THE OBSERVER'S HANDBOOK FOR 1931

PUBLISHED BY

The Royal Astronomical Society of Canada

EDITED BY C. A. CHANT

TWENTY-THIRD YEAR OF PUBLICATION

TORONTO
198 COLLEGE STREET
PRINTED FOR THE SOCIETY
1931

1931 CALENDAR 1931

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

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

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

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CONTENTS

PREFACE

In the present issue of the HANDBOOK there is a much fuller list of stars occulted by the moon than any given heretofore. These have been computed for Ottawa and Toronto, and it is very desirable that they be used by a considerable number of observers in central Ontario and Quebec. Calculations will be supplied for the western parts of Canada if observers can be found to use them.

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 Miss M. S. Burland, Mr. R. M. Motherwell and Dr. R. J. McDiarmid, of the Dominion Observatory, Ottawa; Mr. J. H. Horning and Mr. W. S. Armstrong, of Toronto; 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, 1930. THE EDITOR.

ANNIVERSARIES AND FESTIVALS, 1931

New Year's Day	Thur.,	Jan. 1
Epiphany	Tues.,	Jan. 6
Septuagesima Sunday		Feb. 1
Quinquagesima (Shrove Sunday)		Feb. 15
Ash Wednesday		Feb. 18
Quadragesima (First Sunday in Lent)		Feb. 22
St. David	Sun.,	Mar. 1
St. Patrick	Tues.,	Mar. 17
Annunciation (Lady Day)	Wed.,	Mar. 25
Palm Sunday		Mar. 29
Good Friday		Apr. 3
Easter Sunday		Apr. 5
St. George	Thur.,	Apr. 23
Accession of King George V, (1910)		May 6
Rogation Sunday		May 10
Ascension Day	Thur.,	May 14
Empire (Victoria) Day	Sun.,	May 24
Pentecost (Whit Sunday)		May 24
Birthday of Queen Mary (1867)		May 26
Trinity Sunday		May 31
Birthday of King George (1865)		June 3
Corpus Christi	Thur.,	June 4
Birthday of Prince of Wales (1894)		June 23
St. John Baptist (Mid-summer Day)		June 24
Dominion Day	Wed.,	July 1
Labour Day	Mon.,	Sept. 7
Hebrew New Year (Rosh Hashanah) (5692)	Sat.,	Sept. 12
St. Michael (Michaelmas Day)	Tues.,	Sept. 29
All Saints' Day	Sun.,	Nov. 1
Armistice Day (Thanks-giving)		Nov. 11
First Sunday in Advent		Nov. 29
St. Andrew	Mon.,	Nov. 30
Queen Alexandria (1844-1925)	Mon.,	Dec. 21
Christmas Day	Fri.,	Dec. 25

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.

1931 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

Date	Apparent R.A.	Equation of Time	Apparent Decl.
	h m s	m s	° ′ ″
Jan. 1	18 41 50	+ 3 6.2	−23 06 07
" 4	18 55 04	+ 4 30.6	−22 50 48
" 7	19 08 15	+ 5 51.7	−22 31 24
" 10	19 21 21	+ 7 08.7	−22 08 01
" 13	19 34 23	+ 8 21.0	−21 40 43
" 16	19 47 20	+ 9 27.9	−21 09 38
" 19	20 00 11	+10 29.0	−20 34 53
" 22	20 12 55	+11 23.5	−19 56 38
" 25	20 25 32	+12 11.1	−19 15 02
" 28	20 38 02	+12 51.4	−18 30 15
" 31	20 50 25	+13 24.3	−17 42 28
Feb. 3	21 02 40	+13 49.7	−16 51 53
" 6	21 14 47	+14 07.7	−15 58 38
" 9	21 26 48	+14 18.6	−15 02 54
" 12	21 38 41	+14 22.5	−14 04 53
" 15	21 50 28	+14 19.6	−13 04 45
" 18	22 02 08	+14 10.1	−12 02 42
" 21	22 13 42	+13 54.3	−10 58 55
" 24	22 25 10	+13 32.4	− 9 53 37
" 27	22 36 32	+13 04.9	− 8 46 59
Mar. 2	22 47 49	+12 32.1	− 7 39 11
" 5	22 59 01	+11 54.6	− 6 30 25
" 8	23 10 09	+11 13.1	− 5 20 50
" 11	23 21 14	+10 28.1	− 4 10 36
" 14	23 32 16	+ 9 40.2	− 2 59 53
" 17	23 43 16	+ 8 49.9	− 1 48 51
" 20	23 54 13	+ 7 57.6	− 0 37 40
" 23	0 05 09	+ 7 04.0	+ 0 33 29
" 26	0 16 04	+ 6 09.4	+ 1 44 25
" 29	0 26 58	+ 5 14.4	+ 2 54 58

Date	Apparent R.A.	Equation of Time	Apparent Decl.
	h m s	m s	° ′ ″
Apr. 1	0 37 53	+ 4 19.5	+ 4 04 59
" 4	0 48 48	+ 3 25.2	+ 5 14 19
" 7	0 59 45	+ 2 32.3	+ 6 22 50
" 10	1 10 44	+ 1 41.3	+ 7 30 22
" 13	1 21 45	+ 0 52.6	+ 8 36 47
" 16	1 32 49	+ 0 06.8	+ 9 41 56
" 19	1 43 56	− 0 35.8	+10 45 38
" 22	1 55 06	− 1 14.8	+11 47 44
" 25	2 06 21	− 1 50.1	+12 48 05
" 28	2 17 39	− 2 21.3	+13 46 31
May 1	2 29 02	− 2 48.1	+14 42 54
" 4	2 40 30	− 3 10.3	+15 37 06
" 7	2 52 02	− 3 27.4	+16 28 59
" 10	3 03 40	− 3 39.3	+17 18 25
" 13	3 15 23	− 3 45.9	+18 05 17
" 16	3 27 11	− 3 47.3	+18 49 25
" 19	3 39 05	− 3 43.4	+19 30 41
" 22	3 51 03	− 3 34.6	+20 08 58
" 25	4 03 06	− 3 21.1	+20 44 09
" 28	4 15 14	− 3 03.2	+21 16 06
" 31	4 27 26	− 2 41.2	+21 44 46
June 3	4 39 41	− 2 15.3	+22 10 01
" 6	4 52 00	− 1 45.8	+22 31 49
" 9	5 04 23	− 1 13.2	+22 50 05
" 12	5 16 48	− 0 38.0	+23 04 44
" 15	5 29 15	− 0 00.7	+23 15 44
" 18	5 41 43	+ 0 37.9	+23 23 03
" 21	5 54 12	+ 1 17.2	+23 26 38
" 24	6 06 41	+ 1 56.2	+23 26 30
" 27	6 19 09	+ 2 34.5	+23 22 39
" 30	6 31 35	+ 3 11.5	+23 15 06

1931 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

Date	Apparent R.A.	Equation of Time	Apparent Decl.
	h m s	m s	°
July 3	6 44 00	+ 3 46.6	+23 03 54
" 6	6 56 22	+ 4 19.3	+22 49 04
" 9	7 08 42	+ 4 49.3	+22 30 41
" 12	7 20 58	+ 5 15.8	+22 08 46
" 15	7 33 11	+ 5 38.6	+21 43 26
" 18	7 45 19	+ 5 57.0	+21 14 44
" 21	7 57 22	+ 6 10.6	+20 42 48
" 24	8 09 20	+ 6 19.1	+20 07 45
" 27	8 21 13	+ 6 22.2	+19 29 40
" 30	8 33 00	+ 6 19.8	+18 48 42
Aug. 2	8 44 42	+ 6 12.1	+18 04 56
" 5	8 56 19	+ 5 59.0	+17 18 31
" 8	9 07 50	+ 5 40.6	+16 29 34
" 11	9 19 16	+ 5 17.1	+15 38 12
" 14	9 30 37	+ 4 48.5	+14 44 34
" 17	9 41 53	+ 4 14.9	+13 48 48
" 20	9 53 05	+ 3 36.6	+12 51 05
" 23	10 04 11	+ 2 53.6	+11 51 33
" 26	10 15 14	+ 2 06.4	+10 50 20
" 29	10 26 13	+ 1 15.5	+ 9 47 35
Sept. 1	10 37 08	+ 0 21.3	+ 8 43 26
" 4	10 48 01	− 0 35.7	+ 7 38 01
" 7	10 58 51	− 1 34.9	+ 6 31 28
" 10	11 09 40	− 2 35.9	+ 5 23 56
" 13	11 20 27	− 3 38.2	+ 4 15 34
" 16	11 31 14	− 4 41.4	+ 3 06 32
" 19	11 42 00	− 5 45.2	+ 1 56 59
" 22	11 52 45	− 6 48.9	+ 0 47 06
" 25	12 03 32	− 7 52.1	− 0 23 00
" 28	12 14 20	− 8 54.0	− 1 33 10

Date	Apparent R.A.	Equation of Time	Apparent Decl.
	h m s	m s	°
Oct. 1	12 25 09	− 9 54.0	− 2 43 14
" 4	12 36 01	−10 51.6	− 3 53 05
" 7	12 46 57	−11 46.1	− 5 02 32
" 10	12 57 55	−12 37.0	− 6 11 27
" 13	13 08 58	−13 23.9	− 7 19 38
" 16	13 20 05	−14 06.3	− 8 26 55
" 19	13 31 18	−14 43.8	− 9 33 06
" 22	13 42 35	−15 16.0	−10 38 01
" 25	13 53 58	−15 42.4	−11 41 31
" 28	14 05 28	−16 02.5	−12 43 24
" 31	14 17 04	−16 15.9	−13 43 32
Nov. 3	14 28 47	−16 22.3	−14 41 43
" 6	14 40 38	−16 21.2	−15 37 46
" 9	14 52 37	−16 12.5	−16 31 30
" 12	15 04 43	−15 56.2	−17 22 44
" 15	15 16 56	−15 32.3	−18 11 16
" 18	15 29 17	−15 00.9	−18 56 55
" 21	15 41 46	−14 22.2	−19 39 31
" 24	15 54 21	−13 36.3	−20 18 54
" 27	16 07 04	−12 43.4	−20 54 56
" 30	16 19 53	−11 43.7	−21 27 26
Dec. 3	16 32 49	−10 37.8	−21 56 18
" 6	16 45 50	− 9 26.0	−22 21 22
" 9	16 59 57	−08 09.0	−22 42 32
" 12	17 12 08	− 6 47.8	−22 59 40
" 15	17 25 22	− 5 23.1	−23 12 43
" 18	17 38 39	− 3 56.0	−23 21 35
" 21	17 51 57	− 2 27.3	−23 26 15
" 24	18 05 16	− 0 57.8	−23 26 42
" 27	18 18 35	+ 0 31.5	−23 22 54
" 30	18 31 53	+ 1 59.9	−23 14 53

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.

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

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

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

JANUARY

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

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

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

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

APRIL

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

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

MAY

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

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

JUNE

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

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

JULY

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

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

AUGUST

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

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

SEPTEMBER

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

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

OCTOBER

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

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

NOVEMBER

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

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

DECEMBER

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

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

THE PLANETS DURING 1931

In the following notes on the planets a general account of the phenomena resulting from their motions is given. Fuller details regarding any particular phenomenon will be found on the pages headed "The Sky for the Month" (pages 28, 30,...).

MERCURY

Among the planets, Mercury is notable in several respects. It is the smallest in diameter, the smallest in mass, the nearest to the sun and the swiftest in its orbital motion. It also has the most eccentric orbit, with the greatest inclination to the ecliptic.

Its apparent separation from the sun is never great, its maximum value ranging from 18° to 28°. In the year 1931, it reaches greatest elongation six times. At such times, when we search for it, in the west just after sunset, or in the east just before sunrise, it is never high above the horizon, and even with clear sky, the planet is not easily located, although it is as bright as a first magnitude star.

On account of the inclination of the ecliptic to the horizon, Mercury is usually best seen, in northern latitudes, as an evening star in the spring and as a morning star in the autumn.

The greatest eastern elongations in 1931 (Mercury, an evening star) are on April 10, 19° 27′, August 8, 27° 23′, December 2, 21° 19′.

The greatest western elongations (Mercury, a morning star) are on January 28, 24° 54′, May 27, 24° 57′, September 20, 17° 52′.

The April elongation is the best of the year for evening observation, while the elongation of May is the most suitable for morning observation.

VENUS

The next planet in order from the sun is Venus, by far the brightest and most conspicuous of all in our skies—it is nearly the earth's twin in respect to magnitude, density and general constitution, if not in other physical conditions.

Venus comes the closest to the earth of any body except Eros, the moon, and an occasional comet. Its mean distance from the sun is 67 millions of miles, and its distance from the earth ranges from 26 million to 160 million miles.

It is so brilliant that it is easily seen with the naked eye in the daytime for several weeks when near its greatest elongation. At the beginning of the year Venus is seen as a morning star, and because of its then great brilliancy, magnitude −4.4., 15 times as bright as Sirius, it is a very beautiful object for observation.

Venus continues to be a morning star till the late summer; September 7 it is in superior conjunction with the sun; some time later it is seen in the western sky as an evening star.

MARS

At the beginning of the year Mars is in the constellation Leo. On January 25 it is nearest the earth, and on January 27 is in opposition to the sun, and as a result is visible all night. Mars reaches its greatest brightness between January 25 and 29, when its magnitude is −1.1, about as bright as Sirius, but gradually grows fainter and by May 1 is of magnitude +1.0.

