R. K. Young.

THE OBSERVER'S HANDBOOK FOR 1928

PUBLISHED BY

The Royal Astronomical Society of Canada

EDITED BY C. A. CHANT

TWENTIETH YEAR OF PUBLICATION

TORONTO
198 COLLEGE STREET
PRINTED FOR THE SOCIETY
1928

1928 CALENDAR 1928

JANUARY						
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		

FEBRUARY						
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		
Fri.	3	10	17	24		
Sat.	4	11	18	25		

MARCH						
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	

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

MAY						
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		

JUNE						
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	

JULY						
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		

AUGUST						
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	31	
Sat.	4	11	18	25		

SEPTEMBER						
Sun.	2	9	16	23	30	
Mon.	3	10	17	24		
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	

OCTOBER						
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		

NOVEMBER						
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		

DECEMBER						
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	

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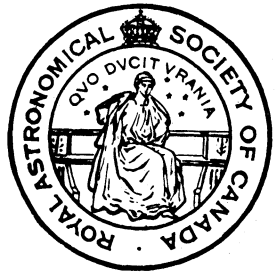

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1928

CONTENTS

PREFACE

It had been hoped to add four, or even eight, pages to the HANDBOOK for 1928, but it was not found possible to do so. Consequently the work follows the same lines as in recent years.

It may be stated that four circular star-maps, 9 inches in diameter, roughly for the four seasons, may be obtained from the Director of University Extension, University of Toronto, for one cent each; also a set of 12 circular maps, 5 inches in diameter, with brief explanation, is supplied by *Popular Astronomy*, Northfield, Minn., for 15 cents. Besides these may be mentioned Young's *Uranography*, containing four maps with R.A. and Decl. circles and excellent descriptions of the constellations, price 72 cents; Norton's *Star Atlas and Telescopic Handbook* (10*s.* 6*d.*); Olcott's *A Field-book of the Stars* ($1.50); McKready's *A Beginner's Star Book* ($5.00).

In the preparation of this HANDBOOK the Editor has been assisted by Mr. R. M. Motherwell, Dominion Observatory, Ottawa, who computed the occultations of the stars by the moon; Mr. H. F. Balmer, Goodsell Observatory, Northfield, Minn.; Mr. J. A. Pearce, Dominion Astrophysical Observatory, Victoria, B.C.; Mr. R. M. Petrie, Victoria, B.C.; and his colleague, Dr. R. K. Young, of the University of Toronto.

The minima of Algol have been computed from an observation by Stebbins (*Ap. J.*, vol. 53, 1921), J.D. 2422619.7866 with the period 2.86731077, given by Hellerick (*A.N.*, vol. 209, p. 227, 1919).

TORONTO, December, 1927. THE EDITOR.

ANNIVERSARIES AND FESTIVALS, 1928

New Year's Day	Sun., Jan. 1	Pentecost (Whit Sunday)	May 27
Epiphany	Fri., Jan. 6	Trinity Sunday	June 3
Septuagesima Sunday	Feb. 5	Corpus Christi	Thur., June 7
Quinquagesima (Shrove Sunday)	Feb. 19	St. John Baptist	Sun., June 24
St. David	Thur., Mar. 1	Dominion Day	Sun., July 1
Ash Wednesday	Feb. 22	Labour Day	Mon., Sept. 3
St. Patrick	Sat., Mar. 17	St. Michael (Michaelmas Day)	Sat., Sept. 29
Palm Sunday	Apr. 1	All Saints Day	Thur., Nov. 1
Good Friday	Apr. 6	First Sunday in Advent	Dec. 2
Easter Sunday	Apr. 8	St. Andrew	Fri., Nov. 30
St. George	Mon., Apr. 23	Conception Day	Sat., Dec. 8
Rogation Sunday	May 13	St. Thomas Day	Wed., Dec. 21
Victoria Day	Thur., May 24	Christmas Day	Tues., Dec. 25
Ascension Day	Thur., May 17		

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.

1928 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

Date	Apparent R.A.	Equation of Time	Apparent Decl.	Date	Apparent R.A.	Equation of Time	Apparent Decl.
	h m s	m s	° ′ ″		h m s	m °	′ ″
Jan. 1	18 40 37	+ 2 58.6	−23 07 15	Apr. 3	0 47 49	+3 30.8	+ 5 08 00
" 4	18 53 51	+ 4 23.4	−22 52 18	" 6	0 58 45	+2 37.7	+ 6 16 36
" 7	19 07 02	+ 5 44.8	−22 33 16	" 9	1 09 44	+1 46.4	+ 7 24 13
" 10	19 20 09	+ 7 02.0	−22 10 14	" 12	1 20 44	+0 57.4	+ 8 30 43
" 13	19 33 12	+ 8 14.6	−21 43 18	" 15	1 31 48	+0 11.2	+ 9 35 57
" 16	19 46 09	+ 9 21.9	−21 12 34	" 18	1 42 54	−0 31.7	+10 39 47
" 19	19 59 00	+10 23.4	−20 38 10	" 21	1 54 05	−1 11.1	+11 42 02
" 22	20 11 45	+11 18.5	−20 00 14	" 24	2 05 19	−1 46.6	+12 42 34
" 25	20 24 22	+12 06.9	−19 18 57	" 27	2 16 37	−2 18.0	+13 41 12
" 28	20 36 53	+12 48.0	−18 34 27	" 30	2 28 00	−2 45.1	+14 37 48
" 31	20 49 17	+13 21.7	−17 46 56	May 3	2 39 27	−3 07.6	+15 32 13
Feb. 3	21 01 33	+13 47.9	−16 56 35	" 6	2 50 59	−3 25.2	+16 24 18
" 6	21 13 41	+14 06.6	−16 03 34	" 9	3 02 36	−3 37.8	+17 13 57
" 9	21 25 42	+14 18.0	−15 08 04	" 12	3 14 18	−3 45.1	+18 01 02
" 12	21 37 36	+14 22.4	−14 10 16	" 15	3 26 06	−3 47.1	+18 45 24
" 15	21 49 23	+14 20.0	−13 10 20	" 18	3 37 59	−3 43.7	+19 26 56
" 18	22 01 04	+14 11.0	−12 08 28	" 21	3 49 57	−3 35.3	+20 05 30
" 21	22 12 39	+13 55.8	−11 04 51	" 24	4 02 00	−3 22.2	+20 40 59
" 24	22 24 07	+13 34.6	− 9 59 41	" 27	4 14 07	−3 04.5	+21 13 15
" 27	22 35 30	+13 07.8	− 8 53 09	" 30	4 26 19	−2 42.8	+21 42 13
Mar. 1	22 46 47	+12 35.6	− 7 45 26	June 2	4 38 34	−2 17.2	+22 07 48
" 4	22 58 00	+11 58.6	− 6 36 44	" 5	4 50 53	−1 48.1	+22 29 54
" 7	23 09 08	+11 17.4	− 5 27 13	" 8	5 03 15	−1 16.0	+22 48 29
" 10	23 20 13	+10 32.6	− 4 17 03	" 11	5 15 39	−0 41.2	+23 03 27
" 13	23 31 15	+ 9 44.8	− 3 06 23	" 14	5 28 06	−0 04.2	+23 14 48
" 16	23 42 15	+ 8 54.6	− 1 55 24	" 17	5 40 34	+0 34.2	+23 22 27
" 19	23 53 12	+ 8 02.5	− 0 44 14	" 20	5 53 03	+1 13.5	+23 26 23
" 22	00 04 08	+ 7 09.1	+ 0 26 54	" 23	6 05 32	+1 52.7	+23 26 36
" 25	00 15 04	+ 6 14.7	+ 1 37 53	" 26	6 18 00	+2 31.2	+23 23 06
" 28	00 25 58	+ 5 19.8	+ 2 48 30	" 29	6 30 27	+3 08.4	+23 15 54
" 31	00 36 53	+ 4 25.0	+ 3 58 35				

1928 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

Date	Apparent R.A.	Equation of Time	Apparent Decl.	Date	Apparent R.A.	Equation of Time	Apparent Decl.
	h m s	m s	° ′ ″		h m s	m s	° ′ ″
July 2	6 42 52	+3 43.6	+23 05 01	Oct. 3	12 35 01	−10 46.9	− 3 46 35
" 5	6 55 14	+4 16.5	+22 50 31	" 6	12 45 55	−11 41.8	− 4 56 04
" 8	7 07 34	+4 46.5	+22 32 27	" 9	12 56 54	−12 33.1	− 6 05 01
" 11	7 19 50	+5 13.2	+22 10 52	" 12	13 07 56	−13 20.4	− 7 13 16
" 14	7 32 03	+5 36.1	+21 45 51	" 15	13 19 03	−14 03.1	− 8 20 38
" 17	7 44 11	+5 54.9	+21 17 29	" 18	13 30 15	−14 40.9	− 9 26 57
" 20	7 56 15	+6 09.0	+20 45 52	" 21	13 41 32	−15 13.4	−10 32 02
" 23	8 08 14	+6 18.1	+20 11 05	" 24	13 52 55	−15 40.2	−11 35 41
" 26	8 20 07	+6 21.8	+19 33 17	" 27	14 04 24	−16 00.8	−12 37 45
" 29	8 31 55	+6 20.0	+18 52 34	" 30	14 16 00	−16 14.9	−13 38 02
Aug. 1	8 43 37	+6 12.7	+18 09 03	Nov. 2	14 27 42	−16 21.9	−14 36 23
" 4	8 55 14	+6 00.0	+17 22 53	" 5	14 39 32	−16 21.6	−15 32 37
" 7	9 06 46	+5 41.9	+16 34 10	" 8	14 51 30	−16 13.7	−16 26 34
" 10	9 18 12	+5 18.6	+15 43 03	" 11	15 03 35	−15 58.1	−17 18 02
" 13	9 29 34	+4 50.4	+14 49 38	" 14	15 15 48	−15 34.8	−18 06 51
" 16	9 40 50	+4 17.3	+13 54 05	" 17	15 28 09	−15 03.9	−18 52 47
" 19	9 52 02	+3 39.4	+12 56 33	" 20	15 40 36	−14 25.6	−19 35 42
" 22	10 03 09	+2 57.0	+11 57 10	" 23	15 53 12	−13 40.2	−20 15 24
" 25	10 14 12	+2 10.4	+10 56 05	" 26	16 05 54	−12 47.8	−20 51 44
" 28	10 25 11	+1 19.8	+ 9 53 28	" 29	16 18 42	−11 48.8	−21 24 34
" 31	10 36 07	+0 25.9	+ 8 49 26	Dec. 2	16 31 37	−10 43.5	−21 53 45
Sept. 3	10 47 00	−0 31.0	+ 7 44 08	" 5	16 44 38	− 9 32.4	−22 19 09
" 6	10 57 50	−1 30.1	+ 6 37 43	" 8	16 57 44	− 8 16.0	−22 40 41
" 9	11 08 39	−2 31.1	+ 5 30 17	" 11	17 10 55	− 6 55.1	−22 58 12
" 12	11 19 27	−3 33.3	+ 4 22 01	" 14	17 24 09	− 5 30.6	−23 11 38
" 15	11 30 13	−4 36.5	+ 3 13 02	" 17	17 37 26	− 4 03.5	−23 20 54
" 18	11 40 59	−5 40.1	+ 2 03 32	" 20	17 50 44	− 2 34.7	−23 25 58
" 21	11 51 45	−6 43.7	+ 0 53 38	" 23	18 04 03	− 1 05.1	−23 26 47
" 24	12 02 32	−7 46.7	− 0 16 28	" 26	18 17 23	+ 0 24.2	−23 23 22
" 27	12 13 20	−8 48.7	− 1 26 39	" 29	18 30 41	+ 1 52.7	−23 15 44
" 30	12 24 09	−9 49.0	− 2 36 44				

To obtain the R.A. of Mean Sun, subtract the Equation of Time from the Right Ascension; adding 12h to this gives the Sidereal Time at 0h G.C.T.

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

OCCULTATIONS OF STARS BY THE MOON, 1928

The following list of occultations was prepared for Ottawa and contains no stars fainter than magnitude 4.8. Anyone who has not observed an occultation or eclipse of a star by the moon should plan to do so. It is a striking phenomenon, especially when the immersion occurs at the dark limb of the moon, although an emersion at the dark limb is not without its thrill as the star suddenly pops into view apparently from out the depths of space. From new moon to full moon the immersion occurs at the dark limb and from full moon to new moon the emersion occurs at the dark limb. In the accompanying list the letter *d* after the position angle indicates that that particular phenomenon occurs at the dark limb.

The graphical method of the late Wm. F. Rigge has been used in these predictions and the time is correct within a minute for all central occultations, but in the case of a grazing occultation like that of May 27 the error is likely to be quite large.

75th MERIDIAN CIVIL TIME

Date	Star	Mag.	Immersion	Position Angle	Emersion	Position Angle
1927			h m	°	h m	°
Jan. 2	ξ^1 Ceti	4.6	0 23.6	103 d	1 11.6	212
Jan. 12	ν Virginis	4.2	2 36.1	162	3 40.1	265 d
Jan. 19	44 Ophiuchi	4.1	12 33.8	51	13 27.8	316 d
Jan. 26	30 Piscium	4.7	15 53.5	57 d	17 06.3	233
Jan. 26	33 Piscium	4.8	18 08.4	117 d	18 42.6	178
Jan. 28	ν Piscium	4.6	13 41.2	7 d	14 22.2	289
Feb. 14	ω^1 Scorpii	4.3	7 26.2	135	8 44.2	264 d
Feb. 25	ξ^1 Ceti	4.6	.....	.....	10 29.0	243
Mar. 6	ν Virginis	4.2	.....	.....	19 43.4	289 d
Apr. 12	σ Sagittarii	2.1	3 23.1	78	4 44.2	287 d
Apr. 16	τ Aquarii	4.4	12 13.4	60	13 16.5	237 d
Apr. 24	ϵ Geminorum	3.2	15 37.2	114 d	16 47.5	243
Apr. 25	κ Geminorum	3.6	14 52.3	118 d	16 01.3	247
May 25	η Leonis	3.6	.....	.....	12 16.9	304
May 27	ν Virginis	4.2	13 23.6	186 d	13 42.1	221
June 3	θ Ophiuchi	3.3	21 25.0	135	22 33.1	262 d
July 2	σ Sagittarii	2.1	21 43.4	52 d	22 43.1	317
Aug. 12	ϵ Geminorum	3.2	4 32.2	108	5 28.2	237 d
Aug. 13	κ Geminorum	3.6	.....	.....	4 33.0	270 d
Aug. 30	τ Aquarii	4.4	21 29.9	2 d	22 04.4	306
Sept. 9	κ Geminorum	3.6	12 31.1	133	13 24.9	255 d
Sept. 22	ϕ Sagittarii	3.3	18 03.1	98 d	19 28.6	262
Oct. 9	η Leonis	3.6	4 43.9	100	5 53.7	300 d
Oct. 11	ν Virginis	4.2	5 15.2	90	6 11.5	326 d
Oct. 31	τ Tauri	4.3	3 02.1	57	4 11.3	272 d
Nov. 29	MARS	−1.2	7 58.5	149	.....	.....
Dec. 25	τ Tauri	4.3	2 07.2	60 d	3 05.3	282
Dec. 30	η Leonis	3.6	3 02.7	92	4 10.5	325 d

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 the 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 of corresponding days from year to year, and so it is impossible to give in any general table the exact time of sunrise and sunset day by day.

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

The Times for Any Station

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

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

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

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

JANUARY

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

FEBRUARY

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

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

APRIL

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

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

MAY

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

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

JUNE

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

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

JULY

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

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

AUGUST

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

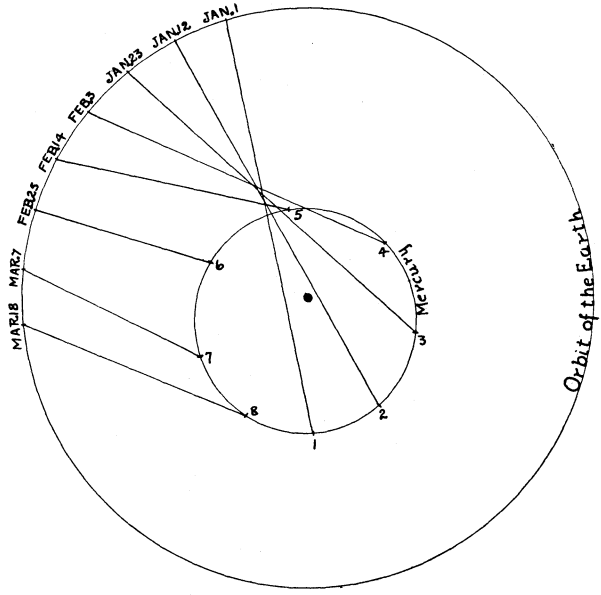
For an explanation of this table and its use at various places, see pages 8 and 9.

