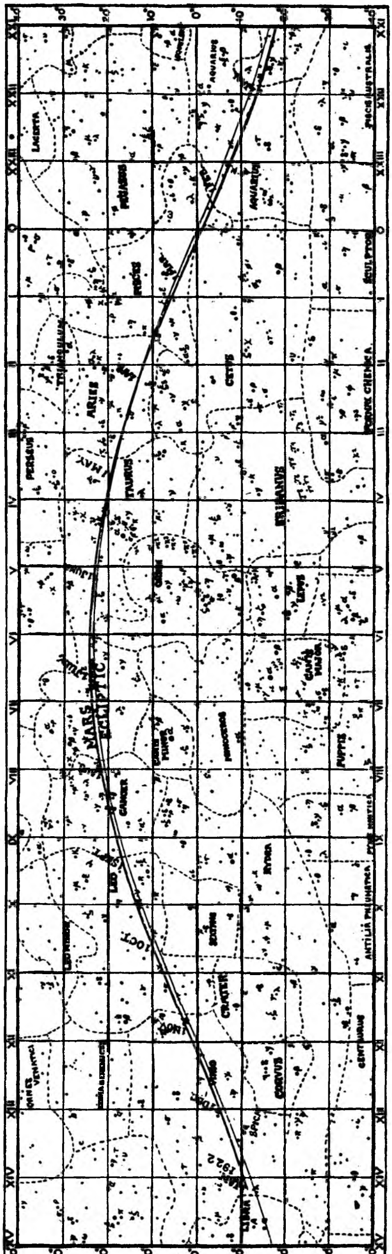
VENUS ♀

Venus was in superior conjunction with the sun on July 3, 1920, and since that date has been an evening star, gradually separating from the sun and increasing in brightness. At the beginning of the year it is a splendid evening star. It continues to separate from the sun until Feb. 9, and attains its greatest brilliancy on March 17 (see page 33). On April 22 it comes between us and the sun (inferior conjunction) and after that date it is a morning star, continuing so until superior conjunction on Feb. 9, 1922.

The phases of Venus can easily be seen with a small telescope. When about midway between greatest elongation and inferior conjunction the planet has an apparent diameter of 40″, and with a magnifying power of only 45 it looks in the telescope exactly as the moon when four days' old does to the naked eye, and of the same apparent size.

MARS ♂

This planet is a most interesting object of study, but during 1921 it will not be well placed for observation, as it is moving in that part of its orbit which is far from the earth. Its distance from the earth on the 15th of each month is given on pages 28, 30, etc. It is a comparatively faint evening star during the first few months, and after its conjunction with the sun at the end of June it becomes a morning star. During the autumn and winter it will be fairly prominent, and it will grow steadily brighter until June, 1922, when its next opposition occurs. In the accompanying map its path among the stars is shown.

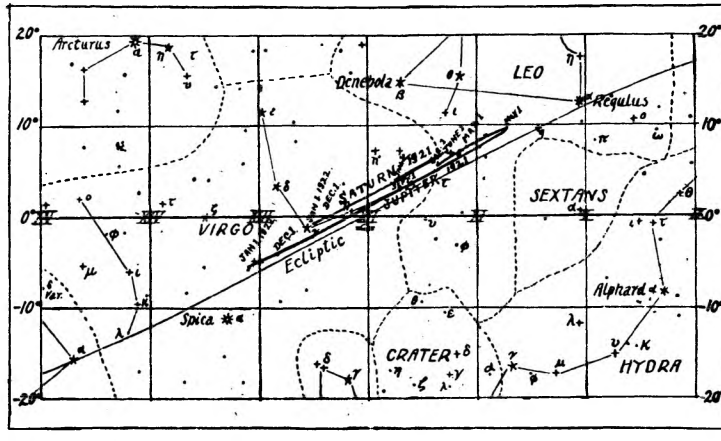

MARS
ECLIPTIC
MAY
OCT.
PERSEUS
TRIANGULUM
ARIES
TAURUS
ERIDANUS
CETUS
PISCES
PEGASUS
AQUARIUS
LACERTA
SCULPTOR
PISCIS AUSTRALIS
LEPUS
CANIS MAJOR
MONOCEROS
PUPPIS
CANCER
LEO
LEO MINOR
HYDRA
SEXTANS
CRATER
CORVUS
VIRGO
SPICA
LIBRA
CENTAURUS
ANTLIA PNEUMATICA
CANES VENATICI
FORNAX CHEMICA

Jupiter ♃

Jupiter is the greatest of all the planets. Its brightness exceeds that of any of the fixed stars and is surpassed by Venus only. The planet is a very conspicuous object in the sky, and reaches its best at the beginning of March, when it is visible all night. After that it apparently drifts steadily to the western sky and it is a brilliant evening star until the sun overtakes it on Sept. 22. It will be swallowed up in the sun's rays until November, when it will be a bright morning star. Jupiter's motion with respect to Saturn is described below.

Jupiter is a fine object for a small telescope. Even a field glass will reveal its disc and also its four large moons. These were discovered by Galileo in 1610, but since then five more have been detected. However, they are all very faint (see page 56).

The paths of Jupiter and Saturn are shown in the accompanying map.



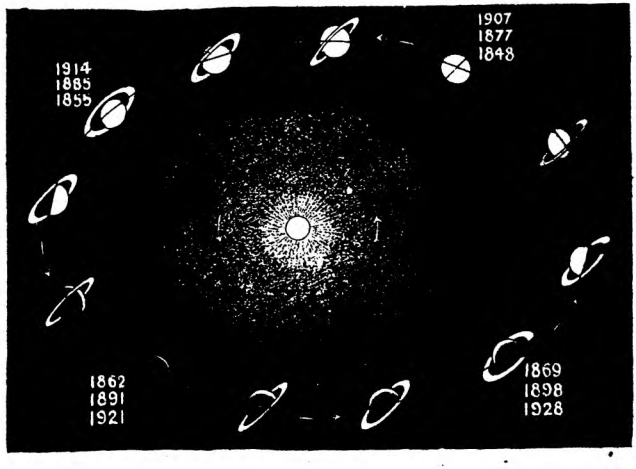
Saturn ♄

From the map it will be seen that at the beginning of the year Saturn is some 8° east of Jupiter and both are retrograding, On Jan. 1 Saturn rises at about 10.30 p.m., half an hour after its larger brother. On March 4 it is in opposition to the sun and is then visible all night.

By many observers Saturn, with its unique ring-system and its numerous satellites, is considered the finest object in the sky.

As the ring-system remains always parallel to itself (see accompanying Figure), it happens that twice during the planet's revolution in 29½ years the edge of the rings will be turned towards the earth's orbit and they become invisible. When the plane of the rings passes between the earth and the sun the dark side of the ring is towards us and the edge alone is visible—and that only in a large instrument. "When the earth is crossing the plane of the ring, so that the edge is exactly towards us, the ring becomes absolutely invisible to all existing

telescopes for several days; and in the longer periods, while the dark side of the ring is presented to us—sometimes for several weeks—only the most powerful instruments can see it, like a fine needle of light piercing the planet's ball, and with satellites strung like beads upon it." (Young's *Manual of Astronomy*). This phenomen occurs in 1920-21. On April 10, 1921, as the planet slowly moves forward in its orbit, the sun changes from being on the south side of the rings to the north side, that is, before the date given the sun illuminates the south face of the rings, after that date the north face. By the motion of the earth in its orbit it moves from the south to the north side of the rings on Nov. 7, 1920; then on February 22 it moves back to the south side; and finally, on Aug. 10, it moves to the north side again and remains there. Now for the rings to be visible to us the sun and the earth must be on the same side. Consequently,



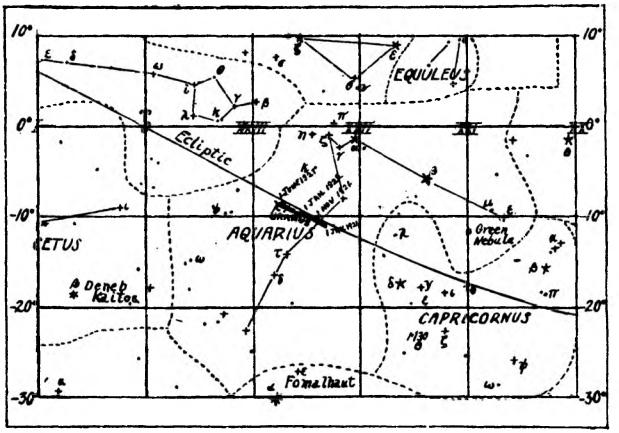
on Nov. 7, 1920, the rings disappear and remain invisible until Feb. 22, 1921; they then become visible and remain so until April 10, when they disappear and remain invisible until Aug. 3, from which date, as both earth and sun are on the north side, they will continue to be visible for another half-revolution of the planet.

For some years it has been interesting to see Jupiter gaining on Saturn as they revolve in their orbits. They come to conjunction on Sept. 14, but unfortunately the sun is in the same part of the sky at that time and we cannot see them. When the sun shall have moved on far enough for us to see the planets, Jupiter will be east of Saturn. Nearly twenty years will elapse before they will be together.

Uranus ♅

This planet was discovered by Sir William Herschel in 1781 and it appears to the naked eye on a dark night as a small star of the sixth magnitude. During

1921 it will be in Aquarius, as the accompanying map shows. It is in opposition to the sun on Aug. 31 (see page 43) when it will be visible all night. This is the best time of the year for observing it, and its position and motion can be followed with a field-glass.



Neptune ♆

The planet Neptune is the most distant known member of the solar system, being 2,800 millions of miles from the sun and requiring 165 years to complete a revolution. During the year it is in Cancer. It is in opposition to the sun on February 1 (see page 31). It appears as a star of the eighth magnitude and so cannot be seen with the naked eye.

Algol

The minima of Algol are calculated from Chandler's formula, with Hartwig's correction of 1h 30m *earlier*. The times are given to the nearest 10 minutes.

ECLIPSES IN 1921

PREPARED BY R. M. MOTHERWELL

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

I. An Annular Eclipse of the Sun, April 7, 1921; the path of the Annular Eclipse crossing the North Atlantic Ocean from a point east of Newfoundland, touching the extreme north part of Scotland and the northwest coast of Norway and ending in the Arctic Ocean north of Siberia. It is visible as a partial eclipse in the north portion of Africa, in Europe, and in the northwest part of Asia.

II. A Total Eclipse of the Moon, April 21, 1921; the beginning visible in North America, South America, the Atlantic Ocean and the Pacific Ocean; the ending visible in North America, South America, Australia, the Pacific Ocean and the eastern portion of Asia.

Circumstances of the eclipse:

	d	h	m	
Moon enters penumbra	April 21	23	57.3	= 11.57.3 p.m.
Moon enters umbra	" 22	1	3.2	
Total Eclipse begins	" 22	2	23.5	
Middle of the Eclipse	" 22	2	44.4	
Total Eclipse ends	" 22	3	5.3	
Moon leaves umbra	" 22	4	25.7	
Moon leaves penumbra	" 22	5	32.0	

Mangitude of the eclipse = 1.074 (Moon's diameter = 1.0).