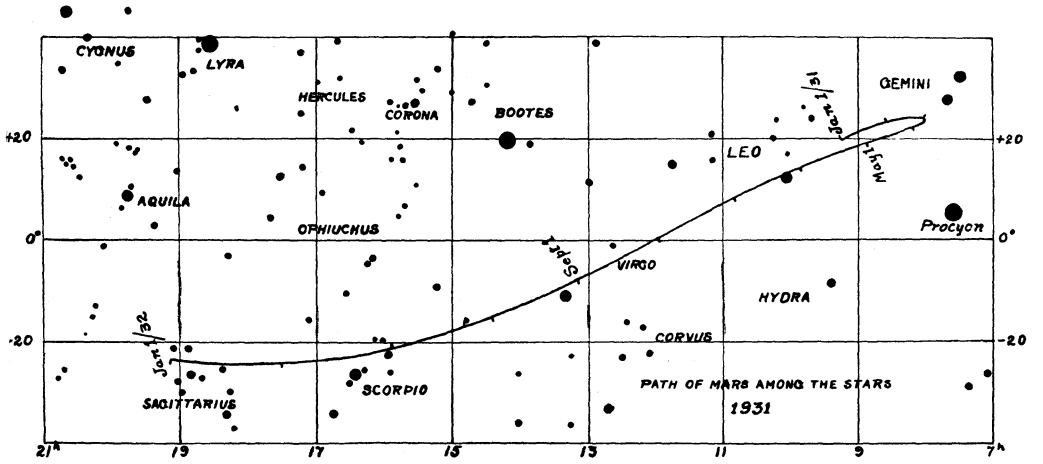

Fig. 1. Path of Mars among the Stars during 1931

The opposition of January is not specially good for observation. The planet's average distance from the earth at opposition is 48.6 million miles. When opposition occurs near the planet's perihelion this distance may be reduced to 34.5 millions of miles, while near aphelion it can be as great as 62.9 millions of miles. As Mars passes aphelion April 1, its distance on January 27 is considerably greater than the average distance of 48.6 millions of miles, and hence this opposition is not a good one to observe the planet.

November 18, Venus and Mars are in conjunction, visible very shortly after sunset.

Jupiter

Jupiter, the next planet beyond Mars, is easily the largest and most massive of all the planets, and in brightness it is second only to Venus.

A small telescope will give a good view of the planet since a magnification of 60 diameters gives to it an apparent diameter equal to that of the moon as seen by the naked eye. Bands are seen on its surface, parallel to the equator. They are believed to be clouds, though they are much more permanent than the cloud formations on the earth's surface.

Jupiter is known to possess nine moons. The four largest (two of them larger than Mercury) can be seen with field glasses, but the others are extremely faint bodies and require the most powerful instruments to detect them.

January 6, Jupiter is in opposition to the sun and is visible all night. July 25, the planet is in conjunction with the sun and for some time is not visible, appearing again in the early fall as a morning star.

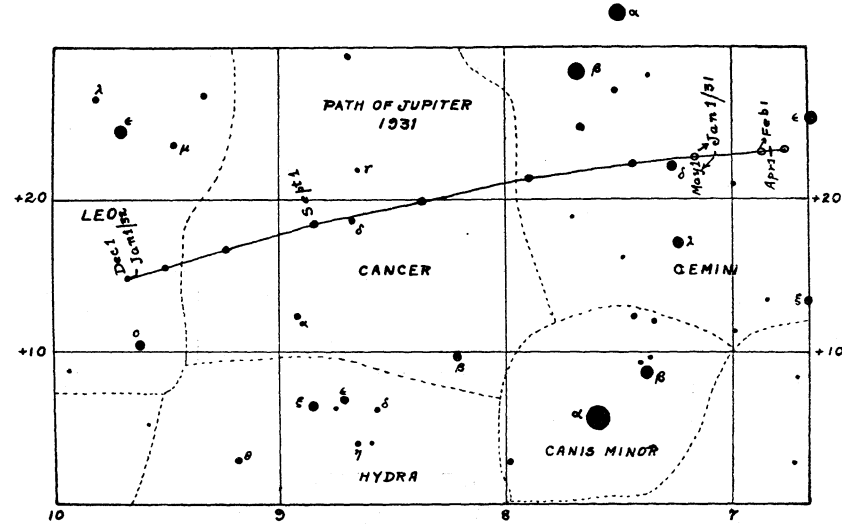

Fig. 2. Path of Jupiter among the Stars during 1931

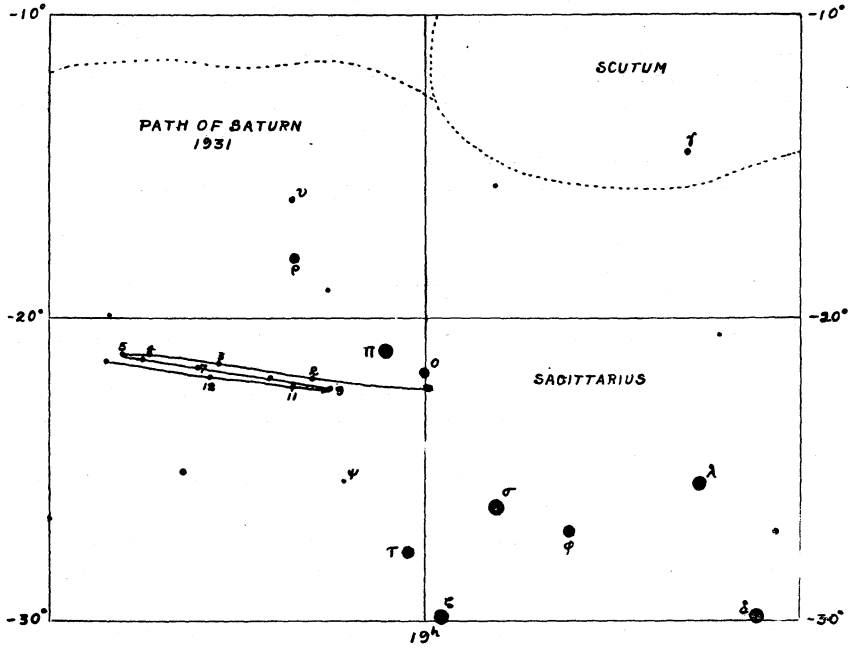

Fig. 3. Path of Saturn among the Stars during 1931

The dots on the path show the position on the 1st day of the month.

Saturn

Saturn possesses a remarkable set of rings and has ten satellites. It is considered to be one of the finest objects in the sky for the visual astronomer.

During 1931 the rings of Saturn are particularly well placed for examination.

Saturn, during December, 1930, and January, 1931, on account of its closeness to the sun, is not visible, and is in conjunction January 5. By February 15 it is again visible as a morning star. July 13 Saturn is in opposition with the sun, crossing the meridian at midnight, and is therefore visible all night.

During the autumn it is an evening star.

Uranus

Uranus was discovered by Sir William Herschel in 1781. Before that time Saturn's path was considered the outermost boundary of the solar system, and when the planet was first seen by Herschel he thought it must be a comet. A year

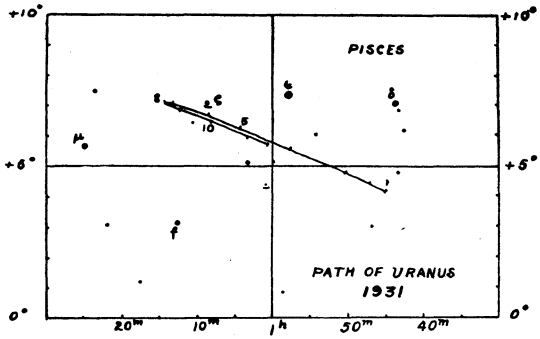

Fig. 4. Path of Uramus among the Stars during 1931

The dots on the path show the position of the planet on the 1st day of the month.

later its true nature was recognized. The planet has four satellites, two discovered by Herschel a few years after his discovery of Uranus. In 1851 Lassell rediscovered and observed these two satellites, Oberon and Titania, and independently discovered and observed the two fainter satellites Ariel and Umbriel. The satellites are very faint, about magnitude 14.

The period of Uranus about the sun is 84 years, and consequently its motion in the heavens is slow. Its period of rotation is 10¾ hours. It is of the sixth magnitude and can be seen with the naked eye, but its motion is better observed by the aid of a field glass. A large telescope is necessary to show an appreciable disc. Uranus is in conjunction with the sun on April 5. Sometime later it is visible in the morning. On October 11, it is in opposition to the sun and is visible the entire night.

Neptune

Neptune was discovered in 1846 as the result of the mathematical discussion of the planet Uranus, which, for some unknown reason, was not following the path predicted for it. The story of the discovery is one of the most interesting romances in the history of astronomy.

Neptune until very recently was considered the most distant planet of the solar system, being 2,800 millions of miles from the sun, and requiring 165 years to complete a revolution. The discovery of the new planet, Pluto, at Flagstaff Observatory, Arizona, in 1930, has robbed Neptune of this distinction. Pluto is believed to be considerably farther out in space than Neptune.

Neptune is in opposition with the sun February 23, and is visible all night at the beginning of the year. On August 29 it is in conjunction with the sun and is not visible. Neptune appears as an eighth magnitude star and hence can be seen only with a telescope. It has a single satellite, about magnitude 13. The satellite was discovered by Lassell a few months following the discovery of the planet.

Pluto

Percival Lowell, founder and late Director of the Lowell Observatory, Flagstaff, Arizona, 15 years ago, due to his researches on the motions of the planets Uranus and Neptune, was led to believe that there was beyond Neptune another body which was producing some small attraction on these planets. From these extensive mathematical investigations, he definitely concluded the body was there, and predicted its position in the heavens fairly closely, within about 5 degrees.

The body was discovered by the staff of the Lowell Observatory at Flagstaff about the beginning of the year 1930. The investigations of the early observations led at once to the conclusion that the predicted body was a trans-Neptunian planet. It is about the fourteenth magnitude.

ECLIPSES, 1931

In the year 1931 there will be five eclipses, three of the sun and two of the moon.

I. *A Total Eclipse of the Moon*, April 2. This eclipse is invisible in North America. The beginning is visible generally in the western part of the Pacific Ocean, Asia, Australia, the Indian Ocean, Europe, and Africa; the ending is visible generally in Asia except the eastern part, the Indian Ocean, Europe, Africa, the Atlantic Ocean and the eastern part of South America.

Circumstances of the Eclipse

Moon enters penumbra	April	2d	17h	27.2m G.C.T.
Moon enters umbra		2	18	23.2
Total eclipse begins		2	19	22.3
Middle of the eclipse		2	20	7.4
Total eclipse ends		2	20	52.6
Moon leaves umbra		2	21	51.7
Moon leaves penumbra		2	22	48.0

Magnitude of the eclipse, 1.509 (Moon's diameter, 1.0)

II. *A Partial Eclipse of the Sun*, April 17-18. Invisible in America or Europe. Visible generally in Asia and the north polar regions.

Circumstances of the Eclipse

Eclipse begins	April 17d	22h	57.4m	G.C.T.
Greatest eclipse	18	0	45.1	
Eclipse ends	18	2	32.3	

Magnitude of greatest eclipse, 0.511 (Sun's diameter, 1.0)

III. *A Partial Eclipse of the Sun*, September 12. Visible only in Alaska, the eastern tip of Asia and the northern part of the Pacific Ocean. This is a very small eclipse.

Circumstances of the Eclipse

Eclipse begins	September 12d	4h	13.1m	G.C.T.
Greatest eclipse	12	4	40.9	
Eclipse ends	12	5	9.3	

Magnitude of greatest eclipse, 0.047 (Sun's diameter, 1.0)

IV. *A Total Eclipse of the Moon*, September 26. This eclipse is invisible in North America and the western part of South America. The beginning is visible generally in the western part of the Pacific Ocean, Asia, Australia, the Indian Ocean, Europe, and Africa except the northwestern part; the ending is visible generally in Asia except the north eastern part, the Indian Ocean, Europe, Africa, the Atlantic Ocean, and the eastern part of South America.

Circumstances of the Eclipse

Moon enters penumbra	September 26d	16h	40.7m	G.C.T.
Moon enters umbra	26	17	54.2	
Total eclipse begins	26	19	5.5	
Middle of the eclipse	26	19	48.0	
Total eclipse ends	26	20	30.5	
Moon leaves umbra	26	21	41.8	
Moon leaves penumbra	26	22	55.3	

Magnitude of the eclipse, 1.326 (Moon's diameter, 1.0)

V. *A Partial Eclipse of the Sun*, October 11. This eclipse is visible only in the southern half of South America and in the Atlantic and Pacific Oceans near to it and surrounding the south pole.

Circumstances of the Eclipse

Eclipse begins	October 11d	11h	1.0m	G.C.T.
Greatest eclipse	11	12	55.2	
Eclipse ends	11	14	48.9	

Magnitude of greatest eclipse, 0.898 (Sun's diameter, 1.0)

THE SKY FOR JANUARY, 1931

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 42m to 20h 54m and its Decl. changes from 23° 6′ S. to 17° 26′ S. The equation of time (see p. 6) increases from 3m 6s to 13m 34s. Due to this rapid rise in value the time of mean noon appears, for the first ten days of the month, to remain 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 winter sign of the zodiac. On January 3rd, the earth is in perihelion.

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

Mercury on the 15th is in R.A. 18h 27m, Decl. 20° 7′ S., and transits at 10.50. On the 6th, it is in inferior conjunction with the sun and is a morning star all month. On the 28th it reaches its greatest elongation west, and on that date it rises about 1½ hours before the sun.

Venus on the 15th is in R.A. 16h 30m, Decl. 17° 30′ S., and transits at 8.56. It is a bright object in the morning sky. On the 15th it is about 25° above the southern horizon at sunrise. Its magnitude falls from −4.4 to −4.1.