The reader may consult the pages headed *The Sky for the Month* (pages 28, 30, . . .) to find the conjunctions and other phenomena for the planets desired. In the following notes an account is given of some phenomena connected with their orbits and positions relative to the sun and earth.

Mercury

Of all the planets Mercury is the smallest—the 3rd and 4th moons of Jupiter are larger—and the least massive. It is nearest the sun, moves the most rapidly and receives the most light and heat. Its orbit is the most eccentric and is inclined at the greatest angle to the ecliptic.

Naked eye observation of the planet is possible only at or near the time of greatest elongation from the sun. Since at greatest elongation the planet is never more than 28°, and sometimes only 18°, from the sun, it is always at a low



Orbits of Mercury and the Earth, showing positions of the two planets for the first complete revolution of Mercury during 1928. Greatest elongations occur on February 9 and March 22. The diagram shows that the March elongation is much greater than that of February.

altitude and involved in twilight when the sun is below the horizon. Moreover, due to the rapid motion of the planet, the period during which its elongation is great enough for observation is small, about ten days. The result is that, although its brightness at greatest elongation is at least equal to that of Aldebaran and sometimes almost that of Sirius (mag. +1.1 to −1.2), comparatively few people ever see Mercury.

Due to the inclination of the ecliptic to the horizon in northern latitudes the planet is best seen as an evening star in the spring and as a morning star in the autumn.

Greatest eastern elongations (Mercury an evening star):

Feb. 8, 18° 12′; June 2, 23° 32′; Sept. 29, 25° 52′.

Greatest western elongations (Mercury a morning star):

Mar. 22, 27° 46′; July 20, 20° 11′; Nov. 9, 19° 4′.

Venus

Venus is the planet which most nearly resembles the earth in all qualities of which we have knowledge. While its orbit is inside that of the earth, its distance from the sun is almost double that of Mercury. As a result at greatest elongation the planet is about 48° from the sun and it is visible either as a morning or an evening star except for about a month at the time of conjunction with the sun. Identification of the planet is simple since it has a characteristic silvery appearance, and since, when brightest, about 36 days before or after inferior conjunction, it is about 12 times as bright as Sirius, the brightest star, the sun and moon being the only brighter objects. Indeed, when brightest, the planet can be seen with the naked eye in full sun light and at night it casts a noticeable shadow.

The time taken by Venus to pass from one conjunction to the next similar one, the synodic period, is 584 days, of which 440 are spent in passing from greatest elongation west through superior conjunction to greatest elongation east. This year superior conjunction occurs on July 1. Consequently at the beginning of the year the planet has passed its greatest western elongation and is moving in toward the sun with diminishing brightness. Since its greatest eastern elongation does not occur until 220 days after superior conjunction it does not reach its best position for observation as an evening star nor its greatest brilliancy this year.

Mars

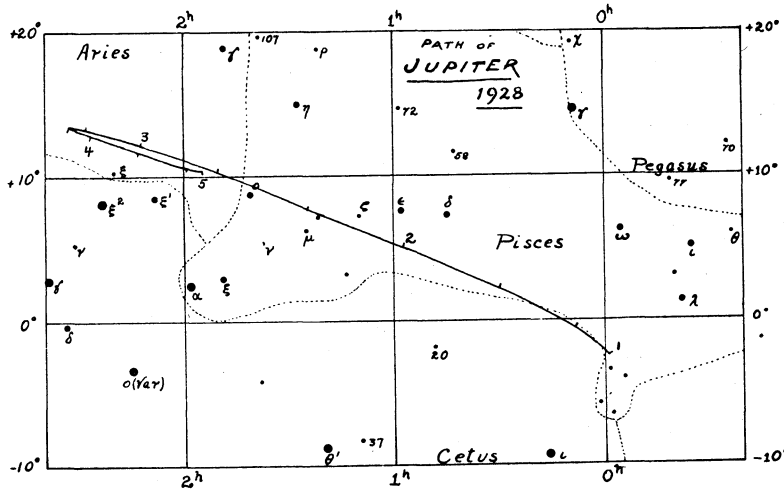
At the beginning of the year Mars is a morning star, rising about two hours ahead of the sun. Due to its distance, faintness and southern declination at this time, it is a poor object for observation. During the year the planet's position for observation steadily improves as the result of its northerly motion in declination and its constantly decreasing distance from the earth with consequent increasing brightness.

On Dec. 15 Mars reaches its nearest point to the earth, with a distance of 54,343,200 miles, and on Dec. 21 it is in opposition with the sun. This is not an extremely favourable opportunity for the study of the planet's surface for, although its declination is 26° 39′ N., its distance is about 6,000,000 miles greater than the average and 20,000,000 miles greater than the least distance at opposition.

For a map showing the path of Mars at the time of opposition see third page of cover.

Jupiter is the nearest of the major planets and is usually exceeded in brightness only by Venus. It is the greatest of the planets, its volume being nearly 50 per cent. and its mass almost 150 per cent. greater than the combined volumes and masses of all the other planets. (See *The Principal Elements of the Solar System*, page 55.)

A small telescope is sufficient to give a good view of the planet, for a magnification of 60 diameters gives it an apparent diameter equal to that of the moon as seen to the naked eye. The surface markings of Jupiter are in the form of bands, parallel to its equator, which are believed to be cloud formations in the



PATH OF JUPITER AMONG THE STARS, 1928

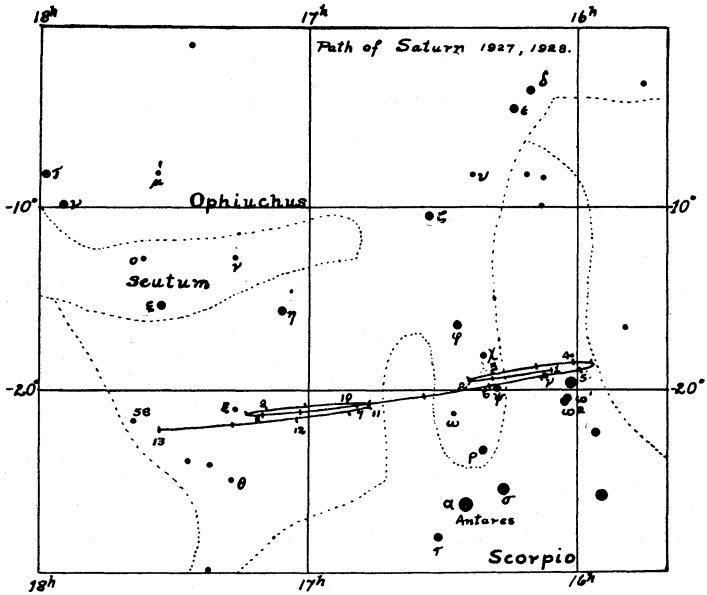
The marks on the path indicate the positions on the first of each month, as follows:—1, Jan. 1; 2, April 1; 3, July 1; 4, Oct. 1; 5, Jan. 1, 1929.

atmosphere. In a telescope of moderate size the changing position of these markings due to axial rotation can be seen.

Jupiter possesses nine moons, of which four can be seen with an ordinary field glass while the others require the most powerful telescopes. The four brightest, two of which are larger than Mercury, were among the first objects discovered after the invention of the telescope and are interesting objects for observation on account of their rapidly changing positions.

At the beginning of the year the planet is a fine evening star. From the end of March until about May 15 it is too near the sun for observation. After this date it is seen as a morning star, its position for observation improving during the rest of the year.

Of all celestial objects Saturn is unique in its possession of a surrounding ring system, and for this reason it is considered to be perhaps the finest object in the sky. During this year the earth is at its maximum distance from the plane of the rings, affording a better opportunity for the study of their structure than there has been for the past or will be for the next fifteen years. (See *Observer's Handbook, 1927*, for description of rings.)

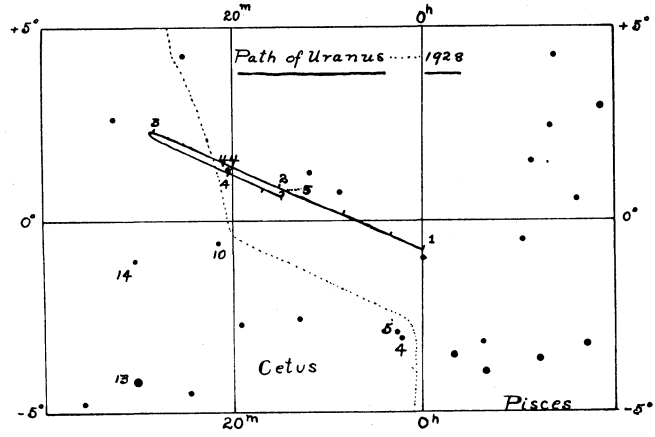


Path of Saturn among the Stars during 1927 and 1928. The positions of the planet are marked on the first of each month, the numbers referring to the following dates:—1, Jan. 1, 1927; 2, March, 1; 4, July, 1; 5, Sept. 1; 6, Nov. 1; 7, Jan. 1, 1928; 8, March, 1; 9, May, 1; 10, July, 1; 11, Sept. 1; 12, Nov. 1; 13, Jan. 1, 1929.

During the first part of the year Saturn is a morning star, constantly improving its position for observation. On June 6 it comes into opposition and is visible the whole night. During the last part of the year it is seen as an evening star, slowly moving in toward the sun until by the end of November it is too close for observation. On December 13 conjunction occurs and during the month the planet is too near the sun to be observed.

URANUS

Until less than a century and a half ago Saturn was believed to be at the outer boundary of the solar system. This conviction was so strong that when Uranus was discovered by Sir William Herschel in 1781 it was first announced as a comet, its true nature not being known until about a year later.



PATH OF URANUS AMONG THE STARS, 1928

The positions are indicated on the first of each month, as follows:—1, Jan. 1, 1928; 2, April 1; 3, July 1; 4, Oct. 1; 5, Jan. 1, 1929.

Having a period of 84 years its annual motion through the stars is small, about 4°. To the eye it appears as a star of about the sixth magnitude. Since this is the limit of naked eye visibility, some form of optical aid must be employed or its observation. Its motion among the stars can be detected readily with a field glass, but a large telescope is necessary to show an appreciable disc.

NEPTUNE

Neptune, at a distance of 30 astronomical units from the sun, is the farthest known member of the solar system. Its discovery in 1846 was the result of a mathematical discussion of the differences between the observed and predicted positions of Uranus which, by 1845, had assumed the (to the astronomer) intolerable proportions of 2′ of arc. Since its discovery it has travelled about half way around its orbit, its period being 165 years. The planet appears as a star of the eighth magnitude and has a satellite of magnitude 13.

ECLIPSES, 1928

There will be five eclipses in 1928, three of the sun and two of the moon.

I. A total eclipse of the sun, May 19, 1928, invisible in North America. This eclipse is total for only 24 minutes and its path is near the Antarctic Circle

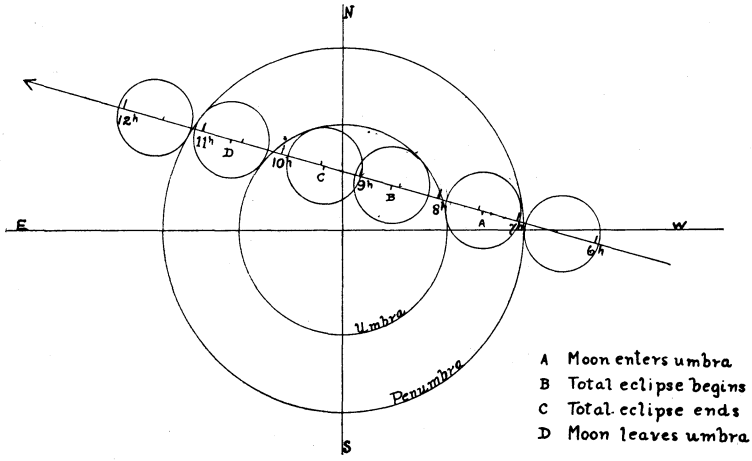
far from land. Greatest eclipse at May 19d 13h 24m Greenwich Civil Time. Partial phase visible in South Africa, Madagascar and the tip of South America.

II. A total eclipse of the moon, June 3, 1928. The beginning is visible generally in the western part of South America and of North America, the Pacific Ocean, Australia and the eastern borders of Asia; the ending is visible generally in the Pacific Ocean, Australia and the eastern part of Asia.

The middle of the eclipse is at June 3d 12h 9m, G.C.T.

III. A partial eclipse of the sun, June 17, 1928. It is visible in central Eurasia near the Arctic Circle. Greatest eclipse at June 17d 20h 52m G.C.T.; magnitude 4 per cent. of sun's diameter.

IV. A partial eclipse of the sun, November 12, 1928. Visible over nearly all Europe, Egypt and the west part of Asia. Greatest eclipse at Nov. 12d 9h 48m G.C.T.; magnitude 81 per cent. of sun's diameter.



ECLIPSE OF NOVEMBER 27

The diagram shows the path of the moon through the earth's shadow. The hours on the path are Greenwich Civil Time. To get the standard time subtract the number of the hour belt of the observer and the result will be in standard time—thus:—the total phase begins when the centre of the moon is at 7h 24m G.C.T. In E.S.T. Toronto this would be 1h 24m A.M., Nov. 27.

V. A total eclipse of the moon, Nov. 27, 1928, visible in Canada. The beginning is visible generally in the western and northern borders of Europe, the Atlantic Ocean, North and South America, the Pacific Ocean and the northern part of Asia; the ending is visible generally in North America, the northern part of South America, the Pacific Ocean, Australia and the eastern parts of Asia.

Circumstances of the eclipse, Nov. 27, G.C.T.:—

Moon enters penumbra, 6.25; enters umbra, 7.24; total eclipse begins, 8.39- middle of eclipse, 9.01; total eclipse ends, 9.29; moon leaves umbra, 10.33; leaves penumbra, 11.38. Magnitude of eclipse, 1.15 (moon's diameter, 1).

THE SKY FOR JANUARY, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During January the sun's R.A. increases from 18h 41m to 20h 53m, and its Decl. changes from 23° 7′ S to 17° 30′ S. The equation of time (see page 6) increases from 2m 59s to 13m 31s. 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 21st the sun enters the sign Aquarius, the second of the winter signs of the zodiac. On January 4 the earth is in perihelion (see opp. page for distance).

The Moon.—For its phases and conjunctions with the planets, see opp. page. During January the moon occults 6 stars (see p. 8).

Mercury on the 15th is in R.A. 19h 59m, Decl. 22° 45′ S, and transits at 12.28. On the 8th it is in superior conjunction, after which it is an evening star. During the month it is too near the sun for observation.

Venus on the 15th is in R.A. 16h 48m, Decl. 20° 20′ S, and transits at 9.15. It is a fine morning star, about 6 times as bright as Sirius and rising about 3h ahead of the sun. During the month its magnitude changes from −3.7 to −3.5.

Mars on the 15th is in R.A. 17h 47m, Decl. 23° 51′ S, and transits at 10.14. It now rises about two hours before the sun and at sunrise has an altitude of about 15° and an azimuth 35° east of south.

Jupiter on the 15th is in R.A. 23h 57m, Decl. 1° 41′ S, and transits at 16.22. It is a fine evening star, somewhat brighter than Sirius, and visible for over five hours after sunset. For its path among the stars, see page 23. For the configuration of its satellites, see next page, and for their eclipses, etc., see page 52.

Saturn on the 15th is in R.A. 16h 56m, Decl. 21° 5′ S, and transits at 9.21. It is a morning star, rising about 2½ hours before the sun. At sunrise it has an altitude of about 20° and an azimuth 30° east of south. Magnitude +0.7. For its position among the stars, see map on page 25.

Uranus on the 15th is in R.A. 0h 1m, Decl. 0° 38′ S, and transits at 16.26.