III. A Total Eclipse of the Sun, October 1, 1921, the path of totality extending from a point in the Southern Pacific west of the southern extremity of South America, past Cape Horn and thence southward, ending close to the South Pole. It is visible as a partial eclipse in the south half of South America and in the South Atlantic and Antarctic Oceans.

IV. A Partial Eclipse of the Moon, October 16, 1921; the beginning visible in Asia, except the eastern portion, Europe, Africa, the eastern part of South America, the Indian Ocean, and the Atlantic Ocean; the ending visible in western Asia, Europe, Africa, South America, North America, except the extreme western part, the Atlantic Ocean and the western part of the Indian Ocean.

Circumstances of the Eclipse:

	d	h	m
Moon enters penumbra	October 16	3	1.2
Moon enters umbra	" 16	4	14.0
Middle of the Eclipse	" 16	5	53.8
Moon leaves umbra	" 16	7	33.6
Moon leaves penumbra	" 16	8	46.3

Magnitude of the eclipse = 0.938 (Moon's diameter = 1.0).

(In all cases the time given is Eastern Standard Time, hours numbering from midnight.)

THE SKY FOR JANUARY 1921

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	19h 45m	22h 47m	22h 40m	11h 20m	11h 44m	22h 23m	9h 1m
Decl.	23° 16′ S	8° 47′ S	9° 26′ S	5° 40′ N	4° 8′ N	10° 56′ S	17° 0′ N
Transit	12h 7m	15h 10m	15h 2m	3h 44m	4h 8m	14h 44m	1h 26m

The Sun.—During January the sun's R.A. increases from 18h 46m to 20h 58m and its Decl. changes from 23° 2′S. to 17° 10′S. The equation of time (see p. 6) increases from 3m 34s to 13m 34s, and, on account of this rapid rise in value, the time of mean noon appears to remain, for the first ten days of the month, at the same distance from the time of sunrise, that is, the forenoons, as indicated by our clocks are of the same length. On the 20th the sun enters the sign Aquarius, the second of the winter signs of the zodiac. The change in the length of the day for any latitude may be found on page 10. On January 1 the earth is in perihelion, at a distance of 91,341,000 miles.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 4th the moon occults a star in Scorpio (see p. 8).

Mercury is moving in the farther side of its orbit, passing superior conjunction on the 16th (see opposite page) and is therefore unsuitably placed for observation this month.

Venus is a prominent evening star in the south-south-west all month, setting about 3¾ hrs. after the sun. Stellar magnitude, −3.8, increasing. A small telescope should show its phase like the moon about 10 days old. It passes Mars on the 9th (see opposite page).

Mars is moving through constellation Aquarius and visible as a fair evening star (mag. +1.3) for 4 hours after sunset. On the 15th it is 180,787,000 miles from the earth, which distance is increasing.

Jupiter is a very conspicuous object (mag. −1.9) in Leo and rises on the 1st at about 10 p.m. It is stationary on the 4th, when it begins to retrograde, moving away from Saturn and towards Regulus. For the configurations of its satellites see next page; for their eclipses see p. 52.

Saturn is in Virgo and rises half an hour later than Jupiter. On the 5th it begins to retrograde, but it moves more slowly than Jupiter. Stellar magnitude +1.1, increasing.

For Uranus and Neptune, see page 25.

JANUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Mimima of Algol	Configurations of Jupiter's Satellites at 2h 30m
			h m	
Sat.	1	15h ☿ in Aphelion	19 40	
Sun.	2			4O123
Mon.	3			4O23*
Tues.	4	8h ♃ Stationary	16 30	d23O4
Wed.	5	8h ♄ Stationary		3O14*
Thur.	6			31O24
Fri.	7		13 20	2O14*
Sat.	8	15h 2m☌☿ ☾, ☿ 6° 21′ S		21O34
● Sun.	9	0h 27m N.M.; 1h☌♂♁, ♂0° 15′ S.; 4h☌♀♁, ♀0° 41′ S.; 10h☌♀♂, ♀0° 25′ S.; 4h moon in Apogee		O1234
Mon.	10		10 10	1O234
Tues.	11			231O4
Wed.	12	22h 40m☌♁ ☾, ♁ 5° 19′ S.		3O14*
Thur.	13	4h 38m☌♂☾, ♂5° 23′ S.; 7h 33m☌♀☾, ♀5° 32′ S	6 50	341O2
Fri.	14			42O1*
Sat.	15			421O3
Sun.	16	14h☌☿☉Superior	3 40	4O123
☽ Mon.	17	1h 31m Moon F.Q.		41O23
Tues.	18			423O1
Wed.	19		0 30	4320*
Thur.	20			341O2
Fri.	21		21 20	d3O41
Sat.	22			21O34
♋ Sun.	23	0h☿ Greatest Hel. Lat. S.; 18h 8m F.M.; Moon in Perigee		O2134
Mon.	24	10h 46m☌♆ ☾♆5° 8′ N	18 10	1O234
Tues.	25			23O14
Wed.	26	20h 53m☌♃☾, ♃5° 3′ N.		32O14
Thur.	27	7h 51m☌♄☾, ♄5° 34′ N.	15 00	d3024
Fri.	28	12h ♀ in ♌		32O14
Sat.	29			d21O3
☾ Sun.	30	15h 2m Moon L.Q.	11 50	4O213
Mon.	31			41O23

Explanation of symbols and abbreviations on page 4.

THE SKY FOR FEBRUARY

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	23h 1m	0h 45m	0h 7m	11h 11m	11h 39m	22h 29m	8h 58m
Decl.	5° 12′ S	6° 45′ N	0° 14′ N	6° 45′ N	4° 46′ N	10° 19′ S	17° 15′ N
Transit	13h 21m	15h 5m	14h 27m	1h 34m	2h 1m	12h 49m	23h 16m

The Sun.—During February the sun's R.A. increases from 20h 58m to 22h 47m and its Decl. changes from 17° 10′ to 7° 41′S. On the 19th the sun enters the third winter sign, Pisces. For the change in the length of the day see page 11. The equation of time reaches a maximum value of 14m 24s on the 12th (see page 6).

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

Mercury is an evening star this month, rapidly improving in position until it reaches its greatest elongation east on the 15th, on which date it should be easily seen, 6° south of the setting sun, and at an altitude of about 16°. Because the ecliptic cuts the horizon at an angle of 60° at sunset, this is the best time of the year to observe the planets as evening stars. Mercury sets 1h 35m after sunset, its stellar magnitude is 0 and its phase resembles the moon at first quarter.

Venus on the 9th is at its greatest elongation east, being in the south-west at sunset, at an altitude of about 42°, and setting at 11 p.m. It has a stellar magnitude of −4.0, increasing, and a phase like a half-moon. The conjunction on the 11th with the moon is visible as an occultation, although not in Eastern Canada.

Mars is still an evening star (mag. +1.5) setting 3 hours after sunset. On the 15th it is 196,084,000 miles distant, and still receding from the earth.

Jupiter on the 1st rises at 7.45 p.m., its position being practically the same as last month. Its stellar magnitude is now a maximum, −2.0. For the configuration of its satellites see next page; for their eclipses, etc., see p. 52.

Saturn's position has changed less than Jupiter's, and it still rises about half an hour later. It is slightly brighter than last month having a stellar magnitude of +1.0. Regarding the visibility of Saturn's rings, see page 23.

For *Uranus* and *Neptune* see page 25.

FEBRUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol	Configurations of Jupiter's Satellites at 1h 15m
			h m	
Tues.	1	13h☌☿⊙		
Wed.	2		8 40	43210
Thur.	3			43102
Fri.	4			4302*
Sat.	5	7h Moon in Apogee	5 20	42103
Sun.	6			4013*
♍ Mon.	7	19h 37m N.M.		10423
Tues.	8	2h☌☿♁, ☿ 0° 9′ N.	2 10	20314
Wed.	9	7h 11m☌♁☾, ♁ 5° 6′ S.; 11h 0m☌☿☾, ☿ 4° 34′ S.; 23h ♀ Greatest elong. E. 46° 46′		32104
Thur.	10		23 00	30124
Fri.	11	0h ☿ in♌; 4h 43m☌♂☾, ♂ 3° 18′ S.; 23h 41m☌♀☾, ♀ 0° 17′ S.		3024*
Sat.	12			21034
Sun.	13		19 50	0134*
Mon.	14			10423
♎ Tues.	15	13h 53m Moon F.Q.; 6h ☿ Greatest elong. E. 18° 8′; 14h ☿ in Perihelion		24031
Wed.	16		16 40	42310
Thur.	17			43012
Fri.	18			43102
Sat.	19		13 30	d420*
Sun.	20	20h 43m☌♆☾, ♆ 5° 10′ N.; 19h Moon in Perigee		42013
Mon.	21	4h ☿ Stationary		41023
♏ Tues.	22	4h 32m F.M.	10 20	d4013
Wed.	23	3h 15m☌♃☾, ♃ 5° 12′ N.; 15h 55m☌♄☾, ♄ 5° 37′ N.		2130*
Thur.	24	14h☌♁⊙		30214
Fri.	25	21h ☿ Greatest Hel. Lat. N.	7 10	31024
Sat.	26			21034
Sun.	27			2034*
Mon.	28		4 00	10234

Explanation of symbols and abbreviations on page 4.

THE SKY FOR MARCH

POSITION OF PLANETS ON THE 15TH

.	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	22h 20m	2h 4m	1h 25m	10h 58m	11h 31m	22h 35m	8h 55m
Decl.	8° 55′ S	18° 9′ N	8° 44′ N	8° 10′ N	5° 40′ N	9° 44′ S	17° 26′ N
Transit	10h 50m	14h 34m	13h 54m	23h 26m	23h 59m	11h 5m	21h 24m

The Sun.—During March the sun's R.A. increases from 22h 47m to 0h 41m, and its Decl. changes from 7° 41′ S. to 4° 26′ N. On the 20th the sun crosses the equator and enters the first sign of spring, Aries. The equation of time decreases from 12m 31s to 4m 17s (see page 6). For changes in the length of the day, see page 12.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 14th the moon occults two stars in Taurus (see page 8).

Mercury on the 29th reaches its best position as a morning star, but although 28° from the sun it is only 10° above the horizon at sunrise and 26° southward. This is owing to the small inclination of the ecliptic in the east at sunrise at this time of the year. Field-glasses and a good horizon are essential to locate the planet at this elongation. Stellar mag. +0.6, decreasing.

Venus is moving in the nearer side of its orbit, and although its crescent phase is steadily decreasing it reaches its greatest brilliancy (mag. −4.3) on the 17th. At sunset on that date it is 10°S. of the setting sun and high in the sky (altitude 38°). Its great brilliancy enables it to be easily seen even in broad daylight. During the last week of the month and the first week of April it remains nearly in the same place, 6°E. of Alpha Arietis (Hamal) setting 2h 50m after the sun.

Mars is now moving through the constellation Pisces and sets about 2h after the sun. It is overtaking Venus, the conjunction occurring early next month. On the 15th it is 209,331,000 miles from the earth.