Mars on the 15th is in R.A. 9h 2m, Decl. 21° 21′ N., and transits at 1.28. On the 27th it is in opposition with the sun and is visible throughout the night. At that time its magnitude is −1.1. It is in the constellation of Cancer.

Jupiter on the 15th is in R.A. 7h 2m, Decl. 22° 51′ N., and transits at 23.24. On the 6th it is in opposition with the sun, and is visible all night. It is a bright object, of magnitude −2.2, in the constellation of Gemini. For the configurations of its satellites see next page, and for their eclipses, etc., see p. 52.

Saturn on the 15th is in R.A. 19h 6m, Decl. 22° 14′ S., and transits at 11.31. It is in conjunction with the sun on the 5th, after which it becomes a morning star. It is in the constellation of Sagittarius.

Uranus on the 15th is in R.A. 0h 44m, Decl. 4° 1′ N., and transits at 17.07.

Neptune on the 15th is in R.A. 10h 30m, Decl. 10° 12′ N., and transits at 2.56.

JANUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 0h 45m
			h	m	
Thur.	1	8h ☿ in Perihelion			43021
Fri.	2	16h □♁⊙	17	10	42310
Sat.	3	5h ⊕ in Perihelion.....miles			42031
♑ Sun.	4	8h 14.9m F.M.; 11h 26m ☌♃☾, ♃ 4°52′S			14023
Mon.	5	7h ♀ in Perihelion; 9h ☌♄⊙; 22h ☌☿⊙ Inferior	14	00	d2043
Tues.	6	3h ☌☿♄, ☿ 2°28′N.; 10h 27m ☌♂☾, ♂ 0°34′S.; 13h☍♃⊙			20134
Wed.	7	19h 19m ☌♆☾, ♆ 3°2′S			31024
Thur.	8		10	50	30214
Fri.	9				32104
Sat.	10				20314
☾ Sun.	11	0h 9.2m Moon L.Q.; 15h ☿ Greatest Hel. Lat. N.	7	40	10234
Mon.	12				20143
Tues.	13				2403*
Wed.	14	17h 49m ☌♀☾, ♀ 8°16′N	4	30	43102
Thur.	15				43012
Fri.	16	18h 55m ☌☿☾, ☿ 7° 50′ N.; 21h ☿ Stationary in R.A.			43210
Sat.	17	12h 56m ☌♄☾, ♄ 5° 21′ N	1	10	4201*
♍ Sun.	18	13h 35.6m N.M.			41023
Mon.	19		22	00	d4013
Tues.	20				2403*
Wed.	21				31042
Thur.	22		18	50	30124
Fri.	23				32104
Sat.	24	19h 19m ☌♁☾, ♁ 0° 13′ S			23014
Sun.	25	9h ♂ nearest ⊕	15	40	10234
☽ Mon.	26	19h 5.5m Moon F.Q.			02134
Tues.	27	4h ♀ Greatest Hel. Lat. N.; 14h☍♂⊙			21034
Wed.	28	13h ☿ Greatest elong. W. 24° 54′	12	30	d3024
Thur.	29				d3012
Fri.	30				34210
Sat.	31	17h 1m ☌♃☾, ♃ 4° 50′ S	9	20	42301

Explanation of symbols and abbreviations on page 4

THE SKY FOR FEBRUARY, 1931

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 54m to 22h 44m and its Decl. changes from 17° 26′ S. to 8° 2′ S. The equation of time reaches a maximum value of 14m 22s on the 12th (see p. 6). For the change in the length of the day see p. 11. On the 19th the sun enters Pisces, the third winter zodiacal sign.

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

Mercury on the 15th is in R.A. 20h 31m, Decl. 20° 18′ S., and transits at 10.56. It is a morning star all month, and is approaching the sun. At sunrise on the 15th it is about 7° above the horizon, in the S.E.

Venus on the 15th is in R.A. 18h 38m, Decl. 20° 25′ S., and transits at 9.02. On the 1st it reaches its greatest elongation west and on that date rises about 3 hours before the sun.

Mars on the 15th is in R.A. 8h 15m, Decl. 24° 17′ N., and transits at 22.34. On that date it is about 25° above the eastern horizon at sunset. It is in the constellation of Cancer and is visible all night. During the month its magnitude decreases from −1.0 to −0.4.

Jupiter on the 15th is in R.A. 6h 48m, Decl. 23° 13′ N., and transits at 21.08. It is a brilliant evening star in the constellation of Gemini. At sunset on the 15th it is about 35° above the eastern horizon and is well situated for observation during the month. For the configurations of its satellites see next page, and for their eclipses, etc., see p. 52.

Saturn on the 15th is in R.A. 19h 21m, Decl. 21° 49′ S., and transits at 9.44. It is in Sagittarius and rises about 2 hours before the sun on the 15th. Its magnitude is +0.8.

Uranus on the 15th is in R.A. 0h 48m, Decl. 4° 26′ N., and transits at 15.09.

Neptune on the 15th is in R.A. 10h 27m, Decl. 10° 29′ N., and transits at 0.51.

FEBRUARY

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 23h 45m
			h	m	
Sun.	1	14h ☌☿♄, ☿ 0° 3′ N.; 17h ♀ Greatest elong. W. 46° 55′			4O213
♒Mon.	2	5h 45m ☌♂☾, ♂ 0° 19′ S.; 19h 25.9m F.M.			42103
Tues.	3		6	10	4301*
Wed.	4	2h ☿ in♉; 4h 5m ☌♆☾, ♆ 2° 54′ S.			4302*
Thur.	5				34210
Fri.	6		3	00	23014
Sat.	7				10234
Sun.	8		23	50	02134
☾Mon.	9	11h 9.6m Moon L.Q.			21034
Tues.	10				d2014
Wed.	11		20	30	31024
Thur.	12				32104
Fri.	13	2h 42m ☌♀☾, ♀ 7° 54′ N.			23014
Sat.	14	0h 34m ☌♄☾, ♄ 5° 27′ N.; 8h ☿ in Aphelion	17	20	14023
Sun.	15	10h 15m ☌☿☾, ☿ 3° 33′ N.			40123
Mon.	16				42103
♍Tues.	17	8h 10.8m N.M.	14	10	42031
Wed.	18				43102
Thur.	19				dd430
Fri.	20		11	00	42301
Sat.	21	4h 7m ☌♁☾, ♁ 0° 31′ S.			41023
Sun.	22				0123*
Mon.	23	19h☍♆☉; 23h ♂ Greatest Hel. Lat. N.	7	50	21043
Tues.	24	21h ☌♀♄, ♀ 1° 43′ N.			20314
☽Wed.	25	11h 41.9m Moon F.Q.			31024
Thur.	26		4	40	30214
Fri.	27				3204*
Sat.	28	0h 18m ☌♃☾, ♃ 4° 56′ S.			1034*

Explanation of symbols and abbreviations on page 4

THE SKY FOR MARCH, 1931

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 44m to 0h 38m, and its Decl. changes from 8° 2′ S. to 4° 5′ N. The equation of time decreases from 12m 44s to 4m 19s (see p. 6). For changes in the length of the day see p. 12. On the 21st at 14h 7m (G.C.T.) the sun enters the first spring sign of the zodiac, Aries and Spring begins. On that day the sun crosses the equator going north.

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

Mercury on the 15th is in R.A. 23h 35m, Decl. 4° 27′ S., and transits at 12.10. It is in superior conjunction with the sun on the 16th, and after that date becomes an evening star. On the 31st it sets about 1¼ hours after the sun.

Venus on the 15th is in R.A. 20h 51m, Decl. 17° 1′ S., and transits at 9.24. It is still a morning star. During the month its magnitude decreases from −3.8 to −3.6.

Mars on the 15th is in R.A. 8h 2m, Decl. 24° 0′ N., and transits at 20.32. At sunset on the 15th it is about 50° above the south-eastern horizon. in Cancer and is in good position for observation. By the end of the month its magnitude has dropped to +0.3.

Jupiter on the 15th is in R.A. 6h 46m, Decl. 23° 18′ N., and transits at 19.16. It is in Gemini. Its magnitude decreases from −2.0 to −1.8 during the month, though it is still a bright object and is very near to the zenith at sunset on the 15th. For the configurations of its satellites see next page, and for their eclipses, etc., see p. 52.

Saturn on the 15th is in R.A. 19h 32m, Decl. 21° 29′ S., and transits at 8.04. It is a morning star in Sagittarius, and at sunrise on the 15th is 20° above the southern horizon.

Uranus on the 15th is in R.A. 0h 53m, Decl. 4° 59′ N., and transits at 13.24.

Neptune on the 15th is in R.A. 10h 24m, Decl. 10° 46′ N., and transits at 22.54.

MARCH

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 23h 0m
			h	m	
Sun.	1	5h 20m ☌♂☾, ♂ 1° 12′ S.	1	30	O1234
Mon.	2				12O43
Tues.	3	14h 16m ☌♆☾, ♆ 2° 56′ S.	22	20	24O31
Wed.	4	5h 36.1m F.M.			431O2
Thur.	5				43O21
Fri.	6	16h ☿ Greatest Hel. Lat. S	19	10	4321O
Sat.	7	3h ♃ Stationary in R.A.			d4O**
Sun.	8	23h ♂ Stationary in R.A.			4O123
Mon.	9		15	50	412O3
Tues.	10				24O13
Wed.	11	0h 15.2m Moon L.Q.			13O42
Thur.	12		12	40	3O124
Fri.	13	11h 2m ☌♄☾, ♄ 5° 34′ N.			321O4
Sat.	14				32O14
Sun.	15	0h 20m ☌♀☾, ♀ 5° 37′ N.; 19h ☌☿☉ Superior.	9	30	O234*
Mon.	16				12O34
Tues.	17				2O134
Wed.	18		6	20	13O24
Thur.	19	2h 50.6m N.M.; 10h 42m ☌☿☾, ☿ 0° 8′ N.			3O412
Fri.	20	13h 4m ☌♁☾, ♁ 0° 43′ S.			3421O
Sat.	21	9h 7m ☉ enters ♈, Spring commences	3	10	432O1
Sun.	22				4O32*
Mon.	23				d41O3
Tues.	24	6h ♀ in ♉	0	00	42O13
Wed.	25	17h ☿ in ♌			d41O2
Thur.	26	2h ☌☿♁, ☿ 0° 45′ N.	20	50	43O12
Fri.	27	0h 4.2m Moon F.Q.; 9h 8m ☌♃☾, ♃ 5° 0′ S.			3214O
Sat.	28	17h 13m ☌♂☾, ♂ 2° 12′ S.			321O*
Sun.	29		17	40	1O324
Mon.	30	7h ☿ in Perihelion; 23h 51m ☌♆☾, ♆ 3° 1′ S.			dO234
Tues.	31				2O134

Explanation of symbols and abbreviations on page 4

THE SKY FOR APRIL, 1931

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 38m to 2h 29m, and its Decl. from 4° 5′ N. to 14° 43′ N. The equation of time changes from +4m 19s to −2m 48s (see p. 6). For changes in the length of the day see p. 13. On the 21st the sun enters Taurus, the second spring zodiacal sign. On the 18th there is a partial eclipse of the sun, but it is invisible on this continent.

The Moon—For its phases and conjunctions with the planets, see opp. page. On the 2nd there is a total eclipse of the moon, not visible in Canada.

Mercury on the 15th is in R.A. 2h 35m, Decl. 18° 22′ N., and transits at 13.05. It is an evening star during April. On the 10th it reaches its greatest elongation east and is in good position for observation. On that date it sets about 2¾ hours after the sun at a point 25° N. of W. After that date Mercury approaches the sun and is in inferior conjunction with it on the 30th.

Venus on the 15th is in R.A. 23h 13m, Decl. 6° 17′ S., and transits at 9.45. It is a bright morning star. It rises about 1¼ hours before the sun on the 15th.

Mars on the 15th is in R.A. 8h 30m, Decl. 21° 33′ N., and transits at 18.59. At sunset on that date it is very near the meridian. Its magnitude falls from +0.4 on the 1st to +0.9 at the end of the month.

Jupiter on the 15th is in R.A. 6h 56m, Decl. 23° 9′ N., and transits at 17.24. On the 2nd it is in quadrature with the sun and is then on the meridian at sunset. Its magnitude is still decreasing and at the end of the month is −1.6. It is still in Gemini. For the configurations of its satellites, see next page, and for their eclipses, etc., see p. 52.

Saturn on the 15th is in R.A. 19h 39m, Decl. 21° 14′ S., and transits at 6.09. It is in quadrature with the sun on the 13th, and then rises about 3¾ hours before the sun.

Uranus on the 15th is in R.A. 0h 59m, Decl. 5° 39′ N., and transits at 11.28.

Neptune on the 15th is in R.A. 10h 21m, Decl. 11° 0′ N., and transits at 20.49.

