THE OBSERVER'S HANDBOOK FOR 1946

PUBLISHED BY

The Royal Astronomical Society of Canada

C. A. CHANT, EDITOR
F. S. HOGG, ASSISTANT EDITOR
DAVID DUNLAP OBSERVATORY

THIRTY-EIGHTH YEAR OF PUBLICATION

TORONTO
198 COLLEGE STREET
PRINTED FOR THE SOCIETY
BY THE UNIVERSITY OF TORONTO PRESS
1945

1946 **CALENDAR** **1946**

JANUARY

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

FEBRUARY

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

MARCH

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

APRIL

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

MAY

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

JUNE

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

JULY

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

AUGUST

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

SEPTEMBER

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

OCTOBER

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

NOVEMBER

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

DECEMBER

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

JULIAN DAY CALENDAR, 1946

J.D. 2,430,000 plus the following:

Jan. 1..........1822	May 1.........1942	Sept. 1.........2065
Feb. 1..........1853	June 1.........1973	Oct. 1.........2095
Mar. 1..........1881	July 1.........2003	Nov. 1.........2126
Apr. 1..........1912	Aug. 1.........2034	Dec. 1.........2156

The Julian Day commences at noon.
Thus J.D. 2,431,822 = Jan. 1.5 G.C.T.

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CONTENTS

TABLES IN RECENT OBSERVER'S HANDBOOKS

PRINTED IN CANADA

PREFACE

The HANDBOOK for 1946 is the 38th issue. The chief improvement in this edition is in the tables of stars. Their positions have been brought up to the 1950 equinox.

Four circular star maps, 9 inches in diameter at a price of one cent each, and a set of four maps, plotted on equatorial coordinates, bound in a cover at a price of ten cents, are obtainable from the Director of University Extension, University of Toronto. For fuller information reference may be made to Norton's *Star Atlas and Reference Handbook* (Gall and Inglis, ninth edition (1943), price 12s 6d).

Throughout this HANDBOOK distances are based on the standard value 8″.80 for the sun's parallax, rather than the new value 8″.790 as determined by Sir Harold Jones, the Astronomer Royal. The predictions of the minima of Algol are based on a period of 2.867318 days by W. M. Smart, and from a minimum at J.D. 2,429,234.6859 observed by J. S. Hall. Careful observations of three minima by D. W. Rosebrugh, in November 1945 confirmed the HANDBOOK predictions within about three minutes.

To the Assistant Editor, Dr. F. S. Hogg, the credit for preparing this volume is chiefly due; but sincere thanks are tendered to all those whose names are mentioned in the book and especially to Miss Ruth J. Northcott of the staff of the David Dunlap Observatory.

David Dunlap Observatory, C. A. CHANT
Richmond Hill, Ont., December 1945.

ANNIVERSARIES AND FESTIVALS 1946

New Year's Day	Tue.	Jan.	1
Epiphany	Sun.	Jan.	6
Septuagesima Sunday		Feb.	17
St. David	Fri.	Mar.	1
Quinquagesima (Shrove Sunday)		Mar.	3
Ash Wednesday		Mar.	6
St. Patrick	Sun.	Mar.	17
Palm Sunday		Apr.	14
Good Friday		Apr.	19
Easter Sunday		Apr.	21
St. George	Thu.	Apr.	23
Empire Day (Victoria Day)	Fri.	May	24
Birthday of the Queen Mother, Mary (1867)	Sun.	May	26
Rogation Sunday		May	26
Ascension Day	Thu.	May	30
Pentecost (Whit Sunday)		Jun.	9
Trinity Sunday		Jun.	16
Corpus Christi	Thu.	Jun.	20
St. John Baptist (Midsummer Day)	Mon.	Jun.	24
Dominion Day	Mon.	July	1
Birthday of Queen Elizabeth, (1900)	Sun.	Aug.	4
Labour Day	Mon.	Sep.	2
Hebrew New Year (Rosh Hashanah)	Thu.	Sep.	26
St. Michael (Michaelmas Day)	Mon.	Sep.	29
All Saints' Day	Fri.	Nov.	1
Remembrance Day	Mon.	Nov.	11
St. Andrew	Sat.	Nov.	30
First Sunday in Advent		Dec.	1
Ascension of King George VI (1936)	Wed.	Dec.	11
Birthday of King George VI (1895)	Sat.	Dec.	14
Christmas Day	Wed.	Dec.	25

Thanksgiving Day, date set by Proclamation

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.	♇ Pluto

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

Α, α,	Alpha.	Ι, ι,	Iota.	Ρ, ρ,	Rho.
Β, β,	Beta.	Κ, κ,	Kappa.	Σ, σ, ς,	Sigma.
Γ, γ,	Gamma.	Λ, λ,	Lambda.	Τ, τ,	Tau.
Δ, δ,	Delta.	Μ, μ,	Mu.	Υ, υ,	Upsilon.
Ε, ε,	Epsilon.	Ν, ν,	Nu.	Φ, φ,	Phi.
Ζ, ζ,	Zeta.	Ξ, ξ,	Xi.	Χ, χ,	Chi.
Η, η,	Eta.	Ο, ο,	Omicron.	Ψ, ψ,	Psi.
Θ, θ, ϑ,	Theta.	Π, π,	Pi.	Ω, ω,	Omega.

THE CONFIGURATIONS OF JUPITER'S SATELLITES

In the Configurations of Jupiter's Satellites (pages 31, 33, 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.