Jupiter reaches the middle point of its retrogression (that is, is in opposition) on March 4, and hence is at its best, having maximum brightness and being visible all night. For the configuration of its satellites, see next page; and for their eclipses, etc., see page 52.

Saturn is now 8°E. of Jupiter and its opposition occurs on the 12th. Its stellar magnitude is a maximum this month, +0.8.

For *Uranus* and *Neptune*, see page 25.

MARCH

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configurations of Jupiter's Satellites at 0h 15m
			h	m	
☾ Tues.	1	9h 3m Moon L.Q.			
Wed.	2	21h ☌ ☿ ☉ Inferior			21304
Thur.	3	4h ♀ in Perihelion	0	40	30241
Fri.	4	21h ☍ ♃ ☉; 21h Moon in Apogee			34102
Sat.	5		21	30	42301
Sun.	6				42103
Mon.	7	1h ☌ ☿ ♁, ☿ 4° 16′ N.			d4023
Tues.	8	14h 18m ☌ ☿ ☾, ☿ 1° 8′ S.; 16h 48m ☌ ♁ ☾, ♁ 5° 0′ S.	18	20	40213
● Wed.	9	13h 9m N.M.			42130
Thur.	10				4301*
Fri.	11		15	10	34102
Sat.	12	2h 5m ☌ ♂ ☾, ♂ 0° 52′ S.; 8h ☍ ♄ ☉; 22h 42m ☌ ♀ ☾, ♀ 5° 40′ N.			32041
Sun.	13				21034
Mon.	14		12	00	d0234
Tues.	15	6h ☿ Stationary			01234
☽ Wed.	16	22h 49m Moon F.Q.			d2104
Thur.	17	3h ♀ Greatest Brilliancy	8	50	32014
Fri.	18				31024
Sat.	19				32014
Sun.	20	4h 47m ☌ Ψ ☾, Ψ 5° 18′ N.; 22h 51m ☉ enters ♈, Spring Commences; 20h Moon in Perigee	5	40	d2103
Mon.	21	8h ☿ in ♉			40123
Tues.	22	7h 57m ☌ ♃ ☾, ♃ 5° 27′ N.; 22h 55m ☌ ♄ ☾, ♄ 5° 48′ N			4023*
○ Wed.	23	15h 18m F.M.	2	30	42103
Thur.	24				43201
Fri.	25	0h ♀ Greatest Hel. Lat. N.; 11h ☌ ☿ ♁, ☿ 0° 4′ S.	23	20	43102
Sat.	26				43201
Sun.	27				42103
Mon.	28	1 h ☌ in ♌	20	00	40123
Tues.	29				10243
Wed.	30	5h ☿ Greatest elong. W. 27° 50′			21034
☾ Thur.	31	4h 13m Moon L.Q.; 14h ☿ in Aphelion; 16h ♀ Stationary	16	50	32014

Explanation of symbols and abbreviations on page 4.

THE SKY FOR APRIL

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	0h 12m	2h 6m	2h 52m	10h 47m	11h 23m	22h 41m	8h 54m
Decl.	1° 31′ S	20° 9′ N	16° 39′ N	9° 17′ N	6° 31′ N	9° 10′ S	17° 32′ N
Transit	10h 40m	12h 34m	13h 19m	21h 13m	21h 49m	9h 9m	19h 20m

The Sun.—During April the sun's R.A. increases from 0h 41m to 2h 33m, and its Decl. increases from 4° 26′ N. to 15° 0′ N. On the 20th it enters the second spring sign, Taurus. The equation of time changes from +4m 2s to −2m 57s (see page 6). For the length of the day in various latitudes, consult page 13.

The Moon.—For its phases and conjunctions with the planets, see opposite page. On the 11th the moon occults two stars in Taurus, on the 14th a star in Gemini and on the 27th one in Sagittarius (see page 8).

Mercury is again moving in the farther side of its orbit and will not be suitably placed for observation this month.

Venus is retrograding during the month. Inferior conjunction takes place on the 22nd, after which it is a morning star.

Mars is now moving through the constellation Aries setting earlier each night, as the sun is slowly overtaking it. On the 15th it is 222,530,000 miles distant. After its conjunction with Venus on the 4th (see opposite page) it rapidly draws away from it.

Jupiter on the 1st has altitude 30° in the east at sunset, and forms a striking isosceles triangle with Regulus and Denebola, Alpha and Beta of Leo. As it is approaching its second stationary point it appears to move more slowly and remains relatively at rest with regard to Saturn, which it precedes by 9°. For the configurations of its satellites, see next page; and for their eclipses, etc., see page 52.

Saturn follows Jupiter across the sky, being visible from sunset until 4 a.m. It is at the right angle of a right-angled traingle which it forms with Regulus and Denebola. Its brightness has decreased slightly since last month, its magnitude being +1.0.

For *Uranus* and *Neptune*, see page 25.

APRIL

ASTRONOMICAL PHENOMENA

(75th Meridina Time, Hours Numbering from Midnight)

			Minima of Algol	Configurations of Jupiter's Satellites at 23h 15m
			h m	
Fri.	1	16h Moon in Apogee		d3O14
Sat.	2			21O4*
Sun.	3		13 40	O2134
Mon.	4	13h☌♀ ♂, ♀ 7° 24′ N.		1O423
Tues.	5	3h 25m☌ ♁ ☾, ♁ 4° 59′ S.		24O13
Wed.	6	2h 18m☌ ☿ ☾, ☿ 5° 49′ S.	10 30	432O*
Thur.	7	7h 0m☉Ann ecl, invis. in Canada (see p. 27)		431O2
Fri.	8	4h 5m N.M.		43O21
Sat.	9	12h 57m ☌♀ ☾, ♀ 8° 28′ N.; 21h 54m ☌♂☾, ♂ 1° 30′ N.	7 20	421O*
Sun.	10			4O13*
Mon.	11			41O23
Tues.	12		4 10	42O13
Wed.	13			23O**
Thur.	14			31O24
Fri.	15	5h 12m Moon F.Q.	1 00	3O214
Sat.	16	10h 45m☌♆ ☾, ♆ 5° 22′ N.; 10h Moon in Perigee.		213O4
Sun.	17		21 50	O134*
Mon.	18	11h 50m☌♃ ☾, ♃ 5° 36′ N.		1O234
Tues.	19	4h 13m☌ ♄ ☾, ♄ 5° 56′ N.		2O134
Wed.	20	23h ☿ Greatest Hel. Lat. S.	18 40	231O4
Thur.	21	7h ☾ Tot. ecl. (see p. 27); 19h ♆ Stationary.		d3O42
Fri.	22	2h 49m F.M.; 13h☌♀☉ Inferior		34O12
Sat.	23		15 30	4213O
Sun.	24			42O13
Mon.	25			41O23
Tues.	26		12 10	42O13
Wed.	27			4213O
Thur.	28	21h☌☿ ♀, ☿ 6° 52′ S		43O12
Fri.	29	23h 9m Moon L.Q.; 12h Moon in Apogee	9 00	34O2*
Sat.	30			231O4

Explanation of symbols and abbreviations on page 4.

THE SKY FOR MAY

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	3h 51m	1h 27m	4h 19m	10h 45m	11h 19m	22h 45m	8h 54m
Decl.	21° 5′ N	10° 8′ N	21° 54′ N	9° 23′ N	6° 51′ N	8° 48′ S	17° 30′ N
Transit	12h 21m	9h 57m	12h 48m	19h 13m	19h 48m	7h 15m	17h 23m

The Sun—During May the sun's R.A. increases from 2h 33m to 4h 35m, and its Decl. increases from 15° 0′ to 22° 1′N. On the 21st the sun enters Gemini, the third spring sign of the zodiac. The equation of time increases from 2m 57s to a maximum of 3m 48s on the 15th, and then falls to 2m 36s on the 31st (see page 6). The length of the day in latitude 44°N. increases 61m during the month (see page 14).

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

Mercury, during the last two weeks of the month, rapidly improves its position for observation. On the 31st it sets about 1¾ h. after the sun and so, with a good horizon, should be seen about 10° south of the sun and at an altitude of 17°. Stellar magnitude 0.

Venus is a bright morning star rising (on the 15th) 1½h. before the sun. It is due east of Alpha Andromeda (Alpheratz). Its crescent phase is increasing and the planet attains greatest brilliancy (mag. −4.2) on the 28th. It reaches a stationary point on the 11th, and then moves forward in its orbit, crossing to the south side of the ecliptic (see opposite page).

Jupiter becomes stationary on the 6th, after which it moves away from Regulus towards Saturn. It will be interesting to watch Jupiter overtake Saturn (see page 24). The planet this month has stellar magnitude −1.7, and is slightly brighter than Sirius. For the configuration of its satellites, see next page; for their eclipses, etc., see page 52.

Saturn becomes stationary on the 21st, after which it moves forward in its orbit. See map on p. 24. Saturn's stellar magnitude is now +1.2, the same as that of Spica.

For *Uranus* and *Neptune*, see page 25.

MAY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol	Configurations of Jupiter's Satellites at 22h 30m
			h m	
Sun.	1	18h □ ♆ ☉		20134
Mon.	2	14h 5m ☌ ♁ ☾, ♁ 4° 56′ S.	5 50	10234
Tues.	3			d0134
Wed.	4			21034
Thur.	5	23h 45m ☍ ♀ ☾, ♀ 2° 55′ N.	2 40	30124
Fri.	6	7h ♃ Stationary		31024
● Sat.	7	8h 59m ☌ ☿ ☾, ☿ 1° 0′ N.; 16h 2m N.M.	23 30	32104
Sun.	8	17h 4m ☌ ♂ ☾, ♂ 3° 27′ N.		d2013
Mon.	9	23h ☿ in ♌		41023
Tues.	10	6h ☌ ☿ ☉ Superior	20 20	40213
Wed.	11	13h ♀ Stationary; 15h Moon in Perigee		42103
Thur.	12			4301*
Fri.	13	16h 19m ☌ ♆ ☾, ♆ 5° 18′ N.	17 10	43102
☽ Sat.	14	7h ☿ in Perihelion; 10h 25m Moon F.Q.		d4320
Sun.	15	16h 58m ☌ ♃ ☾, ♃ 5° 28′ N.		4201*
Mon.	16	8h 48m ☌ ♄ ☾, ♄ 5° 52′ N.	14 00	14023
Tues.	17			02143
Wed.	18			21034
Thur.	19	22h ☌ ☿ ♂, ☿ 1° 4′ N.	10 50	3014*
Fri.	20	1 h ♀ in ♉		31024
♉ Sat.	21	11h ♄ Stationary; 15h 15m F.M.		32104
Sun.	22		7 30	204**
Mon.	23			10234
Tues.	24	20h ☿ Greatest Hel. Lat. N.		01243
Wed.	25		4 20	21403
Thur.	26			43201
Fri.	27	6h Moon in Apogee		43102
Sat.	28	13h ♀ Greatest Brilliancy	1 10	43201
☾ Sun.	29	16h 45m Moon L.Q.; 23h 32m ☍ ♁ ☾, ♁ 4° 47′ S.		43210
Mon.	30		22 00	41023
Tues.	31	10′ □ ♁ ☉; 18h □ ♃ ☉		40123

Explanation of symbols and abbreviations on page 4.