Neptune on the 15th is in R.A. 10h 4m, Decl. 12° 26′, and transits at 2.31.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

JANUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites at 19h 45m
			h m	
Sun.	1			30142
Mon.	2			4203*
Tues.	3		9 40	42103
Wed.	4	2h ⊕ in Perihelion, 91,341,000 miles		40123
Thur.	5			41302
Fri.	6		6 30	43201
♋ Sat.	7	1h 8m F.M		4310*
Sun.	8	20h ☌ ☿ ☉, Superior		43012
Mon.	9		3 20	4203*
Tues.	10	2h 39m ☌ ♆ ☾, ♆ 4° 38′ S		21043
Wed.	11			01234
Thur.	12		0 10	13024
Fri.	13			32014
☾ Sat.	14	16h 14m Moon L.Q	20 50	31204
Sun.	15			30124
Mon.	16	12h ☌ ♀ ♄, ♀ 0° 28′ N		21034
Tues.	17		17 40	d2043
Wed.	18	2h ☿ Greatest Hel. Lat. S		d0123
Thur.	19	0h 54m ☌ ♄ ☾, ♄ 1° 18′ N.; 6h 55m ☌ ♀ ☾, ♀ 1° 55′ N		d4102
Fri.	20	6h 47m ☌ ♂ ☾, ♂ 0° 40′ N	14 30	43201
Sat.	21			43120
♍ Sun.	22	15h 19m N.M.; 18h ♃ Greatest Hel. Lat. S		43012
Mon.	23	8h 41m ☌ ☿ ☾, ☿ 2° 18′ N.; 15h ☌ ♃ ♁, ♃ 0° 32′ S.	11 20	d4103
Tues.	24			42013
Wed.	25			4023*
Thur.	26	18h 23m ☌ ♁ ☾, ♁ 4° 43′ N.; 19h 10m ☌ ♃ ☾, ♃ 4° 11′ N	8 10	41032
Fri.	27			32014
Sat.	28			31204
☽ Sun.	29	14h 26m Moon F.Q	5 00	30124
Mon.	30			1024*
Tues.	31			20134

Explanations of symbols and abbreviations on page 4

THE SKY FOR FEBRUARY, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During February the sun's R.A. increases from 20h 53m to 22h 47m, and its Decl. changes from 17° 30′ S to 7° 45′ S. The equation of time reaches a maximum value of 14m 22s on the 12th (see page 6). For the change in the length of the day, see page 11. On the 19th the sun enters the third winter sign of the zodiac, Pisces.

The Moon.—For its phases and conjunctions with the planets, see opp. page. On the 14th the moon occults a star in Scorpio and on the 25th one in Cetus (see p. 8).

Mercury on the 15th is in R.A. 22h 45m, Decl. 5° 28′ S, and transits at 13.08. On the 8th it reaches its greatest eastern elongation, 18° 12′. At sunset the planet is about 15° above the horizon and about 30° south of the west point, and should be observable for about the first ten days of the month. On the 24th it reaches inferior conjunction after which it is a morning star.

Venus on the 15th is in R.A. 19h 29m, Dec. 21° 21′ S, and transits at 9.54. Its elongation is steadily decreasing but it is still a good morning star, rising about 2h before the sun and at sunrise having an altitude of about 15° above the south-east point of the horizon. Its magnitude decreases from −3.5 to −3.4 during the month.

Mars on the 15th is in R.A. 19h 27m, Decl. 22° 43′ S, and transits at 9.52. Until the 27th the planet is in the constellation Sagittarius, after which it enters Capricornus. Due to its southerly declination its altitude at sunrise has not changed much from last month.

Jupiter on the 15th is in R.A. 0h 18m, Decl. 0° 45′ N, and transits at 14.42. It is still a fine evening star of magnitude −1.7, and setting over 3 hours after the sun. For the configuration of its satellites, see opposite page, and for their eclipses, etc., see page 52.

Saturn on the 15th is in R.A. 17h 7m, Decl. 21° 19′ S, and transits at 7.31. The planet now rises about four hours ahead of the sun and is almost on the meridian at sunrise. Magnitude +0.7.

Uranus on the 15th is in R.A. 0h 6m, Decl. 0° 8′ S, and transits at 14.28.

Neptune on the 15th is in R.A. 10h 1m, Decl. 12°43′ N, and transits at 0.26.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

FEBRUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites at 19h 15m
			h m	
	Wed.	1	1 50	1O34*
	Thur.	2		1O324
	Fri.	3	22 40	32O14
	Sat.	4		3214O
♋	Sun.	5 15h 11m F.M.		34O12
	Mon.	6 2h ☿ in ♌; 10h 48m ☌ ♆ ☾, ♆ 4° 30′ S.	19 30	41O2*
	Tues.	7		42O13
	Wed.	8 22h ☿ Greatest elong. E., 18° 12′		41O3*
	Thur.	9	16 20	d4O32
	Fri.	10 17h ☿ in Perihelion		432O1
	Sat.	11		3421O
	Sun.	12	13 00	34O12
☾	Mon.	13 14h 5m Moon L.Q.; 21h ☌ ♀ ♂, ♀ 1° 21′ N.		13O24
	Tues.	14 19h ☿ Stationary		2O134
	Wed.	15 14h 12m ☌ ♄ ☾, ♄ 1° 44′ N.	9 50	12O34
	Thur.	16		O1234
	Fri.	17 12h ☍ ♆ ☉		32O4*
	Sat.	18 7h 47m ☌ ♂ ☾, ♂ 2° 12′ N.; 11h 49m ☌ ♀ ☾, ♀ 3° 32′ N.	6 40	321O4
	Sun.	19		3O124
	Mon.	20		13O42
♍	Tues.	21 0h ☿ Greatest Hel. Lat. N.; 4h 41m N.M.; 9h 38m ☌ ☿ ☾, ☿ 9° 8′ N.	3 30	24O13
	Wed.	22		412O3
	Thur.	23 4h 0m ☌ ♁ ☾, ♁ 4° 31′ N.; 12h 12m ☌ ♃ ☾, ♃ 3° 55′ N.		4O123
	Fri.	24 10h ☌ ☿ ☉, Inferior; 18h ♀ in ♉	0 20	dd41O
	Sat.	25		d432O
	Sun.	26	21 10	43O21
☽	Mon.	27 22h 21m Moon F.Q.		431O2
	Tues.	28		42O31
	Wed.	29	18 00	214O3

Explanation of symbols and abbreviations on page 4.

THE SKY FOR MARCH, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During March the sun's R.A. increases from 22h 47m to 0h 41m, and its Decl. changes from 7° 45′ S to 4° 22′ N. The equation of time decreases from 12m 36s to 4m 7s (see page 6). For changes in the length of the day, see page 12. On the 20th at 3.45 p.m. the sun enters the first spring sign of the zodiac, Aries (see opp. page).

The Moon.—For its phases and conjunctions with the planets, see opp. page. On the 6th the moon occults a star in Virgo (see p. 8).

Mercury on the 15th is in R.A. 22h 0m, Decl. 12° 4′ S, and transits at 10.30. On the 22nd the planet reaches its greatest western elongation, 27° 46′. At sunrise it is no more than 10° above the horizon and about 25° south of east, so that a field glass will be required for its observation.

Venus on the 15th is in R.A. 21h 55m, Decl. 13° 37′ S, and transits at 10.26. Its elongation continues to decrease, placing it in a less favourable position for observation as a morning star. Its magnitude changes from −3.4 to −3.3 during the month.

Mars on the 15th is in R.A. 20h 59m, Decl. 18° 15′ S, and transits at 9.29. During the month it is in the constellation Capricornus.

Jupiter on the 15th is in R.A. 0h 43m, Decl. 3° 24′ N, and transits at 13.12. It is still an evening star of magnitude −1.6. Its elongation is rapidly decreasing and by the end of the month the planet is too close to the sun for observation. For this reason the configurations of the satellites are omitted from the 31st onwards.

Saturn on the 15th is in R.A. 17h 13m, Decl. 21° 23′ S, and transits at 5.42. On the 9th the planet comes into quadrature with the sun and rises about midnight. Its brightness has increased slightly to +0.6. On the 28th it reaches a stationary point and begins to retrograde.

Uranus on the 15th is in R.A. 0h 12m, Decl. 0° 29′ N, and transits at 12.40.

Neptune on the 15th is in R.A. 9h 58m, Decl. 12° 59′ N, and transits at 22.25.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

MARCH

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites at 19h Cm
			h m	
	Thur.	1		O1243
	Fri.	2		1O324
	Sat.	3	14 50	32O14
	Sun.	4 17h 3m☌ ♆ ☾, ♆ 4° 29′ S.		3O4**
	Mon.	5		31O24
♍	Tues.	6 6h 27m F.M.	11 40	2O314
	Wed.	7 17h ☿ Stationary		21O34
	Thur.	8		O4123
	Fri.	9 10h □ ♄ ☉	8 20	14O23
	Sat.	10		423O1
	Sun.	11		432O*
	Mon.	12	5 10	431O2
	Tues.	13		42O1*
☾	Wed.	14 1h 1m☌ ♄ ☾, ♄ 2° 10′ N.; 10h 20m Moon L.Q.		421O3
	Thur.	15 2h ♃ in Perihelion; 11h ☿ in ♉	2 00	4O213
	Fri.	16		41O23
	Sat.	17 13h☌ ☿ ♀, ☿ 0° 36′ N.	22 50	23O41
	Sun.	18 8h 2m☌ ♂ ☾, ♂ 3° 26′ N.		321O4
	Mon.	19 11h 49m☌ ☿ ☾, ☿ 4° 27′ N.; 13h 9m☌ ♀ ☾, ♀ 4° 10′ N.		d3O24
	Tues.	20 15h 45m ☉ enters ♈, Spring commences	19 40	d3O14
♎	Wed.	21 15h 29m N.M.; 16h 16m☌ ♁ ☾, ♁ 4° 26′ N.		21O34
	Thur.	22 8h 28m ☌ ♃ ☾, ♃ 3° 35′ N.; 10h ☿ Greatest elong. W., 27° 46′		O2134
	Fri.	23	16 30	1O234
	Sat.	24 1h☌ ♁ ☉		23O14
	Sun.	25 17h ☿ in Aphelion		321O4
	Mon.	26	13 20	34O12
	Tues.	27		43O2*
☽	Wed.	28 6h 54m Moon F.Q.; 18h ♄ Stationary		421O3
	Thur.	29	10 10	4O213
	Fri.	30 8h ♀ in Aphelion		41O23
	Sat.	31 21h 44m☌ ♆ ☾, ♆ 4° 36′ S.		Invisible

Explanation of symbols and abbreviations on page 4.

THE SKY FOR APRIL, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During April the sun's R.A. increases from 0h 41m to 2h 32m, and its Decl. from 4° 22′ N to 14° 56′ N. The equation of time changes from −4m 7s to +2m 53s (see page 6). For the length of daylight in various latitudes, consult page 13. On the 20th the sun enters the second spring sign, Taurus.

The Moon.—For its phases and conjunctions with the planets, see opp. page. During April the moon ocuclts 4 stars—on the 12th, the 16th, the 24th and the 25th (see page 8).

Mercury on the 15th is in R.A. 0h 28m, Decl. 0° 25′ N, and transits at 10.57. During the month its elongation steadily decreases and at no time is it in a favourable position for observation.

Venus on the 15th is in R.A. 0h 18m, Decl. 0° 16′ N, and transits at 10.47. It is still a morning star, but is not in a favourable position for observation. During the month its magnitude remains constant at −3.3.

Mars on the 15th is in R.A. 22h 32m, Decl. 10° 42′ S, and transits at 9.00. About the 1st the planet enters Aquarius, where it remains until the end of the month. It continues to have a fairly low altitude at sunrise due to its southern declination.

Jupiter on the 15th is in R.A. 1h 10m, Decl. 6° 17′ N, and transits at 11.37. On the 6th the planet comes into conjunction with the sun, after which it is a morning star. During the entire month it is too near the sun for observation.

Saturn on the 15h is in R.A. 17h 12m, Decl. 21° 20′ S, and transits at 3.40. Its brightness has increased slightly to stellar magnitude +0.5 and it is well placed for morning observations.

Uranus on the 15th is in R.A. 0h 18m, Decl. 1° 11′ N, and transits at 10.45.

Neptune on the 15th is in R.A. 9h 56m, Decl. 13° 11′ N, and transits at 20.21.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

APRIL

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites
			h m	
	Sun.	1	7 00	Invisible by reason of the proximity of Jupiter to the Sun, from March 31 to May 14.
	Mon.	2		
	Tues.	3		
♍	Wed.	4 22h 38m F.M	3 50	
	Thur.	5		
	Fri.	6 10h ☌ ♃ ☉		
	Sat.	7 22h ☌ ☿ ♀, ☿ 1° 6′ S	0 30	
	Sun.	8		
	Mon.	9	21 20	
	Tues.	10 8h 17m ☌ ♄ ☾, ♄ 2° 26′ N		
	Wed.	11		
	Thur.	12	18 10	
☾	Fri.	13 3h ☌ ☿ ♉, ☿ 1° 54′ S.; 3h 9m Moon L.Q		
	Sat.	14 19h ☌ ♀ ♉, ♀ 0° 55′ S		
	Sun.	15 1h ☿ Greatest Hel. Lat. S	15 00	
	Mon.	16 7h 30m ☌ ♂ ☾, ♂ 4° 3′ N		
	Tues.	17		
	Wed.	18 5h 33m ☌ ♉ ☾, ♉ 4° 26′ N.; 12h 49m ☌ ♀ ☾, ♀ 3° 18′ N.; 21h 24m ☌ ☿ ☾, ☿ 2° 26′ N	11 50	
	Thur.	19 6h 16m ☌ ♃ ☾, ♃ 3° 13′ N		
●	Fri.	20 0h 25m N.M		
	Sat.	21 15h ♀ Greatest Hel. Lat. S	8 40	
	Sun.	22 6h ☌ ☿ ♃, ☿ 0° 45′ S		
	Mon.	23		
	Tues.	24	5 30	
	Wed.	25		
☽	Thur.	26 16h 42m Moon F.Q		
	Fri.	27	2 20	
	Sat.	28 2h 38m ☌ ♆ ☾, ♆ 4° 47′ S		
	Sun.	29 3h ☌ ♀ ♃, ♀ 0° 26′ S	23 10	
	Mon.	30		

Explanation of symbols and abbreviations on page 4.

THE SKY FOR MAY, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During May the sun's R.A. increases from 2h 32m to 4h 34m, and its Decl. from 14° 56′ N to 22° 0′ N. The equation of time increases from 2m 53s to a maximum of 3m 47s on the 15th, and then falls to 2m 35s on the 31st (see page 6). For changes in the length of the day, see page 14. On the 21st the sun enters Gemini, the third sign of the zodiac. On May 19 there is a total eclipse of the sun visible in South Africa and the Southern Atlantic Ocean, not visible in Canada.

The Moon.—For its phases and conjunctions with the planets, see opp. page. On the 25th the moon occults a star in Leo and on the 27th one in Virgo (see page 8).

Mercury on the 15th is in R.A. 4h 20m, Decl. 23° 11′ N, and transits at 12.52. On the 3rd the planet is in superior conjunction after which it is an evening star. Its elongation increases, and during the last week of the month is sufficiently great for the planet to be observed at sunset about 10° north of west and about 15° above the horizon.

Venus on the 15th is in R.A. 2h 36m, Decl. 14° 2′ N, and transits at 11.06. It is still a morning star though too close to the sun to be well observed. During the month its magnitude changes from −3.3 to −3.4.

Mars on the 15th is in R.A. 23h 57m, Decl. 1° 58′ S, and transits at 8.27. At the beginning of the month the planet enters Pisces, where it remains during the month. Its position for observation has improved from last month.

Jupiter on the 15th is in R.A. 1h 37m, Decl. 8° 53′ N, and transits at 10.05. The planet is now a morning star, but is too near the sun for observation until about the 15th. For the configuration of its satellites, see next page, and for their eclipses, etc., see page 52.

Saturn on the 15th is in R.A. 17h 6m, Decl. 21° 11′ S, and transits at 1.36. It now rises about two hours after sunset and is visible much of the night. During the month its brightness increases from magnitude +0.4 to +0.2.

Uranus on the 15th is in R.A. 0h 23m, Decl. 1° 46′ N, and transits at 8.52.