THE CONSTELLATIONS

LATIN AND ENGLISH NAMES WITH ABBREVIATIONS

Andromeda, (*Chained Maiden*)	And	Andr
Antlia, *Air Pump*	Ant	Antl
Apus, *Bird of Paradise*	Aps	Apus
Aquarius, *Water-bearer*	Aqr	Aqar
Aquila, *Eagle*	Aql	Aqil
Ara, *Altar*	Ara	Arae
Aries, *Ram*	Ari	Arie
Auriga, (*Charioteer*)	Aur	Auri
Bootes, (*Herdsman*)	Boo	Boot
Caelum, *Chisel*	Cae	Cael
Camelopardalis, *Giraffe*	Cam	Caml
Cancer, *Crab*	Cnc	Canc
Canes Venatici, *Hunting Dogs*	CVn	CVen
Canis Major, *Greater Dog*	CMa	CMaj
Canis Minor, *Lesser Dog*	CMi	CMin
Capricornus, *Sea-goat*	Cap	Capr
Carina, *Keel*	Car	Cari
Cassiopeia, (*Lady in Chair*)	Cas	Cass
Centaurus, *Centaur*	Cen	Cent
Cepheus, (*King*)	Cep	Ceph
Cetus, *Whale*	Cet	Ceti
Chamaeleon, *Chamaeleon*	Cha	Cham
Circinus, *Compasses*	Cir	Circ
Columba, *Dove*	Col	Colm
Coma Berenices, *Berenice's Hair*	Com	Coma
Corona Australis, *Southern Crown*	CrA	CorA
Corona Borealis, *Northern Crown*	CrB	CorB
Corvus, *Crow*	Crv	Corv
Crater, *Cup*	Crt	Crat
Crux, (*Southern*) *Cross*	Cru	Cruc
Cygnus, *Swan*	Cyg	Cygn
Delphinus, *Dolphin*	Del	Dlph
Dorado, *Swordfish*	Dor	Dora
Draco, *Dragon*	Dra	Drac
Equuleus, *Little Horse*	Equ	Equl
Eridanus, *River Eridanus*	Eri	Erid
Fornax, *Furnace*	For	Forn
Gemini, *Twins*	Gem	Gemi
Grus, *Crane*	Gru	Grus
Hercules, (*Kneeling Giant*)	Her	Herc
Horologium, *Clock*	Hor	Horo
Hydra, *Water-snake*	Hya	Hyda
Hydrus, *Sea-serpent*	Hyi	Hydi
Indus, *Indian*	Ind	Indi
Lacerta, *Lizard*	Lac	Lacr
Leo, *Lion*	Leo	Leon
Leo Minor, *Lesser Lion*	LMi	LMin
Lepus, *Hare*	Lep	Leps
Libra, *Scales*	Lib	Libr
Lupus, *Wolf*	Lup	Lupi
Lynx, *Lynx*	Lyn	Lync
Lyra, *Lyre*	Lyr	Lyra
Mensa, *Table* (*Mountain*)	Men	Mens
Microscopium, *Microscope*	Mic	Micr
Monoceros, *Unicorn*	Mon	Mono
Musca, *Fly*	Mus	Musc
Norma, *Square*	Nor	Norm
Octans, *Octant*	Oct	Octn
Ophiuchus, *Serpent-bearer*	Oph	Ophi
Orion, (*Hunter*)	Ori	Orio
Pavo, *Peacock*	Pav	Pavo
Pegasus, (*Winged Horse*)	Peg	Pegs
Perseus, (*Champion*)	Per	Pers
Phoenix, *Phoenix*	Phe	Phoe
Pictor, *Painter*	Pic	Pict
Pisces, *Fishes*	Psc	Pisc
Piscis Australis, *Southern Fish*	PsA	PscA
Puppis, *Poop*	Pup	Pupp
Pyxis, *Compass*	Pyx	Pyxi
Reticulum, *Net*	Ret	Reti
Sagitta, *Arrow*	Sge	Sgte
Sagittarius, *Archer*	Sgr	Sgtr
Scorpius, *Scorpion*	Scr	Scor
Sculptor, *Sculptor*	Scl	Scul
Scutum, *Shield*	Sct	Scut
Serpens, *Serpent*	Ser	Serp
Sextans, *Sextant*	Sex	Sext
Taurus, *Bull*	Tau	Taur
Telescopium, *Telescope*	Tel	Tele
Triangulum, *Triangle*	Tri	Tria
Triangulum Australe, *Southern Triangle*	TrA	TrAu
Tucana, *Toucan*	Tuc	Tucn
Ursa Major, *Greater Bear*	UMa	UMaj
Ursa Minor, *Lesser Bear*	UMi	UMin
Vela, *Sails*	Vel	Velr
Virgo, *Virgin*	Vir	Virg
Volans, *Flying Fish*	Vol	Voln
Vulpecula, *Fox*	Vul	Vulp

The 4-letter abbreviations are intended to be used in cases where a maximum saving of space is not necessary.

MISCELLANEOUS ASTRONOMICAL DATA

Units of Length

1 Angstrom unit	= 10^{-8} cm.		
1 micron	= 10^{-4} cm.		
1 meter	= 10^2 cm.	= 3.28084 feet	
1 kilometer	= 10^5 cm.	= 0.62137 miles	
1 mile	= 1.60935×10^5 cm.	= 1.60935 km.	
1 astronomical unit	= 1.49504×10^{13} cm.	= 92,897,416 miles	
1 light year	= 9.463×10^{17} cm.	= 5.880×10^{12} miles	= 0.3069 parsecs
1 parsec	= 30.84×10^{17} cm.	= 19.16×10^{12} miles	= 3.259 l.y.
1 megaparsec	= 30.84×10^{23} cm.	= 19.16×10^{18} miles	= 3.259×10^6 l.y.

Units of Time

Sidereal day = 23*h* 56*m* 04.09*s* of mean solar time
Mean solar day = 24*h* 03*m* 56.56*s* of sidereal time
Synodical month = 29*d* 12*h* 44*m*; sidereal month = 27*d* 07*h* 43*m*
Tropical year (ordinary) = 365*d* 05*h* 48*m* 46*s*
Sidereal year = 365*d* 06*h* 09*m* 10*s*
Eclipse year = 346*d* 14*h* 53*m*

The Earth

Equatorial radius, a = 3963.35 miles; flattening, c = $(a-b)/a = 1/297.0$
Polar radius, b = 3950.01 miles
1° of latitude = $69.057 - 0.349 \cos 2\phi$ miles (at latitude ϕ)
1° of longitude = $69.232 \cos \phi - 0.0584 \cos 3\phi$ miles
Mass of earth = 6.6×10^{21} tons; velocity of escape from ⊕ = 6.94 miles/sec.

Earth's Orbital Motion

Solar parallax = 8.″80; constant of aberration = 20.″47
Annual general precession = 50.″26; obliquity of ecliptic = 23° 26′ 50″ (1939)
Orbital velocity = 18.5 miles/sec.; parabolic velocity at ⊕ = 26.2 miles/sec.

Solar Motion

Solar apex, R.A. 18*h* 04*m*; Dec. + 31°
Solar velocity = 12.2 miles/sec.

The Galactic System

North pole of galactic plane R.A. 12*h* 40*m*, Dec. + 28° (1900)
Centre, 325° galactic longitude, = R.A. 17*h* 24*m*, Dec. −30°
Distance to centre = 10,000 parsecs; diameter = 30,000 parsecs.
Rotational velocity (at sun) = 262 km./sec.
Rotational period (at sun) = 2.2×10^8 years
Mass = 2×10^{11} solar masses

Extragalactic Nebulae

Red shift = +530 km./sec./megaparsec = +101 miles /sec./million l.y.

Radiation Constants

Velocity of light = 299,774 km./sec. = 186,271 miles/sec.
Solar constant = 1.93 gram calories/square cm./minute
Light ratio for one magnitude = 2.512; log ratio = 0.4000
Radiation from a star of zero apparent magnitude = 3×10^{-6} meter candles
Total energy emitted by a star of zero absolute magnitude = 5×10^{25} horsepower

Miscellaneous

Constant of gravitation, G = 6.670×10^{-8} c.g.s. units
Mass of the electron, m = 9.035×10^{-28} gm.; mass of the proton = 1.662×10^{-24} gm.
Planck's constant, h = 6.55×10^{-27} erg. sec.
Loschmidt's number = 2.705×10^{19} molecules/cu. cm. of gas at N.T.P.
Absolute temperature = $T°$ K = $T°$C + 273° = 5/9 ($T°$ F + 459°)