APRIL

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites 22h 30m
			h	m	
Wed.	1	0h ♂ in Aphelion	14	30	1034*
♋ Thur.	2	0h □♃⊙; 15h 5.5m F.M.; Total eclipse of ☾ invisible at Toronto			30124
Fri.	3				31204
Sat.	4		11	20	32014
Sun.	5	21h ♂☌⊙			1402*
Mon.	6				40123
Tues.	7		8	00	4203*
Wed.	8				4103*
☾ Thur.	9	14h ☿ Greatest Hel. Lat. N.; 15h 15.2m Moon L.Q.; 20h 51m ♂♄ ☾, ♄ 5° 35′ N			43012
Fri.	10	6h ☿ Greatest elong. E. 19° 27′	4	50	43120
Sat.	11				43201
Sun.	12				41032
Mon.	13	17h □♄⊙	1	40	40123
Tues.	14	8h 44m ♂♀ ☾, ♀ 1° 32′ N			21043
Wed.	15		22	30	21034
Thur.	16	22h 36m ♂☌, ☾, ☌ 0° 52′ S			30124
♍ Fri.	17	19h 59.7m N.M.; Partial eclipse of ⊙ invisible at Toronto			31204
Sat.	18		19	20	32014
Sun.	19	3h 50m ♂☿ ☾, ☿ 0° 22′ N.; 22h ☿ Stationary in R.A.			1024*
Mon.	20				01234
Tues.	21		16	10	21043
Wed.	22				d2403
Thur.	23	19h 44m ♂♃ ☾, ♃ 4° 58′ S			4302*
Fri.	24		13	00	d4310
◑ Sat.	25	8h 40.1m Moon F.Q.; 14h 21m ♂♂ ☾, ♂ 2° 44′ S.			43201
Sun.	26				41302
Mon.	27	7h 28m ♂♆ ☾, ♆ 3° 1′ S.; 15h ♀ in Aphelion	9	50	40123
Tues.	28				42103
Wed.	29				42013
Thur.	30	5h ♂☿ ⊙ Inferior	6	40	302**

Explanations of symbols and abbreviations on page 4

THE SKY FOR MAY, 1931

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 29m to 4h 32m, and its Decl. from 14° 43′ N. to 21° 54′ N. The equation of time increases from 2m 48s to a maximum of 3m 48s on the 15th, and then decreases to 2m 33s at the end of the month (see p. 6). For changes in the times of sunrise and sunset see p. 14. The sun enters Gemini, the third sign of the zodiac, on the 22nd.

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

Mercury on the 15th is in R.A. 2h 10m, Decl. 10° 6′ N., and transits at 10.41. At the beginning of the month it is too close to the sun for observation. It later becomes a morning star and on the 27th reaches its greatest elongation west, it then rises about 1 hour before the sun.

Venus on the 15th is in R.A. 1h 26m, Decl. 7° 11′ N., and transits at 10.00. It is a morning star, though not very favourably situated for observation. At sunrise on the 15th, it is about 11° above the eastern horizon.

Mars on the 15th is in R.A. 9h 19m, Decl. 17° 31′ N., and transits at 17.50. On the 2nd it is in quadrature with the sun. It is then in Cancer, but enters Leo about the 17th. Its magnitude is still decreasing and by the end of the month is +1.3.

Jupiter on the 15th is in R.A. 7h 14m, Decl. 22° 41′ N., and transits at 15.45. It is an evening star in the constellation of Gemini. Its magnitude decreases from −1.6 to −1.5 during the month. On the 15th Jupiter sets about 4 hours after the sun. For the configurations of its satellites see next page, and for their eclipses etc., see p. 52.

Saturn on the 15th is in R.A. 19h 40m, Decl. 21° 14′ S., and transits at 4.12. On that date it rises about midnight and may be seen low in the south in Sagittarius. Its magnitude increases from +0.7 to +0.5.

Uranus on the 15th is in R.A. 1h 5m, Decl. 6° 16′ N., and transits at 9.37.

Neptune on the 15th is in R.A. 10h 21m, Decl. 11° 5′ N., and transits at 18.51.

MAY

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 22h 0m
			h	m	
Fri.	1				31O24
♋ Sat.	2	0h 14.4m F.M.; 8h □♂☉			32O14
Sun.	3	1h ☿ in ♉; 12h ♄ Stationary in R.A.	3	20	31O4*
Mon.	4				O1324
Tues.	5				12O34
Wed.	6		0	10	2O134
Thur.	7	5h 57m ♂♄ ☾, ♄ 5° 28′ N.			d1O24
Fri.	8		21	00	d3O24
☾ Sat.	9	7h 48.2m Moon L.Q.; 21h ♂♀♁, ♀ 1° 13′ S.			324O1
Sun.	10				431O*
Mon.	11		17	50	4O312
Tues.	12	12h ☿ Stationary in R.A.			412O3
Wed.	13	7h ☿ in Aphelion.			42O13
Thur.	14	8h 49m ♂♁ ☾, ♁ 1° 4′ S.; 20h 40m ♂♀ ☾, ♀ 2° 51′ S.; 23h ♆ Stationary in R.A.	14	40	41O32
Fri.	15	19h 44m ♂☿ ☾, ☿ 5° 10′ S.			43O12
Sat.	16				324O*
♍ Sun.	17	10h 27.9m N.M.	11	30	312O4
Mon.	18				O124*
Tues.	19				12O34
Wed.	20	2h ♀ Greatest Hel. Lat. S.	8	20	2O134
Thur.	21	8h 43m ♂♃ ☾, ♃ 4° 50′ S.			1O234
Fri.	22				3O124
Sat.	23	17h 8m ♂♂ ☾, ♂ 2° 41′ S.	5	10	32O4*
☽ Sun.	24	13h 30m ♂♆ ☾, ♆ 2° 52′ S.; 14h 38.8m Moon F.Q.; 23h □♆☉			321O4
Mon.	25				O412*
Tues.	26		2	00	d41O3
Wed.	27	12h ☿ Greatest elong. W. 24° 57′			42O13
Thur.	28		22	40	41O23
Fri.	29				43O12
Sat.	30				4321O
♋ Sun.	31	9h 33.0m F.M.	19	30	d432O

Explanation of symbols and abbreviations on page 4

THE SKY FOR JUNE, 1931

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 32m to 6h 36m, and its Decl. from 21° 54′ N. to its maximum value of 23° 27′ N. on the 22nd, and then drops to 23° 12′ N. at the end of the month. On the 22nd, the sun reaches summer solstice and enters Cancer, the first summer zodiacal sign, and Summer commences. The duration of daylight is now at its longest and does not change appreciably for some days, see p. 15. For changes in the equation of time see p. 6. The increase in this quantity at the end of the month, taken with the shortening of daylight causes the local mean time of sunset to appear almost constant for several days at the end of June and the beginning of July.

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

Mercury on the 15th is in R.A. 4h 19m, Decl. 20° 7′ N., and transits at 10.51. It is still a morning star, though it is approaching the sun. On the 29th Mercury is in superior conjunction with the sun.

Venus on the 15th is in R.A. 3h 53m, Decl. 18° 59′ N., and transits at 10.24. It is still a bright object in the morning sky, but nearing the sun as it approaches superior conjunction. Its magnitude is −3.3.

Mars on the 15th is in R.A. 10h 19m, Decl. 11° 45′ N., and transits at 16.48. It is still in the constellation of Leo, and is gradually approaching the sun. On the 15th it sets about 4 hours after the sun.

Jupiter on the 15th is in R.A. 7h 40m, Decl. 21° 51′ N., and transits at 14.08. Jupiter is an evening star in the constellation of Gemini. It is approaching the sun and at sunset on the 15th is about 20° above the western horizon. For the configurations of its satellites see next page, and for their eclipses etc., see p. 52.

Saturn on the 15th is in R.A. 19h 35m, Decl. 21° 29′ S., and transits at 2.05. It rises about 1¾ hours after sunset on the 15th and is visible in Sagittarius all night. It is at its greatest brilliancy for the year at the end of June, +0.3.

Uranus on the 15th is in R.A. 1h 10m, Decl. 6° 45′ N., and transits at 7.40.

Neptune on the 15th is in R.A. 10h 21m, Decl. 10° 59′ N., and transits at 16.50.

JUNE

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites 21m 30m
			h	m	
	Mon.	1			43012
	Tues.	2 15h ☿ Greatest Hel. Lat. S.			41023
	Wed.	3 13h 40m ☌♄ ☾, ♄ 5° 17′ N.	16	20	2013*
	Thur.	4			1034*
	Fri.	5			30124
	Sat.	6	13	10	32104
	Sun.	7			32014
☾	Mon.	8 1h 18.2m Moon L.Q.			3024*
	Tues.	9	10	00	10234
	Wed.	10 19h 16m ☌♁ ☾, ♁ 1° 21′ S.			20143
	Thur.	11			12043
	Fri.	12	6	50	d4012
	Sat.	13			43120
	Sun.	14 3h 0m ☌♀ ☾, ♀ 5° 8′ S.; 15h 32m ☌☿ ☾, ☿ 5° 33′ S.			43201
●	Mon.	15 22h 1.7m N.M.	3	40	43102
	Tues.	16 5h ☌♂♆, ♂ 0° 28′ N.			41032
	Wed.	17			42013
	Thur.	18 0h 25m ☌♃ ☾, ♃ 4° 38′ S.	0	30	41203
	Fri.	19			40312
	Sat.	20 19h 38m ☌♆ ☾, ♆ 2° 36′ S.	21	20	d3104
	Sun.	21 0h 0m ☌♂ ☾, ♂ 2° 1′ S.; 16h ☿ in ♌			32014
☽	Mon.	22 4h 28m ☉ enters ♋, Summer commences; 19h 23.2m Moon F.Q.			31024
	Tues.	23	18	10	d0324
	Wed.	24			20134
	Thur.	25			21034
	Fri.	26 7h ☿ in Perihelion.	14	50	03124
	Sat.	27			
	Sun.	28			
♍	Mon.	29 14h ☌☿ ☉ Superior; 19h 46.9m F.M.	11	40	
	Tues.	30 19h 19m ☌♄ ☾, ♄ 5° 9′ N.			

Explanation of symbols and abbreviations on page 4

THE SKY FOR JULY, 1931

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 36m to 8h 41m, and its Decl. decreases from 23° 12′ N. to 18° 20′ N. The equation of time increases from 3m 23s on the 1st to 6m 22s on the 27th, and then drops to 6m 15s at the end of the month. On the 23rd, the sun enters Leo, the second summer sign of the zodiac. For changes in the length of day, see p. 16. The earth is in aphelion on the 5th.

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

Mercury on the 15th is in R.A. 8h 43m, Decl. 19° 59′ N., and transits at 13.17. At the beginning of the month it is too near the sun for observation. It later becomes an evening star and on the 15th sets about 1¼ hours after the sun.

Venus on the 15th is in R.A. 6h 28m, Decl. 23° 16′ N., and transits at 11.01. During the month its magnitude increases from −3.3 to −3.4. It is not favourably situated for observation.

Mars on the 15th is in R.A. 11h 22m, Decl. 4° 53′ N., and transits at 15.53. It is in Leo at the beginning of the month, but enters Virgo about the 21st. At sunset on the 15th it is about 25° above the western horizon.

Jupiter on the 15th is in R.A. 8h 7m, Decl. 20° 39′ N., and transits at 12.38. It is in Cancer most of the month and too close to the sun for observation. On the 25th it is in conjunction with the sun after which it becomes a morning star. For the configurations of its satellites see next page, and for their eclipses etc., see p. 52.

Saturn on the 15th is in R.A. 19h 26m, Decl. 21° 50′ S., and transits at 23.54. On the 13th it is in opposition, and at that time rises at sunset. It is still in Sagittarius.

Uranus on the 15th is in R.A. 1h 12m, Decl. 6° 58′ N., and transits at 5.44.

Neptune on the 15th is in R.A. 10h 24m, Decl. 10° 45′N., and transits at 14.54.

JULY

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites
			h m	
Wed.	1			
Thur.	2		8 30	
Fri.	3			
Sat.	4			
Sun.	5	17h ⊕ in Aphelion	5 20	
Mon.	6	13h ☿ Greatest Hel. Lat. N		
☾ Tues.	7	18h 51.6m Moon L.Q		
Wed.	8	5h 1m ☌♁ ☾, ♁ 1° 42′ S	2 10	
Thur.	9	15h ☌☿ ♃, ☿ 1° 29′ N		
Fri.	10		23 00	
Sat.	11			
Sun.	12	10h □♁ ☉		
Mon.	13	3h ☍♄ ☉	19 50	
Tues.	14	3h 5m ☌♀ ☾, ♀ 5° 4′ S		
● Wed.	15	7h 20.0m N.M.; 9h ♀ in ♌; 18h 38m ☌♃ ☾, ♃ 4° 25′ S		
Thur.	16	13h 40m ☌☿ ☾, ☿ 2° 47′ S	16 40	
Fri.	17			
Sat.	18	3h 38m ☌♆ ☾, ♆ 2° 21′ S		
Sun.	19	10h 22m ☌♂ ☾, ♂ 0° 50′ S	13 30	
Mon.	20			
Tues.	21			
◑ Wed.	22	0h 16.1m Moon F.Q	10 10	
Thur.	23			
Fri.	24			
Sat.	25	15h ☌♃ ☉	7 00	
Sun.	26	0h ♁ Stationary in R.A.		
Mon.	27	23h 3m ☌♄ ☾, ♄ 5° 9′ N		
Tues.	28		3 50	
○ Wed.	29	7h 47.5m F.M		
Thur.	30	0h ☿ in ♉		
Fri.	31		0 40	

By reason of the proximity of Jupiter to the Sun the configurations of the satellites are not given from June 27 to August 11.

Explanation of symbols and abbreviations on page 4

THE SKY FOR AUGUST, 1931

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 41m to 10h 37m, and its Decl. decreases from 18° 20′ N., to 8° 43′ N. The equation of time decreases from 6m 15s to 0m 22s. The sun enters Virgo, the third summer sign of the zodiac on the 24th. See p. 17 for changes in the length of day.

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

Mercury on the 15th is in R.A. 11h 9m, Decl. 2° 23′ N., and transits at 13.38. On the 8th it reaches its greatest elongation east and at that time, is about 8° above the western horizon at sunset. After that date it approaches the sun and is not favourably situated for observation.

Venus on the 15th is in R.A. 9h 10m, Decl. 17° 29′ N., and transits at 11.40. It is too close to the sun for observation throughout August.