Neptune on the 15th is in R.A. 9h 55m, Decl. 13° 13′ N, and transits at 18.22.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

MAY

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites at 4h 15m
			h m	
Tues.	1			
Wed.	2		19 50	
Thur.	3	7h☌☿☉, Superior		Invisible
♋Fri.	4	15h 12m F.M.; 2h☿ in♌		
Sat.	5		16 40	
Sun.	6			
Mon.	7	10h♆ Stationary; 12h 17m☌♄☾, ♄ 2° 29′ N.		
Tues.	8	16h☿ in Perihelion	13 30	
Wed.	9			
Thur.	10	16h♂ Greatest Hel. Lat. S.		
Fri.	11		10 20	
☾Sat.	12	15h 50m Moon L.Q.		
Sun.	13			
Mon.	14		7 10	
Tues.	15	6h 7m☌♂☾, ♂ 3° 49′ N.; 17h 44m☌♁☾, ♁ 4° 27′ N		30214
Wed.	16			31402
Thur.	17	3h 39m☌♃☾, ♃ 2° 47′ N.; 10h□♆☉	4 00	42301
Fri.	18	11h 37m☌♀☾, ♀ 1° 9′ N.; 23h☿ Greatest Hel. Lat. N		42013
Sat.	19	8h 14m N.M., Total ecl. of ☉, invisible in Canada (see p. 27)		41023
Sun.	20	15h 12m☌☿☾, ☿ 1° 26′ N	0 50	40213
Mon.	21			42130
Tues.	22		21 40	43021
Wed.	23			34102
Thur.	24	18h☌♂♁, ♂ 0° 55′ S.		23401
Fri.	25	9h 32m☌♆☾, ♆ 4° 53′ S.	18 30	2034*
☽Sat.	26	4h 12m Moon F.Q.		10234
Sun.	27			02134
Mon.	28		15 10	21034
Tues.	29			3014*
Wed.	30			31024
Thur.	31		12 00	32014

Explanations of symbols and abbreviations on page 4.

THE SKY FOR JUNE, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During June the sun's R.A. increases from 4h 34m to 6h 39m, and its Decl. rises from 22° 0′ N on the 1st to its maximum 23° 27′ on the 22nd. On the 21st the sun reaches the summer solstice and enters the first summer sign of the zodiac, Cancer. The duration of daylight is then longest, but it does not change appreciably for several days, before and after this date (see page 15). The Decl. falls to 23° 13′ on the 30th. The increase in the equation of time (for which see p. 6), taken with the decreasing length of daylight, causes the local mean time of sunset to appear unchanged for several days at the end of June and the beginning of July. On June 17 there is a partial eclipse of the sun, not visible in Canada.

The Moon.—For its phases and conjunctions with the planets, see opp. page. On June 3rd the moon occults a star in Ophiuchus (see page 8).

Mercury on the 15th is in R.A. 6h 54m, Decl. 22° 1′ N, and transits at 13.19. On the 2nd it reaches its greatest eastern elongation, 23° 32′. At sunset it is visible about 10° north of west at an altitude of about 20°. It should continue visible for four or five days after this date. On the 29th the planet reaches inferior conjunction and becomes a morning star.

Venus on the 15th is in R.A. 5h 12m, Decl. 22° 55′ N, and transits at 11.41. It is still a morning star, but is too close to the sun to be observed.

Mars on the 15th is in R.A. 1h 23m, Decl. 7° 2′ N, and transits at 7.50. Until about the 27th the planet is in the constellation Pisces, after which it enters Aries. It now rises over three hours before the sun, reaching an altitude of 30° by sunrise.

Jupiter on the 15th is in R.A. 2h 1m, Decl. 11° 9′ N, and transits at 8.28. It is now a morning star of magnitude −1.7 and rises about 2½ hours before the sun. For the configuration of its satellites, see next page, and for their eclipses, etc., see page 52.

Saturn on the 15th is in R.A. 16h 57m, Decl. 20° 59′ S, and transits at 23.20. On the 6th it comes into opposition with the sun and is visible the whole of the night. Magnitude +0.2.

Uranus on the 15th is in R.A. 0h 27m, Decl. 2° 11′ N, and transits at 6.54.

Neptune on the 15th is in R.A. 9h 57m, Decl. 13° 5′ N, and transits at 16.22.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

JUNE

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites at 3h 15m
			h m	
Fri.	1			21034
Sat.	2	20h ☿ Greatest elong. E., 23° 32′		40123
♋ Sun.	3	7h 14m F.M., Total ecl. of ☾, invisible at Toronto (see p. 27); 14h 35m ☌ ♄ ☾, 2° 19′ N	8 50	40123
Mon.	4	14h ♂ in Perihelion		42103
Tues.	5			43201
Wed.	6	15h ☍ ♄ ☉	5 40	43102
Thur.	7			43201
Fri.	8			42103
Sat.	9		2 30	40123
Sun.	10			0423*
☾ Mon.	11	0h 51m Moon L.Q.; 10h ☿ in ♉	23 20	21034
Tues.	12	3h 18m ☌ ♁ ☾, ♁ 4° 24′ N		32014
Wed.	13	3h 21m ☌ ♂ ☾, ♂ 2° 42′ N.; 22h 45m ☌ ♃ ☾, ♃ 2° 17′ N		31024
Thur.	14		20 10	d3014
Fri.	15			21034
Sat.	16	3h ☿ Stationary; 21h ♀ in ♌		02134
♎ Sun.	17	9h 11m ☌ ♀ ☾, ♀ 1° 9′ S.; 15h 42m N.M., Partial ecl. invisible in Canada (see p. 27)	17 00	10243
Mon.	18	16h 55m ☌ ☿ ☾, ☿ 4° 46′ S		d2043
Tues.	19			24301
Wed.	20		13 50	43102
Thur.	21	11h 7m ☉ enters ♋ Summer commences; 16h ☿ in Aphelion; 18h 56m ☌ ♆ ☾, ♆ 4° 52′ S		43021
Fri.	22			4210*
Sat.	23		10 30	4013*
☽ Sun.	24	17h 47m Moon F.Q.		41023
Mon.	25			42013
Tues.	26		7 20	42301
Wed.	27			31042
Thur.	28			30214
Fri.	29	3h □ ♁ ☉; 8h ☌ ☿ ☉, Inferior; 12h ☌ ☿ ♀, ☿ 4° 55′ S	4 10	21304
Sat.	30	17h 16m ☌ ♄ ☾, ♄ 2° 6′ N		0134*

Explanation of symbols and abbreviations on page 4.

THE SKY FOR JULY, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During July the sun's R.A. increases from 6h 39m to 8h 44m, and its Decl. decreases from 23° 9′ N to 18° 9′ N. The equation of time increases from 3m 32s on the 1st to 6m 22s on the 27th and then falls to 6m 16s on the 31st (see p. 7). On the 23rd the sun enters Leo, the second summer sign of the zodiac. For changes in the length of the day, see page 16. The earth is in aphelion on the 4th (see opp. page for distance).

The Moon.—For its phases and conjunctions with the planets, see opp. page. On July 2 the moon occults a star in Sagittarius (see page 8).

Mercury on the 15th is in R.A. 6h 17m, Decl. 19° 40′ N, and transits at 10.46. On the 20th it reaches its greatest western elongation, 20° 11′. At sunrise it is visible about 15° north of east at an altitude of about 12°.

Venus on the 15th is in R.A. 7h 53m, Decl. 21° 57′ N, and transits at 12.23. On the 1st the planet reaches superior conjunction, after which it is an evening star. During the month it will not be in a suitable position for observation.

Mars on the 15th is in R.A. 2h 45m, Decl. 14° 28′ N, and transits at 7.1.4 It is now in the constellation of Aries, rising about 4½ hours before the sun. During the month its brightness increases from magnitude +0.8 to +0.7, about 40 per cent. brighter than Aldebaran.

Jupiter on the 15th is in R.A. 2h 21m, Decl. 12° 44′ N, and transits at 6.49. It is now of magnitude −1.9 and rises over four hours before the sun. For the configuration of its satellites, see next page, and for their eclipses, etc., see page 52.

Saturn on the 15th is in R.A. 16h 49m, Decl. 20° 50′ S, and transits at 21.14. It is in a good position for observation, being above the horizon until two hours before sunrise. Magnitude +0.4.

Uranus on the 15th is in R.A. 0h 28m, Decl. 2° 16′ N, and transits at 4.57.

Neptune on the 15th is in R.A. 10h 0m, Decl. 12° 48′ N, and transits at 14.27.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

JULY

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 2h 30m
			h	m	
Sun	1	10h ☌ ♀ ☉, Superior			10234
♋ Mon.	2	21h 48m F.M	1	00	20134
Tues.	3	16h ☌ ♂ ♃, ♂ 0° 18′ S			d204*
Wed.	4	5h ⊕ in Aphelion, 94,451,000 miles	21	50	31024
Thur.	5				30412
Fri.	6				23410
Sat.	7		18	40	42031
Sun.	8				41023
Mon.	9	10h 3m ☌ ♁ ☾, ♁ 4° 15′ N			d4013
☾ Tues.	10	7h 16m Moon L.Q.; 14h ☿ Stationary	15	30	42103
Wed.	11	14h 8m ☌ ♃ ☾, ♃ 1° 42′ N.; 22h 7m ☌ ♂ ☾, ♂ 1° 4′ N			d4302
Thur.	12	1h ☿ Greatest Hel. Lat. S			43012
Fri.	13	0h ♁ Stationary	12	20	32410
Sat.	14				20341
Sun.	15	14h 13m ☌ ☿ ☾, ☿ 5° 47′ S			10243
♍ Mon.	16	23h 36m N.M	9	10	02134
Tues.	17	6h 22m ☌ ♀ ☾, ♀ 2° 55′ S			21034
Wed.	18				30124
Thur.	19	5h 54m ☌ ♆ ☾, ♆ 4° 47′ S	6	00	3024*
Fri.	20	16h ♀ in Perihelion; 23h ☿ Greatest elong. W. 20° 11′			32104
Sat.	21				20314
Sun.	22		2	40	10423
Mon.	23				40213
☽ Tues.	24	9h 38m Moon F.Q	23	30	42103
Wed.	25				4301*
Thur.	26				4302*
Fri.	27	22h 1m ☌ ♄ ☾, ♄ 2° 1′ N	20	20	d4320
Sat.	28				42301
Sun.	29				41023
Mon.	30		17	10	40213
Tues.	31	1h ☿ in ♌			21043

Explanation of symbols and abbreviations on page 4.

THE SKY FOR AUGUST, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During August the sun's R.A. increases from 8h 44m to 10h 40m, and its Decl. decreases from 18° 9′ N to 8° 28′ N. The equation of time falls from 6m 13s to 0m 7s (see page 7). For changes in the length of daylight, see page 17. On the 23rd the sun enters the third summer sign of the zodiac, Virgo.

The Moon.—For its phases and conjunctions with the planets, see opp. page. During August the moon occults three stars—on the 12th, the 13th and the 30th (see page 8).

Mercury on the 15th is in R.A. 9h 34m, Decl. 16° 17′ N, and transits at 12.04. On the 16th it is in superior conjunction with the sun and consequently is not in a suitable position for observation during the month.

Venus on the 15th is in R.A. 10h 26m, Decl. 11° 21′ N, and transits at 12.54. It is now about 10° above the west point of the horizon at sunset, setting nearly an hour after the sun. During the month its magnitude changes from −3.4 to −3.3

Mars on the 15th is in R.A. 4h 8m, Decl. 19° 51′ N, and transits at 6.35. During the month it is in the constellation Taurus and on the 24th is about 4½° north of Aldebaran and about 75 per cent. brighter.

Jupiter on the 15th is in R.A. 2h 32m, Decl. 13° 35′ N, and transits at 4.59. On the 1st it is in quadrature with the sun and rises about midnight. On the 30th it reaches a stationary point, after which its motion is retrograde. Magnitude −2.1. For the configuration of its satellites, see next page, and for their eclipses, etc., see page 52.

Saturn on the 15th is in R.A. 16h 45m, Decl. 20° 49′ S, and transits at 19.09. On the 17th it reaches a stationary point, after which it resumes its easterly motion through the stars. Its brightness has decreased slightly to magnitude +0.6, but it is well placed for evening observation, reaching its greatest altitude shortly after sunset.

Uranus on the 15th is in R.A. 0h 27m, Decl. 2° 5′ N, and transits at 2.54.

Neptune on the 15th is in R.A. 10h 4m, Decl. 12° 27′ N, and transits at 12.29.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

AUGUST

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 1h 45m
			h	m	
♋ Wed.	1	10h □ ♃ ☉; 10h 30m F.M			3O14*
Thur.	2		14	0	31O24
Fri.	3				32O14
Sat.	4	16h ☿ in Perihelion			23O4*
Sun.	5	15h 14m ☌ ♁ ☾, ♁ 4° 2′ N	10	50	1O234
Mon.	6				O1234
Tues.	7				21O43
☾ Wed.	8	1h 9m ☌ ♃ ☾, ♃ 1° 7′ N.; 12h 24m Moon L.Q	7	40	243O1
Thur.	9	13h 12m ☌ ♂ ☾, ♂ 0° 35′ S.; 22h ☌ ♀ Ψ, ♀ 0° 59′ N.			341O2
Fri.	10				d43O1
Sat.	11	9h ♀ Greatest Hel. Lat. N	4	30	423O*
Sun.	12				41O23
Mon.	13				4O123
Tues.	14	22h ☿ Greatest Hel. Lat. N	1	20	421O3
♌ Wed.	15	5h 15m ☌ ☿ ☾, ☿ 3° 15′ S.; 8h 49m N.M.; 16h 52m ☌ Ψ ☾, Ψ 4° 43′ S			42O31
Thur.	16	0h ☌ ☿ ☉, Superior; 6h 11m ☌ ♀ ☾, ♀ 3° 51′ S.	22	00	314O2
Fri.	17	2h ♄ Stationary			3O214
Sat.	18	16h ☌ ☿ Ψ, ☿ 1° 17′ N			231O4
Sun.	19		18	50	dO234
Mon.	20				O1234
Tues.	21				21O34
Wed.	22	2h ☌ Ψ ☉	15	40	2O314
♎ Thur.	23	3h 21m Moon F.Q			31O24
Fri.	24	5h 30m ☌ ♄ ☾, ♄ 2° 7′ N			3O241
Sat.	25		12	30	3241O
Sun.	26				4O13*
Mon.	27				4O23*
Tues.	28		9	20	421O3
Wed.	29				42O13
♑ Thur.	30	12h ♃ Stationary; 21h 34m F.M			431O2
Fri.	31		6	10	43O21

Explanation of symbols and abbreviations on page 4.

THE SKY FOR SEPTEMBER, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During September the sun's R.A. increases from 10h 40m to 12h 28m, and its Decl. changes from 8° 28′ N to 3° 0′ S. The equation of time is 0m 7s at the beginning of the month, becomes zero on the 1st and then increases to 10m 9s. For the change in the length of daylight, see page 18. On the 23rd the sun crosses the equator, going southward and enters the first autumn sign of the zodiac, Libra.

The Moon.—For its phases and conjunctions with the planets, see opp. page. The moon occults a star in Gemini on the 9th and one in Sagittarius on the 22nd (see page 8).

Mercury on the 15th is in R.A. 12 h 50m, Decl. 6° 24′ S, and transits at 13.16. On the 29th it reaches its greatest eastern elongation, 25° 52′. This is not a very favourable elongation at which to observe the planet, since its altitude at sunset is hardly 10°. With a field glass it should easily be located about 30° south of west.

Venus on the 15th is in R.A. 12h 47m, Decl. 4° 5′ S, and transits at 13.12. Its elongation continues to increase, but due to its low altitude at sunset, it is not in a favourable position for observation. During the month its brightness remains constant at magnitude −3.3.

Mars on the 15th is in R.A. 5h 23m, Decl. 22° 40′ N, and transits at 5.48. On the 14th it is in quadrature with the sun and is on the meridian at sunrise. It is still in Taurus, its brightness increasing from magnitude +0.4 to 0.0.

Jupiter on the 15th is in R.A. 2h 32m, Decl. 13° 28′ N, and transits at 2.57. It is now of magnitude −2.3 and is visible more than half the night. For the configuration of its satellites, see next page, and for their eclipses, etc., see page 52.

Saturn on the 15th is in R.A. 16h 48m, Decl. 21° 1′ S, and transits at 17.10. On the 5th it comes into quadrature, being 90° east of the sun. It is a good evening star, visible for four hours after sunset. Magnitude +0.7.

Uranus on the 15th is in R.A. 0h 23m, Decl. 1° 40′ N, and transits at 0.48.