1 radian = 57°.2958 = 3437′.75 = 206,265″

π = 3.141,592,653,6

No. of square degrees in the sky = 41,253

1946 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

Date	Apparent R.A.	Corr. to Sundial	Apparent Dec.
	h m s	m s	° ′
Jan. 1	18 43 24	+03 15	−23 04.3
4	18 56 39	+04 39	−22 48.5
" 7	19 09 49	+06 00	−22 28.6
" 10	19 22 56	+07 17	−22 04.7
" 13	19 35 57	+08 29	−21 36.9
" 16	19 48 52	+09 34	−21 05.4
" 19	20 01 42	+10 34	−20 30.3
" 22	20 14 25	+11 27	−19 51.6
" 25	20 27 01	+12 14	−19 09.7
" 28	20 39 30	+12 53	−18 24.6
" 31	20 51 52	+13 25	−17 36.4
Feb. 3	21 04 07	+13 51	−16 45.5
" 6	21 16 14	+14 08	−15 51.9
" 9	21 28 14	+14 18	−14 55.9
" 12	21 40 06	+14 21	−13 57.6
" 15	21 51 52	+14 17	−12 57.3
" 18	22 03 31	+14 07	−11 55.1
" 21	22 15 04	+13 50	−10 51.2
" 24	22 26 31	+13 27	−09 45.7
" 27	22 37 52	+12 59	−08 39.0
Mar. 2	22 49 09	+12 26	−07 31.0
" 5	23 00 21	+11 48	−06 22.1
" 8	23 11 29	+11 07	−05 12.4
" 11	23 22 34	+10 22	−04 02.1
" 14	23 33 35	+09 33	−02 51.3
" 17	23 44 34	+08 43	−01 40.3
" 20	23 55 31	+07 50	−00 29.2
" 23	00 06 26	+06 56	+00 41.9
" 26	00 17 21	+06 01	+01 52.8
" 29	00 28 16	+05 06	+03 03.3
Apr. 1	00 39 11	+04 12	+04 13.2
" 4	00 50 08	+03 18	+05 22.5
" 7	01 01 05	+02 26	+06 31.0
" 10	01 12 04	+01 35	+07 38.4
" 13	01 23 05	+01 47	+08 44.7
" 16	01 34 09	+01 01	+09 49.6
" 19	01 45 16	−00 41	+10 53.1
" 22	01 56 27	−01 20	+11 54.9
" 25	02 07 42	−01 55	+12 55.0
" 28	02 19 01	−02 25	+13 53.2
May 1	02 30 25	−02 51	+14 49.4
" 4	02 41 54	−03 12	+15 43.4
" 7	02 53 27	−03 28	+16 35.0
" 10	03 05 06	−03 39	+17 24.1
" 13	03 16 50	−03 45	+18 10.6
" 16	03 28 38	−03 46	+18 54.4
" 19	03 40 32	−03 42	+19 35.3
" 22	03 52 31	−03 33	+20 13.1
" 25	04 04 34	−03 19	+20 47.9
" 28	04 16 43	−03 01	+21 19.5
" 31	04 28 55	−02 38	+21 47.8
June 3	04 41 12	−02 11	+22 12.7
" 6	04 53 32	−01 40	+22 34.0
" 9	05 05 55	−01 07	+22 51.9
" 12	05 18 20	−00 32	+23 06.0
" 15	05 30 46	+00 05	+23 16.6
" 18	05 43 14	+00 43	+23 23.4
" 21	05 55 43	+01 22	+23 26.6
" 24	06 08 11	+02 01	+23 26.0
" 27	06 20 40	+02 40	+23 21.7
" 30	06 33 07	+03 17	+23 13.7

Date	Apparent R.A.	Corr. to Sundial	Apparent Dec.
	h m s	m s	° ′
July 3	06 45 32	+03 52	+23 02.0
" 6	06 57 54	+04 25	+22 46.8
" 9	07 10 13	+04 54	+22 27.9
" 12	07 22 29	+05 20	+22 05.6
" 15	07 34 40	+05 42	+21 39.9
" 18	07 46 47	+05 59	+21 10.8
" 21	07 58 49	+06 12	+20 38.5
" 24	08 10 47	+06 20	+20 03.1
" 27	08 22 39	+06 23	+19 24.6
" 30	08 34 27	+06 20	+18 43.3
Aug. 2	08 46 08	+06 12	+17 59.2
" 5	08 57 44	+05 59	+17 12.4
" 8	09 09 15	+05 39	+16 23.2
" 11	09 20 40	+05 15	+15 31.6
" 14	09 32 00	+04 45	+14 37.7
" 17	09 43 15	+04 10	+13 41.8
" 20	09 54 25	+03 31	+12 43.9
" 23	10 05 32	+02 48	+11 44.1
" 26	10 16 34	+02 01	+10 42.7
" 29	10 27 33	+01 10	+09 39.7
Sept. 1	10 38 28	+00 16	+08 35.4
" 4	10 49 21	−00 42	+07 29.8
" 7	11 00 11	−01 41	+06 23.2
" 10	11 10 59	−02 43	+05 15.6
" 13	11 21 46	−03 46	+04 07.2
" 16	11 32 32	−04 49	+02 58.1
" 19	11 43 17	−05 53	+01 48.6
" 22	11 54 03	−06 57	+00 38.7
" 25	12 04 51	−07 59	−00 31.5
" 28	12 15 39	−09 01	−01 41.7
Oct. 1	12 26 29	−10 00	−02 51.8
" 4	12 37 22	−10 57	−04 01.6
" 7	12 48 17	−11 52	−05 11.0
" 10	12 59 16	−12 43	−06 19.7
" 13	13 10 19	−13 29	−07 27.7
" 16	13 21 26	−14 12	−08 34.8
" 19	13 32 39	−14 49	−09 40.8
" 22	13 43 57	−15 20	−10 45.6
" 25	13 55 21	−15 45	−11 49.0
" 28	14 06 52	−16 04	−12 50.7
" 31	14 18 30	−16 16	−13 50.6
Nov. 3	14 30 14	−16 22	−14 48.5
" 6	14 42 05	−16 20	−15 44.3
" 9	14 54 04	−16 11	−16 37.7
" 12	15 06 10	−15 54	−17 28.5
" 15	15 18 24	−15 30	−18 16.7
" 18	15 30 46	−14 58	−19 02.0
" 21	15 43 16	−14 18	−19 44.2
" 24	15 55 53	−13 31	−20 23.2
" 27	16 08 36	−12 36	−20 58.9
" 30	16 21 27	−11 36	−21 30.9
Dec. 3	16 34 23	−10 29	−21 59.3
" 6	16 47 25	−09 17	−22 23.9
" 9	17 00 32	−08 00	−22 44.6
" 12	17 13 42	−06 39	−23 01.2
" 15	17 26 57	−05 14	−23 13.7
" 18	17 40 14	−03 47	−23 22.1
" 21	17 53 32	−02 18	−23 26.3
" 24	18 06 52	−00 48	−23 26.2
" 27	18 22 12	+00 42	−23 21.9
" 30	18 33 30	+02 10	−23 13.4

To obtain *local mean* time, apply *corr. to sundial* to *apparent* or *sundial* time.

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 is the *equation of time.* Or, in general, *Apparent Time—Mean Time = Equation of Time.* This is the same as *Correction to Sundial* on page 7, with the sign reversed.

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.