Mars on the 15th is in R.A. 12h 31m, Decl. 3° 0′ S., and transits at 15.01. It is in Virgo all month. On the 15th it is about 15° above the western horizon at sunset.

Jupiter on the 15th is in R.A. 8h 35m, Decl. 19° 8′ N., and transits at 11.04. It is a morning star in Cancer. On the 15th it rises about 1½ hours before the sun. For the configurations of its satellites see next page, and for their eclipses, etc., see p. 52.

Saturn on the 15th is in R.A. 19h 17m, Decl. 22° 10′ S., and transits at 21.43. At sunset on that date, it is 15° above the southern horizon and in view all night, though rather low in the sky.

Uranus on the 15th is in R.A. 1h 12m, Decl. 6° 55′ N., and transits at 3.42.

Neptune on the 15th is in R.A. 10h 28m, Decl. 10° 21′ N., and transits at 12.56.

AUGUST

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 5h 15m
			h	m	
Sat.	1	14h ☌☿♆, ☿ 1° 13′ S.			
Sun.	2		21	30	
Mon.	3				
Tues.	4	13h 4m ☌♁☾, ♁ 2° 0′ S.			
Wed.	5		18	20	
☾ Thur.	6	11h 27.8m Moon L.Q.; 13h ☌♀♃, ♀ 0° 25′ N.			
Fri.	7				
Sat.	8	9h ☿ Greatest elong. E. 27° 23′	15	10	
Sun.	9	7h ☿ in Aphelion			
Mon.	10				
Tues.	11		12	00	
Wed.	12	14h 30m ☌♃☾, ♃ 4° 12′ S.			3O124
● Thur.	13	1h 31m ☌♀☾, ♀ 3° 18′ S.; 15h 27.0m N.M.			d1O34
Fri.	14	14h 8m ☌♆☾, ♆ 2° 10′ S.	8	50	2O134
Sat.	15	8h 43m ☌☿☾, ☿ 5° 8′ S.			O234*
Sun.	16	23h 57m ☌♂☾, ♂ 0° 41′ N.			1O324
Mon.	17	22h ♀ in Perihelion	5	30	32O14
Tues.	18				312O4
Wed.	19				34O12
☽ Thur.	20	6h 36.3m Moon F.Q.	2	20	41O32
Fri.	21	12h ☿ Stationary in R.A.			42O13
Sat.	22		23	10	4O23*
Sun.	23				41O32
Mon.	24	2h 5m ☌♄☾, ♄ 5° 14′ N.			432O1
Tues.	25		20	00	4321O
Wed.	26				34O12
○ Thur.	27	22h 9.5m F.M.			1O42*
Fri.	28		16	50	2O134
Sat.	29	15h ☿ Greatest Hel. Lat. S.; 16h ☌♆☉			1O34*
Sun.	30				dO324
Mon.	31	13h ☌♀♆, ♀ 0° 42′ N.; 18h 58m ☌♁☾, ♁ 2° 7′ S.	13	40	32O14

Explanation of symbols and abbreviations on page 4

THE SKY FOR SEPTEMBER 1931

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 37m to 12h 25m, and its Decl. changes from 8° 43′ N. to 2° 43′ S. On the 1st the equation of time is 0m 22s, it becomes zero on the 2nd, and then increases in value to 9m 54s. For changes in the length of day, see p. 18. On the 24th the sun crosses the equator going south, and enters Libra, the first autumn zodiacal sign. On the 12th there is a partial eclipse of the sun, invisible here.

The Moon—For its phases and conjunctions with the planets, see opp. page. There is a total eclipse of the moon on the 26th, invisible here.

Mercury on the 15th is in R.A. 10h 30m, Decl. 8° 34′ N., and transits at 10.56. On the 5th it is in inferior conjunction with the sun. It then becomes a morning star and on the 21st reaches its greatest elongation west. On that date it rises about 1½ hours before the sun.

Venus on the 15th is in R.A. 11h 37m, Decl. 4° 3′ N., and transits at 12.05. On the 8th it is in superior conjunction with the sun, and is too close to that body to be observed.

Mars on the 15th is in R.A. 13h 46m, Decl. 10° 58′ S., and transits at 14.12. About the 27th it enters Libra. It is too close to the sun for good observation, setting about 1 hour after the sun on the 15th.

Jupiter on the 15th is in R.A. 9h 2m, Decl. 17° 28′ N., and transits at 9.28. It is a morning star in Cancer. Its magnitude remains practically constant all month, at −1.4. At sunrise on the 15th, Jupiter is about 40° above the eastern horizon. For the configurations of its satellites see next page, and for their eclipses, etc., see p. 53.

Saturn on the 15th is in R.A. 19h 12m, Decl. 22° 21′ S., and transits at 19.37. It is in Sagittarius and rises about 3 hours before sunset on the 15th. Its magnitude is decreasing and at the end of the month is +0.7.

Uranus on the 15th is in R.A. 1h 9m, Decl. 6° 36′ N., and transits at 1.36.

Neptune on the 15th is in R.A. 10h 32m, Decl. 9° 56′ N., and transits at 10.59.

SEPTEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol h	Minima of Algol m	Configurations of Jupiter's Satellites at 5h 0m
Tues.	1				32104
Wed.	2				30124
Thur.	3		10	30	13024
Fri.	4	5h ☌ ☿ ♀, ☿ 5° 45′ S.; 19h ☌ ☿ ☉ Inferior			20413
☾ Sat.	5	2h 21.2m Moon L.Q.			41203
Sun.	6		7	20	40132
Mon.	7	22h ☌ ♀ ☉ Superior			d430*
Tues.	8	21h ♀ Greatest Hel. Lat. N.			43210
Wed.	9	10h 34m ☌ ♃ ☾, ♃ 3° 58′ S.; 15h ☌ ♂ in ♉	4	10	43012
Thur.	10	1h ☌ ☿ Ψ, ☿ 3° 19′ S.			43102
♍ Fri.	11	1h 40m ☌ ☿ ☾, ☿ 5° 5′ S.; 2h 24m ☌ Ψ ☾, Ψ 2° 5′ S.; 23h 26.4m N.M.; Partial eclipse of ☉ invisible at Toronto			42013
Sat.	12	1h 18m ☌ ♀ ☾, ♀ 0° 2′ S.	1	00	41203
Sun.	13	9h ☿ Stationary in R.A.			01423
Mon.	14	16h 16m ☌ ♂ ☾, ♂ 2° 13′ N.	21	40	d024*
Tues.	15				d3204
Wed.	16				30214
Thur.	17	3h ☌ ☿ Ψ, ☿ 0° 56′ S.; 15h ☿ in ♌	18	30	31024
☽ Fri.	18	15h 37.3m Moon F.Q.			20314
Sat.	19				21034
Sun.	20	6h 32m ☌ ♄ ☾, ♄ 5° 17′ N.; 22h ☿ Greatest elong. W. 17° 52′	15	20	01243
Mon.	21	12h ♄ Stationary in R.A.			d1032
Tues.	22	6h ☿ in Perihelion			d4320
Wed.	23	19h 24m ☉ enters ♎ Autumn begins	12	10	4301*
Thur.	24				43102
Fri.	25				42031
♋ Sat.	26	14h 44.9m F.M.; Total eclipse of ☾ invisible at Toronto	9	00	42103
Sun.	27	23h 13m ☌ ♁ ☾, ♁ 2° 3′ S.			40123
Mon.	28				41023
Tues.	29		5	50	2301*
Wed.	30				304**

Explanation of symbols and abbreviations on page 4

THE SKY FOR OCTOBER, 1931

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 25m to 14h 21m and its Decl. from 2° 43′ S. to 14° 3′ S. On the 24th the sun enters Scorpio, the second autumnal sign of the zodiac. The equation of time increases from 9m 54s to 16m 19s (see p. 7). For changes in the length of day see p. 19. On the 11th there is a partial eclipse of the sun, but it is invisible here.

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

Mercury on the 15th is in R.A. 13h 8m, Decl. 5° 58′ S., and transits at 11.39. It is not in good position for observation during October. At the beginning of the month it is a morning star, but is approaching the sun. On the 18th it is in superior conjunction with the sun after which it becomes an evening star.

Venus on the 15th is in R.A. 13h 54m, Decl. 10° 54′ S. and transits at 12.24. It is now an evening star, though too close to the sun for observation.

Mars on the 15th is in R.A. 15h 6m, Decl. 17° 50′ S., and transits at 13.35. At sunset on the 15th it is about 8° above the south-western horizon, in the constellation of Libra.

Jupiter on the 15th is in R.A. 9h 23m, Decl. 15° 59′ N., and transits at 7.51. At the beginning of the month it is in Cancer, but enters Leo about the 12th. On the 15th it rises 5½ hours before the sun. For the configurations of its satellites see next page, and for their eclipses, etc., see p. 53.

Saturn on the 15th is in R.A. 19h 14m, Decl. 22° 21′ S., and transits at 17.41. It is in quadrature on the 11th, and is then on the meridian shortly after sunset. It is in Sagittarius.

Uranus on the 15th is in R.A. 1h 5m, Decl. 6° 9′ N., and transits at 23.30.

Neptune on the 15th is in R.A. 10h 36m, Decl. 9° 35′ N., and transits at 9.04.

OCTOBER

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 4h 30m
			h	m	
	Thur.	1			31024
	Fri.	2 13h ☿ Greatest Hel. Lat. N.	2	40	2014*
	Sat.	3			21034
☾	Sun.	4 15h 15.1m Moon L.Q.	23	30	02134
	Mon.	5			10234
	Tues.	6			23014
	Wed.	7 4h 52m ☌♃☾, ♃ 3° 39′ S.	20	20	32104
	Thur.	8 14h 40m ☌♆☾, ♆ 2° 1′ S.			d3402
	Fri.	9			d401*
	Sat.	10	17	00	42103
●	Sun.	11 0h 23m ☌☿☾, ☿ 2° 21′ N.; 1h □♄ ☉; 8h 5.9m N.M.; Partial eclipse of ☉ invisible at Toronto; 11h ☍♁ ☉			40213
	Mon.	12 1h 19m ☌♀☾, ♀ 3° 7′ N.			41023
	Tues.	13 10h 46m ☌♂☾, ♂ 3° 25′ N.	13	50	42301
	Wed.	14			43210
	Thur.	15			34012
	Fri.	16	10	40	3402*
	Sat.	17 14h 19m ☌♄☾, ♄ 5° 13′ N.			21034
◗	Sun.	18 4h 20.0m Moon F.Q.; 11h ☌☿ ☉ Superior			02134
	Mon.	19	7	30	10234
	Tues.	20			d2014
	Wed.	21			32104
	Thur.	22	4	20	30124
	Fri.	23			3024*
	Sat.	24 4h ♄ in ♉			21043
	Sun.	25 3h 6m ☌♁☾, ♁ 1° 56′ S.; 23h ☿ in ♉	1	10	4013*
○	Mon.	26 8h 33.9m F.M.			41023
	Tues.	27	22	00	42031
	Wed.	28			43210
	Thur.	29			43012
	Fri.	30	18	50	43102
	Sat.	31			d4203

Explanation of symbols and abbreviations on page 4

THE SKY FOR NOVEMBER, 1931

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 21m to 16h 24m and its Decl. from 14° 3′ S. to 21° 37′ S. On the 23rd, the sun enters Sagittarius, the third autumn zodiacal sign. The equation of time rises from 16m 19s to a maximum of 16m 23s on the 4th, and then decreases to 11m 22s at the end of the month (see p. 7). For changes in the length of day see p. 20.

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

Mercury on the 15th is in R.A. 16h 20m, Decl. 23° 28′ S., and transits at 12.48. It is an evening star all month, though not very favourably situated for observation. At sunset on the 15th it is about 5° above the south-western horizon.

Venus on the 15th is in R.A. 16h 29m, Decl. 22° 17′ S., and transits at 12.58. At sunset on that date it is about 7° above the south-western horizon.

Mars on the 15th is in R.A. 16h 38m, Decl. 22° 48′ S., and transits at 13.05. On that date it sets about 1 hour after the sun. It is in Ophiuchus most of the month.

Jupiter on the 15th is in R.A. 9h 37m, Decl. 14° 57′ N., and transits at 6.03. It is in the constellation of Leo, and is quite a conspicuous object. During the month, its magnitude increases from −1.7 to −1.8. On the 15th it is in quadrature with the sun, and on that date rises at 11.00 o'clock at night. For the configurations of its satellites see next page, and for their eclipses, etc., see p. 53.

Saturn on the 15th is in R.A. 19h 22m, Decl. 22° 8′ S., and transits at 15.47. It is in Sagittarius, and sets about 4 hours after the sun on the 15th. Its magnitude is +0.8.

Uranus on the 15th is in R.A. 1h 0m, Decl. 5° 43′ N., and transits at 21.24.

Neptune on the 15th is in R.A. 10h 39m, Decl. 9° 20′ N., and transits at 7.05.

NOVEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol		Configurations of Jupiter's Satellites at 4h 0m
			h	m	
Sun.	1				4O13*
Mon.	2		15	40	1O23*
☾ Tues.	3	2h 17.5m Moon L.Q.; 19h 18m ☌♃☾, ♃ 3° 13′ S.; 23h ☿ in ♉			2O314
Wed.	4				23104
Thur.	5	0h 53m ☌♆☾, ♆ 1° 50′ S.; 5h ☿ in Aphelion	12	20	3O214
Fri.	6				31024
Sat.	7				2O314
Sun.	8		9	10	2O34*
● Mon.	9	17h 55.4m N.M.			1O243
Tues.	10	18h 31m ☌☿☾, ☿ 2° 44′ N.			dO413
Wed.	11	0h 9m ☌♀☾, ♀ 4° 16′ N.; 6h 56m ☌♂♂☾, ♂ 4° 4′ N.	6	00	2341O
Thur.	12				43021
Fri.	13				43102
Sat.	14	2h 1m ☌♄☾, ♄ 5° 1′ N.; 19h □♃☉	2	50	42301
Sun.	15				4203*
☽ Mon.	16	21h 13.4m Moon F.Q.	23	40	d4023
Tues.	17				4O213
Wed.	18	22h ☌♀♂, ♀ 0° 4′ N.			2431O
Thur.	19		20	30	3O241
Fri.	20	20h ☌☿♂, ☿ 1° 39′ S.			31024
Sat.	21	8h 3m ☌♁☾, ♁ 1° 55′ S.			2O14*
Sun.	22		17	20	21034
Mon.	23				dO234
Tues.	24				O1234
♋ Wed.	25	2h 9.9m F.M.; 14h ☿ Greatest Hel. Lat. S.	14	10	21304
Thur.	26				3O14*
Fri.	27				31042
Sat.	28		11	00	43201
Sun.	29				42103
Mon.	30	22h □♆☉			4O123

Explanation of symbols and abbreviations on page 4

THE SKY FOR DECEMBER, 1931

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 24m to 18h 41m and its Decl. from 21° 37′ S. to its maximum value of 23° 27′ S. on the 22nd. It is then at the winter solstice, the sun enters Capricornus and winter begins. From this date on the sun moves slowly northward. The length of daylight is at its minimum and changes very slightly for several days (see p. 21). The equation of time is 11m 22s at the first of the month and drops to zero on the 25th (see p. 7).

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

Mercury on the 15th is in R.A. 18h 24m, Decl. 23° 17′ S., and transits at 12.50. Due to its southerly declination the planet is not in good position for observation. On the 3rd it reaches its greatest elongation east and sets about 1 hour after the sun. On the 21st it is in inferior conjunction with the sun.

Venus on the 15th is in R.A. 19h 13m Decl. 23° 54′ S., and transits at 13.42. It is an evening star, and on the 15th sets about 1¾ hours after the sun.

Mars on the 15th is in R.A. 18h 16m, Decl. 24° 17′ S., and transits at 12.45. It is too close to the sun for observation during the month. It is in the constellation of Sagittarius.

Jupiter on the 15th is in R.A. 9h 41m, Decl. 14° 45′ N., and transits at 4.09. On that date it rises about 9.20 in the evening and is a brilliant object in Leo. By the end of the month its magnitude has increased to −2.0. For the configurations of its satellites see next page, and for their eclipses, etc., see p. 53.

Saturn on the 15th is in R.A. 19h 34m, Decl. 21° 44′ S., and transits at 14.02. It is approaching the sun and on the 15th sets about 2 hours after sunset.

Uranus on the 15th is in R.A. 0h 58m, Decl. 5° 30′ N., and transits at 19.24.

Neptune on the 15th is in R.A. 10h 40m, Decl. 9° 17′ N., and transits at 5.08.

DECEMBER

ASTRONOMICAL PHENOMENA

(75th Meridian Civil Time)

			Minima of Algol	Configurations of Jupiter's Satellites at 3h 30m
			h m	
Tues.	1	4h 36m ☌♃☾, ♃ 2° 45′ S.	7 50	4O23*
☾ Wed.	2	8h 6m ☌♆☾, ♆ 1° 33′ S.; 11h 50.5m Moon L.Q.; 22h ☿ Greatest elong. E. 21° 19′.		d421O
Thur.	3			43O1*
Fri.	4		4 30	34102
Sat.	5			32O1*
Sun.	6			21043
Mon.	7		1 20	O1243
Tues.	8	7h ♀ in Aphelion.		O234*
♍ Wed.	9	5h 16.0m N.M.; 22h ♃ Stationary in R.A.	22 10	d2O34
Thur.	10	4h 38m ☌☌☾, ☌ 4° 10′ N.; 14h 48m ☌☿☾, ☿ 3° 55′ N.		32O14
Fri.	11	0h 10m ☌♀☾, ♀ 3° 34′ N.; 10h ♆ Stationary in R.A. 14h ☿ Stationary in R.A.; 16h 30m ☌♄☾, ♄ 4° 45′ N.		31O24
Sat.	12		19 00	d3O14
Sun.	13			21O34
Mon.	14	15h ☿ in ♌		4O213
Tues.	15		15 50	41O23
☽ Wed.	16	0h ☌☿☌, ☿ 1° 20′ N.; 17h 42.9m Moon F.Q.		42O13
Thur.	17			432O1
Fri.	18	14h 56m ☌♇☾, ♇ 2° 6′ S.	12 40	43102
Sat.	19	5h ☿ in Perihelion; 6h ☌♀♄, ♀ 1° 32′ S.		43021
Sun.	20			42103
Mon.	21	4h ☌☿☉ Inferior.	9 30	4O213
Tues.	22	14h 30m ☉ enters ♑, Winter commences.		14023
Wed.	23			2O134
♑ Thur.	24	18h 23.5m F.M.	6 20	32O4*
Fri.	25	19h ♇ Stationary in R.A.		31O24
Sat.	26			3O214
Sun.	27		3 10	21O4*
Mon.	28	9h 32m ☌♃☾, ♃ 2° 25′ S.		O134*
Tues.	29	12h ☿ Greatest Hel. Lat. N.; 13h 31m ☌♆☾, ♆ 1° 15′ S.	23 50	1O243
Wed.	30	19h ♀ Greatest Hel. Lat. S.		2O143
☾ Thur.	31	13h ☿ Stationary in R.A.; 20h 23.1m Moon L.Q.		2341O

Explanation of symbols and abbreviations on page 4

PHENOMENA OF JUPITER'S SATELLITES, 1931

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.
1	5	49	II	SI	16	22	21	III	OD
	6	5	II	TI	17	2	46.7	III	ER
2	19	10	III	OR		5	23	II	OD
3	0	46.3	II	ED	18	5	58	I	OD
	3	43	II	OR		23	43	II	TI
	5	17	I	SI	19	0	22	II	SI
	5	22	I	TI		2	31	II	Te
4	2	0.7	IV	ED		3	10	II	Se
	2	27	I	ED		3	15	I	TI
	4	47	I	OR		3	34	I	SI
	5	30	IV	OR		5	30	I	Te
	19	7	II	SI		5	50	I	Se
	19	13	II	TI	20	0	25	I	OD
	21	56	II	Se		3	1.8	I	ER
	22	1	II	Te		18	30	II	OD
	23	46	I	SI		19	34	IV	OR
	23	48	I	TI		20	1.6	IV	ED
5	2	1	I	Se		21	41	I	TI
	2	3	I	Te		21	59.2	II	ER
	20	55.7	I	ED		22	3	I	SI
	23	13	I	OR		23	42	IV	ER
6	5	37	III	SI		23	56	I	Te
	5	39	III	TI	21	0	18	I	Se
	18	14	I	SI		18	51	I	OD
	18	14	I	TI		21	30.5	I	ER
	20	29	I	Te	22	18	22	I	Te
	20	30	I	Se		18	47	I	Se
7	17	40.7	I	ER	24	1	39	III	OD
9	19	4	III	OD	26	2	0	II	TI
	22	45.8	III	ER		2	59	II	SI
10	3	10	II	OD		4	48	II	Te
	6	7.1	II	ER		4	59	I	TI
11	4	14	I	OD	27	2	9	I	OD
	6	38.1	I	ER		4	56.9	I	ER
11	21	28	II	TI	27	18	47	III	Te
	21	44	II	SI		20	45	II	OD
12	0	16	II	Te		20	57	III	Se
	0	33	II	Se		23	26	I	TI
	1	31	I	TI		23	57	I	SI
	1	40	I	SI	28	0	33.9	II	ER
	3	47	I	Te		1	41	I	Te
	3	55	I	Se		2	12	I	Se
	22	40	I	OD		20	36	I	OD
13	1	6.9	I	ER		23	25.7	I	ER
	19	24.4	II	ER	29	0	28	IV	TI
	19	57	I	TI		3	23	IV	Te
	20	8	I	SI		18	26	I	SI
	22	13	I	Te		19	7	II	Se
						20	7	I	Te
	22	24	I	Se		20	41	I	Se
14	19	35.6	I	ER	31	4	59	III	OD

FEBRUARY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
2	4	18	II	TI	13	21	45.2	I	ER
3	3	55	I	OD	14	18	20	IV	Te
	18	50	III	TI		18	48.8	III	ER
	21	34	III	SI		18	59	I	Se
	22	9	III	Te		19	1.3	II	ER
	23	1	II	OD		23	34	IV	SI
4	0	56	III	Se	15	2	50	IV	Se
	1	11	I	TI	18	1	45	III	TI
	1	52	I	SI		3	39	II	OD
	3	8.8	II	ER	19	1	56	I	OD
	3	26	I	Te		22	12	II	TI
	4	7	I	Se		23	12	I	TI

FEBRUARY—*Continued*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
4	22	21	I	OD	20	0	10	I	SI
5	1	20.9	I	ER		0	11	II	SI
	18	55	II	SI		0	59	II	Te
	19	38	I	TI		1	26	I	Te
	20	15	II	Te		2	25	I	Se
5	20	20	I	SI	20	3	0	II	Se
	21	44	II	Se		20	24	I	OD
	21	52	I	Te		23	40.6	I	ER
	22	35	I	Se	21	18	38	I	SI
6	19	49.8	I	ER		18	42	III	OR
10	22	16	III	TI		19	24	III	ED
11	1	19	II	OD		19	54	I	Te
	1	34	III	SI		20	53	I	Se
	1	34	III	Te		21	36.4	II	ER
	2	57	I	TI		22	49.3	III	ER
	3	46	I	SI	22	22	26	IV	OD
12	0	8	I	OD	23	1	25	IV	OR
					27	0	38	II	TI
	3	16.2	I	ER		1	1	I	TI
	19	48	II	TI		2	4	I	SI
						2	49	II	SI
	21	24		TI		3	15	I	Te
	21	33	II	SI		22	13	I	OD
					28	1	36.1	I	ER
	22	15	I	SI		18	58	III	OD
	22	36	II	Te		19	14	II	OD
						19	28	I	TI
	23	39	I	Te		20	33	I	SI
13	0	22	II	Se		21	43	I	Te
						22	19	III	OR
	0	30	I	Se		22	48	I	Se
	18	35	I	OD		23	24.1		ED

MARCH

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	0	11.5	II	ER	16	21	24	II	SI
	2	50	III	ER		21	41	II	Te
	20	4.9	I	ER	17	0	14	II	Se
2	18	58	II	Se	18	19	50	III	Te
3	20	59	IV	Se		21	32	III	SI
7	0	4	I	OD	19	0	58	III	Se
	21	19		TI	20	0	2	IV	TI
	21	40	II	OD	22	1	3	I	TI
	22	28	I	SI		22	17	I	OD
	22	40	III	OD	23	19	31	I	TI
	23	33	I	Te		20	46	I	SI
8	0	43	I	Se		21	28	II	TI
	2	1	III	OR		21	46	I	Te
	22	0.5	I	ER		23	1	I	Se
9	18	46	II	SI	24	0	2	II	SI
	19	9	II	Te		0	15	II	Te
	19	11	I	Se		20	20.7	I	ER
	21	36	II	Se	25	20	24	III	TI
11	20	57	III	Se		21	15.3	II	ER
12	2	9.5	IV	ED		23	43	III	Te
14	1	56	I	OD	26	1	32	III	SI
	23	10	I	TI	28	20	13.1	IV	ED
15	0	8	II	OD		23	53	IV	ER
	0	23	I	SI	30	0	12	I	OD
	1	25	I	Te		21	25	I	TI
	20	24	I	OD		22	41	I	SI
	23	56.1	I	ER		23	40	I	Te
16	18	51	I	SI	31	0	4	II	TI
	18	53	II	TI		0	56	I	Se
	19	53	I	Te		22	16.3	I	ER
	21	6	I	Se					

APRIL

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	19	25	I	Se	15	22	0	I	Te
	23	50.8	II	ER		23	15	I	Se
2	0	22	III	TI		23	42	II	OD
5	19	25.6	III	ED	16	20	36.2	I	ER
	20	56	IV	Te	17	21	14	II	SI
	22	54.6	III	ER		21	30	II	Te
6	23	20	I	TI	18	0	5	II	Se
7	0	36	I	SI	19	22	24	III	OD
	20	37	I	OD	22	21	42	I	TI
8	0	11.8	I	ER		22	55	I	SI
8	20	4	I	Te		23	39	IV	SI
	21	5	II	OD	23	21	0	III	Se
	21	20	I	Se		22	31.6	I	ER
10	21	27	II	Se	24	19	39	I	Se
12	21	40	III	OR		21	25	II	TI
	23	25.5	III	ED	26	20	55.9	II	ER
					30	20	11	III	Te
14	22	33	I	OD		20	58	I	OD
15	19	45	I	TI		21	13	IV	OD
	21	0	I	SI		21	32	III	SI

MAY

1	20	25	I	Te	17	19	53	I	Se
	21	34	I	Se		20	22	IV	OR
7	21	2	III	TI	19	21	2	II	SI
	22	58	I	OD		21	52	II	Te
8	20	8	I	TI	23	21	27	I	OD
	21	14	I	SI	24	20	52	I	Te
	22	23	I	Te		21	48	I	Se
9	20	51.2	I	ER	26	21	50	II	TI
	21	33	IV	Se	28	20	38.3	II	ER
10	21	7	II	OD	31	20	37	I	TI
12	21	16	II	Se		21	27	I	SI
15	22	7	I	TI					