Neptune on the 15th is in R.A. 10h 8m, Decl. 12° 3′ N, and transits at 10.32.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

SEPTEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 1h 0m
			h	m	
Sat.	1	20h 45m☌ ♁ ☾, ♁ 3° 53′ N			34210
Sun.	2				041**
Mon.	3		3	00	0243*
Tues.	4	8h 13m☌ ♃ ☾, ♃ 0° 42′ N			21034
Wed.	5	11h □ ♄ ☉	23	50	20134
☾ Thur.	6	17h 35m Moon L.Q.; 23h 32m☌ ♂ ☾, ♂ 1° 52′ S			31024
Fri.	7	9h ☿ in ♉			30124
Sat.	8		20	40	32104
Sun.	9				2014*
Mon.	10	6h☌ ♀ ☿, ☿ 1° 31′ S			10423
Tues.	11		17	20	dd403
Wed.	12	2h 26m☌ ♆ ☾, ♆ 4° 46′ S			42013
● Thur.	13	20h 21m N.M.			41302
Fri.	14	0h □ ♂ ☉	14	10	43012
Sat.	15	11h 55m☌ ♀ ☾, ♀ 3° 19′ S.; 13h 56m☌ ☿ ☾, ☿ 5° 21′S			43210
Sun.	16				42301
Mon.	17	15h ☿ in Aphelion	11	00	41023
Tues.	18				40213
Wed.	19				2043*
Thur.	20	15h 24m ☌ ♄ ☾, ♄ 2° 22′ N	7	50	13024
◐ Fri.	21	21h 58m Moon F.Q.			30124
Sat.	22				32104
Sun.	23	2h 6m ☉ enters ♎, Autumn commences	4	40	23014
Mon.	24				10324
Tues.	25				02134
Wed.	26		1	30	2043*
Thur.	27				d140*
Fri.	28	14h ☍ ♁ ☉	22	20	34012
♒ Sat.	29	3h 55m☌ ♁ ☾, ♁ 3° 54′ N.; 7h 42m F.M.; 23h ☿ Greatest elong. E., 25° 52′			43120
Sun.	30	20h ☌ ☿ ♀, ☿ 3° 22′ S			42301

Explanation of symbols and abbreviations on page 4.

THE SKY FOR OCTOBER, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During October the sun's R.A. increases from 12h 28m to 14h 24m, and its Decl. increases from 3° 0′ S to 14° 17′ S. On the 23rd the sun enters the second autumnal sign of the zodiac, Scorpio. The equation of time rises from 10m 9s to 16m 20s, to be subtracted from apparent or sun dial time (see p. 7). For the change in length of daylight, see page 19.

The Moon.—For its phases and conjunctions with the planets, see opp. page. During the month the moon occults three stars—on the 9th, the 11th and the 31st (see page 8).

Mercury on the 15th is in R.A. 14h 23m, Decl. 17° 34′ S, and transits at 12.47. On the 24th the planet reaches inferior conjunction after which it becomes a morning star. At no time during the month is it in a suitable position for observation.

Venus on the 15th is in R.A. 15h 7m, Decl. 17° 56′ S, and transits at 13.34. It now sets about 1h 15m after the sun and at sunset is about 10° above the south west point of the horizon. During the month its brightness increases slightly from magnitude −3.3 to −3.4.

Mars on the 15th is in R.A. 6h 19m, Decl. 23° 41′ N, and trasnits at 4.45. During the month the planet is in the constellation Gemini, its brightness increasing from magnitude 0.0 to −0.5.

Jupiter on the 15th is in R.A. 2h 21m, Decl. 12° 32′ N, and transits at 0.48. On the 28th it comes into opposition with the sun and is on the meridian at midnight, being visible all night. Its magnitude is now −2.4. For the configuration of its satellites, see next page, and for their eclipses, etc., see page 53.

Saturn on the 15th is in R.A. 16h 56m, Decl. 21° 20′ S, and transits at 15.21. It is an evening star, setting 3 hours after the sun. Magnitude +0.7.

Uranus on the 15th is in R.A. 0h 19m, Decl. 1° 12′ N, and transits at 22.42.

Neptune on the 15th is in R.A. 10h 12m, Decl. 11° 44′ N, and transits at 8.37.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

OCTOBER

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites at 0h 15m
			h m	
Mon.	1	12h 57m ☌ 2 ☾, 2 0° 35′ N	19 10	41O32
Tues.	2			4O213
Wed.	3			421O3
Thur.	4	22h ♂ in ♌	16 00	4O13*
Fri.	5	3h 51m ☌ ♂ ☾, ♂ 2° 30′ S		34O12
☾ Sat.	6	0h 6m Moon L.Q.; 11h ♀ in ♉		312O4
Sun.	7		12 50	32O14
Mon.	8	0h ☿ Greatest Hel. Lat. S		1O324
Tues.	9	10h 4m ☌ Ψ ☾, Ψ 4° 55′ S		O1234
Wed.	10		9 30	21O34
Thur.	11			2O134
Fri.	12	13h ☿ Stationary		3O24*
● Sat.	13	10h 56m N.M	6 20	d31O4
Sun.	14	21h 8m ☌ ☿ ☾, ☿ 5° 32′ S		324O1
Mon.	15	23h 12m ☌ ♀ ☾, ♀ 1° 27′ S		41O32
Tues.	16		3 10	4O123
Wed.	17			421O3
Thur.	18	2h 49m ☌ ♄ ☾, ♄ 2° 39′ N		42O13
Fri.	19		0 00	431O2
Sat.	20			d43O2
◑ Sun.	21	16h 6m Moon F.Q	20 50	324O1
Mon.	22			1O42*
Tues.	23			O1243
Wed.	24	3h ☌ ☿ ☉, Inferior	17 40	21O34
Thur.	25			2O134
Fri.	26	12h 41m ☌ ♁ ☾, ♁ 4° 1′ N		31O24
Sat.	27	0h ☿ in ♌	14 30	d3O24
♋ Sun.	28	17h 43m F.M.; 17h 26m ☌ 2 ☾, 2 0° 50′ N.; 19h ☍ 2 ☉		32O14
Mon.	29			13O24
Tues.	30		11 20	O4123
Wed.	31	15h ☿ in Perihelion		412O3

Explanation of symbols and abbreviations on page 4.

THE SKY FOR NOVEMBER, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During November the sun's R.A. increases from 14h 24m to 16h 27m, and its Decl. changes from 14° 17′ S to 21° 44′ S. On the 22nd the sun enters Sagittarius, the third autumnal sign of the zodiac. The equation of time on the 3rd rises to a maximum of 16m 23s, to be subtracted from apparent time—that is, the sun dial is that amount ahead of the mean time clock (see page 7). For the changes in the length of daylight, see page 20. On November 12 there is a partial eclipse of the sun, not visible in Canada.

The Moon.—For its phases and conjunctions with the planets, see opp. page. On the 29th the moon occults the planet Mars (see page 8).

Mercury on the 15th is in R.A. 14h 12m, Decl. 11° 7′ S, and transits at 10.38. On the 9th the planet reaches its greatest western elongation, 19° 4′. At sunrise it is visible at an altitude of about 17°, 30° south of east. The planet should be in a favourable position for observation from the 5th to the 16th.

Venus on the 15th is in R.A. 17h 48m, Decl. 25° 9′ S, and transits at 14.13. Its elongation continues to increase, thus improving its position for observation. On the 15th the planet sets 2h after the sun and at sunset has an altitude of about 15° and an azimuth 60° south of west. Its magnitude changes from −3.4 to −3.5 during the month.

Mars on the 15th is in R.A. 6h 41m, Decl. 24° 42′ N, and transits at 3.05. On the 12th it reaches a stationary point, after which it moves westward through the stars. Its position during the month does not change more than 3° while its brightness increases from magnitude −0.5 to −1.2.

Jupiter on the 15th is in R.A. 2h 6m, Decl. 11° 13′ N, and transits at 22.26. The planet is of magnitude −2.4 and is well placed for observation since it does not set until two hours before sunrise. For the configuration of its satellites, see next page, and for their eclipses, etc., see page 53.

Saturn on the 15th is in R.A. 17h 9m, Decl. 21° 42′ S, and transits at 13.32. It is still an evening star, setting on the 15th about two hours after the sun. Its elongation is decreasing and by the end of the month it is too near the sun for observation. Magnitude +0.7.

Uranus on the 15th is in R.A. 0h 15m, Decl. 0° 50′ N, and transits at 20.36.

Neptune on the 15th is in R.A. 10h 14m, Decl. 11° 33′ N, and transits at 6.38.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

NOVEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites at 23h 0m
			h m	
Wed.	0	15h ☿ in Perihelion		42013
Thur.	1	17h ☿ Stationary; 23h 41m☌ ♂ ☾, ♂ 2° 15′ S.		41302
Fri.	2		8 10	43012
Sat.	3			4320*
☾ Sun.	4	9h 6m Moon L.Q		43120
Mon.	5	16h 32m☌ Ψ ☾, Ψ 5° 3′ S	4.50	40132
Tues.	6	22h ☌ ♀ ♄, ♀ 2° 41′ S		14203
Wed.	7			20413
Thur.	8		1 40	13024
Fri.	9	2h ☿ Greatest elong. W., 19° 4′; 23h ♀ in Aphelion		30124
Sat.	10	10h 52m☌ ☿ ☾, ☿ 0° 31′ S.; 21h ☿ Greatest Hel. Lat. N	22 30	32104
Sun.	11			d3204
◍ Mon.	12	4h 35m N.M., Partial ecl. of ☉, invisible in Canada (see p. 27); 5h ♂ Stationary	19 20	01324
Tues.	13			12034
Wed.	14	14h 57m ☌ ♄ ☾, ♄ 2° 53′ N		20143
Thur.	15	10h 27m ☌ ♀ ☾, ♀ 0° 43′ N	16 10	14032
Fri.	16			43012
Sat.	17			4321O
Sun.	18		13 00	43201
Mon.	19			4032*
◑ Tues.	20	8h 36m Moon F.Q		d4103
Wed.	21		9 50	42013
Thur.	22	21h 41m☌ ♀ ☾, ♁ 4° 8′ N		41032
Fri.	23	16h □ Ψ ☉		34012
Sat.	24	23h 5m☌ ♃ ☾, ♃ 1° 14′ N	6 40	32104
Sun.	25			32014
Mon.	26			O324*
◎ Tues.	27	4h 6m F.M., Total ecl. of ☾, visible in Canada (see p. 27)	3 30	10234
Wed.	28			20134
Thur.	29	7h 3m ☌ ♂ ☾, ♂ 0° 52′ S		1034*
Fri.	30			

Explanation of symbols and abbreviations on page 4.

THE SKY FOR DECEMBER, 1928

The times of transit are given in Local Mean Time; to change to Standard Time, see p. 9. Estimates of altitude are for an observer in latitude 45° N.

The Sun.—During December the sun's R.A. increases from 16h 27m to 18h 44m, and its Decl. reaches a maximum value 23° 27′ on the 22nd. This is the time of the winter solstice, and the sun enters the first of the winter signs of the zodiac, Capricornus. It is then vertical to points on the tropic of Capricorn on the earth. From this time it slowly moves northward, the daylight period being the shortest and changing very little for several days before and after the solstice (see p. 21). The equation of time changes from 11m 6s watch slow to 3m 19s watch fast (see page 7).

The Moon.—For its phases and conjunctions with the planets, see opp. page. On the 25th the moon occults a star in Taurus and on the 30th one in Leo (see page 8).

Mercury on the 15th is in R.A. 17h 20m, Decl. 24° 14′ S, and transits at 11.48. On the 18th it reaches superior conjunction and during the month is too near the sun for observation.

Venus on the 15th is in R.A. 20h 25m, Decl. 21° 27′ S, and transits at 14.52. It is now a fine evening star and its position continues to improve. It now sets more than three hours later than the sun, and at sunset has an altitude of 25° and an azimuth of 20° north of south.

Mars on the 15th is in R.A. 6h 9m, Decl. 26° 26′ N, and transits at 0.35. On the 21st it is in opposition and is visible the whole night. It is in the constellation Gemini until about the 23rd, after which it is in Taurus. During the first half of the month its brightness increases from magnitude −1.2 to −1.4, after which it decreases to −1.2 at the end of the month.

Jupiter on the 15th is in R.A. 1h 56m, Decl. 10° 28′ N, and transits at 20.19. The planet is still well situated for observation, setting 11 hours after the sun. During the month its brightness decreases from magnitude −2.4 to −2.2. On the 26th it reaches a stationary point, after which it begins to move eastward again. For the configuration of its satellites, see next page, and for their eclipses, etc., see page 53.

Saturn on the 15th is in R.A. 17h 24m, Decl. 22° 1′ S, and transits at 11.49. On the 13th it is in conjunction with the sun, after which it is a morning star. During the month it is too near the sun for observation.

Uranus on the 15th is in R.A. 0h 14m, Decl. 0° 43′ N, and transits at 18.37.

Neptune on the 15th is in R.A. 10h 14m, Decl. 11° 32′ N, and transits at 4.40.

For further information regarding the planets, with maps of their paths, see pages 22 to 26.

DECEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites at 22h 0m
			h m	
Fri.	0		0 18	30124
Sat.	1		0 10	31204
Sun.	2	7h ♀ Greatest Hel. Lat. S.; 23h 31m ☌ Ψ ☾, Ψ 5° 4′ S.	21 07	32401
☾ Mon.	3	21h 32m Moon L.Q.	21 00	41032
Tues.	4	1h Ψ Stationary; 8h ☿ in ♉		d4023
Wed.	5		17 56	42013
Thur.	6		17 50	4103*
Fri.	7			43012
Sat.	8		14 43	43120
Sun.	9		14 40	32401
Mon.	10			13042
Tues.	11	16h 1m ☌ ☿ ☾, ☿ 0° 37′ N.	11 34	01234
● Wed.	12	0h 6m N.M.; 3h 27m ☌ ♄ ☾, ♄ 3° 5′ N.	11 30	2034*
Thur.	13	4h ♁ Stationary; 14h ☌ ♄ ☉		12034
Fri.	14	15h ☿ in Aphelion		30124
Sat.	15	10h ♂ nearest ⊕, 54,343,200 miles 12h ☌ ☿ ♄, ☿ 2° 21′ S.; 16h 22m ☌ ♀ ☾, ♀ 2° 39′ N.	8 23 8 20	31204
Sun.	16			32014
Mon.	17		5 12	13024
Tues.	18	8h ☌ ☿ ☉, Superior	5 10	04123
◑ Wed.	19	22h 43m Moon F.Q.		42103
Thur.	20	5h 36m ☌ ♁ ☾, ♁ 4° 5′ N.	2 01	42103
Fri.	21	9h ☍ ♂ ☉; 21h 4m ☉ enters ♑, Winter commences	2 00	43012
Sat.	22	6h 19m ☌ ♃ ☾, ♃ 1° 28′ N	22 50	d4310
Sun.	23		22 50	43201
Mon.	24			41302
Tues.	25	8h □ ♁ ☉		40132
♋ Wed.	26	3h 30m ☌ ♂ ☾, ♂ 0° 55′ N.; 5h ♃ Stationary; 14h 55m F.M.	19 39 19 40	24103
Thur.	27			d2043
Fri.	28		16 28	dO24*
Sat.	29		16 20	31024
Sun.	30	8h 14m ☌ Ψ ☾, Ψ 4° 55′ S.		32014
Mon.	31		13 17	13024
Tues.	32		13 10	

Explanation of symbols and abbreviations on page 4.

PHENOMENA OF JUPITER'S SATELLITES, 1928

E—Eclipse, O—occultation, T—transit, S—shadow, D—disappearance, R—reappearance
I—ingress, e—egress. The Roman numerals denote the satellites.
75th Meridian Civil Time.