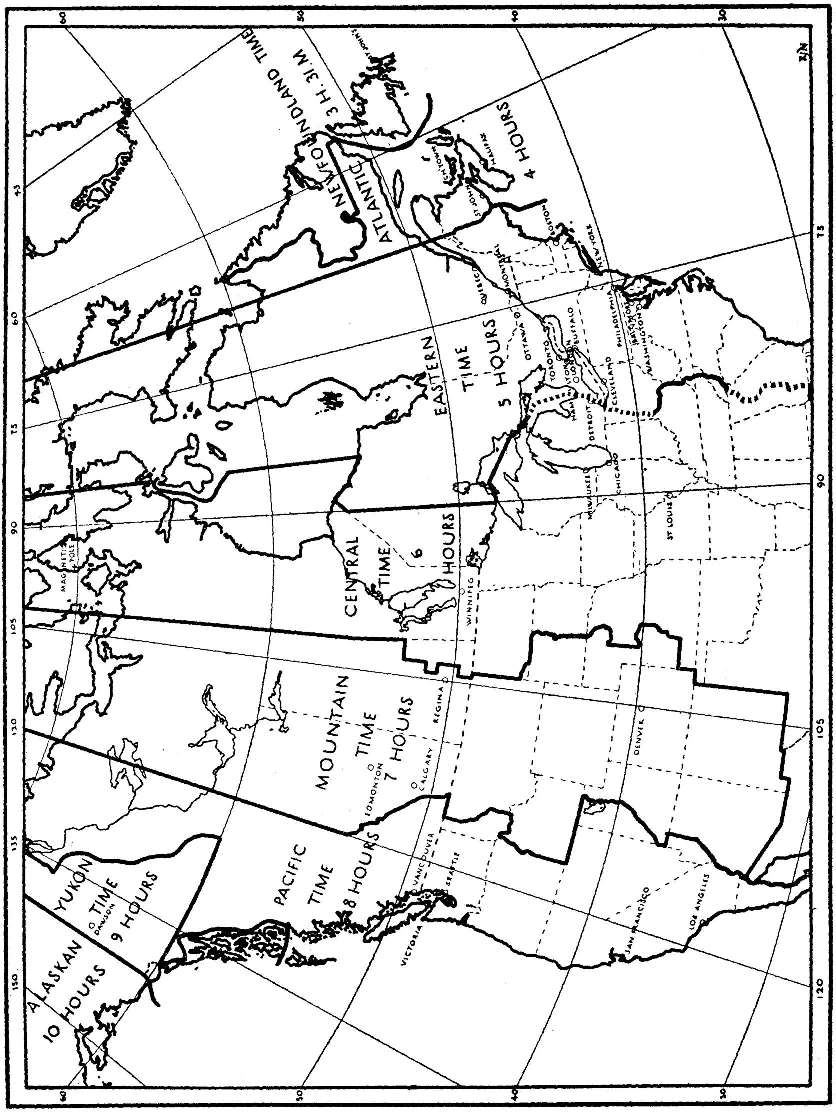
4. *Standard Time*—In everyday life we use still another kind of time. A moment's thought will show that in general two places will not have the same mean time; indeed, difference in longitude between two places is determined from their difference in time. But in travelling it is very inconvenient to 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.

The boundaries of the time belts are shown on the map on page 9.

Daylight Saving Time is the standard time of the next zone eastward. It is adopted in many places between certain specified dates during the summer.

MAP OF STANDARD TIME ZONES



Revised Zone Limits: replace broken portions of zone limits by a line down the centre of Lake Michigan, thence along northern and eastern borders of Indiana; also along northern and western borders of Georgia.

TIMES OF SUNRISE AND SUNSET

In the tables on pages 11 to 16 are given the times of sunrise and sunset for places in latitudes 36°, 40°, 44°, 46°, 48°, 50° and 52°. The times are given in Local Mean Time, and in the table below are given corrections to change from Local Mean to Standard Time for the cities and towns named.

How the Tables are Constructed

The time of sunrise and sunset at a given place, in local mean time, varies from day to day, and depends principally upon the declination of the sun. Variations in the equation of time, the apparent diameter of the sun and atmospheric refraction at the points of sunrise and sunset also affect the final result. These quantities, as well as the solar declination, do not have precisely the same values on corresponding days from year to year, and so the table gives only approximately average values. The times are for the rising and setting of the upper limb of the sun, and are corrected for refraction. 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 Standard 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 local time of sunrise and sunset for the proper latitude, on the desired day, and apply the correction to get the Standard Time.

34°	min.	**44°**	min.	**46°**	min.	**50°**	min.
Los Angeles	− 7	Brantford	+21	Glace Bay	0	Brandon	+40
		Guelph	+21	Moncton	+19	Kenora	+18
38°		Halifax	+14	Montreal	− 6	Medicine Hat	+22
St. Louis	+ 1	Hamilton	+20	New Glasgow	+11	Moose Jaw	+ 2
San Francisco	+10	Kingston	+ 6	North Bay	+18	Port. la Prairie	+33
Washington	+ 8	Kitchener	+22	Ottawa	+ 3	Regina	− 2
		Milwaukee	− 8	Parry Sound	+20	Trail	− 9
40°		Minneapolis	+13	Quebec	−15	Vancouver	+12
Baltimore	+ 6	Orillia	+18	St. John, N.B.	+24	Winnipeg	+28
New York	− 4	Oshawa	+15	Sault St. Marie	+37		
Philadelphia	+ 1	Owen Sound	+24	Sherbrooke	−12	**52°**	
Pittsburgh	+20	Peterborough	+13	Sudbury	+24	Calgary	+36
		St. Catharines	+17	Sydney	+ 1	Saskatoon	+ 6
42°		Stratford	+24	Three Rivers	−10		
Boston	−16	Toronto	+18			**54°**	
Buffalo	+15	Woodstock, Ont.	+23	**48°**		Edmonton	+34
Chicago	−10	Yarmouth	+24	Port Arthur	+57	Prince Albert	+ 1
Cleveland	+26			St. John's, Nfd.	0	Prince Rupert	+41
Detroit	−28	**46°**		Seattle	+ 9		
London, Ont.	+25	Charlottetown	+13	Timmins	+26	**60°**	
Windsor	+32	Fredericton	+26	Victoria	+13	Dawson	+18

Example.—Find the time of sunrise at Owen Sound, also at Regina, on February 12.

In the above list Owen Sound is under "44°", and the correction is + 24 min. On page 11 the time of sunrise on February 12 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 7.17 and subtracting 2 min. we get the time of sunrise 7.15 (Mountain Standard Time).