THE SKY FOR JUNE

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	7h 16m	2h 31m	5h 50m	10h 53m	11h 21m	22h 46m	8h 57m
Decl.	22° 44′ N	11° 54′ N	24° 10′ N	8° 28′ N	6° 33′ N	8° 41′ S	17° 20′ N
Transit	13h 43m	8h 59m	12h 17m	17h 19m	17h 47m	5h 14m	15h 23m

The Sun.—During June the sun's R.A. increases from 4h 35m to 6h 40m, and its Decl. increases to the maximum 23° 27′ on the 21st. On that date the sun enters the first summer sign, Cancer, and our days are longest, being 15h 29m in latitude 44°N. (see page 15). The Decl. falls to 23° 12′ on the 30th. The equation of time becomes zero on the 10th and rises to 3m 19s on the 30th (see page 6). The increase in the equation of time taken with decreasing length of the day causes the local mean time of sunset to appear constant for several days at the end of June and the beginning of July.

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

Mercury, during the first two weeks, is a good evening star, reaching its greatest elongation east on the 10th, on which date it is about 17° above the horizon and 16° southward from the sun at sunset. Its magnitude is +0.7, decreasing, and its crescent phase should be easily seen with a telescope. As it sets 1h 50m after sunset this is the best eastern elongation this year.

Venus improves as a morning star. On the 15th it rises on the E.-N.-E horizon 2 hours before the sun. It has a stellar magnitude −4.1, decreasing, and half the disc is illuminated.

Mars is now too close to the sun to be observed. Conjunction takes place on the 28th, after which it is a morning star. It is 240,232,000 miles from us on the 15th of the month.

Jupiter, at sunset, is a conspicuous evening star in the south-west, having an altitude of about 45°. Its stellar magnitude is now −1.5, or about 12 times as bright as Regulus. For the configurations of its satellites, see next page; and for their eclipses, etc., see page 52.

Saturn is in line with Regulus and Jupiter, following Jupiter's lead by half an hour. It is now slightly fainter than Regulus or Spica. On the 9th it is quadrature with the sun.

For *Uranus* and *Neptune*, see page 25.

JUNE

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configurations of Jupiter's Satellites at 21h 45m
			h	m	
Sun.	1				42103
Mon.	2	22h 4m☌ ♀ ☾, ♀ 1° 36′ S.	18	50	23401
Tues.	3				31042
Wed.	4				d3014
Thur.	5		15	40	23104
● Fri.	6	1h 15m N.M.; 11h 57m☌ ♂☾, ♂4° 54′ N.			01234
Sat.	7	19h 43m☌ ☿ ☾, ☿ 6° 37′ N.			0234*
Sun.	8	4h Moon in Perigee	12	30	21034
Mon.	9	12h□♄☉; 23h 34m☌ Ψ ☾, Ψ 5° 9′ N.			23014
Tues.	10	23h ☿ Greatest elong. E. 24° 13′			31042
Wed.	11		9	20	34021
☽ Thur.	12	1h28′☌ ♃ ☾, ♃ 5° 5′N.; 14h 47m☌ ♄ ☾, ♄ 5° 35′ N.; 16h 0m Moon F.Q.			42310
Fri.	13				4013*
Sat.	14	14h ♁ Stationary	6	10	4023*
Sun.	15				42103
Mon.	16				42031
Tues.	17	7h ☿ in ♉	2	50	43102
Wed.	18				34021
Thur.	19		23	40	23104
♋ Fri.	20	4h 41m F.M.			0134*
Sat.	21	18h 36m☉ enters ♋, Summer commences			10234
Sun.	22		20	30	d2034
Mon.	23	11h ♀ in Aphelion; 21h Moon in Apogee			20134
Tues.	24	7h ☿ Stationary			31024
Wed.	25		17	20	30214
Thur.	26	6h 52m☌ ♁ ☾, ♁ 4° 34′ S.			32104
Fri.	27	13h ☿ in Aphelion			2041*
☾ Sat.	28	8h 17m Moon L.Q.	14	10	41023
Sun.	29	2 ☌ ♂☉			42013
Mon.	30				4203*

Explanation of symbols and abbreviations on page 4.

THE SKY FOR JULY

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	6h 49m	4h 24m	7h 17m	11h 8m	11h 28m	22h 45m	9h 1m
Decl.	18° 15′ N	18° 33′ N	23° 13′ N	6° 47′ N	5° 43′ N	8° 50′ S	17° 5′ N
Transit	11h 18m	8h 53m	11h 46m	15h 37m	15h 57m	3h 15m	13h 29m

The Sun.—During July the sun's R.A. increases from 6h 40m to 8h 44m, and its Decl. decreases from 23° 8′ to 18° 6′N. On the 22nd it enters Leo, the second summer sign of the zodiac. The equation of time increases from 3m 31s to a maximum of 6m 19s on the 26th and then falls to 6m 13s on the 31st. During the month the length of the day in lat. 44°N. decreases by 47m (see page 16). The earth is farthest from the sun on the 4th, being 94,454,000 miles distant.

The Moon.—For its phases and conjunctions with the planets see opposite page. On the 18th it occults a star in Sagittarius, and on the 29th one in Taurus (see page 8).

Mercury is moving in the nearer side of its orbit and passes inferior conjunction on the 7th. Although its greatest elongation west occurs on the 28th, it is more favourably situated for observation on the 31st on which date it rises 1½ hours before the sun. It is 12° south of the sun and has an altitude of 16°. Its stellar magnitude then is +0.2, and is becoming brighter.

Venus is at greatest elongation west on the 1st, being 45° from the sun, and it rises on the E.-N.-E. horizon 2h 40m before the sun. On the 2nd it is in close conjunction with the moon, and on the 16th it is in conjunction with Alpha Tauri (Aldebaran), see opposite page.

Mars is a morning star in Gemini, too close to the sun for observations. On the 15th it is 243,154,000 miles from the earth.

Jupiter is still a conspicuous evening star, although much nearer the horizon this month at sunset. It is slightly closer to Saturn, now preceding it by 5°. Its stellar magnitude is −1.4, its brightness decreasing each month. For the configurations of its satellites, see next page; and for their eclipses, etc., see page 52.

Saturn's position changes less than 2° a month, so it is still found midway between the constellations of Leo and Virgo. Its lead on Jupiter will gradually diminish, Jupiter overtaking it two months hence.

For *Uranus* and *Neptune*, see page 25.

JULY

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol	Configurations of Jupiter's Satellites at 20h 45m
			h m	
Fri.	1	14h ♀ Greatest Elong. W. 45° 44′	11 00	43102
Sat.	2	0h 36m ☌ ♀ ☾, ♀ 0° 43′ S.		43012
Sun.	3			43210
Mon.	4	2h ⊕ in Aphelion	7 50	4201*
● Tues.	5	6h 22m ☌ ♂ ☾, ♂ 5° 48′ N.; 8h 36m N.M.; 15h 5m ☌ ☿ ☾, ☿ 0° 34′ N.		41023
Wed.	6	8h Moon in Perigee		20143
Thur.	7	9h 27m ☌ Ψ ☾, Ψ 4° 58′ N.	4 40	20134
Fri.	8	0h ☌ ☿ ☉ Inferior		d304*
Sat.	9	14h ☌ ☿ ♂, ☿ 5° 46′ S.; 14h 17m ☌ ♃ ☾, ♃ 4° 32′ N.; 23h 56m ☌ ♄ ☾, ♄ 5° 8′ N.		30124
Sun.	10		1 30	32104
☽ Mon.	11	23h 16m Moon F.Q.		23014
Tues.	12		22 20	10234
Wed.	13			02143
Thur.	14			21403
Fri.	15	22h ♀ Greatest Hel. Lat. S.	19 00	d430*
Sat.	16			4302*
Sun.	17	22h ☿ Greatest Hel. Lat. S.		43210
Mon.	18	21h ☿ Stationary	15 50	42301
♍ Tues.	19	19h 8m F.M.		41023
Wed.	20			40213
Thur.	21	5h Moon in Apogee	12 40	42103
Fri.	22			d4021
Sat.	23	12h 3m ☌ ♁ ☾, ♁ 4° 24′ S.		3042*
Sun.	24		9 30	32104
Mon.	25			23014
Tues.	26			10324
☾ Wed.	27	21h 20m Moon L.Q.	6 20	01234
Thur.	28	17h ☿ Greatest Elong. W. 19° 41′		21034
Fri.	29			20314
Sat.	30		3 10	30142
Sun.	31	13h 24m ☌ ♀ ☾, ♀ 2° 8′ N.		dd340

Explanations of symbols and abbreviations on page 4.

THE SKY FOR AUGUST

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	9h 7m	6h 48m	8h 42m	11h 30m	11h 40m	22h 41m	9h 5m
Decl.	18° 7′ N	21° 26′ N	19° 24′ N	4° 29′ N	4° 27′ N	9° 13′ S	16° 46′ N
Transit	11h 33m	9h 14m	11h 9m	13h 56m	14h 6m	1h 9m	11h 32m

The Sun.—During August the sun's R.A. increases from 8h 44m to 10h 40m, and its Decl. decreases from 18° 6′ to 8° 23′N. On the 23rd it enters the third summer sign, Virgo. The equation of time falls from 6m 10s to 0m 21s (see page 7) and the length of day decreases by 1h 20m in latitude 44°N. (see page 17).

The Moon.—For its phases and conjunctions with the planets, see opposite page. It occults a star in Gemini on the 29th (see page 8).

Merury is in superior conjunction with the sun on the 22nd and therefore is not well placed for observation after the first week (See July.)

Venus.—Although Venus was at its greatest elongation west on July 1 it rises earlier this month, over 3 hours before the sun. This is due to the fact that the inclination of the ecliptic to the eastern horizon is steeper, and consequently this is the best time of the year to observe the planets as morning stars. Venus now forms a great isosceles triangle with Betelgeuse and Procyon, the planet being at the vertex.

Mars is improving as a morning star, rising on the 15th 1h 10m before the sun. It is now 241,150,000 miles from us. Venus is daily gaining on Mars.

Jupiter for the first part of the month may be seen during twilight as a star of magnitude −1.3. Towards the end of the month it fades into the sun's light, to reappear next October, as a morning star. For the configurations of its satellites, see next page; for their eclipses, etc., see page 25.

Saturn follows closely behind Jupiter; its stellar magnitude is the same as last month +1.4.

For *Uranus* and *Neptune*, see page 25.