JANUARY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
0	17	58	II	OR	16	18	17	II	SI
	18	3	II	ED		18	27	II	Te
	20	35	II	ER		20	46	II	Se
	22	37	I	OD		21	3	I	OD
1	19	47	I	TI	17	18	14	I	TI
	20	38	III	OD		19	26	I	SI
	21	5	I	SI		20	28	I	Te
	22	0	I	Te		21	38	I	Se
2	20	38	I	ER	18	18	56	IV	TI
3	17	46	I	Se		18	57	I	ER
5	18	36	III	Se		21	18	IV	Te
7	18	2	II	OD	19	19	11	III	TI
	20	41	II	OR	23	18	36	II	TI
	20	41.4	II	ED		20	54	II	SI
8	21	45	I	TI		21	12	II	Te
9	18	10	II	Se	24	20	14	I	TI
	19	4	I	OD		21	22	I	SI
10	18	28	I	Te	25	20	52	I	ER
	19	42	I	Se	26	18	3	I	Se
12	17	48	III	Te	30	18	17	III	ED
	20	6	III	SI		20	48	III	ER
14	20	47	II	OD					

FEBRUARY

1	19	33	I	OD		19	43	I	SI
	20	28	II	ER	10	19	12	I	ER
2	18	59	I	Te	17	18	47	III	Se
	19	59	I	Se		18	54	II	Te
6	18	13	III	OD	18	18	20	I	Se
8	18	37	II	OD	24	19	9	II	TI
9	18	46	I	TI	25	19	35	I	Te

MARCH

3	19	23	I	TI	11	18	41	I	OD
4	19	25	I	ER					

MAY

17	4	8	I	SI	18	4	10	I	OR

JUNE

2	3	21	I	TI	21	3	26	II	SI
5	4	4	II	ED	22	2	52	III	ED
14	3	1	II	TI	23	3	16	II	OR
	3	11	II	Se	25	2	38	I	SI
15	3	19	III	OD		3	49	I	TI
17	3	22	I	ED	26	3	8	I	OR
18	2	54	I	Se	30	3	31	II	ER
19	4	0	I	Te		3	42	II	OD

JULY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
3	1	38	I	ED		4	9	I	TI
	2	14	III	TI	19	3	28	I	OR
	4	4	III	Te	20	0	46	I	Te
4	2	25	I	Te	21	0	40	III	OD
7	3	46	II	ED		2	22	III	OR
9	2	54	II	Te	23	3	11	II	SI
10	3	2	III	Se	25	0	34	II	ER
	3	33	I	ED		1	2	II	OD
11	2	13	I	TI		3	16	II	OR
	3	4	I	Se	26	1	49	I	ED
12	1	32	I	OR	27	0	33	I	TI
16	2	53	II	Se		1	20	I	Se
	3	21	II	TI		2	41	I	Te
18	0	39	II	OR	29	0	59	III	ER
	2	48	I	SI					

AUGUST

1	0	49	II	ED		2	38	II	Se
	3	8	II	ER		3	8	II	TI
	3	38	II	OD		4	52	I	SI
2	3	44	I	ED	18	2	0	I	ED
3	0	10	II	Te		23	20	I	SI
	1	4	I	SI	19	0	9	II	OR
	2	27	I	TI		0	40	I	TI
	3	13	I	Se		1	29	I	Se
	4	34	I	Te		2	47	I	Te
4	1	46	I	OR	20	0	00	I	OR
	2	57	III	ED	22	1	4	III	SI
8	0	23	III	Te		3	1	III	Se
	3	24	II	ED	24	2	57	II	SI
10	0	1	II	Se	25	3	55	I	ED
	0	35	II	TI	26	0	9	II	ER
	2	45	II	Te		0	27	II	OD
	2	58	I	SI		1	14	I	SI
10	4	20	I	TI		2	30	I	TI
11	0	6	I	ED		2	36	II	OR
	3	40	I	OR		3	23	I	Se
	23	35	I	Se		4	37	I	Te
12	0	55	I	Te		22	23	I	ED
14	23	1	III	Se	27	1	50	I	OR
15	2	50	III	TI		23	4	I	Te
	4	14	III	Te	29	5	4	III	SI
17	0	20	II	SI					

SEPTEMBER

2	0	15	III	OD	8	23	2	III	ED
	0	25	II	Ed	9	1	0	III	ER
	1	33	III	OR		3	0	II	ED
	2	43	II	ER		3	55	III	OD
	2	52	II	OD		5	1	I	SI
	3	7	I	SI		5	8	III	OR
	4	19	I	TI	10	2	12	I	ED
	5	1	II	OR		21	31	II	SI
3	0	18	I	ED		23	29	I	SI
	3	40	I	OR		23	49	II	Se
	21	36	I	SI		23	49	II	TI
	22	46	I	TI	11	0	34	I	TI
	23	31	II	Te		1	39	I	Se
	23	45	I	Se		1	56	II	Te
4	0	53	I	TI		2	41	I	Te
	22	7	I	OR		23	54	I	OR

SEPTEMBER—*Continued*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
12	21	8	I	Te	25	2	46	II	SI
16	3	3	III	ED		3	17	I	SI
	5	0	III	ER		4	7	I	TI
17	4	6	I	ED		4	33	II	TI
18	0	9	II	SI		5	4	II	Se
	1	23	I	SI		5	26	I	Se
	2	12	II	TI	26	0	30	I	ED
	2	21	I	TI		3	29	I	OR
	2	26	II	Se		21	8	III	SI
	3	32	I	Se		21	26	II	ED
	4	19	II	Te		21	45	I	SI
	4	28	I	Te		22	23	I	TI
	22	35	I	ED		23	2	III	Se
19	1	43	I	OR		23	55	I	Se
	20	47	I	TI	27	0	40	I	Te
	21	18	III	TI	27	0	46	III	TI
	22	1	I	Se		1	12	II	OR
	22	24	III	Te		1	49	III	Te
	22	54	I	Te		21	55	I	OR
	22	55	II	OR					

OCTOBER

2	5	11	I	SI		5	37	I	Se
	5	24	II	SI	19	0	42	I	ED
3	2	24	I	ED		3	8	I	OR
	5	14	I	OR		21	56	I	SI
	23	39	I	SI		22	11	I	TI
4	0	0	II	ED		23	58	II	SI
	0	18	I	TI	20	0	5	I	Se
	1	8	III	SI		0	18	I	Te
	1	49	I	Se		0	31	II	TI
	2	25	I	Te		2	16	II	Se
	3	28	II	OR		2	40	II	Te
	4	6	III	TI		19	12	I	ED
	5	10	III	Te		21	34	I	OR
	20	53	I	ED	21	18	28	II	ED
	23	40	I	OR		18	34	I	Se
5	20	0	II	TI		18	44	I	Te
	20	17	I	Se		21	3	II	OR
	20	51	I	Te		23	10	III	ED
	21	0	II	Se		1	27	III	OR
	22	7	II	Te	22	5	22	I	SI
10	4	19	I	ED	25	5	28	I	TI
11	1	33	I	SI		2	38	I	ED
	2	2	I	TI	26	4	52	I	OR
	2	36	II	ED		23	50	I	SI
	3	43	I	Se		23	54	I	TI
	4	9	I	Te		2	0	I	Se
	5	9	III	SI	27	2	2	I	Te
	5	43	II	OR		2	36	II	SI
	22	48	I	ED		2	46	II	TI
12	1	24	I	OR		4	54	II	Se
	20	2	I	SI		4	55	II	Te
	20	27	I	TI		21	6	I	ED
	21	20	II	SI		23	18	I	OR
	22	11	I	Se	28	18	19	I	SI
	22	16	II	TI		18	20	I	TI
	22	35	I	Te		20	28	I	Se
	23	38	II	Se		20	28	I	Te
13	0	24	II	Te		21	4	II	ED
	19	50	I	OR		23	20	II	ER
14	18	50	II	OR	29	3	12	III	ED
	19	9	III	ER		5	5	III	ER
	22	11	III	OR		17	46	I	ER
18	3	27	I	SI	30	18	3	II	Te
	3	45	I	TI		18	13	II	Se
	5	10	II	ED					

NOVEMBER

1	18	21	III	Te		3	54	I	Se
	19	5	III	Se		5	0	II	TI
2	4	27	I	OD	3	5	15	II	SI
3	1	37	I	TI		22	53	I	OD
	1	45	I	SI	4	1	13	I	ER
	3	45	I	Te		20	3	I	TI

NOVEMBER—*Continued*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
	20	13	I	SI	18	2	21	I	OD
	22	11	I	Te		23	31	I	TI
	22	23	I	Se	19	0	3	I	SI
5	23	19	II	OD		1	39	I	Te
	1	55	II	ER		2	12	I	Se
	19	41	I	ER		3	47	II	OD
6	18	8	II	TI		20	48	I	OD
	18	34	II	SI		23	32	I	ER
	20	18	II	Te	20	17	57	I	TI
	20	51	II	Se		18	32	I	SI
8	20	18	III	TI		20	6	I	Te
	21	15	III	SI	20	20	41	I	Se
	21	39	III	Te		22	40	II	TI
	23	6	III	Se		23	51	II	SI
10	3	21	I	TI	21	0	52	II	Te
	3	39	I	SI		2	7	II	Se
11	0	37	I	OD	22	18	1	I	ER
	3	8	I	ER		20	25	II	ER
	21	47	I	TI	23	2	50	III	TI
	22	8	I	SI	26	1	16	I	TI
	23	54	I	Te		1	58	I	SI
12	0	18	I	Se		3	25	I	Te
	1	32	II	OD		18	8	III	OR
	4	31	II	ER		19	20	III	ED
	19	3	I	OD		21	12	III	ER
	21	37	I	ER		22	33	I	OD
13	18	21	I	Te	27	1	27	I	ER
	18	46	I	Se		19	43	I	TI
	20	24	II	TI		20	27	I	SI
	21	12	II	SI		21	51	I	Te
	22	35	II	Te		22	36	I	Se
	23	29	II	Se	28	0	59	II	TI
15	17	49	II	ER		2	29	II	SI
	23	33	III	TI		3	12	II	Te
16	0	59	III	Te		19	56	I	ER
	1	16	III	SI	29	19	12	II	OD
	3	7	III	Se		23	1	II	ER

DECEMBER

1	18	4	II	Se		21	4	II	SI
3	3	3	I	TI		21	9	II	Te
	19	55	III	OD		23	20	II	Se
	21	37	III	OR	17	18	32	II	ER
	23	22	III	ED	19	1	6	I	TI
4	0	20	I	OD		2	13	I	SI
	1	14	III	ER		22	25	I	OD
	21	29	I	TI	20	1	43	I	ER
	22	22	I	SI		19	34	I	TI
	23	38	I	Te		20	41	I	SI
5	0	31	I	Se		21	43	I	Te
	18	47	I	OD		22	50	I	Se
	21	52	I	ER	21	18	34	III	Te
6	18	5	I	Te		20	12	I	ER
	19	0	I	Se		21	26	III	SI
	21	31	II	OD		23	14	III	Se
7	1	37	II	ER	22	21	20	II	TI
8	18	26	II	SI		23	36	II	Te
	18	44	II	Te		23	42	II	SI
	20	42	II	Se	23	1	57	II	Se
10	23	23	III	OD	24	17	47	II	OR
11	1	10	III	OR	24	17	53	II	ED
	2	8	I	OD		20	9	II	ER
	23	17	I	TI	27	0	15	I	OD
12	0	17	I	SI		21	24	I	TI
12	1	26	I	Te		22	37	I	SI
	2	26	I	Se		23	33	I	Te
	20	35	I	OD	28	0	46	I	Se
	23	48	I	ER		18	43	I	OD
13	17	44	I	TI		20	25	III	TI
	18	46	I	SI		22	8	I	ER
	19	53	I	Te		22	20	III	Te
	20	55	I	Se	29	1	28	III	SI
	23	52	II	OD		18	1	I	Te
14	17	24	III	SI		19	14	I	Se
	18	16	I	ER		23	49	II	TI
	19	13	III	Se	31	17	58	II	OD
15	18	54	II	TI					

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 Diameter 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	3009	0.0556	4.7(?)	0.055	88d
♀ Venus	0.723	67.2	224.70	0.62	7575	0.817	4.94	0.88	225d
⊕ Earth	1.000	92.9	365.26	1.00	7917.8	1.000	5.55	1.000	23h 56m 4s
♂ Mars	1.524	141.5	686.97	1.88	4216	0.108	3.92	0.151	24h 37m 23s
♃ Jupiter	5.203	483.3	4332.58	11.86	86728	318.4	1.32	1314	9h 55m ±
♄ Saturn	9.539	886.1	10759.2	29.46	72430	95.2	0.72	765	10h 14m ±
♅ Uranus	19.191	1782.8	30685.9	84.02	30878	14.6	1.22	59	10h 45m ±
♆ Neptune	30.071	2793.4	60187.6	164.79	32932	16.9	1.11	72	?
☉ Sun	....	....	....	....	864392	333400	1.39	1301100	25d 7h 48m±
☾ Moon	From ⊕238,857 mls.		27.32	0.075	2160	0.0123	3.39	0.020	27d 7h 43m 11.5s

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.
i 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 Leon Campbell, Harvard Observatory, Cambridge, Mass., 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 ncludes 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 obervations, 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 to which, from his measurements, he assigned a parallax of 0″.78. Its brightness is only 1/20,000 that of Alpha Centauri. 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″.53. 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.

The following list, prepared by Mr. J. A. Pearce, gives some of the latest values obtained.

Name	R.A. (1900) h	m	Decl. (1900) °	′	Vis. Mag. Harvard	Parallax ″	Distance Light Years
Prox. Cen	14	22.9	−62	15	10.5	0.78	4.08
* αCentauri	14	32.8	−60	25	0.33	.759	4.30
Barnard	17	52.9	+ 4	28	9.67	.533	6.12
Lal. 21185	10	57.9	+36	38	7.60	.403	8.09
* αCan. Maj	6	40.7	−16	35	−1.58	.376	8.67
Innes	11	12.0	−57	2	(12)	.339	9.62
C.Z. 5h 243	5	7.7	−44	59	8.3	.319	10.22
τCeti	1	39.4	−16	28	3.65	.318	10.25
* αCan. Min	7	34.1	+ 5	29	0.48	.312	10.45
ϵErid	3	28.2	− 9	48	3.81	.311	10.48
*61 Cygni	21	2.4	+38	15	5.57	.306	10.65
Lac. 9352	22	59.4	−36	26	7.44	.292	11.16
* Σ2398	18	41.8	+59	29	9.33	.287	11.36
ϵIndi	21	55.7	−57	12	4.74	.284	11.48
* Groom. 34	0	12.5	+43	27	7.98	.281	11.60
* Krüger 60	22	24.5	+57	12	9.64	.262	12.44
Lac. 8760	21	11.4	−39	15	6.65	.251	12.99
Oe. Arg. 17415-6	17	37.0	+68	26	9.2	.247	13.20
Van Maanen	0	43.9	+ 4	55	12.3	.246	13.25
Gould 32416	23	59.5	−37	51	8.5	.203	15.87
αAquilae	19	45.9	+ 8	36	0.89	.200	16.30
O^2 Erid	4	10.7	− 7	49	4.48	.198	16.5
*70 Oph	18	10.4	+ 2	31	4.28	.192	17.0
Cordoba 32416	23	59.5	−37	51	8.3	.191	17.1
+HR 7703	20	4.6	−36	21	5.34	.190	17.2
* ηCassiop	0	43.0	+57	17	3.64	.184	17.7
Alb. 8164	23	44.0	+ 1	52	8.7	.183	17.8
σDrac	19	32.6	+69	29	4.78	.182	17.9
HR 8832	23	8.5	+56	37	5.65	.177	18.4
* HR 6416	17	11.5	−46	32	5.58	.175	18.6
* A Oph	17	9.2	−26	27	5.29	.174	18.7
* HR 6426	17	12.1	−34	53	5.89	.170	19.2
*e*Erid	3	15.9	−43	27	4.30	.152	21.5
* ξUrs. Maj	11	12.9	+32	6	4.41	.150	21.7
δErid	3	38.5	−10	6	3.72	.142	23.0
* αLyrae	18	33.6	+38	41	0.14	.134	24.3
βHydri	0	20.5	−77	49	2.90	.133	24.5
αPis. Aus	22	52.1	−30	9	1.29	.128	25.5
χDrac	18	22.9	+72	41	3.69	.127	25.7
* ζHerc	16	37.5	+31	47	3.00	.116	28.1
* μHerc	17	42.5	+27	47	3.48	.116	28.1
βLeonis	11	44.0	+15	8	2.23	.109	29.9
αBootis	14	11.1	+19	42	0.24	.105	31.1
βVirg	11	45.5	+ 2	20	3.80	.105	31.1
βCan. Ven	12	29.0	+41	54	4.32	.104	31.4
* 85 Peg	23	56.8	+26	34	5.85	.101	32.3
βGemin	7	39.2	+28	16	1.21	.095	34.3
αTauri	4	30.2	+16	18	1.06	.064	50.9
αAurigae	5	9.3	+45	54	0.21	.063	51.8
αLeonis	10	3.0	+12	27	1.34	.045	72.5
αErid	1	34.0	−57	45	0.60	.041	79.5
* αUrs. Min	1	22.6	+88	46	2.12	.041	79.5
βCentauri	13	56.8	−59	53	0.86	.027	120.7
αOrionis	5	49.8	+ 7	23	0.92	.022	148.2
αScorp	16	23.3	−26	13	1.22	.019	171.6
αCygni	20	38.0	+44	35	1.33	.012	271.7
αCarinae	6	21.7	−52	38	−0.86	.007	465.7

*Double or multiple star; magnitude of brighter component given.