DATE		Latitude 36° Sunrise	Latitude 36° Sunset	Latitude 40° Sunrise	Latitude 40° Sunset	Latitude 44° Sunrise	Latitude 44° Sunset	Latitude 46° Sunrise	Latitude 46° Sunset	Latitude 48° Sunrise	Latitude 48° Sunset	Latitude 50° Sunrise	Latitude 50° Sunset	Latitude 52° Sunrise	Latitude 52° Sunset
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
January	**1**	7 11	4 57	7 22	4 45	7 35	4 32	7 42	4 25	7 50	4 17	7 59	4 08	8 08	3 59
	3	7 11	4 58	7 23	4 47	7 35	4 34	7 42	4 26	7 50	4 19	7 59	4 10	8 08	4 01
	5	7 12	5 00	7 23	4 49	7 35	4 36	7 42	4 29	7 50	4 22	7 58	4 13	8 07	4 03
	7	7 11	5 02	7 22	4 50	7 35	4 38	7 42	4 31	7 49	4 23	7 58	4 15	8 06	4 06
	9	7 11	5 04	7 22	4 52	7 34	4 40	7 41	4 33	7 49	4 26	7 57	4 18	8 05	4 08
	11	7 11	5 06	7 22	4 54	7 34	4 42	7 40	4 36	7 48	4 28	7 56	4 20	8 05	4 11
	13	7 11	5 08	7 21	4 56	7 33	4 45	7 39	4 39	7 47	4 31	7 55	4 23	8 03	4 14
	15	7 10	5 10	7 20	4 58	7 32	4 48	7 38	4 41	7 45	4 34	7 54	4 26	8 01	4 18
	17	7 10	5 12	7 20	5 00	7 30	4 50	7 37	4 44	7 44	4 37	7 52	4 29	7 59	4 21
	19	7 09	5 14	7 19	5 02	7 29	4 53	7 35	4 46	7 42	4 39	7 50	4 32	7 57	4 24
	21	7 08	5 15	7 18	5 05	7 28	4 55	7 34	4 48	7 40	4 42	7 48	4 35	7 56	4 27
	23	7 07	5 17	7 15	5 08	7 26	4 57	7 32	4 51	7 39	4 45	7 46	4 38	7 54	4 31
	25	7 06	5 19	7 14	5 10	7 26	5 00	7 31	4 54	7 37	4 48	7 44	4 41	7 51	4 35
	27	7 05	5 21	7 12	5 13	7 24	5 02	7 29	4 57	7 35	4 51	7 42	4 45	7 48	4 38
	29	7 04	5 23	7 11	5 15	7 22	5 05	7 27	5 00	7 33	4 54	7 39	4 48	7 46	4 42
	31	7 02	5 25	7 10	5 17	7 19	5 08	7 24	5 03	7 30	4 57	7 36	4 51	7 43	4 45
February	**2**	7 00	5 27	7 08	5 20	7 17	5 11	7 22	5 06	7 27	5 00	7 33	4 55	7 39	4 49
	4	6 59	5 29	7 06	5 22	7 15	5 13	7 20	5 09	7 25	5 04	7 30	4 58	7 35	4 53
	6	6 57	5 32	7 04	5 25	7 13	5 16	7 18	5 11	7 22	5 07	7 27	5 02	7 32	4 56
	8	6 55	5 34	7 02	5 27	7 10	5 19	7 15	5 14	7 20	5 10	7 24	5 05	7 29	5 00
	10	6 53	5 36	7 00	5 29	7 08	5 22	7 13	5 17	7 17	5 13	7 21	5 08	7 25	5 03
	12	6 51	5 38	6 59	5 31	7 05	5 24	7 09	5 20	7 14	5 16	7 17	5 12	7 21	5 07
	14	6 49	5 40	6 55	5 34	7 03	5 27	7 06	5 23	7 10	5 19	7 14	5 15	7 18	5 10
	16	6 47	5 42	6 53	5 36	7 00	5 30	7 02	5 26	7 06	5 23	7 10	5 19	7 14	5 14
	18	6 45	5 44	6 50	5 39	6 57	5 33	6 59	5 29	7 03	5 26	7 07	5 22	7 11	5 18
	20	6 43	5 46	6 48	5 41	6 54	5 35	6 56	5 32	6 59	5 29	7 03	5 26	7 07	5 22
	22	6 40	5 48	6 45	5 43	6 50	5 38	6 53	5 35	6 56	5 32	6 59	5 29	7 02	5 26
	24	6 38	5 50	6 42	5 45	6 47	5 40	6 49	5 38	6 52	5 35	6 55	5 32	6 58	5 30
	26	6 35	5 52	6 39	5 47	6 44	5 43	6 46	5 41	6 49	5 38	6 51	5 36	6 53	5 33
	28	6 33	5 54	6 36	5 49	6 40	5 46	6 43	5 44	6 45	5 41	6 47	5 39	6 49	5 31

DATE		Latitude 36° Sunrise	Latitude 36° Sunset	Latitude 40° Sunrise	Latitude 40° Sunset	Latitude 44° Sunrise	Latitude 44° Sunset	Latitude 46° Sunrise	Latitude 46° Sunset	Latitude 48° Sunrise	Latitude 48° Sunset	Latitude 50° Sunrise	Latitude 50° Sunset	Latitude 52° Sunrise	Latitude 52° Sunset
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
March	**2**	6 30	5 55	6 33	5 52	6 37	5 48	6 39	5 46	6 41	5 44	6 43	5 42	6 46	5 40
	4	6 27	5 57	6 30	5 54	6 34	5 51	6 36	5 49	6 37	5 47	6 39	5 46	6 41	5 44
	6	6 24	5 59	6 27	5 57	6 30	5 54	6 32	5 52	6 33	5 51	6 35	5 49	6 37	5 47
	8	6 22	6 01	6 24	5 59	6 26	5 56	6 28	5 55	6 29	5 54	6 31	5 53	6 32	5 51
	10	6 19	6 03	6 21	6 01	6 23	5 59	6 24	5 58	6 25	5 57	6 26	5 56	6 28	5 55
	12	6 17	6 04	6 18	6 03	6 19	6 02	6 20	6 01	6 21	6 00	6 22	5 59	6 23	5 58
	14	6 14	6 06	6 15	6 05	6 15	6 04	6 16	6 03	6 17	6 03	6 18	6 02	6 19	6 02
	16	6 11	6 07	6 12	6 07	6 12	6 07	6 13	6 06	6 13	6 06	6 14	6 05	6 14	6 05
	18	6 08	6 10	6 08	6 09	6 08	6 09	6 09	6 09	6 09	6 09	6 10	6 09	6 10	6 09
	20	6 06	6 11	6 05	6 11	6 05	6 11	6 05	6 11	6 05	6 12	6 05	6 12	6 05	6 12
	22	6 03	6 13	6 02	6 13	6 02	6 14	6 02	6 14	6 01	6 15	6 01	6 15	6 00	6 15
	24	6 00	6 15	5 59	6 15	5 58	6 16	5 58	6 16	5 57	6 18	5 57	6 18	5 55	6 19
	26	5 57	6 16	5 56	6 17	5 55	6 19	5 54	6 19	5 53	6 20	5 52	6 21	5 51	6 22
	28	5 54	6 18	5 52	6 19	5 51	6 21	5 50	6 22	5 49	6 23	5 48	6 24	5 46	6 26
	30	5 51	6 19	5 49	6 21	5 48	6 23	5 46	6 24	5 45	6 25	5 43	6 27	5 41	6 29
April	**1**	5 48	6 21	5 46	6 23	5 44	6 25	5 42	6 27	5 41	6 28	5 39	6 30	5 37	6 32
	3	5 45	6 22	5 43	6 25	5 40	6 28	5 38	6 29	5 37	6 31	5 35	6 33	5 32	6 36
	5	5 42	6 24	5 40	6 27	5 37	6 30	5 35	6 33	5 32	6 34	5 30	6 36	5 28	6 39
	7	5 40	6 26	5 36	6 29	5 33	6 33	5 31	6 35	5 28	6 37	5 26	6 40	5 23	6 43
	9	5 37	6 28	5 33	6 31	5 29	6 35	5 27	6 38	5 24	6 40	5 21	6 43	5 19	6 46
	11	5 34	6 29	5 30	6 33	5 25	6 38	5 23	6 40	5 20	6 43	5 17	6 46	5 14	6 49
	13	5 32	6 31	5 27	6 35	5 22	6 40	5 19	6 43	5 16	6 46	5 13	6 49	5 10	6 52
	15	5 29	6 32	5 24	6 38	5 19	6 43	5 16	6 46	5 13	6 49	5 09	6 52	5 06	6 56
	17	5 26	6 35	5 21	6 40	5 15	6 45	5 12	6 48	5 09	6 52	5 05	6 56	5 01	6 59
	19	5 24	6 37	5 18	6 42	5 12	6 48	5 09	6 51	5 05	6 55	5 01	6 59	4 56	7 02
	21	5 21	6 38	5 15	6 44	5 09	6 50	5 05	6 54	5 01	6 58	4 57	7 02	4 52	7 06
	23	5 18	6 40	5 12	6 46	5 06	6 53	5 02	6 56	4 58	7 01	4 53	7 05	4 48	7 09
	25	5 16	6 41	5 09	6 48	5 02	6 55	4 58	6 59	4 54	7 03	4 49	7 08	4 44	7 13
	27	5 13	6 43	5 07	6 50	4 59	6 57	4 55	7 01	4 51	7 06	4 45	7 11	4 40	7 16
	29	5 11	6 44	5 04	6 52	4 56	7 00	4 52	7 04	4 47	7 08	4 42	7 14	4 36	7 20