AUGUST

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol		Configurations of Jupiter's Satellites at 19h 45m
			h	m	
	Mon.	1			43201
	Tues.	2 9h 3m☌☿☾, ☿4° 16′ N.; 23h 59m☌♂☾, ♂6° 8′ N.	0	0	41O2*
●	Wed.	3 15h 18m N.M.; 21h 23m☌♆☾, ♆4° 53′ N.; 17h Moon in Perigee			40123
	Thur.	4	20	50	42103
	Sat.	6 7h 01m☌♃☾, ♃3° 55′ N.; 8h☌♆☉; 12h 39m☌♄☾, ♄4° 39′ N.			43102
	Sun.	7	17	40	3412O
	Mon.	8			324O*
	Tues.	9			1O4**
☽	Wed.	10 9h 14m Moon F.Q.; 13h☿ in Perihelion; 19h☌☿♂, ☿0° 11′ S.	14	20	O1234
	Thur.	11			12O34
	Fri.	12			2O134
	Sat.	13	11	10	31O24
	Sun.	14			3O124
	Mon.	15 3h☌☿♆, ☿1° 26′ N.			32O14
	Tues.	16	8	00	dO34*
	Wed.	17 8h Moon in Apogee			4O123
○	Thur.	18 10h 28m F.M.			41203
	Fri.	19 16h☌♁☾, ♁4° 22′ S.	4	50	42013
	Sat.	20 19h ☿, Greatest Hel. Lat. N.			41302
	Sun.	21			43012
	Mon.	22	1	40	4321O
	Tues.	23 5h☌☿☉, Superior			d4302
	Wed.	24 19h☌♂♆, ♂1° 6′ N.	22	30	4O132
	Thur.	25			14203
☾	Fri.	26 7h 51m Moon L.Q.			2O143
	Sat.	27	19	20	d1O24
	Sun.	28			
	Mon.	29			
	Tues.	30 7h 19m☌♀☾, ♀4° 31′ N.	16	10	
	Wed.	31 9h 42m☌♆☾, ♆4° 53′ N.; 10h☍♁☉, 16h 23m☌♂☾, ♂5° 52′ N.			

Explanation of symbols and abbreviations on page 4.

THE SKY FOR SEPTEMBER

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	12h 37m	9h 19m	10h 0m	11h 53m	11h 53m	22h 36m	9h 10m
Decl.	4° 15′ S	15° 57′ N	13° 29′ N	1° 54′ N	2° 58′ N	9° 40′ S	16° 27′ N
Transit	13h 1m	9h 43m	10h 25m	12h 18m	12h 18m	23h 03m	9h 35m

The Sun.—During September the sun's R.A. increases from 10h 40m to 12h 29m, and its Decl. changes from 8° 23′N. to 3° 5′S. On the 23rd the sun crosses the equator and enters Libra, the first autumn sign of the zodiac. The equation of time becomes zero on the 1st and then increases to 10m 11s. In latitude 44°N. the length of the day decreases by 1h 26m (see page 18).

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

Mercury is not well placed for observation this month, owing to the small inclination of the ecliptic to the western horizon at sunset.

Venus moves very swiftly amongst the stars this month. It crosses to the north side of the ecliptic on the 9th and is in conjunction with Regulus on the 24th. Its stellar magnitude is −3.4 and it shows a gibbous phase, like the moon between full and last quarter. On the 13th it is in close conjunction with Neptune (see opposite page).

Mars is now a prominent morning star in the constellation Leo (see map on page 24), and it rises about 1h 20m before the sun on the first of the month. Its conjunction with Regulus on the 17th should be interesting. Venus is rapidly gaining on Mars, especially during the latter part of the month. On the 15th Mars is 233,518,000 miles from us.

Jupiter is in conjunction with the sun on the 22nd and is therefore too close to it to be observed this month. On the 14th he passes Saturn, but, unfortunately we shall not be able to see this conjunction (see page 24).

Saturn is in conjunction with the sun on the 21st and cannot be observed during the month.

For *Uranus* and *Neptune*, see page 25.

SEPTEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol h m
●	Thur.	1 2h Moon in Perigee; 22h 33m N.M.	
	Fri.	2 17h 29m☌☿☾, ☿ 3° 53′ N.	13 00
	Sat.	3 2h 19m☌♃☾, ♃ 3° 19′ N.; 3h 57m☌♄☾, ♄ 4° 15′ N.	
	Sun.	4	
	Mon.	5	9 40
	Tues.	6 12h☌☿♃, ☿ 0° 19′ S.; 23h☌☿♄, ☿ 1° 25′ S.	
	Wed.	7	
	Thur.	8 22h 30m Moon F.Q.	6 30
☽	Fri.	9	
	Sat.	10 5h ♀ in♌	
	Sun.	11	3 20
	Mon.	12	
	Tues.	13 7h☿in♍; 7h☌♀♆, ♀ 0° 5′ N.; 15h Moon in Apogee	
	Wed.	14 12h☌♃♄, ♃ 1° 2′ S.	0 10
	Thur.	15 20h 9m☌♂☾, ♂ 4° 27′ S.	
	Fri.	16	21 00
♍	Sat.	17 2h 20m F.M.	
	Sun.	18	
	Mon.	19	17 50
	Tues.	20	
	Wed.	21 8h☌♄☉	
	Thur.	22 17h☌♃☉	14 40
	Fri.	23 9h 20m☽enters ♎, Autumn commences; 13h ☿ in Aphelion	
☾	Sat.	24 16h 18m Moon L.Q.	
	Sun.	25	11 30
	Mon.	26	
	Tues.	27 20h 26m☌♆☾, ♆ 4° 56′ N.	
	Wed.	28	8 20
	Thur.	29 3h 4m☌♀☾, ♀ 4° 50′ N.; 9h Moon in Perigee; 7h ♂Greatest Hel. Lat. N.; 7h 13m☌♂☾, ♂5° 0′ N.	
	Fri.	30 19h 55m☌♄☾, ♄ 3° 57′ N.; 22h 19m☌♃☾, ♃ 2° 46′ N.	

By reason of the proximity of Jupiter to the Sun the phenomena of the Satellites are not given from August 28 to Oct. 17.

Explanation of symbols and abbreviations on page 4.

THE SKY FOR OCTOBER

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	14h 47m	11h 39m	11h 12m	12h 17m	12h 7m	22h 33m	9h 13m
Decl.	19° 29′ S	3° 53′ N	6° 36′ N	0° 39′ S	1° 31′ N	10° 1′ S	16° 14′ N
Transit	13h 13m	10h 5m	9h 39m	10h 43m	10h 33m	20h 56m	7h 39m

The Sun.—During October the sun's R.A. increases from 12h 29m at 14h 25m, and its Decl. increases from 3° 5′ to 14° 21′S. On the 24th the sun enters the second autumnal sign Scorpio. The equation of time rises from 10m 12s to 16m 19s, to be subtracted from apparent time (see page 7). The length of the day in latitude 44° N. decreases by 1h 26m (see page 19).

The Moon.—For its phases and conjunctions with the planets, see next page. On the 22nd the moon occults a star in Gemini (see page 8).

Mercury is at its greatest elongation east on the 7th (see opposite page). Although 25½° from the sun it has an altitude of only about 7° at sunset, and therefore the planet at this elongation will be difficult to observe.

Venus is still a prominent morning star, being visible 2h 40m before sunrise on the 15th. On the 3rd it is in close conjunction with Mars, and is also at the apex of a great isosceles triangle formed with Regulus and Denebola. On the 21st it is in conjunction with Saturn and on the 25th with Jupiter. Stellar magnitude −3.4.

Mars on the 1st rises at 3.30 a.m. and is visible for 2½ hours. On the 3rd Venus overtakes Mars (see just above). It is 220,569,000 miles distant from us on the 15th, and is approaching us at the rate of 630,500 miles daily. Stellar magnitude +1.9.

Jupiter on the 15th rises 1½ hours before the sun, and has an altitude at sunrise of about 17°. Venus passes Jupiter on the 25th (see above). Stellar magnitude −1.2 brightness increasing.

Saturn on the 15th is situated between Venus and Jupiter and exchanges places with Venus on the 22nd. Stellar magnitude +1.2. This is a very interesting conjunction of the planets.

For *Uranus* and *Neptune*, see page 25.

OCTOBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol	Configurations of Jupiter's Satellites at 5 h 30m
			h m	
● Sat.	1	7h 26m N.M.; Total Eclipse invis. in Canada; see p. 27	5 00	
Sun.	2	1h 42m☌☿☾, ☿ 4° 3′ S.		
Mon.	3	7h☌♀♂, ♀ 0° 11′ S.		
Tues.	4		1 50	
Wed.	5			
Thur.	6		22 40	
Fri.	7	18h☿ Greatest Elong. E. 25° 23′		
☽ Sat.	8	15h 12m F.Q.		
Sun.	9		19 30	
Mon.	10			
Tues.	11	6h Moon in Apogee		
Wed.	12		16 20	
Thur.	13	1h 37m☌♁☾, ♁ 4° 32′ S.; 20h ♀ in Perihelion; 21m ☿ Greatest Hel. Lat. S.		
Fri.	14			
Sat.	15		13 10	
☉ Sun.	16	18h 00m F.M.; Partial Ecl. vis. in Can. (see p. 27)		
Mon.	17			
Tues.	18		10 00	3120 4
Wed.	19	23h☿ Stationary		3201 4
Thur.	20			3102 4
Fri.	21		6 50	1023 4
Sat.	22	3h☌♀♄, ♀ 0° 35′ S.		203 4*
☾ Sun.	23	23h 32m L.Q.		1204 3
Mon.	24		3 40	d401 2
Tues.	25	4h 19m☌♆☾, ♆ 4° 55′ N.; 11h☌♀♃, ♀ 0° 31′ N.		d341 0
Wed.	26			4320 1
Thur.	27	1h 30m Moon in Perigee; 20h 18m☌♂☾, ♂ 3° 38′ N.	0 30	4310 2
Fri.	28	10h 24m☌♄☾, ♄ 3° 41′ N.; 17h☌♃☾, ♃ 2° 14′ N.; 22h 56m☌♀☾, ♀ 2° 25′ N.		4013 2
Sat.	29		21 10	4203*
● Sun.	30	18h 39m N.M.; 18h 58m☌☿☾, ☿ 2° 36′ S.		4210 3
Mon.	31	5h☌☿☉, Inferior		4031 2

See page 45.

Explanation of symbols and abbreviations on page 4.

THE SKY FOR NOVEMBER

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	14h 8m	14h 1m	12h 22m	12h 40m	12h 19m	22h 31m	9h 14m
Decl.	10° 25′ S	10° 46′ S	0° 56′ S	3° 4′ S	0° 15′ N	10° 9′ S	16° 9′ N
Transit	10h 32m	10h 25m	8h 46m	9h 4m	8h 44m	18h 54m	5h 39m

The Sun.—During November the sun's R.A. increases from 14h 25m to 16h 28m, and its Decl. changes from 14° 21′S. to 21° 46′S. On the 23rd the sun enters Sagittarius, the third autumn sign of the zodiac. The equation of time rises to a maximum of 16m 20s on the 3rd (see page 7). In latitude 44°N. the length of the day decreases by 1h 4m (see page 18).

The Moon.—For its phases and conjunctions with the planets see opposite page. On the 18th the moon occults a star in Gemini, and on the 20th one in Cancer (see page 8).