THE BRIGHTEST STARS

Their Magnitudes, Types, Proper Motions, Distances and Radial Velocities

Prepared by W. E. HARPER

The accompanying table contains the chief known facts regarding 260 stars brighter than apparent magnitude 3.51 as listed in *Harvard Annals*, Volume 50. The position of the star for 1900 is given in the second and third columns. The fourth and fifth columns give the apparent visual magnitude and type taken from the same publication. In a few cases the type is changed to conform with a later determination.

The parallaxes are taken from Schlesinger's Advance Copy of Catalogue of Parallaxes, 1924 Edition, and for such stars the proper motions are copied from the same source. The remaining proper motions were computed using the abbreviated μ_α and μ_δ as they appeared in the HANDBOOK for 1915, where this table first appeared, and are not necessarily correct to the third decimal place. Three or four spectroscopic parallaxes have been added to those given in Schlesinger's catalogue. The small letter *s* following the parallax indicates a spectroscopic determination has also been made. The distance is also given in light years in the eighth column as to the lay mind that seems a fitting unit. The real parallax of a star cannot be a negative quantity, but in some cases the result of the calculation gives a negative quantity. In each such case the distance in light years is computed on the assumption that the parallax is positive and equal to $''.001$. The sign (:) after it indicates that the value is uncertain. The absolute magnitude or the magnitude the star would appear to have if it were at a distance of 32.6 light years is given in the ninth column. At that distance the sun would appear as a star of magnitude 5.5. The radial velocity, taken from Voûte's list supplemented from our observatory card catalogue, is given in the last column. Those starred indicate that the star is a spectroscopic binary for which the velocity of the system is given. Where only the whole number appears the velocity may be regarded as approximate. There are 74 starred out of 235 radial velocities set down or one in three of the bright stars is a spectroscopic binary. The sign || denotes a visual double and the combined magnitude is given.

The 20 first magnitude stars are printed in black face type.

NOTE.—Some of the parallaxes in this table differ slightly from those given in the previous table. The reader should be not surprised at this, and it has not been thought worth while to harmonize the two tables.—EDITOR.

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
α Andromedae	0 3	+28 32	2.2	Aop	.207	.....	.....	.....	−13.0*
β Cassiopeiae	4	+58 36	2.4	F5	.561	.071 s	46	1.7	+12.8
γ Pegasi	8	+14 38	2.9	B2	.010	.....	.....	.....	+ 7. *
β Hydri	20	−77 49	2.9	G0	2.243	.141	23	3.6	+22.2
α Phoenicis	21	−42 51	2.4	K0	.446	.....	.....	.....	+75.8*
δ Andromedae	34	+30 19	3.5	K2	.167	.026 s	125	0.6	− 5. *
α Cassiopeiae	35	+55 59	2.2–2.8	K0	.062	.016 s	204	−1.8	− 3.0
β Ceti	39	−18 32	2.2	K0	.230	.042 s	78	0.3	+13.5
||γ Cassiopeiae	51	+60 11	2.2	B0p	.031	.036	91	0.0	− 4.7
β Phoenicis	1 2	−47 15	3.4	K0	.042	.....	.....	.....	− 0.6
β Andromedae	4	+35 5	2.4	M0	.219	.045 s	72	0.7	− 2.
δ Cassiopeiae	19	+59 43	2.8	A5	.306	.....	.....	.....	+ 9.
||α Ursae Minoris	23	+88 46	2.1	F8	.043	.007 s	466	−3.7	−14.8*
γ Phoenicis	24	−43 50	3.4	K5	.222	.....	.....	.....	+26. *
α **Eridani**	34	−57 44	0.6	B5	.093	.049 s	67	−1.0	
ϵ Cassiopeiae	47	+63 11	3.4	B3	.043	.001 s	3260	−6.6	− 7.4
β Arietis	49	+20 19	2.7	A5	.150	.064 s	51	1.7	− 0.6*
α Hydri	56	−62 3	3.0	F0	.256	.....	.....	.....	− 5.
||γ Andromedae	58	+41 51	2.3	K0	.073	.007 s	466	−3.5	−10.9
α Arietis	2 2	+22 59	2.2	K2	.242	.033 s	99	−0.2	−14.3
β Trianguli	4	+34 31	3.1	A5	.161	.014	262	−1.2	.....*
o Ceti	14	− 3 26	1.7–9.6	M6e	.239	.062	53	0.7	+63.9
||θ Eridani	54	−40 42	3.4	A2	.071	.....	.....	.....	+20.
α Ceti	57	+ 3 42	2.8	M1	.080	.011 s	296	−2.0	−25.8
γ Persei	58	+53 7	3.1	Gp	.012	.012 s	272	−1.5	+ 2. *
ρ Persei	59	+38 27	3.4–4.2	M6	.176	.038 s	86	1.3	+28.6
β Persei	3 2	+40 34	2.1–3.2	B8	.011	.....	.....	.....	+ 5. *
α Persei	17	+49 30	1.9	F5	.041	.015 s	217	−2.2	− 2.4
δ Persei	36	+47 28	3.1	B5	.047	.005 s	652	−3.4	+ 0.7
||η Tauri	41	+23 48	3.0	B5p	.053	.007 s	466	−2.8	+15.
ζ Persei	48	+31 55	2.9	B1	.023	− .003 s	3260 :	−7.1	+21.2
γ Hydri	49	−74 33	3.2	Ma	.128	.....	.....	.....	+16.8
||ϵ Persei	51	+39 43	3.0	B1	.041	− .012 s	3260 :	−7.0	.....*
γ Eridani	53	−13 47	3.2	K5	.133	.018 s	181	−0.5	+62.2
λ Tauri	55	+12 12	3.3–4.2	B3	.015	− .008	3260 :	−6.7	+13.6*
α Reticuli	4 13	−62 43	3.4	G5	.069	.....	.....	.....	+35.4

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Pax		Rg.	
	h m	°							
α **Tauri**	4 30	+16 18	1.1	K5	.205	.057 s	57		
α Doradus	32	−55 15	3.5	A0p	.003	.....	.....		
π^3 Orionis	44	+ 6 47	3.3	F8	.474	.136 s	24	4.0	
ι Aurigae	50	+33 0	2.9	K2	.030	.018 s	181	−0.8	+
ε Aurigae	55	+43 41	3.4–4.1	F5p	.015	.002 s	1630	−5.0	−
η Aurigae	5 0	+41 6	3.3	B3	.082	.014 s	233	−1.0	+ 3.0
ε Leporis	1	−22 30	3.3		.074	.022 s	148	0.0	+ 1.1
β Eridani	3	− 5 13	2.9		.17	.052 s	63	1.5	− 8.
μ Leporis	8	−16	3.3		3	.....	.....	.....	+28.0
‖α **Aurigae**	9	+45	0.2		59	.075 s	43	−0.4	+30.2*
‖β **Orionis**	10	− 8 19	0.3	B8p	.005	.006	543	−5.8	+22.6*
‖η Orionis	19	− 2 29	3.4	B1	.000	.....	.....	.....	+35.5*
γ Orionis	20	+ 6 16	1.7	B2	.019	.019 s	172	−1.9	+19.
β Tauri	20	+28 31	1.8	B8	.180	.024 s	136	−1.3	+11.
β Leporis	24	−20 50	3.0	G0	.095	.004 s	815	−4.0	−13.7
‖δ Orionis	27	− 0		B0	.006	.009 s	362	−2.8	+17.6*
α Leporis	28	−17 54	2.7	F		.014 s	233	−1.6	+24.6
‖ι Orionis	31	− 5 59	2.9			.....	.....	.....	+21.3*
ε Orionis	31	− 1 16	1.7			.005 s	652	−3.7	+26.3
ζ Tauri	32	5	3.0			.001 s	3260 :	−7.2	+16.4*
‖ζ Orionis	36	− 2	1.8			− .019 s	3260 :	−8.2	+17.9
α Columbae	36	−34	2.8	B5p	.040	.....	.....	.....	.....
κ Orionis	43	− 9 42	2.2	B0	.009	.029 s	112	2.5	+19.
β Columbae	47	−35 48	3.2	K0	.397	.....	.....	.....	+89.2
α **Orionis**	50	+ 7 23	1.0–1.4	M1	.032	.017 s	192	−2.8	+21.3*
β Aurigae	52	+44 56	2.1	A0p	.046	.034 s	96	−0.2	−19. *
‖θ Aurigae	53	+37 12	2.7	A0p	.106	.016 s	204	−1.3	+28.5
η Geminorum	6 9	+22 32	3.2–4.2	M2	.062	.014 s	233	−1.1	+20. *
μ Geminorum	17	+22 34	3.2	M3	.129	.016 s	204	−0.8	+55.2
β Can. Majoris	18	−17 54	2.0	B1	.003	.012 s	272	−2.6	+33. *
α **Carinae**	22	−52 38	−0.9	F0	.022	.005 s	652	−7.4	+20.2
γ Geminorum	32	+16 29	1.9	A0	.066	.043 s	76	0.1	−12.3*
ν Puppis	35	−43 6	3.2	B8	.020	.....	.....	.....	+26.0*
ε Geminorum	38	+25 14	3.2	G5	.020	.007 s	466	−2.6	+ 9.5
ξ Geminorum	40	+13 0	3.4	F5	.230	.048 s	68	1.8	+26.7
‖α **Can. Majoris**	41	−16 35	−1.6	A0	1.315	.371 s	9	1.2	− 7.4*
α Pictoris	47	−61 50	3.3	A5	.271	.....	.....	.....	.....
τ Puppis	47	−50 30	2.8	K0	.094	.....	.....	.....	+37. *

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel
	h m	° ′			″	″			km./sec.
‖ε Can. Majoris	6 55	−28 50	1.6	B1	.000	.....	.....	.....	+28.2
ζ Geminorum	58	20 43	3.7–4.3	G0p	.007	.005 s	652	−2.8	+ 6.8*
o^2 Can. Majoris	59	−23 41	3.1	B5p	.000	.....	.....	.....	.....
δ Can. Majoris	7 4	−26 14	2.0	G2p	.005	.010	326	−2.9	+34. *
L ^{2}Puppis	10	−44 29	3.4–6.2	Md	.334	.....	.....	.....	+52.6
π Puppis	14	−36 55	2.7	K5	.012	.....	.....	.....	+16.3
β Can. Minoris	22	+ 8 29	3.1	B8	.063	.020 s	163	−0.4	.....
σ Puppis	26	−43 6	3.3	K5	.192	.....	.....	.....	+87.3
‖α_2 Geminorum	28	+32 6	2.0	A0	.201	.077 s	42	1.4	+ 6.2*
α_1 Geminorum	28	+32 6	2.8	A0	.209	.....	.....	.....	− 1.0*
α **Can. Minoris**	34	+ 5 29	0.5	F5	1.242	.312 s	10	3.0	− 4.3
β **Geminorum**	39	+28 16	1.2	K0	.623	.101 s	32	1.2	+ 3.6
ξ Puppis	45	−24 37	3.5	G6p	.007	.003 s	1087	−4.2	+ 4.2
ζ Puppis	8 0	−39 43	2.3	Od	.036	.....	.....	.....	.....
ρ Puppis	3	−24 1	2.9	F5	.097	.028 s	116	0.1	+46.
‖γ Velorum	6	−47 3	2.2	Oap	.000	.....	.....	.....	.....
‖ε Carinae	8 20	−59 11	1.7	K0	.032	.....	.....	.....	+11.7
o Urs. Majoris	22	+61 3	3.5	G0	.166	−.004 s	3260:	−6.5	+20.3
‖ε Hydrae	41	+ 6 47	3.5	F8	.193	.015 s	217	−0.6	+37.2*
δ Velorum	42	−54 20	2.0	A0	.093	.....	.....	.....	.....
ζ Hydrae	50	+ 6 20	3.3	K0	.101	.014 s	233	−1.0	+23.0
ι Urs. Majoris	52	+48 26	3.1	A5	.500	.070 s	47	2.3	+ 8.
λ Velorum	9 4	−43 2	2.2	K5	.022	.....	.....	.....	+18.8
β Carinae	12	−69 18	1.8	A0	.192	.....	.....	.....	−16.0
ι Carinae	14	−58 51	2.2	F0	.023	.....	.....	.....	+13.1
α Lyncis	15	+34 49	3.3	K5	.214	.002 s	1630	−5.1	+38.5
κ Velorum	19	−54 35	2.6	B3	.017	.....	.....	.....	+21.9*
α Hydrae	23	− 8 14	2.2	K2	.036	.006 s	543	−3.9	− 4.0
θ Urs. Majoris	26	+52 8	3.3	F8p	1.096	.056 s	58	2.0	+15.8
N Velorum	28	−56 36	3.0	K5	.041	.....	.....	.....	−13.9
ε Leonis	40	+24 14	3.1	G0p	.045	−.001 s	3260:	−6.9	+ 5.1
‖υ Carinae	45	−64 36	3.1	F0	.062	.....	.....	.....	+13.2
α **Leonis**	10 3	+12 27	1.3	B8	.244	.058 s	56	0.1	.....
q Carinae	14	−60 50	3.4	K5	.045	.....	.....	.....	+ 9.2
‖γ Leonis	14	+20 21	2.3	K0	.347	.004 s	815	−4.7	−36.
μ Urs. Majoris	16	+42 0	3.2	K5	.082	.034 s	96	0.9	−22.

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
θ Carinae	10 39	−63 52	3.0	B0	.063	.....	.....	.....	+16.
η Carinae	41	−59 10	1.0–7.4	Pec	.000	.....	.....	.....	.....
μ Velorum	42	−48 54	2.8	G5	.084	.....	.....	.....	+ 7.1
ν Hydrae	45	−15 40	3.3	K0	.214	.035 s	93	1.0	− 0.7
β Urs. Majoris	56	+56 55	2.4	A0	.089	.047 s	69	0.8	−10.9*
α Urs. Majoris	58	+62 17	2.0	G5	.137	.074 s	44	1.4	− 8.
ψ Urs. Majoris	11 4	+45 2	3.2	K0	.067	.049 s	67	1.6	− 3.4
δ Leonis	9	+21 4	2.6	A3	.208	.078 s	42	2.1	−18.
θ Leonis	9	+15 59	3.4	A0	.103	.019 s	172	−0.2	+ 6.8
λ Centauri	31	−62 28	3.3	B9	.046	.....	.....	.....	+11.
β Leonis	44	+15 8	2.2	A2	.507	.101 s	32	2.2	+ 1.3
γ Urs. Majoris	49	+54 15	2.5	A0	.095	.004 s	815	−4.5	−10.0
δ Centauri	12 3	−50 10	2.9	B3p	.044	.....	.....	.....	.....
ε Corvi	5	−22 4	3.2	K0	.063	.025 s	130	0.2	+ 5.2
δ Crucis	10	−58 12	3.1	B3	.051	.....	.....	.....	+25.
δ Urs. Majoris	10	+57 35	3.4	A2	.113	.045 s	72	1.7	−10.7
γ Corvi	11	−16 59	2.8	B8	.159	.....	.....	.....	− 7. *
α **Crucis**	21	−62 33	1.0	B1	.048	.030	109	−1.6	+19.
‖δ Corvi	25	−15 58	3.1	A0	.249	.010 s	326	−1.9	−53.5
γ Crucis	26	−56 33	1.5	M6	.270	.....	.....	.....	+21.5
β Corvi	29	−22 51	2.8	G5	.061	.028	116	0.0	− 7.4
α Muscae	31	−68 35	2.9	B3	.038	.....	.....	.....	+13.5
γ Centauri	36	−48 24	2.4	A0	.200	.....	.....	.....	− 9.
γ Virginis	36	− 0 54	2.9	F0	.561	.073 s	45	2.2	−20.0
β Muscae	40	−67 34	3.3	B3	.041	.....	.....	.....	+35. *
β Crucis	42	−59 9	1.5	B1	.054	.008 s	408	−4.0	+13.
ε Urs. Majoris	50	+56 30	1.7	A0p	.117	.042	78	−0.2	−11.9*
‖α Can. Venat.	51	+38 51	2.8	A0p	.233	.015 s	217	−1.3	+ 1.0*
ε Virginis	57	+11 30	3.0	K0	.270	.048 s	68	1.4	−13.6
γ Hydrae	13 13	−22 39	3.3	G5	.085	.017 s	192	−0.5	− 5.1
ι Centauri	15	−36 11	2.9	A2	.111	.....	.....	.....	+ 2.0
‖ζ Urs. Majoris	20	+55 27	2.4	A2p	.131	.038 s	86	0.3	− 9.6*
α **Virginis**	20	−10 38	1.2	B2	.051	.009 s	362	−4.0	+ 1.6*
ζ Virginis	30	− 0 5	3.4	A2	.285	.038	86	1.3	.....
ε Centauri	34	−52 57	2.6	B1	.091	.....	.....	.....	+ 6.
η Urs. Majoris	44	+49 49	1.9	B3	.116	− .004 s	3260 :	−8.1	− 6.
μ Centauri	44	−41 59	3.3	B2p	.030	.....	.....	.....	+12.6