DATE		Latitude 36° Sunrise	Latitude 36° Sunset	Latitude 40° Sunrise	Latitude 40° Sunset	Latitude 44° Sunrise	Latitude 44° Sunset	Latitude 46° Sunrise	Latitude 46° Sunset	Latitude 48° Sunrise	Latitude 48° Sunset	Latitude 50° Sunrise	Latitude 50° Sunset	Latitude 52° Sunrise	Latitude 52° Sunset
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May	**1**	5 09	6 46	5 02	6 53	4 53	7 02	4 49	7 06	4 44	7 11	4 38	7 17	4 32	7 23
	3	5 07	6 48	4 59	6 56	4 50	7 04	4 46	7 09	4 40	7 14	4 34	7 20	4 28	7 26
	5	5 05	6 49	4 56	6 58	4 47	7 07	4 43	7 11	4 37	7 17	4 31	7 23	4 25	7 29
	7	5 03	6 51	4 54	7 00	4 44	7 09	4 40	7 14	4 34	7 20	4 27	7 26	4 21	7 32
	9	5 01	6 52	4 51	7 02	4 42	7 11	4 37	7 16	4 31	7 22	4 24	7 29	4 17	7 36
	11	4 59	6 54	4 49	7 04	4 39	7 14	4 34	7 19	4 28	7 25	4 21	7 32	4 14	7 39
	13	4 57	6 56	4 47	7 06	4 37	7 16	4 31	7 21	4 25	7 28	4 18	7 35	4 11	7 42
	15	4 55	6 57	4 45	7 08	4 35	7 18	4 28	7 24	4 22	7 30	4 15	7 38	4 07	7 45
	17	4 53	6 59	4 44	7 10	4 33	7 20	4 26	7 26	4 20	7 33	4 13	7 40	4 04	7 48
	19	4 51	7 01	4 42	7 11	4 31	7 22	4 24	7 28	4 17	7 35	4 10	7 43	4 01	7 52
	21	4 50	7 03	4 40	7 13	4 29	7 24	4 22	7 31	4 15	7 38	4 07	7 46	3 58	7 55
	23	4 49	7 04	4 39	7 15	4 27	7 26	4 20	7 33	4 13	7 40	4 05	7 48	3 55	7 57
	25	4 48	7 05	4 37	7 16	4 25	7 28	4 18	7 35	4 11	7 43	4 03	7 51	3 53	8 00
	27	4 47	7 07	4 36	7 18	4 24	7 30	4 16	7 37	4 09	7 45	4 01	7 53	3 51	8 03
	29	4 46	7 08	4 35	7 20	4 22	7 32	4 15	7 39	4 07	7 47	3 59	7 56	3 49	8 05
	31	4 45	7 10	4 34	7 21	4 21	7 34	4 14	7 41	4 06	7 49	3 57	7 58	3 47	8 08
June	**2**	4 45	7 11	4 33	7 23	4 20	7 35	4 13	7 43	4 05	7 51	3 56	8 00	3 45	8 10
	4	4 44	7 12	4 33	7 24	4 19	7 37	4 12	7 44	4 04	7 53	3 55	8 02	3 44	8 12
	6	4 44	7 13	4 32	7 25	4 18	7 38	4 11	7 46	4 02	7 54	3 53	8 04	3 42	8 14
	8	4 43	7 14	4 31	7 26	4 17	7 40	4 10	7 47	4 02	7 56	3 52	8 05	3 41	8 16
	10	4 43	7 16	4 31	7 27	4 17	7 41	4 09	7 49	4 01	7 57	3 51	8 07	3 40	8 18
	12	4 43	7 16	4 31	7 28	4 17	7 42	4 09	7 50	4 01	7 58	3 51	8 08	3 40	8 19
	14	4 43	7 17	4 31	7 29	4 17	7 43	4 08	7 51	4 00	7 59	3 50	8 09	3 39	8 20
	16	4 43	7 18	4 31	7 30	4 17	7 44	4 08	7 52	4 00	8 00	3 50	8 10	3 39	8 21
	18	4 43	7 19	4 31	7 31	4 17	7 45	4 08	7 53	4 00	8 01	3 50	8 11	3 39	8 22
	20	4 43	7 19	4 31	7 31	4 17	7 45	4 08	7 54	4 00	8 02	3 50	8 12	3 39	8 23
	22	4 44	7 20	4 31	7 32	4 17	7 46	4 08	7 55	4 01	8 03	3 50	8 12	3 39	8 23
	24	4 44	7 20	4 32	7 32	4 18	7 46	4 09	7 55	4 01	8 03	3 51	8 13	3 40	8 24
	26	4 44	7 21	4 32	7 33	4 18	7 47	4 10	7 55	4 02	8 03	3 52	8 13	3 41	8 24
	28	4 45	7 21	4 33	7 33	4 19	7 47	4 11	7 55	4 03	8 03	3 53	8 13	3 42	8 24
	30	4 46	7 21	4 34	7 33	4 20	7 47	4 12	7 55	4 04	8 03	3 54	8 13	3 43	8 24