JUNE

1	21	5.2	I	ER	9	20	8	I	Se
3	20	27.6	IV	ED	13	21	1	II	Se
5	21	3	III	Se					

AUGUST

13	4	43	II	TI	22	4	53	II	OR
20	4	35	III	OR	23	4	39	I	Te
					30	4	22	I	TI
22	4	42.3	I	ED	31	3	57	I	OR

SEPTEMBER

4	4	7	IV	Se	15	5	11	I	Te
7	3	46	III	Te	21	5	18	III	SI
	3	57	II	Se	22	3	59	I	SI
14	3	39	II	SI		4	52	I	TI
	4	31	III	TI	23	4	24	I	OR
	4	51.2	I	ED	29	3	37.7	IV	ED
	4	56	III	Se	30	3	6.1	I	ED
	5	12	II	TI		3	23.3	II	ED
15	4	22	I	Se					

OCTOBER

1	2	39	I	Se	16	5	24	II	TI
	3	39	I	Te	17	2	4	I	Te
2	2	43.6	III	ER	18	3	11	II	OR
	2	52	II	Te	20	1	56	III	TI
	3	11	III	OD		5	34	III	Te
7	4	59.3	I	ED	23	3	13.7	I	ED
8	2	12	IV	Te		5	42	II	SI
	2	15	I	SI	24	1	43	I	TI
	3	19	I	TI		2	49	I	Se
	4	33	I	Se		4	0	I	Te
	5	37	I	Te		5	32	IV	SI
9	2	43	II	TI	25	1	12	I	OR
	2	50	I	OR		5	53	II	OR

OCTOBER—*Continued*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
	3	3.2	III	ED	27	1	10	III	SI
	3	27	II	Se		4	47	III	Se
	5	34	II	Te	30	5	6.8	I	ED
15	4	9	I	SI	31	2	25	I	SI
	5	17	I	TI		3	39	I	TI
16	3	9	II	SI		4	42	I	Se
	4	46	I	OR		5	55	I	Te

NOVEMBER

1	3	5.4	II	ED	16	4	13	I	Te
	3	7	I	OR	17	1	23	I	OR
2	2	32	IV	OD		2	40	II	SI
3	2	50	II	Te		5	9	II	TI
	5	8	III	SI		5	30	II	Se
7	3	39	III	OR	19	1	35	IV	OR
	4	19	I	SI		3	4	II	OR
	5	34	I	TI	21	2	49.9	III	ED
8	1	28.1	I	ED	22	5	14.1	I	ED
	5	1	I	OR	23	2	34	I	SI
	5	41.2	II	ED		3	48	I	TI
9	1	4	I	Se		4	51	I	Se
	2	19	I	Te		6	5	I	Te
10	2	36	II	TI		23	42.4	I	ED
	2	56	II	Se	24	3	15	I	OR
	4	7	IV	Se		5	12	II	SI
	5	25	II	Te		23	20	I	Se
12	0	29	II	OR	25	0	33	I	Te
14	2	31.3	III	ER		1	40	III	Te
	4	0	III	OD	26	0	10.7	II	ED
	6	12	I	SI		5	36	II	OD
15	3	21.1	I	ED	27	4	52	IV	TI
16	0	41	I	SI		23	45	II	Te
	1	56	I	TI	30	4	28	I	SI
	2	58	I	Se		5	40	I	TI

DECEMBER

1	1	35.5	I	ED	16	6	4	I	Te
	5	6	I	OR		23	50.2	I	ED
	22	56	I	SI	17	3	12	I	OR
2	0	8	I	TI		22	14	I	TI
	0	37	III	Se		23	29	I	Se
	1	13	I	Se	18	0	31	I	Te
	1	52	III	TI	19	2	10	II	SI
	2	25	I	Te		4	14	II	TI
	5	28	III	Te		5	1	II	Se
	23	33	I	OR		22	20.1	III	ER
3	2	46.2	II	ED		22	52	III	OD
4	23	23	II	TI	20	2	29	III	OR
	23	54	II	Se	21	2	10	II	OR
5	2	14	II	Te	22	1	26.4	IV	ER
	2	35.6	IV	ED		6	9	IV	OD
7	6	21	I	SI	23	4	36	I	SI
8	3	28.6	I	ED		5	35	I	TI
9	0	50	I	SI		6	54	I	Se
	0	59	III	SI	24	1	43.5	I	ED
	1	58	I	TI		5	0	I	OR
	3	7	I	Se		23	5	I	SI
	4	15	I	Te	25	0	2	I	TI
	4	36	III	Se		1	22	I	Se
	5	37	III	TI		2	19	I	Te
10	1	23	I	OR		23	26	I	OR
	5	21.5	II	ED	26	4	44	II	SI
	22	42	I	Te		6	36	II	TI
11	23	36	II	SI		22	38.6	III	ED
12	1	49	II	TI	27	2	18.2	III	ER
	2	27	II	Se		2	24	III	OD
	4	40	II	Te		6	2	III	OR
	22	53	III	OR		23	49.2	II	ED
13	23	46	II	OR	28	4	32	II	OR
14	2	21	IV	Te	29	22	37	II	Te
15	5	21.9	I	ED	30	5	18	IV	SI
16	2	43	I	SI		6	30	I	SI
	3	47	I	TI	31	3	37	I	ED
	4	56	III	SI		6	46	I	OR
	5	0	I	Se					

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

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

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 includes five classes, two of which are subdivided, as follows:—

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

Name	Limiting Mags.	Period	Class	Discoverer
		d. h. m.		
U Cephei	7.0– 9.2	2 11 49.6	V.	W. Ceraski....1880
o Ceti	1.7– 9.5	331.7	II.	Fabricius....1596
p 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 SUN'S NEIGHBOURS—STARS NEARER THAN FIVE PARSECS

This table includes all stars known to be nearer than five Parsecs = 16.3 l−y. The apparent magnitudes *m*, and type are taken from Luyten's Study of the Nearby Stars, H.A. *85*, 73. The parallaxes, π, and proper motions, μ, are taken from Schlesinger's Catalogue of Parallaxes. M is the absolute magnitude and L the luminosity, the Sun being taken as unity. Sirius A, Procyon A and Altair are the only giant stars, the remainder being dwarfs. Wolf 359, the fifth star nearest the Sun, is intrinsically the faintest star known. It is also noteworthy that fifty per cent. of the stars are members of binary systems.

Name	(1900)α		(1900)δ		m	Type	π	μ	M	L
	h	m	°	′			″	″		
Sun.....					−26.7	Go			4.8	1.00
Prox. Cen.....	14	22.8	−62	15	11.2	M(?)	0.765	3.76	15.6	.00005
αCen. A.....	14	32.8	−60	25	0.3	G2	.758	3.68	4.7	1.10
αCen. B.....	14	32.8	−60	25	1.7	K3	.760	3.68	6.1	0.30
Barnard.....	17	52.9	+ 4	25	9.7	Mb	.538	10.30	13.3	.0004
Wolf 359.....	10	51.6	+ 7	36	13.5	M4e	.404	.....	16.5	.00002
L1 21185.....	10	57.9	+36	38	7.6	Mb	.392	4.78	10.6	.005
Sirius A.....	6	40.7	−16	35	−1.6	A0	.371	1.32	1.2	28.
Sirius B.....	6	40.7	−16	35	8.4	F	.371	.....	11.2	.0028
B.D.−12.4523	16	24.8	−12	24	9.5	M5	.349	.....	12.2	.001
Innes.....	11	12.0	−57	02	12	.....	.340	2.69	14.7	.0001
C.Z.−5h243..	5	7.7	−44	59	9.2	K2	.317	8.75	11.7	.002
τCet.....	1	39.4	−16	28	3.6	K0	.315	1.92	6.1	.30
Procyon A....	7	34.1	+ 5	29	0.5	F5	.312	1.24	3.0	5.2
Procyon B....	7	34.1	+ 5	29	12.5	.....	.312	.....	15.0	.00008
ϵEri.....	3	28.2	− 9	48	3.8	K0	.310	.97	6.3	.25
61 Cyg. A.....	21	02.4	+38	15	5.6	K7	.300	5.20	8.0	.052
61 Cyg. B.....	21	02.4	+38	15	6.3	K8	.300	5.20	8.7	.028
Lac 9352.....	22	59.4	−36	26	7.1	Ma	.292	6.90	9.4	.014
Bu 8798A.....	18	41.7	+59	29	9.3	Mb	.287	2.31	11.6	.002
Bu 8798B.....	18	41.7	59	29	10.0	Mb	.287	.....	12.3	.001
Grmb 34A....	0	12.7	+43	27	8.1	Ma	.282	2.89	10.3	.006
Grmb 34B....	0	12.7	+43	27	10.7	Mb	.282	.....	12.9	.0006
ϵ Indi.....	21	55.7	−57	12	4.7	K5	.281	4.70	6.9	.14
Kruger 60A...	22	24.4	+57	12	9.6	Mb	.257	.87	11.6	.002
Kruger 60B...	22	24.4	+57	12	11.3	.....	.....	.....	13.3	.0004
van Maanen..	0	43.9	+ 4	55	12.3	Fo	.255	3.01	14.3	.0002
Lac 8760.....	21	11.4	−39	15	6.6	Ma	.253	3.53	8.6	.030
Anon.....	2	50.3	+52	05	9.2	.....	.239	0.49	11.1	.003
Gould 32416..	23	59.5	−37	15	8.2	Ma	.220	6.11	9.9	.009
Oe. Arg. 17415	17	37.0	+68	26	9.1	Mb	.213	1.33	10.7	.004
+20.2465....	10	14.2	+20	22	9.2	Ma	.207	.49	10.8	.004
Altair.....	19	45.9	+ 8	36	0.9	A5	.204	.66	2.4	9.1
o^2Eri A.....	4	10.7	− 7	49	4.5	G5	.203	4.08	6.0	.33
o^2Eri B.....	4	10.7	− 7	49	9.7	Ao	.203	4.08	11.2	.003
o^2Eri C.....	4	10.7	− 7	49	10.8	Mb	.203	4.08	12.3	.001

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 tnird 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	° ′			″	″			k m./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	.....*
ο 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	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′							km./sec.
α **Tauri**	4 30	+16 18	1.1	K5	.205	.057 s	57	−0.1	+54.5
α Doradus	32	−55 15	3.5	A0p	.003	.....	.....	.....	+26.
π^3 Orionis	44	+ 6 47	3.3	F8	.474	.136 s	24	4.0	+24.7
ι Aurigae	50	+33 0	2.9	K2	.030	.018 s	181	−0.8	+18.5
ε Aurigae	55	+43 41	3.4–4.1	F5p	.015	.002 s	1630	−5.0	− 9. *
η Aurigae	5 0	+41 6	3.3	B3	.082	.014 s	233	−1.0	+ 3.0
ε Leporis	1	−22 30	3.3	K5	.074	.022 s	148	0.0	+ 1.1
β Eridani	3	− 5 13	2.9	A3	.117	.052 s	63	1.5	− 8.
μ Leporis	8	−16 19	3.3	A0p	.053	.....	.....	.....	+28.0
‖α **Aurigae**	9	+45 54	0.2	G0	.439	.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 22	2.4	B0	.006	.009 s	362	−2.8	+17.6*
α Leporis	28	−17 54	2.7	F0	.006	.014 s	233	−1.6	+24.6
‖ι Orionis	31	− 5 59	2.9	Oe5	.000	.....	.....	.....	+21.3*
ε Orionis	31	− 1 16	1.8	B0	.004	.005 s	652	−3.7	+26.3
ζ Tauri	32	+21 5	3.0	B3p	.028	−.001 s	3260:	−7.2	+16.4*
‖ζ Orionis	36	− 2 0	1.8	B0	.012	−.019 s	3260:	−8.2	+17.9
α Columbae	36	−34 8	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
||α^2 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 Ophiuchi	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 50	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

OCCULTATION OF STARS BY THE MOON, 1931

The following predictions have been prepared for Ottawa and Toronto but can be used within a radius of three hundred miles from either place by application of the formula

E.S.T. (for place of observation)
$=$E.S.T. (as given for Ottawa, or Toronto) $+a\Delta\lambda+b\Delta\phi$,

where $\Delta\lambda$ and $\Delta\phi$ are the differences between the longitude and latitude of the place of observation and Ottawa or Toronto in degrees. The values of a and b are given in minutes in the list of predictions. The longitude of Ottawa is 75°.7. and its latitude 45°.4. The longitude of Toronto is 79°.4 and its latitude 43°.7, If you desire to find the time any star will be occulted for a station near Ottawa subtract its longitude and latitude from 75°.7 and 45°.4 respectively. This will give $\Delta\lambda$ and $\Delta\phi$. From the predictions for Ottawa for the star in question look for the a and b and form the products $a\times\Delta\lambda$ and $b\times\Delta\phi$. Add these to the predicted times for Ottawa and you will obtain approximately the times of immersion and emersion for the place. If the place is near Toronto you would work in the same way, save that you would find $\Delta\lambda$ and $\Delta\phi$ by taking the longitude and latitude from 79°.4 and 43°.7, and you would also take a and b from the table of predictions for Toronto. If the place lies between Ottawa and Toronto you might work from either centre and would obtain the same result within a minute or so. The predictions are given for both immersion and emersion, but it is particularly desirable to obtain the time of disappearance. The angle P which gives the point of disappearance or reappearance is measured on the limb of the moon eastward from the north point.

When the occultation takes place near a tangent to the moon and is nearly a grazing contact, the predictions are a little uncertain and differ considerably from place to place on the earth's surface. In these cases the a and b are not computed. The international abbreviations for the constellation names have been used throughout.