Mercury is moving in the near side of its orbit, having passed through inferior conjunction on the 30th of October. On the 16th, at its greatest elongation west, 19½°, it is well placed as a morning star, being 8° south of the sun and at an altitude of about 18°. This is the best westerly elongation this year. It has a stellar magnitude of −0.3 and its phase as seen through a telescope resembles our moon at first quarter.

Venus is visible as a morning star for two hours before sunrise. On the 6th it is in conjunction with Spica, and on the 27th in conjunction with the moon. Its disc is now nearly all illuminated.

Mars on the 1st rises at 3 a.m. It forms a right-angled traingle with Regulus and Denebola, the latter being in the right angle. It is now 201,655,000 miles from us. During the last half of the month it overtakes and passes both Saturn and Jupiter. Stellar magnitude +4.9.

Jupiter rises at 3 a.m. on the 15th. Its stellar magnitude is now −1.3, or it is 10 times as bright as Spica. On the morning of the 25th there is a pretty configuration of the moon, Jupiter and Mars. For the configuration of its satellites, see next page; for their eclipses, etc., see page 52.

Saturn precedes Jupiter by half an hour, and for the first two weeks is between that planet and Mars. After the 13th it becomes the leading planet, as the others one by one overtake it. Its stellar magnitude is now +1.2, the same as Spica.

On the 1st of the month the planets are arranged as follows with respect to Spica: Mars, Saturn, Jupiter, Venus and Spica. Due to the rapid changes of Venus and Mars, on the 30th, they are situated in this order: Saturn, Jupiter, Mars, Spica, and Venus.

For *Uranus* and *Neptune*, see page 25.

NOVEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol	Configurations of Jupiter's Satellites at 5h 0m
			h m	
Tues.	1	22h ☿ in ♌	18 00	31420
Wed.	2			32014
Thur.	3	22h ♂ in Aphelion		31024
Fri.	4	17h ♀ Greatest Hel. Lat. N.	14 50	03124
Sat.	5			21034
Sun.	6	12h ☿ in Perihelion		d2034
☽ Mon.	7	10h 54m Moon F.Q.	11 40	01324
Tues.	8	1h Moon in Apogee; 16h □ ♆ ☉; 22h ☿ Stationary		31024
Wed.	9	8h 47m ☌ ♁ ☾, ♁ 4° 30′ S.		32014
Thur.	10		8 30	3140*
Fri.	11			4012*
Sat.	12			41203
Sun.	13	21h ☌ ♂ ♄, ♂ 0° 53′ S.	5 20	42013
Mon.	14			4023*
♍ Tues.	15	8h 39m F.M.; 15h ♁ Stationary		43102
Wed.	16	11h ☿, Greatest Elong. W. 19° 27′; 19h ☿, Greatest Hel. Lat. N.	2 10	43201
Thur.	17			34120
Fri.	18	18h ♆ Stationary	23 00	30412
Sat.	19			d1043
Sun.	20			20134
Mon.	21	5h Moon in Perigee; 9h 56m ☌ ♆ ☾, ♆ 4° 48′ N.	19 50	01234
☾ Tues.	22	6h 41m Moon L.Q.		d3024
Wed.	23			32014
Thur.	24	21h 49m ☌ ♄ ☾, ♄ 3° 25′ N.	16 30	31204
Fri.	25	8h 46m ☌ ♃ ☾, ♃ 1° 43′ N.; 7h 43m ☌ ♂ ☾, ♂ 1° 56′ N.		30124
Sat.	26	18h ☌ ♂ ♃, ♂ 0° 10′ N.		10243
Sun.	27	21h 24m ☌ ♀ ☾, ♀ 1° 26′ S.	13 20	24013
Mon.	28	0h 56m ☌ ☿ ☾, ☿ 1° 20′ S.; 9h □ ♁ ☉		41023
♎ Tues.	29	8h 26m N.M.		d4102
Wed.	30		10 10	43201

Explanation of symbols and abbreviations on page 4.

THE SKY FOR DECEMBER

POSITION OF PLANETS ON THE 15TH

	☿ Mercury	♀ Venus	♂ Mars	♃ Jupiter	♄ Saturn	♅ Uranus	♆ Neptune
R.A.	17h 0m	16h 32m	13h 29m	12h 58m	12h 28m	22h 33m	9 13m
Decl.	23° 18′ S	21° 17′ S	7° 54′ S	4° 53′ S	0° 34′ S	9° 59′ S	16° 13′ N
Transit	11h 25m	10h 58m	7h 55m	7h 25m	6h 54m	16h 57m	3h 40m

The Sun.—During December the sun's R.A. increases from 16h 28m to 18h 45m, and its Decl. reaches the maximum value of 23° 27′S. on the 22nd. On this date the sun enters the first sign of winter, Capricornus, and it is vertical to points on the Tropic of Capricorn on the earth. From this time it slowly comes northward. The equation of time changes from 10m 59s watch slow to 3m 28s watch fast (see page 7). The length of the day in latitude 44°N. reaches a minimum of 8h 53m on the 22nd.

The Moon.—For its phases and conjunctions with the planets, see opposite page. It occults a star in Sagittarius on the 2nd, one in Pisces on the 10th and one in Cancer on the 18th (see page 8).

Mercury is approaching the sun and is not suitably placed for observation this month. In superior conjunction on the 27th (see opposite page).

Venus, on the 1st, is visible as a morning star 1h 40m before sunrise. During the month it approaches so near to the sun that it cannot be observed conveniently.

Mars, on the 1st, rises at 2.30 a.m. It is approaching Spica and on the 11th is 4° north of it. On the 23rd the moon occults Mars, the occultations being visible between the tropics. On the 15th its distance from us is 178,705,000 miles, and decreasing.

Jupiter precedes Mars by half an hour and is situated about midway between that planet and Saturn. Stellar magnitude now, −1.5. From now on Jupiter gains on Saturn and they will not be together again for twenty years (see p. =).

For the configuration of its satellites, see next page; for their eclipses, etc., see page 52.

Saturn, on the 1st, rises at 1.30 p.m., and will continue to rise 1 hour earlier each fortnight.

For *Uranus* and *Neptune*, see page 25.

DECEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Time, Hours Numbering from Midnight)

			Minima of Algol	Configurations of Jupiter's Satellites 4h 30m.
			h m	
Thur.	1			43210
Fri.	2			43012
Sat.	3		7 00	41023
Sun.	4			24013
Mcn.	5	22hMocn in Apogee		1043*
Tues.	6	17h 15m☌♁☾, ♁ 4° 16′ S.	3 50	03124
☽ Wed.	7	8h 20m Mocn F.Q.		3204*
Thur.	8			32104
Fri.	9		0 40	30124
Sat.	10	6h☿ in♉		10324
Sun.	11		21 30	20134
Mcn.	12			1043*
Tues.	13			04132
☾ Wed.	14	21h 51m F.M.	18 20	34210
Thur.	15			d3420
Fri.	16			43012
Sat.	17	17h Mocn in Perigee	15 10	41032
Sun.	18	15h 39m☌♆☾, ♆ 4° 36′ N.		42013
Mcn.	19			41203
Tues.	20	12h♀ in Aphelion	12 00	40312
☾ Wed.	21	14h 54m L.Q.		d4310
Thur.	22	4h 8m☉enters♑, Winter commences; 6h 10m☌♄☾, ♄ 3° 8′ N.; 21h 0m☌♃☾, ♃ 1° 12′ N.		32014
Fri.	23	17h 59m☌♂☾, ♂ 0° 8′ N.	8 40	3024*
Sat.	24			13024
Sun.	25			20134
Mon.	26		5 30	12034
Tues.	27	11h☌☿☉ Superior		01324
Wed.	28	2h 58m☌♀☾, ♀ 4° 38′ S.		13024
♑ Thur.	29	0h 39m N.M.; 3h 35m☌☿☾, ☿ 6° 45′ S.; 8h□♄☉	2 20	32014
Fri.	30	18h♀ in♉		3042*
Sat.	31		23 10	43102

Explanation of symbols and abbreviations on page 4.

PHENOMENA OF JUPITER'S SATELLITES

E—eclipse, O—occultation, T—transit, S—shadow, D—disappearance, R—reappearance, I—ingress, e—egress. The Roman numerals denote the satellites.
Eastern Standard Time, hours numbering from Midnight.

JANUARY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen
2	5	17	I	SI	18	5	49	I	Se
	6	25	I	TI		6	45	I	Te
3	2	28.7	I	ED	19	0	43	I	ED
	4	8	II	SI		3	55	I	OR
	5	52	I	OR		4	49	II	ED
	6	22	II	TI		22	1	I	SI
	6	57	II	Se		22	57	I	TI
	23	45	I	SI	20	0	17	I	Se
4	10	53	I	TI		1	12	I	Te
	2	2	I	Se		22	22	I	OR
	3	8	I	Te		22	31	II	SI
	4	14	IV	OD		23	37	IV	OR
	22	53	I	ED	21	0	19	II	TI
5	0	19	II	OR		1	20	II	Se
	4	1	I	SI		3	5	II	Te
7	1	12	III	ER		5	44.6	III	ED
	2	22	III	OD	22	22	2	II	OR
	5	31	III	OR	24	23	12	III	Se
10	4	21.7	I	ED		23	24	III	TI
	6	41	II	SI	25	2	29	III	Te
11	1	39	I	SI		5	26	I	SI
	2	42	I	TI		6	17	I	TI
	3	55	I	Se	26	2	36.1	I	ED
	4	57	I	Te		5	41	I	OR
	22	49.9	I	ED		6	40.8	II	ED
12	0	51	IV	SI		23	54	I	SI
	1	28.9	II	ED	27	0	44	I	TI
	2	8	I	OR		2	11	I	Se
	5	3	IV	Se		2	59	I	Te
	6	27	II	OR	28	0	8	I	OR
	22	24	I	Se		1	4	II	SI
	23	24	I	Te		2	38	II	TI
13	22	47	II	Se		3	53	II	Se
14	0	44	II	Te		5	25	II	Te
	1	47.1	III	ED		21	25	I	Te
	5	9.4	III	ER		22	56	IV	Se
	6	0	III	OD	29	2	28	IV	TI
17	6	14.7	I	ED		5	44	IV	Te
18	3	32	I	SI	30	0	22	II	OR
	4	30	I	TI	31	23	50	III	SI

FEBRUARY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen
1	2	51	III	TI	10	3	42	I	SI
	3	9	III	Se		4	14	I	TI
	5	55	III	Te		5	58	I	Se
2	4	29.3	I	ED		6	30	I	Te
3	1	48	I	SI	11	0	51	I	ED
	2	29	I	TI		3	37	I	OR
	4	5	I	Se		6	10	II	SI
	4	45	I	Te		22	10	I	SI
	22	57.7	I	ED		22	40	I	TI
4	1	53	I	OR		22	51	III	OR
	3	37	II	TI	12	0	27	I	Se
	4	56	II	SI		0	56	I	Te
	6	26	II	Te		22	3	I	OR
	20	56	I	TI	13	1	10.2	II	ED
	22	33	I	Se		4	58	II	OR
	23	11	I	Te	14	20	19	II	TI
5	22	34.3	II	ED		20	28	IV	Te
6	2	41	II	OR		22	17	II	Se
	5	5.7	IV	ED		23	6	II	Te
7	20	51	II	Te	17	5	36	I	SI
8	3	48	III	TI		5	59	I	TI
	6	14	III	Se	18	2	44.6	I	ED
9	6	22.7	I	ED		5	21	I	OR