DATE		Latitude 36° Sunrise	Latitude 36° Sunset	Latitude 40° Sunrise	Latitude 40° Sunset	Latitude 44° Sunrise	Latitude 44° Sunset	Latitude 46° Sunrise	Latitude 46° Sunset	Latitude 48° Sunrise	Latitude 48° Sunset	Latitude 50° Sunrise	Latitude 50° Sunset	Latitude 52° Sunrise	Latitude 52° Sunset
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July	**2**	4 47	7 20	4 35	7 33	4 21	7 47	4 13	7 54	4 05	8 03	3 55	8 13	3 44	8 23
	4	4 48	7 20	4 36	7 33	4 22	7 46	4 14	7 54	4 06	8 02	3 56	8 12	3 46	8 22
	6	4 49	7 19	4 37	7 32	4 23	7 46	4 15	7 53	4 07	8 01	3 58	8 11	3 47	8 21
	8	4 50	7 19	4 38	7 31	4 25	7 45	4 17	7 52	4 09	8 00	3 59	8 10	3 49	8 20
	10	4 51	7 18	4 39	7 30	4 26	7 44	4 18	7 51	4 10	7 59	4 01	8 08	3 51	8 18
	12	4 52	7 18	4 41	7 30	4 28	7 43	4 20	7 50	4 12	7 58	4 03	8 07	3 53	8 17
	14	4 53	7 18	4 42	7 29	4 29	7 42	4 22	7 49	4 14	7 57	4 05	8 06	3 55	8 15
	16	4 55	7 17	4 44	7 28	4 31	7 40	4 24	7 47	4 16	7 56	4 07	8 04	3 58	8 13
	18	4 56	7 16	4 45	7 26	4 32	7 39	4 26	7 46	4 18	7 54	4 10	8 02	4 00	8 11
	20	4 57	7 15	4 47	7 25	4 34	7 38	4 28	7 44	4 20	7 52	4 12	8 00	4 03	8 09
	22	4 59	7 13	4 48	7 23	4 36	7 36	4 30	7 42	4 22	7 50	4 14	7 58	4 06	8 07
	24	5 00	7 12	4 50	7 22	4 38	7 34	4 32	7 40	4 25	7 48	4 17	7 55	4 08	8 04
	26	5 02	7 11	4 52	7 20	4 40	7 32	4 34	7 38	4 27	7 45	4 19	7 53	4 11	8 01
	28	5 03	7 09	4 53	7 18	4 42	7 30	4 37	7 36	4 30	7 43	4 22	7 50	4 14	7 58
	30	5 05	7 07	4 55	7 17	4 44	7 27	4 39	7 33	4 32	7 40	4 25	7 47	4 17	7 55
August	**1**	5 06	7 05	4 57	7 15	4 46	7 25	4 41	7 31	4 35	7 38	4 28	7 44	4 21	7 52
	3	5 08	7 04	4 59	7 12	4 48	7 22	4 43	7 28	4 37	7 35	4 31	7 41	4 24	7 49
	5	5 09	7 02	5 01	7 11	4 50	7 20	4 45	7 26	4 40	7 31	4 33	7 37	4 27	7 45
	7	5 11	7 00	5 02	7 08	4 53	7 17	4 48	7 23	4 42	7 28	4 36	7 34	4 30	7 41
	9	5 12	6 58	5 04	7 06	4 55	7 15	4 50	7 20	4 45	7 25	4 39	7 31	4 33	7 37
	11	5 14	6 56	5 06	7 03	4 58	7 12	4 53	7 17	4 48	7 22	4 42	7 27	4 36	7 34
	13	5 15	6 53	5 08	7 01	5 00	7 09	4 55	7 13	4 50	7 18	4 45	7 24	4 39	7 30
	15	5 17	6 51	5 10	6 58	5 02	7 06	4 58	7 10	4 53	7 15	4 48	7 20	4 42	7 26
	17	5 19	6 49	5 12	6 55	5 05	7 03	5 00	7 07	4 56	7 11	4 51	7 16	4 46	7 21
	19	5 20	6 46	5 14	6 52	5 07	6 59	5 03	7 03	4 59	7 07	4 54	7 12	4 49	7 17
	21	5 22	6 43	5 16	6 49	5 09	6 56	5 05	7 00	5 01	7 04	4 57	7 08	4 52	7 13
	23	5 23	6 41	5 18	6 46	5 11	6 53	5 08	6 56	5 04	7 00	5 00	7 04	4 56	7 09
	25	5 25	6 38	5 20	6 43	5 14	6 50	5 11	6 53	5 07	6 57	5 03	7 00	4 59	7 05
	27	5 26	6 35	5 22	6 40	5 16	6 47	5 13	6 49	5 09	6 53	5 06	6 56	5 02	7 00
	29	5 28	6 33	5 24	6 37	5 18	6 43	5 15	6 45	5 12	6 49	5 09	6 52	5 05	6 56
	31	5 30	6 30	5 25	6 34	5 20	6 40	5 18	6 42	5 15	6 45	5 12	6 48	5 09	6 51

DATE		Latitude 36° Sunrise	Latitude 36° Sunset	Latitude 40° Sunrise	Latitude 40° Sunset	Latitude 44° Sunrise	Latitude 44° Sunset	Latitude 46° Sunrise	Latitude 46° Sunset	Latitude 48° Sunrise	Latitude 48° Sunset	Latitude 50° Sunrise	Latitude 50° Sunset	Latitude 52° Sunrise	Latitude 52° Sunset
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
September	**2**	5 31	6 27	5 27	6 31	5 23	6 36	5 20	6 38	5 18	6 41	5 15	6 44	5 12	6 47
	4	5 33	6 24	5 29	6 28	5 25	6 32	5 23	6 34	5 20	6 37	5 18	6 40	5 15	6 41
	6	5 34	6 22	5 31	6 25	5 27	6 28	5 25	6 31	5 23	6 33	5 21	6 35	5 19	6 37
	8	5 36	6 19	5 33	6 22	5 30	6 25	5 28	6 27	5 26	6 29	5 24	6 31	5 22	6 33
	10	5 38	6 16	5 35	6 18	5 32	6 21	5 31	6 23	5 29	6 25	5 27	6 27	5 25	6 28
	12	5 39	6 13	5 37	6 15	5 34	6 17	5 33	6 19	5 31	6 21	5 30	6 22	5 28	6 23
	14	5 41	6 10	5 39	6 12	5 36	6 14	5 35	6 15	5 34	6 16	5 33	6 18	5 31	6 19
	16	5 42	6 07	5 41	6 08	5 39	6 10	5 38	6 11	5 37	6 12	5 36	6 13	5 34	6 14
	18	5 44	6 04	5 43	6 05	5 41	6 07	5 41	6 07	5 40	6 08	5 39	6 09	5 38	6 10
	20	5 46	6 01	5 45	6 02	5 44	6 03	5 44	6 03	5 43	6 04	5 42	6 05	5 41	6 05
	22	5 47	5 58	5 47	5 58	5 46	5 59	5 46	5 59	5 45	6 00	5 45	6 00	5 44	6 00
	24	5 49	5 55	5 49	5 55	5 48	5 55	5 48	5 55	5 48	5 56	5 48	5 56	5 47	5 56
	26	5 51	5 52	5 51	5 52	5 51	5 52	5 51	5 52	5 51	5 51	5 51	5 51	5 51	5 51
	28	5 52	5 49	5 52	5 49	5 53	5 48	5 53	5 48	5 54	5 47	5 54	5 47	5 54	5 46
	30	5 53	5 46	5 54	5 46	5 55	5 44	5 56	5 44	5 57	5 43	5 57	5 43	5 57	5 42
October	**2**	5 55	5 44	5 56	5 43	5 57	5 41	5 58	5 40	5 59	5 39	6 00	5 38	6 00	5 37
	4	5 56	5 41	5 58	5 40	5 59	5 37	6 01	5 36	6 02	5 35	6 03	5 34	6 04	5 32
	6	5 58	5 38	6 00	5 36	6 02	5 34	6 03	5 32	6 04	5 31	6 06	5 29	6 07	5 28
	8	5 59	5 35	6 02	5 33	6 04	5 30	6 06	5 28	6 07	5 27	6 09	5 25	6 11	5 23
	10	6 01	5 32	6 04	5 30	6 07	5 27	6 08	5 25	6 10	5 23	6 12	5 21	6 14	5 19
	12	6 03	5 30	6 06	5 27	6 09	5 24	6 11	5 21	6 13	5 19	6 15	5 17	6 17	5 15
	14	6 04	5 27	6 08	5 24	6 11	5 20	6 14	5 18	6 16	5 15	6 19	5 13	6 21	5 10
	16	6 06	5 25	6 10	5 21	6 14	5 17	6 17	5 14	6 19	5 11	6 22	5 09	6 25	5 06
	18	6 08	5 22	6 12	5 18	6 17	5 13	6 19	5 11	6 22	5 08	6 25	5 05	6 28	5 02
	20	6 10	5 19	6 15	5 15	6 20	5 10	6 22	5 07	6 25	5 04	6 28	5 01	6 32	4 58
	22	6 12	5 17	6 17	5 12	6 22	5 07	6 25	5 04	6 28	5 00	6 31	4 57	6 35	4 54
	24	6 14	5 14	6 19	5 09	6 25	5 04	6 28	5 00	6 31	4 57	6 35	4 53	6 39	4 50
	26	6 16	5 12	6 21	5 06	6 27	5 01	6 31	4 57	6 35	4 53	6 38	4 49	6 43	4 46
	28	6 18	5 09	6 24	5 03	6 30	4 57	6 34	4 53	6 38	4 49	6 42	4 45	6 47	4 42
	30	6 20	5 07	6 26	5 00	6 33	4 55	6 37	4 50	6 41	4 46	6 45	4 42	6 50	4 38