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
ζ Centauri	13 49	−46 48	3.1	B2p	.079	.....	.....	.....	.....
η Boötis	50	+18 54	2.8	G0	.370	.098 s	33	2.8	− 0.2*
β **Centauri**	57	−59 53	0.9	B1	.039	.036	91	−1.3	+12.0*
π Hydrae	14 1	−26 12	3.5	K0	.165	.....	.....	.....	+27.6
θ Centauri	1	−35 53	2.3	K0	.748	.....	.....	.....	+ 1.8
α **Boötis**	11	+19 42	0.2	K0	2.287	.080 s	41	−0.3	−5 .0
γ Boötis	28	+38 45	3.0	F0	.182	.058 s	56	1.8	−35.
η Centauri	29	−41 43	2.6	B3p	.052	.....	.....	.....	0.
‖α **Centauri**	33	−60 25	0.3	G0	3.682	.758	4	4.7	+22.2
α Circini	34	−64 32	3.4	F0	.312	.....	.....	.....	+ 7.3
α Lupi	35	−46 58	2.9	B2	.036	.....	.....	.....	+ 8. *
‖ε Boötis	41	+27 30	2.7	K0	.045	.016 s	204	−1.3	−16.4
‖α² Librae	45	−15 38	2.9	K2	.129	.....	.....	.....	−17. *
β Urs. Minoris	51	+74 34	2.2	K5	.028	.011 s	296	−2.6	+17.0
β Lupi	52	−42 44	2.8	B2p	.066	.....	.....	.....	0. *
κ Centauri	53	−41 42	3.4	B3	.037	.....	.....	.....	+10. *
σ Librae	58	−24 53	3.4	M6	.094	.029 s	112	0.7	− 4.2
ζ Lupi	15 5	−51 43	3.5	K0	.132	.....	.....	.....	− 9.2
γT Australis	10	−68 19	3.1	A0	.064	.....	.....	.....	.....
β Librae	12	− 9 1	2.7	B8	.108	.....	.....	.....	−38. *
δ Lupi	15	−40 17	3.4	B2	.032	.....	.....	.....	.....
γ Urs. Minoris	21	+72 11	3.1	A2	.017	.....	.....	.....	− 8.
ι Draconis	23	+59 19	3.5	K0	.010	.034 s	96	1.2	−10.2
γ Lupi	28	−40 50	3.0	B3	.042	.....	.....	.....	.....
α Cor. Borealis	30	+27 3	2.3	A0	.160	.053 s	62	0.9	+ 0.4*
α Serpentis	39	+ 6 44	2.8	K0	.142	.046 s	71	1.1	+ 3.3
βT Australis	46	−63 7	3.0	F0	.440	.....	.....	.....	.....
π Scorpii	53	−25 50	3.0	B2p	.042	.....	.....	.....	*
δ Scorpii	54	−22 20	2.5	B0	.042	.....	.....	.....	*
‖β Scorpii	16 0	−19 32	2.8	B1	.041	.....	.....	.....	− 9.5*
δ Ophiuchi	9	− 3 26	3.0	K8	.159	.040 s	82	1.0	−19.0
ε Ophiuch	13	− 4 27	3.3	K0	.088	.046 s	71	1.6	− 9.2
‖σ Scorpii	15	−25 21	3.1	B1	.033	.....	.....	.....	+ 2.0*
‖η Draconis	23	+61 44	2.9	G5	.062	.042 s	78	1.0	−13.9
‖α **Scorpii**	23	−26 12	1.2	M2p	.032	.026 s	126	−1.7	− 3.1*
β Herculis	26	+21 42	2.8	K0	.104	.030 s	109	0.2	−25.5*
τ Scorpii	30	−28 1	2.9	B0	.042	.....	.....	.....	+ 1.5

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
ζ Ophiuchi	16 32	−10 22	2.7	B0	.024	.....	.....	.....	−15.0
||ζ Herculis	38	+31 47	3.0	G0	.601	.111 s	29	3.2	−70. *
α T Australis	38	−68 51	1.9	K2	.034	.....	.....	.....	− 3.7
ϵ Scorpii	44	−34 7	2.4	K0	.668	.....	.....	.....	− 2.0
μ^1 Scorpii	45	−37 53	3.1	B3p	.032	.....	.....	.....	.....
ζ Arae	50	−55 50	3.1	Ma	.047	.....	.....	.....	− 6.1
κ Ophiuchi	53	+ 9 32	3.4	K0	.296	.208 s	116	0.6	−55.3
||η Ophiuchi	17 5	−15 36	2.6	A0	.094	.....	.....	.....	− 1.1
η Scorpii	5	−43 6	3.4	F2	.291	.....	.....	.....	−28.
ζ Draconis	8	+65 50	3.2	B5	.023	.019 s	172	−0.4	−14.6
||α Herculis	10	+14 30	3.1–3.9	M7	.030	−.002 s	3260:	−6.9	−32.4
δ Herculis	11	+24 57	3.2	A2	.164	.029 s	112	0.5	−42. *
π Herculis	12	+36 55	3.4	K2	.021	.019 s	172	−0.2	−25.1
θ Ophiuchi	16	−24 54	3.4	B3	.030	.....	.....	.....	− 0.9
β Arae	17	−55 26	2.8	K2	.035	.....	.....	.....	− 1.0
υ Scorpii	24	−37 13	2.8	B3	.040	.....	.....	.....	.....
α Arae	24	−49 48	3.0	B3p	.085	.....	.....	.....	.....
λ Scorpii	27	−37 2	1.7	B2	.040	.....	.....	.....	− 1. *
β Draconis	28	+52 23	3.0	G0	.012	.004 s	815	−4.0	−19.7
θ Scorpii	30	−42 56	2.0	F0	.010	.....	.....	.....	+ 5.
α Ophiuchi	30	+12 38	2.1	A5	.264	.049 s	67	0.5	.....
κ Scorpii	36	−38 58	2.5	B2	.032	.....	.....	.....	.....
β Ophiuchi	39	+ 4 37	2.9	K0	.157	.024 s	136	−0.2	−11.5
ι^1 Scorpii	41	−40 5	3.1	F5p	.000	.....	.....	.....	−27.8
||μ Herculis	43	+27 47	3.5	G5	.817	.111 s	29	3.7	−15.7
G Scorpii	43	−37 1	3.2	K2	.062	.....	.....	.....	+24.7
ν Ophiuchi	54	− 9 46	3.5	K0	.118	.026 s	126	0.6	+12.6
γ Draconis	54	+51 30	2.4	K5	.026	.017 s	192	−1.4	−27.0
γ Sagittarii	59	−30 26	3.1	K0	.206	.....	.....	.....	+22. *
η Sagittarii	18 11	−36 48	3.2	M6	.223	.....	.....	.....	0.0
δ Sagittarii	15	−29 52	2.8	K0	.042	.....	.....	.....	−20.2
η Serpentis	16	− 2 55	3.4	K0	.898	.065 s	50	2.5	+ 9.5
ϵ Sagittarii	18	−34 26	2.0	A0	.139	.....	.....	.....	−11.0
λ Sagittarii	22	−25 29	2.9	K0	.197	.....	.....	.....	−43.2
||α **Lyrae**	34	+38 41	0.1	A0	.348	.124 s	26	0.6	−13.8
φ Sagittarii	39	−27 6	3.3	B8	.053	.....	.....	....	+26. *
||β Lyrae	46	+33 15	3.4–4.1	B2p	.011	−.014 s	3260:	−6.6	*
σ **Sagittarii**	49	−26 25	2.1	B3	.081	.....	.....	.....	− 1.

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
γ Lyrae	18 55	+32 33	3.3	A0	.010	.....	.....	.....	−20. *
||ζ Sagittarii	56	−30 1	2.7	A2	.026	.....	.....	.....	+22.
τ Sagittarii	19 1	−27 49	3.4	K0	.265	.....	.....	.....	+42. *
ζ Aquilae	1	+13 43	3.0	A0	.103	.040 s	82	1.0	−38.6
π Sagittarii	4	−21 11	3.0	F2	.041	.016 s	204	−1.0	−10.3
δ Draconis	13	+67 29	3.2	K0	.135	.038 s	86	1.1	+25.1
δ Aquilae	21	+ 2 55	3.4	F0	.267	.057 s	57	2.2	−32. *
||β Cygni	27	+27 45	3.2	K0p	.010	.003 s	1087	−4.4	−23. *
γ Aquilae	42	+10 22	2.8	K2	.018	.018 s	181	−0.9	− 2.1
||δ Cygni	42	+44 53	3.0	A0	.067	.038 s	86	0.9	−37.
α **Aquilae**	46	+ 8 36	0.9	A5	.659	.204 s	16	2.4	−33.
θ Aquilae	20 6	− 1 7	3.4	A0	.035	.015 s	217	−0.7	−29.2*
||β Capricorni	15	−15 6	3.2	G0p	.042	.005 s	652	−3.3	−18.8*
α Pavonis	18	−57 3	2.1	B3	.090	.....	.....	.....	+ 2.0*
γ Cygni	19	+39 56	2.3	F8p	.006	−.002 s	3260 :	−7.7	− 5.6
α Indi	31	−47 38	3.2	K0	.072	.....	.....	.....	− 0.8
α **Cygni**	38	+44 55	1.3	A2p	.004	.005	652	−5.2	− 4.
ε Cygni	42	+33 36	2.6	K0	.485	.041 s	80	0.7	−10. *
ζ Cygni	21 9	+29 49	3.4	K0	.061	.024 s	136	0.3	+17. *
α Cephei	16	+62 10	2.6	A5	.163	.083 s	39	2.2	−30.7
β Aquarii	26	− 6 1	3.1	G0	.020	−.003 s	3260	−6.9	+ 6.4
β Cephei	27	+70 7	3.3	B1	.013	.007 s	466	−2.5	−14.1*
ε Pegasi	39	+ 9 25	2.5	K0	.028	.002 s	1630	−5.9	+ 5.3
δ Capricorni	42	−16 35	3.0	A5	.395	.114 s	29	3.3	*
γ Gruis	48	−37 5(	3.2	A0	.108	.....	.....	.....	− 3.
α Aquarii	22 1	− 0 48	3.2	G0	.009	.009 s	362	−2.0	+ 7.1
α Gruis	2	−47 27	2.2	B5	.200				
α Tucanae	12	−60 45	2.9	K2	.085	.....	.....	.....	+41.
β Gruis	37	−47 24	2.2	M6	.122	.....	.....	.....	+ 1.2
η Pegasi	38	+29 42	3.1	G0	.039	−.001 s	3260 :	−6.9	+ 4.3*
α **P. Australis**	52	−30 9	1.3	A3	.367	.137	24	2.0	+ 6.7
β Pegasi	59	+27 32	2.6	M3	.235	.016 s	204	−1.4	+ 8.6
α Pegasi	59	+14 40	2.6	A0	.077	.038 s	86	0.5	+ 4. *
γ Cephei	23 35	+77 4	3.4	K1	.167	.069 s	47	2.6	−41.6

ASTRONOMICAL CONSTANTS

Solar Parallax, 8″.80

Mass of the sun, 1.983×10^{33} grams = 332000 times the mass of the earth

Temperature of the sun's surface, 5740° C.

Solar Constant, 1.925 calories per sq. cm. per min.

Obliquity of the ecliptic, 23° 27′ 8″.26 − 0.4684 $(t-1900)$

Mean Distance Earth to Sun, 149,504,201 km. = 92,897,416 statute miles

Mean Distance Earth to Moon, 384,403 km. = 238,857 statute miles

Equatorial Horizontal Parallax of Moon, 57′ 2″.70

Gaussian constant of gravitation, $\kappa = .017202099$

Newtonian constant of gravitation, $\kappa = 6.658\times10^{-8}$ c.g.s.

Acceleration in one second due to gravity, $g = 9.8060$ meters $- .0260 \cos 2\phi - \frac{2h}{R}g$

i

Reduction from geographic latitude ϕ to geocentric latitude ϕ',

$$\phi' - \phi = -11' 35''.66 \sin 2\phi + 1''.17 \sin 4\phi.$$

Dimensions of the earth:

Equatorial radius, $a = 6378.388$ km. = 3963.34 statute miles

Polar radius, $b = 6356.909$ km. = 3949.99 statute miles

Mass of the earth, 5.974×10^{27} grams

Density of the earth, 5.515 grams per cubic cm.

Velocity of light, 299,796 km. or 186,285 miles per sec.

Length of the year:

Tropical	$365^d.24219879 - 0000000614$	$(t-1900)$
Sidereal	$365\ .25636042 + 000000011$	$(t-1900)$
Anomalistic	$365\ .25964134 + 0000000304$	$(t-1900)$
Eclipse	$346\ .620031\ + 00000032$	$(t-1900)$

Length of the day:

Sidereal	$23^h56^m\ 4^s.091$ of mean solar time
Mean Solar	$24\ \ 3\ \ 56\ .555$ of sidereal time

Length of the month:

Synodical	$29^d.530588 = 29^d\,12^h44^m\ 2^s.8$
Tropical	$27\ .321582 = 27\ \ 7\ 43\ \ 4\ .7$
Sidereal	$27\ .321661 = 27\ \ 7\ 43\ 11\ .5$
Anomalistic	$27\ .554550 = 27\ 13\ 18\ 33\ .1$
Nodical	$27\ .212220 = 27\ \ 5\ \ 5\ 35\ .8$

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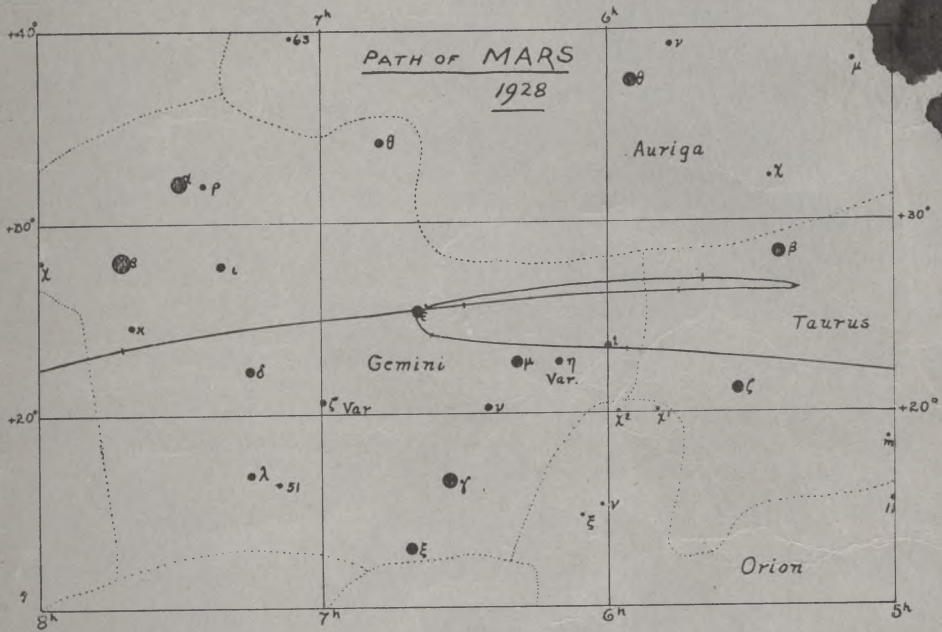

PATH OF MARS AMONG THE STARS FROM SEPT. 5, 1928 to MAY 9, 1929

The planet enters the map (R.A.5h) on Sept. 5, 1928 and it leaves the map (R.A.8h) on May 9, 1929. Its position is shown on the first of each month between these dates. Oct. 1, just within Gemini; Nov. 1, just above "n" in Gemini; Dec. 1, near Epsilon; Jan. 1, 1929, in Taurus, on upper portion of curve; Feb. 1, at stationary point; Mar. 1, approaching boundary of Gemini; April 1, on lower portion of curve in R.A.6½h; May 1, near west boundary of Gemini.

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