FEBRUARY—*Continued*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phne·
18	21	36.3	III	ED	23	5	4	IV	OR
19	0	4	I	ED		20	22	II	OR
	0	25	I	SI	25	4	38.2	I	ED
	2	10	III	TI	26	1	34.8	III	ED
	2	21	I	OR		1	58	I	SI
19	2	40	I	Te		2	8	I	TI
	21	13	I	ED		4	15	I	Se
	23	47	I	OR		4	24	I	Te
20	3	46.1	II	ED		5	27	III	OR
	20	49	I	Se		23	6.7	I	ED
	21	6	I	Te	27	1	3	I	OR
21	22	1	II	SI		20	27	I	SI
	22	33	II	TI		20	34	I	TI
22	0	51	II	Se		22	43	I	Se
	1	21	II	Te		22	50	I	Te
	23	5.9	IV	ED	28	19	57	I	OR

MARCH

1	0	35	II	SI	15	21	0	I	Se
	0	47	II	TI		22	38	III	TI
	3	25	II	Se		23	40	III	SI
	3	35	II	Te	16	1	46	III	Te
	18	59	III	Se		2	55	III	Se
	19	12	III	Te	17	0	17	II	OD
2	19	40.3	II	ED		3	42.8	II	ER
	22	36	II	OR	18	19	2	II	SI
5	3	52	I	TI		21	11	II	Te
	3	52	I	SI		21	52	II	Se
	5	33.8	III	ED	19	21	30	IV	TI
6	0	59	I	OD	20	0	45	IV	SI
	3	16.8	I	ER		1	3	IV	Te
	22	18	I	TI		4	27	I	OD
	22	21	I	SI		4	36	IV	Se
7	0	34	I	Te	21	1	47	I	TI
	0	37	I	Se		2	10	I	SI
	19	25	I	OD		4	2	I	Te
	21	45.9	I	ER		4	26	I	Se
8	3	1	II	TI		22	53	I	OD
	3	10	II	SI	22	1	33.5	I	ER
	5	49	II	Te		20	13	I	TI
	5	59	II	Se		20	38	I	SI
	19	0	I	Te		22	28	I	Te
	19	6	I	Se		22	54	I	Se
	19	21	III	TI	23	1	56	III	TI
	19	41	III	SI		3	39	III	SI
	22	29	III	Te		20	2.2	I	ER
	22	57	III	Se	24	2	33	II	OD
9	22	2	II	OD	25	20	38	II	TI
10	1	7.3	II	ER		21	37	II	SI
11	18	56	II	Te		23	26	II	Te
	19	17	II	Se	26	0	27	II	Se
	21	4.5	IV	ER		20	44	III	ER
12	5	36	I	TI	27	19	35.8	II	ER
	5	47	I	SI	28	3	32	I	TI
13	2	43	I	OD		4	4	I	SI
	5	10.8	I	ER	29	0	38	I	OD
14	0	2	I	TI		3	27.9	I	ER
	0	15	I	SI		21	58	I	TI
	2	18	I	Te		22	33	I	SI
	2	32	I	Se	30	0	14	I	Te
	21	9	I	OD		0	49	I	Se
	23	39.3	I	ER		19	4	I	OD
15	5	15	II	TI		21	56.6	I	ER
	18	44	I	SI	31	19	17	I	Te
	20	44	I	Te					

APRIL

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	22	55	II	TI	14	22	14	I	Te
2	0	12	II	SI		23	6	I	Se
	1	44	II	Te	15	20	14.5	I	ER
	3	2	II	Se	17	1	41	III	OD
3	0	42.1	III	ER		22	40	II	OD
3	22	11.3	II	ER	19	19	36	II	Te
5	2	24	I	OD		21	31	II	Se
	22	30	IV	Se	20	19	35	III	SI
	23	44	I	TI		22	45	III	Se
6	0	27	I	SI	21	0	25	I	OD
	2	0	I	Te		21	47	I	TI
	2	43	I	Se		22	46	I	SI
	20	50	I	OD	22	0	2	I	Te
	23	51.1	I	ER		1	1	I	Se
7	20	26	I	Te		22	9.3	I	ER
	21	12	I	Se	23	19	29	I	Se
9	1	14	II	TI	25	1	3	II	OD
	2	48	II	SI	26	21	19	II	SI
	22	12	III	OD		22	1	II	Te
10	1	26	III	OR	27	0	7	II	Se
	1	28.1	III	ED		22	28	III	Te
	20	18	II	OD		23	35	III	SI
11	0	46.6	II	ER	28	2	15	I	OD
13	1	31	I	TI		23	36	I	TI
	2	22	I	SI	29	0	40	I	SI
	20	50	IV	OD		1	51	I	Te
	22	37	I	OD		20	42	I	OD
14	0	41	IV	OR	30	0	4.2	I	ER
	1	45.8	I	ER		20	19	I	Te
	19	58	I	TI		21	24	I	Se
	20	51	I	SI		23	15.9	IV	ED

MAY

3	21	38	II	TI	16	0	34	III	ER
	23	55	II	SI	17	20	49.6	IV	ER
4	0	27	II	Te	19	21	42	II	OD
	22	54	III	TI	21	21	15	II	Se
5	21	49.9	II	ER		23	39	I	TI
6	1	27	I	TI	22	0	53	I	SI
	22	33	I	OD		20	13	III	OD
7	19	54	I	TI		20	46	I	OD
	21	4	I	SI		23	32	III	OR
	22	10	I	Te	23	0	18.3	I	ER
	23	18	I	Se		20	23	I	Te
8	19	35	IV	TI		21	36	I	Se
	20	28	I	ER	27	0	15	II	OD
	20	35.5	III	ER	28	21	4	II	SI
	23	32	IV	Te		21	20	II	Te
11	0	7	II	TI		23	51	II	Se
13	0	24.8	II	ER	29	22	40	I	OD
14	21	46	I	TI	30	0	10	III	OD
	22	59	I	SI		20	2	I	TI
15	0	1	I	Te		21	17	I	SI
	1	13	I	Se		22	17	I	Te
	21	25.3	III	ED		23	31	I	Se
	22	23.1	I	ER	31	20	42.2	I	ER

JUNE

1	22	35	III	Se	7	22	37.4	I	ER
	22	55	IV	OD	9	21	38	III	Te
4	21	6	II	TI		23	31	III	SI
	23	41	II	SI	11	22	9	IV	Se
	23	57	II	Te	14	21	1	I	OD
6	21	26.5	II	ER	15	20	37	I	Te
	21	57	I	TI		21	49	I	Se
	23	12	I	SI	16	22	26	III	TI

JUNE—*Continued*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
19	21	29	IV	OR	22	22	34	I	Te
20	20	29	III	ER	23	20	56.7	I	OD
	21	24	II	OD	27	21	24.2	III	ED
21	22	58	I	OD	29	20	52	II	SI
22	20	19	I	TI		21	21	II	Te
	21	2	II	Se		22	16	I	TI
	21	30	I	SI					

JULY

1	20	7	I	Se	15	20	42	I	TI
4	20	44	III	OD	16	21	10.9	I	ER
6	21	14	II	TI	23	20	30.6	IV	ER
7	21	25	I	OD	24	20	19	I	Se
8	20	59	I	Te		20	49	II	Se
	21	1.1	II	ER	31	19	59	I	SI
	22	1	I	Se		20	40	II	SI
14	21	1	IV	TI					

AUGUST

2	20	21.4	III	ER

OCTOBER

21	5	50	I	SI	25	5	0	II	TI
24	5	11	III	TI	29	5	4	I	ED
	5	54	III	Se	30	5	1	I	Te

NOVEMBER

3	4	42	II	OR	22	5	28	I	Te
5	6	57.6	I	ED	26	3	33	II	SI
7	4	23	I	OR		5	29	II	TI
11	4	16	III	OD		6	13	II	Se
13	5	59	I	SI	29	4	15	I	SI
17	5	48.9	II	ED		5	14	I	TI
18	5	3.8	III	ED		5	34	III	Te
19	5	23	II	Te		6	29	I	Se
21	5	12.9	I	ED	30	4	48	I	OR
22	4	34	I	Se					

DECEMBER

3	6	7	II	SI	21	3	10	III	Se
5	5	3	II	OR		5	26	III	Te
6	2	57	III	SI	22	4	23	I	SI
	5	35	III	Se		5	34	I	T
	6	8	I	SI		6	36	I	S
7	3	27.7	I	ED	23	5	5	I	OR
8	2	49	I	Se	24	2	14	I	Te
	3	53	I	Te		3	29.7	III	ER
12	2	50.5	II	ED		5	51	III	OD
14	2	48	II	Te	28	3	5	II	SI
	5	20.8	I	ED		5	30	II	TI
15	2	30	I	SI		5	43	II	Se
	3	38	I	TI	29	6	17	I	SI
	4	43	I	Se	30	2	25	II	OR
	5	50	I	Te		3	35	I	ED
16	3	10	I	OR	31	1	58	I	TI
17	4	5	III	OR		2	58	I	Se
19	5	25.5	II	ED		4	9	I	Te
21	2	53	II	TI		4	50.3	III	ED

METEORS AND SHOOTING STARS

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

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

Name of Shower	Duration	Greatest Display	Radiant Point R.A.		Decl.
			h	m	°
Quadrantids	Dec. 28-Jan. 9	Jan. 3	15	20	+ 53
Aurigids	Feb. 7-23	Feb. 10	5	0	+ 41
Lyrids	April 16-22	April 21	18	4	+ 33
η Aquarids	April 29-May 8	May 4-6	22	32	- 2
Herculids	May 13-29	May 24	16	36	+ 30
Scorpiids	May-June-July	June 4	16	48	- 21
Sagittids	June-July	July 28	20	12	+ 24
Capricornids	July-Aug.	July 22	20	20	- 12
δ Aquarids	July 18-Aug. 12	July 28-31	22	36	- 11
α β Perseids	July Aug.-Sept.	Aug. 16	3	12	+ 43
Perseids	July 8-Aug. 25	Aug. 11-12	3	4	+ 57
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	$9^{h}\ 55^{m}\ \pm$
♄ Saturn.....	9.539	886.0	10759.2	29.46	73000	94.8	0.72	760	$10^{h}\ 14^{m}\ \pm$
♅ Uranus....	19.183	1781.9	30686.8	84.02	31900	14.6	1.22	65	$10^{h}\ 45^{m}\ \pm$
♆ Neptune...	30.055	2971.6	60181.1	164.78	34800	17.0	1.11	85	?
☉ Sun.....	....	....	....	....	866400	332000	1.39	1300000	$25^{d}\ 7^{h}\ 48^{m}\ \pm$
☾ Moon.....	From ⊕ 238,840 mls		27.32	0.075	2163	1/81.5	3.39	0.020	$27^{d}\ 7^{h}\ 43^{m}$

SATELLITES OF THE SOLAR SYSTEM

Name	Stellar Magnitude.	Mean Distance in Miles	Sidereal Period d. h. m. s.	Discoverer	Date
THE EARTH					
The Moon..	..	238,840	27 7 43 11		
MARS					
1. Phobos.....	14	5,850	7 39 15	Asaph Hall....	Aug. 17, 1877
2. Deimos....	13	14,650	1 6 17 54	Asaph Hall....	Aug. 11, 1877
JUPITER					
5. (Nameless).	13	112,500	11 57 23	Barnard.....	Sept. 9, 1892
1. Io.....	6½	261,000	1 18 27 33	Galileo.....	Jan. 7, 1610
2. Europa....	6½	415,000	3 13 13 42	Galileo.....	Jan. 8, 1610
3. Ganymede .	6	664,000	7 3 42 33	Galileo.....	Jan. 7, 1610
4. Callisto....	7	1,167,000	16 16 32 11	Galileo.....	Jan. 7, 1610
6. (Nameless).	14	7,372,000	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

DOUBLE STARS

Close scrutiny of the sky reveals the fact that many of the stars are composed of two or more components, that is, they are *double* or *multiple* stars. Over 15,000 such objects have been discovered.