OCCULTATIONS VISIBLE AT OTTAWA

By R. M. MOTHERWELL

Date 1931		Star	Mag.	Immersion				Emersion			
				E. S. T.	*a*	*b*	P	E. S. T.	a	b	P
				h m	m	m	°	h m	m	m	°
Jan.	8	*l* Leo	5.2	00 52	−0.9	−0.6	140	01 59	−1.5	+0.2	284
"	24	Uranus	6.2	20 09	−1.4	+0.8	35	21 14	−0.5	−1.3	262
"	28	36 Tau	5.6	21 47	−1.5	−1.2	95	22 58	−1.1	−0.1	238
"	30	136 Tau	4.6	15 23	+0.1	+1.4	79	16 20	−0.2	+1.5	259
Feb.	5	σ Leo	4.2	01 16	0.0	−3.1	183	01 58	−2.6	+1.2	252
"	8	621 B Vir	6.4	04 28	−1.7	−0.1	106	05 40	−1.1	−1.3	324
"	10	31 B Sco	5.4	05 21	.....	.....	49	05 53	.....	.....	2
"	24-5	104 B Tau	5.5	23 32	−0.4	−0.1	46	00 19	+0.5	+1.9	296
"	26	107 B Aur	6.5	19 33	.....	.....	145	20 15	.....	.....	207
"	27	49 Aur	5.1	17 21	−1.1	+1.1	87	18 36	−1.5	+0.7	267
"	27	54 Aur	5.8	20 00	.....	.....	24	20 28	.....	.....	344
Mar.	1	4 Cnc	6.2	04 13	.....	.....	44	04 35	.....	.....	351
"	31-										
Apr.	1	σ Leo	4.2	23 32	−0.9	−0.2	146	00 38	−1.4	−0.9	290
"	4	40 H Virg	5.1	03 56	−1.0	−1.6	138	04 59	−0.9	−1.4	276
"	6	48 B Sco	4.9	02 20	−1.3	−0.7	137	03 29	−1.7	−0.6	261
"	8	W Sgr	4.3	02 29	−0.7	+0.2	133	03 33	−1.9	+1.1	243
"	9	183 B Sgr	6.2	04 48	−1.8	+1.0	52	06 03	−2.1	−0.3	294
"	23-4	47 Gem	5.6	23 19	+0.5	−1.9	136	00 02	+0.1	−0.9	251
"	24	ω Cnc	6.1	17 52	−1.6	−1.1	119	19 10	−1.6	−0.5	280
"	28-9	β Vir	3.8	23 04	−0.4	−2.1	163	00 00	−1.2	−1.0	273
May	8	40 B Cap	6.2	02 08	−1.0	+1.0	110	03 14	−1.5	+1.7	222
"	9	33 Cap	5.3	02 46	−1.1	+1.6	74	04 06	−1.5	+1.4	243
"	19	136 Tau	4.6	21 41	+0.5	−1.1	103	22 30	+0.5	−0.8	265
"	20	49 Aur	5.1	12 28	−1.3	+1.0	86	13 47	−1.7	+0.3	271
"	28	621 B Vir	6.4	18 48	−1.1	+1.0	95	19 46	−0.4	−0.8	335
"	28-9	40 H Vir	5.1	23 11	−1.1	−1.4	144	00 17	−1.3	−1.1	275
June	2	183 B Sgr	6.2	22 01	0.0	+0.3	133	22 54	−1.6	+2.1	229
"	18	λ Cnc	5.9	13 00	−1.5	−0.5	120	14 17	−1.7	−0.1	277
July	1-2	56 B Cap	6.3	23 14	−1.4	+2.2	27	00 09	−1.8	+0.3	298
"	18	χ Leo	4.6	21 00	−0.1	−1.3	76	21 39	+0.2	−2.0	340
"	20	319 B Vir	6.3	21 12	−0.9	+1.1	61	21 44	−0.3	−2.7	357

OCCULTATIONS VISIBLE AT OTTAWA—*continued*

Date 1931	Star	Mag.	Immersion				Emersion			
			E. T. S.	*a*	*b*	P	E. T. S.	*a*	*b*	P
			h m	m	m	°	h m	m	m	°
Aug. 4	171 B Psc	6.3	02 55	−1.9	+1.1	78	04 08	+0.7	+2.1	201
" 7	ζ Ari	4.8	01 17	−0.1	+0.7	65	02 20	−0.4	+0.9	239
" 10	415 B Tau	6.1	00 31	+0.2	+0.3	130	01 04	+0.8	+1.7	216
" 11	47 Gem	5.6	03 28	−0.2	+0.0	125	04 13	+0.2	+0.2	234
" 22	W Sgr	4.3	18 15	−1.6	+0.5	115	19 32	−1.9	+0.3	253
" 23	183 Sgr	6.2	20 27	−1.8	+0.2	89	21 50	−1.7	−0.1	250
" 30	80 B Psc	6.3	03 35	−1.5	−0.3	72	04 46	−0.6	+0.7	212
" 31	147 B Psc	5.9	04 34	−2.0	−2.0	101	05 27	−0.3	+2.4	187
Sept. 4	27 Tau	3.7	01 33	.....	.....	13	02 20	.....	.....	293
" 5	107 B Aur	6.5	23 09	+0.3	+0.9	102	23 57	+0.5	+1.7	236
" 8	*c* Gem	5.5	02 02	−0.1	+0.7	120	02 51	+0.1	+2.0	247
" 21	56 B Cap	6.3	19 22	.....	.....	9	20 07	.....	.....	306
" 24	50 Aqr	5.9	01 21	−0.7	−0.1	52	02 30	−0.3	−0.4	238
Oct. 1	χ Tau	5.3	22 33	−0.1	+1.6	79	23 34	−0.3	+2.0	237
" 3	354 B Tau	6.4	00 11	+0.2	+2.7	32	01 01	−1.5	+0.4	296
" 6	λ Cnc	5.9	01 26	−0.1	+1.0	102	02 26	−0.4	+1.2	275
" 29	χ Tau	5.3	06 52	+0.3	−3.6	139	07 30	−0.9	+0.6	212
Nov. 14	A Sgr	4.9	15 22	.....	.....	3	15 50	.....	.....	326
" 17	82 B Aqr	6.2	16 05	.....	.....	354	16 39	.....	.....	302
" 28	*c* Gem	5.5	22 35	−0.5	+1.1	98	23 43	−1.0	+1.2	272
Dec. 3	89 Leo	5.7	08 43	−1.3	−1.3	108	09 48	−0.5	−1.9	327
" 22	23 Tau	4.3	04 45	.....	.....	26	05 14	.....	.....	318
" 22	χ Tau	5.3	18 19	−0.6	+1.6	79	19 27	−0.7	+2.0	236
" 27	γ Cnc	4.7	08 18	+0.1	−1.7	116	09 10	+0.3	−1.4	290
" 28	34 Leo	6.4	21 22	−0.3	−1.2	163	21 57	+0.1	+3.0	239

OCCULTATIONS VISIBLE AT TORONTO

By R. K. YOUNG

Date 1931	Star	Mag.	Immersion				Emersion			
			E. S. T. h m	a m	b m	P °	E. S. T. h m	a m	b m	P °
Jan. 8	l Leo	5.2	0 50	−0.9	−1.2	149	1 53	−1.6	+0.7	274
" 24	Uranus	.....	20 05	−0.8	+0.7	38	21 13	−0.7	−1.0	256
" 28	36 Tau	5.6	21 43	−1.7	−1.5	102	22 53	−1.5	+0.6	230
Feb. 5	σ Leo	4.2	1 29	.....	.....	208	1 39	.....	.....	227
" 8	621 B Vir	6.4	4 22	−1.5	−0.3	115	5 37	−1.3	−1.1	316
" 10	31 B Sco	5.4	5 06	−2.6	+1.6	65	5 55	−1.1	−2.4	347
" 24	104 B Tau	5.5	23 30	−0.4	−0.4	56	0 23	−0.4	−0.9	286
" 26	107 B Aur	6.5	19 36	.....	.....	160	19 56	.....	.....	188
" 27	49 Aur	5.1	17 16	.....	.....	86	18 29	.....	.....	264
" 27	54 Aur	5.8	19 23	−1.8	+1.5	66	20 44	−1.8	−1.6	301
Mar. 1	4 Cnc	6.2	4 08	+0.3	−1.4	101	4 58	+0.2	−0.7	249
" 5	β Vir	3.8	2 16	.....	.....	193	2 48	.....	.....	246
" 24	χ Tau	5.3	20 44	−1.3	0.0	54	21 41	0.0	−2.1	295
" 31	σ Leo	4.2	23 46	−1.2	−1.4	131	00 55	−1.1	−1.6	306
Apr. 4	40 H Vir	5.1	3 54	−1.1	−1.5	142	4 58	−1.1	−1.3	274
" 5	40 B Sco	5.4	23 07	.....	.....	48	23 32	.....	.....	0
" 6	48 B Sco	4.9	02 03	.....	.....	173	02 42	.....	.....	235
" 9	183 B Sgr	6.2	04 39	−2.0	+1.3	56	05 55	−2.0	−0.6	293
" 23	47 Gem	5.6	23 24	+0.6	−2.2	146	00 04	0.0	−0.7	243
" 28	β Vir	3.8	23 06	−0.2	+2.4	173	23 55	−1.8	−0.9	263
" 29	27 B Vir	6.5	03 32	0.0	−1.8	133	04 23	+0.2	−1.4	284
May 8	40 B Cap	6.2	02 03	−0.8	+0.8	114	03 05	−1.6	+2.4	220
" 9	33 Cap	5.3	02 39	−1.0	+1.7	76	03 57	+1.5	+2.0	243
" 28	40 H Vir	5.1	23 09	−1.0	−1.5	151	00 13	−1.6	−1.0	271
July 1	56 B Cap	6.3	23 04	−1.5	+2.3	32	00 02	−1.6	+0.4	297
" 10	36 Ari	6.5	01 57	.....	.....	140	02 10	.....	.....	163
" 18	χ Leo	4.6	21 01	−0.2	−1.3	81	21 43	+0.2	−2.0	338
" 20	319 B Vir	6.3	21 10	.....	.....	67	21 47	.....	.....	354
Aug. 4	171 B Psc	6.3	02 46	−1.7	+1.4	74	03 53	−0.8	+2.2	204

OCCULTATIONS VISIBLE AT TORONTO—*continued*

Date 1931	Star	Mag.	Immersion				Emersion			
			E. S. T.	*a*	*b*	*P*	E. S. T.	*a*	*b*	*P*
			h m	m	m	°	h m	m	m	°
Aug. 7	ζ Ari	4.8	1 13	0.0	+1.8	62	2 16	−0.4	+1.9	242
" 8	36 Tau	5.6	0 05	.....	.....	128	0 33	.....	.....	193
" 11	47 Gem	5.6	3 27	−0.2	+0.5	124	4 11	+0.4	+2.0	234
" 20	65 B Sco	5.5	19 33	−1.9	−0.6	95	20 52	−1.6	−1.4	294
" 23	W Sgr	4.3	18 10	−1.2	+0.4	122	19 23	−2.0	+0.8	250
" 23	183 B Sgr	6.2	20 18	−1.9	+0.5	90	21 43	−1.8	0.0	250
" 30	80 B Psc	6.3	03 29	−1.7	−0.1	71	04 42	−0.7	+1.0	210
" 31	147 B Psc	5.9	04 30	.....	.....	100	05 21	.....	.....	183
Sept. 4	27 Tau	3.7	01 30	.....	.....	10	02 12	.....	.....	296
" 8	*c* Gem	5.5	02 00	0.0	+0.4	120	02 49	+0.2	+1.8	246
" 21	56 B Cap	6.3	19 14	.....	.....	10	19 49	.....	.....	309
" 24	50 Aqr	5.9	01 19	−0.8	0.0	52	07 29	−0.5	−0.3	237
Oct. 1	χ Tau	5.3	22 29	−0.1	+1.6	77	23 30	−0.2	+2.0	239
" 3	354 B Tau	6.4	00 08	+0.5	+2.7	30	00 55	−1.4	+0.4	298
" 6	λ Cnc	5.9	01 24	0.0	+1.0	103	02 22	−0.3	+1.3	273
" 8	37 Leo	5.5	02 51	+0.2	+1.1	95	03 43	−0.3	+0.3	306
" 27	ζ Ari	4.8	20 58	.....	.....	...	21 20	.....	.....	...
Nov. 2	ω Cnc	6.1	00 23	.....	.....	15	00 34	.....	.....	356
" 2	4 Cnc	6.2	00 23	−0.4	+1.1	101	01 28	−0.8	+1.3	272
" 27	406 B Tau	5.6	01 22	.....	.....	157	01 29	.....	.....	196
" 28	*c* Gem	5.5	22 31	−0.5	+1.1	100	23 37	−0.8	+1.3	269
Dec. 5	*g* Vir	5.6	03 20	−0.3	+1.0	102	04 14	−0.3	−0.3	323
" 12	128 B Cap	6.5	19 01	−1.4	−1.1	87	20 01	0.0	+0.6	207
" 15	*h* Aqr	5.4	21 47	.....	.....	3	23 27	.....	.....	289
" 22	23 Tau	4.8	04 42	.....	.....	39	05 22	.....	.....	306
" 23	χ Tau	5.3	18 14	−0.5	+1.6	77	19 21	−0.7	+2.0	238
" 29	χ Leo	4.6	22 13	.....	.....	59	22 48	.....	.....	343

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 $- .0260 \cos 2\phi - \frac{2h}{R}g$

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	$29^d.530588 = 29^d12^h44^m\ 2^s.8$
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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(*b*) To publish from time to time the results of the work of the Society; and,

(*c*) To acquire and maintain a Library, and such apparatus and real and personal property as may be necessary and convenient for the carrying into effect of the objects of the Society."

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