A star may appear double in two ways. First, one may just happen to be nearly in line with the other as seen from the earth. Second, the two bodies may be physically connected, each revolving about their common centre of gravity. The former are called *optical doubles*, the latter *binary stars*. In the course of time the binaries exhibit a change in the distance between the components and also in the direction of the line joining them, that is, in the position angle.

While the close pairs require a large instrument for their detection, there are many within the range of small instruments. Such observations also allow one to determine the quality of the instrument employed. It has been found that a telescope having an objective 1 inch in diameter should be able to distinguish two stars 4″.56 apart, and the resolving power is inversely proportional to the diameter of the objective. Thus a telescope of 3-inch aperture should separate stars 1/3 of 4″.56, or 1″.52 apart; for one of aperture 10 inches, stars 1/10 of 4″.56, or 0″.45 apart should be seen separate; and so on. With the Yerkes refractor, of aperture 40 inches, a double star with distance 0″.11 can be detected.

In choosing a double star for testing a telescope care should be taken not to select a binary, with varying distance between its components.

The stars in the following short lists can be identified from almost any star atlas, and observation of them will prove of great interest to the amateur.

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	44*i* 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 Canum Venat.	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."

VARIABLE STARS

The study of variable stars is especially suited to amateur observers. In it they can make observations of permanent scientific value, since all the brighter and more interesting objects are within the range of modest instruments. An ordinary field glass or a small telescope is all that is required.

In recent years there has been organized the American Association of Variable Star Observers, with a working membership of about 70, and reports of observations are published monthly in *Popular Astronomy*. The recording secretary is Howard O. Eaton, 428 Lake St., Madison, Wis., and additional observers are desired.

The *novae* or "new" stars comprise one class of variables, and all the recent brighter objects of this sort have been discovered by amateurs. The long-period variable Omicron Ceti, or *Mira*, was discovered by Fabricius in 1596, while Algol, the best-known variable of short-period, was discovered by Goodricke, a deaf mute, in 1783.

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"	*a* Orionis
IV. Variables of short period:	
a. "Ordinary" cases	δ Cephei
b. Stars with "minima successively bright and faint"	β Lyræ
V. Stars of the Algol type	β Persei

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

THE DISTANCES OF THE STARS

The measurement of the distances of the stars is one of the most important problems in astronomy. Without such information it is impossible to form any idea as to the magnitude of our universe or the distribution of the various bodies in it.

The parallax of a star is the apparent change of position in the sky which the star would exhibit as one would pass from the sun to the earth at a time when the line joining earth to sun is at right angles to the line drawn to the star; or, more accurately, it is the angle subtended by the semi-major axis of the earth's orbit when viewed perpendicularly from the star. Knowing the parallax, the distance can be deduced at once.

For many years attempts were made to measure stellar parallaxes, but without success. The angle to be measured is so exceedingly small that it was lost in the unavoidable instrumental and other errors of observation. The first satisfactory results were obtained by Bessel, who in 1838, by means of a heliometer, succeeded in determining the parallax of 61 Cygni, a 6th magnitude star with a proper motion of 5″ a year. On account of this large motion the star was thought to be comparatively near to us, and such proved to be the case. At about the same time Henderson, at the Cape of Good Hope, from meridian-circle observations, deduced the parallax of Alpha Centauri to be 0″.75. For a long time this was considered to be the nearest of all the stars in the sky, but in 1913 Innes, director of the Union Observatory, Johannesburg, South Africa, discovered a small 11th mag. star, 2° 13′ from Alpha Centauri, with a large proper motion, and which proved to have a parallax of 0″.78. Its brightness is only 1/20,000 that of Alpha Centauri and the mass of the body is the least known. In 1916 Barnard discovered an 11th mag. star in Ophiuchus with a proper motion of 10″ per year, the greatest on record, and its parallax is about 0″.6. It is believed to be next to Alpha Centauri in distance from us.

The distances of the stars are so enormous that a very large unit has to be chosen to express them. The one generally used is the light-year, that is, the distance travelled by light in a year, or 186,000x60x60x24x365¼ miles. A star whose parallax is 1″ is distant 3.26 light years; if the parallax is 0″.1, the distance is 32.6 l.-y.; if the parallax is 0″.27 the distance is 3.26 ÷ .27 = 12 l.-y. In other words, the distance is inversely proportional to the parallax. In recent years the word *parsec* has been introduced to express the distances of the stars. A star whose distance is 1 parsec is such that its *par*-allax is 1 *sec*-ond. Thus 1 parsec is equivalent to 3.26 l.-y., 10 parsecs = 32.6 l.-y., etc.

In later times much attention has been given to the determination of parallaxes, chiefly by means of photography, and now several hundred are known with tolerable accuracy.

In the following short list the parallaxes and some other information are given for a few stars. While the distances of some of those at the top of the list are comparatively accurate, those towards the end must be considered only approximate. Some of the brightest stars in the sky, such as Canopus, Rigel, Spica, Deneb, and others, are so distant that is impossible to obtain even an approximate value for the parallax.

Name	Magnitude	Annual Parallax	Proper Motion	Distance	
				Times Sun's Distance	Light Years
		″	″		
α Centauri....	0.7	0.75	3.67	275,000	4
21 185 Lalande.	6.9	0.50	4.75	447,000	6.5
61 Cygni.....	5.1	0.40	5.16	550,000	8
Sirius.....	−1.4	0.39	1.31	570,000	8.3
Procyon....	0.5	0.27	1.25	825,000	12
σ Draconis....	4.7	0.25	.....	907,000	13.2
Altair.....	1.0	0.20	0.65	1,120,000	16.3
ε Indi.....	5.2	0.20	4.60	1,120,000	16.3
o^2 Eridani.....	4.5	0.19	4.05	1,169,000	17
β Cassiopeiæ..	2.4	0.16	0.55	1,375,000	20
Vega.....	0.2	0.16	0.36	1,375,000	20
70 Ophiuchi....	4.1	0.15	1.13	1,444,000	21
e Eridani.....	4.4	0.14	3.03	1,581,000	23
Aldebaran..	1.0	0.12	0.19	1,856,000	27
Capella.....	0.2	0.11	0.43	1,994,000	29
Regulus....	1.4	0.10	0.27	2,200,000	32
Polaris.....	2.1	0.07	0.05	3,231,000	47
85 Pegasi.....	5.8	0.054	1.29	4,125,000	60

GEOGRAPHICAL POSITIONS OF SOME POINTS IN CANADA

Name	Latitude N.			Longitude W.			Feet above Sea Level
	°	′	″	°	′	″	
Banff, Alta	51	10		115	35		4542
Barrie, Ont	44	23		79	41		839
Battleford, Sask	52	41		108	20		1620
Brandon, Man	49	51		99	57		1176
Calgary, Alta	51	02	39.21	7	36	15.1	3428
Charlottetown, P.E.I	46	14		63	10		38
Collingwood, Ont	44	30		80	15		595
Edmonton, Alta	53	31	58.81	113	30	27.0	2188
Father Point, Que	48	31		68	19		20
Fort Churchill	58	51		94	11		....
Fort Simpson	61	52		121	43		....
Fredericton, N.B	45	57		66	36		164
Golden, B.C	51	16		116	55		2550
Gravenhurst, Ont	44	54		79	20		770
Guelph, Ont	43	32	43.7	80	15	09.0	1063
Halifax, N.S	44	39		63	36		97
Hamilton, Ont	43	16		79	54		303
Herschel Is	69	30		139	15		....
Kingston, Ont	44	13		76	29		285
London, Ont	42	59		81	13		808
Medicine Hat	50	1		110	37		2161
Moncton, N.B	46	9		64	45		50
Montreal Que	45	30	17.0	73	34	39.45	187
New Westminster, B.C	49	13		122	54		330
No. West River, Ungava	53	31	31.45	60	10	17.85	....
Ottawa, Ont	45	23	38	75	42	58.20	273.4
Owen Sound, Ont	44	33	56.42	80	56	40.5	585
Peterborough, Ont	44	17		78	19		722
Portage la Prairie, Man	49	58		98	17		830
Port Simpson, B.C	54	34		130	26		26
Prince Albert, Sask	53	10		106	0		1432
Quebec, Que	46	48		71	13		296
Regina, Sask	50	27		104	37		1885
Revelstoke, B.C	51	00	11.25	7	52	49.8	1503
Rose Point, Ont	45	19	00.73	80	02	28.5	602
St. Catharines, Ont	43	10		79	17		347
St. John, N.B	45	17		66	4		70
St. Johns, Nfd	47	34		52	42		125
Stratford, Ont	43	23		81	00		1191
Toronto, Ont	43	39	35.9	79	23	39.75	350
Vancouver, B.C	49	17	48.0	123	07	05.52	11
Victoria, B.C	48	25	31.38	123	21	42.0	55
Windsor, Ont	42	20		83	4		625
Winnipeg, Man	49	53	51.53	97	08	28.53	751
York Factory	57	00		92	28		55

INDEX

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

The Library and the offices of the General Secretary and the General Treasurer are at 198 College Street, Toronto.

Ordinary meetings are held in Toronto in the Physics Building on alternate Tuesdays, beginning in September and continuing to the end of May. In addition, ordinary meetings are at present held at Montreal, Ottawa, Winnipeg and Victoria. The Society also has organizations at Guelph, Hamilton, Peterborough and Regina, but during the war the meetings were discontinued and have not yet been revived.

The Society publishes a monthly JOURNAL, containing each year about 500 pages of interesting articles, and a yearly HANDBOOK of 64 pages, containing information for the amateur observer. Subscription, $2.00 a year; single copies of the JOURNAL or HANDBOOK, 25 cents.

Membership in the Society is open to anyone interested in Astronomy and many more members are desired. The annual fee of $2.00 includes subscription to the publications.

For further information apply to the General Secretary, Mr. A. F. Hunter, M.A., at the above address.