DATE		Latitude 36° Sunrise	Latitude 36° Sunset	Latitude 40° Sunrise	Latitude 40° Sunset	Latitude 44° Sunrise	Latitude 44° Sunset	Latitude 46° Sunrise	Latitude 46° Sunset	Latitude 48° Sunrise	Latitude 48° Sunset	Latitude 50° Sunrise	Latitude 50° Sunset	Latitude 52° Sunrise	Latitude 52° Sunset
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
November	**1**	6 22	5 05	6 28	4 58	6 35	4 52	6 39	4 47	6 44	4 43	6 48	4 39	6 53	4 34
	3	6 24	5 03	6 31	4 55	6 38	4 49	6 42	4 44	6 47	4 40	6 52	4 35	6 57	4 30
	5	6 26	5 01	6 33	4 53	6 41	4 46	6 45	4 41	6 50	4 37	6 55	4 32	7 00	4 27
	7	6 27	4 59	6 35	4 51	6 43	4 43	6 48	4 38	6 53	4 34	6 58	4 28	7 04	4 23
	9	6 29	4 57	6 37	4 49	6 46	4 41	6 51	4 36	6 56	4 31	7 01	4 25	7 07	4 19
	11	6 31	4 56	6 39	4 47	6 48	4 39	6 53	4 33	6 59	4 29	7 04	4 22	7 11	4 16
	13	6 33	4 54	6 42	4 45	6 51	4 37	6 56	4 31	7 02	4 26	7 08	4 20	7 14	4 13
	15	6 35	4 52	6 44	4 44	6 54	4 35	6 59	4 29	7 05	4 24	7 11	4 17	7 18	4 10
	17	6 37	4 51	6 47	4 42	6 57	4 32	7 02	4 27	7 08	4 21	7 15	4 14	7 22	4 07
	19	6 39	4 50	6 49	4 41	6 59	4 31	7 04	4 25	7 10	4 19	7 18	4 12	7 25	4 04
	21	6 41	4 49	6 51	4 39	7 01	4 29	7 07	4 23	7 13	4 17	7 21	4 10	7 28	4 02
	23	6 43	4 48	6 54	4 38	7 04	4 28	7 10	4 21	7 16	4 15	7 24	4 08	7 31	4 00
	25	6 45	4 48	6 56	4 37	7 06	4 27	7 12	4 20	7 19	4 14	7 27	4 06	7 35	3 58
	27	6 47	4 47	6 58	4 36	7 09	4 25	7 15	4 19	7 22	4 12	7 30	4 04	7 38	3 56
	29	6 48	4 47	6 59	4 36	7 11	4 24	7 18	4 18	7 25	4 11	7 33	4 03	7 41	3 55
December	**1**	6 50	4 47	7 01	4 35	7 13	4 23	7 20	4 17	7 27	4 10	7 36	4 02	7 44	3 54
	3	6 52	4 46	7 03	4 35	7 15	4 23	7 22	4 16	7 30	4 09	7 38	4 01	7 47	3 52
	5	6 54	4 46	7 05	4 35	7 18	4 23	7 25	4 15	7 32	4 08	7 41	4 00	7 49	3 51
	7	6 56	4 46	7 07	4 35	7 20	4 22	7 27	4 15	7 35	4 07	7 43	3 59	7 52	3 50
	9	6 57	4 46	7 09	4 35	7 22	4 22	7 29	4 15	7 37	4 07	7 45	3 59	7 54	3 50
	11	6 59	4 46	7 10	4 35	7 24	4 22	7 31	4 15	7 39	4 07	7 48	3 58	7 57	3 49
	13	7 01	4 47	7 12	4 35	7 25	4 22	7 32	4 15	7 40	4 07	7 50	3 58	7 59	3 49
	15	7 02	4 47	7 14	4 36	7 27	4 23	7 34	4 16	7 42	4 07	7 51	3 59	8 01	3 49
	17	7 04	4 48	7 16	4 36	7 29	4 23	7 36	4 16	7 44	4 08	7 53	3 59	8 03	3 49
	19	7 05	4 49	7 17	4 37	7 30	4 24	7 37	4 17	7 45	4 08	7 54	4 00	8 04	3 49
	21	7 06	4 50	7 18	4 38	7 31	4 25	7 38	4 18	7 46	4 09	7 55	4 01	8 05	3 50
	23	7 07	4 51	7 19	4 39	7 32	4 26	7 39	4 19	7 47	4 10	7 56	4 02	8 06	3 51
	25	7 08	4 52	7 20	4 40	7 33	4 27	7 40	4 20	7 48	4 11	7 57	4 03	8 07	3 52
	27	7 09	4 53	7 21	4 41	7 34	4 28	7 41	4 21	7 49	4 13	7 58	4 04	8 08	3 54
	29	7 09	4 54	7 21	4 42	7 34	4 30	7 41	4 22	7 50	4 14	7 58	4 06	8 08	3 56
	31	7 10	4 56	7 22	4 44	7 35	4 31	7 42	4 24	7 50	4 16	7 59	4 07	8 08	3 58

BEGINNING OF MORNING AND ENDING OF EVENING TWILIGHT

	Latitude 35°		Latitude 40°		Latitude 45°		Latitude 50°		Latitude 52°	
	Morn.	Eve.	Morn.	Eve.	Morn.	Eve.	Morn.	Eve.	Morn.	Eve.
Jan. 1	5 38	6 29	5 45	6 22	5 52	6 15	6 00	6 07	6 04	6 04
11	5 39	6 37	5 45	6 31	5 52	6 24	5 59	6 17	6 02	6 14
21	5 38	6 45	5 43	6 40	5 48	6 35	5 54	6 30	5 56	6 28
31	5 34	6 54	5 38	6 50	5 41	6 47	5 45	6 44	5 46	6 42
Feb. 10	5 27	7 03	5 29	7 01	5 31	7 00	5 32	6 59	5 32	6 58
20	5 17	7 12	5 17	7 12	5 18	7 12	5 15	7 14	5 14	7 15
Mar. 2	5 06	7 20	5 04	7 22	5 02	7 26	4 56	7 30	4 54	7 33
12	4 52	7 29	4 48	7 33	4 43	7 39	4 35	7 47	4 31	7 51
22	4 38	7 38	4 31	7 45	4 23	7 54	4 11	8 06	4 05	8 11
Apr. 1	4 23	7 47	4 13	7 57	4 01	8 09	3 46	8 25	3 38	8 33
11	4 07	7 57	3 55	8 09	3 39	8 25	3 19	8 46	3 08	8 57
21	3 51	8 07	3 36	8 23	3 17	8 43	2 50	9 10	2 36	9 25
May 1	3 37	8 19	3 18	8 37	2 54	9 02	2 20	9 37	2 01	9 57
11	3 23	8 30	3 02	8 52	2 33	9 22	1 48	10 08	1 20	10 37
21	3 12	8 41	2 47	9 07	2 13	9 42	1 13	10 44	0 02	——
31	3 04	8 51	2 36	9 20	1 56	10 01	0 23	11 42	——	——
June 10	2 59	8 59	2 29	9 30	1 43	10 16	——	——	——	——
20	3 02	9 04	2 27	9 35	1 39	10 23	——	——	——	——
30	3 02	9 04	2 31	9 35	1 44	10 22	——	——	——	——
July 10	3 09	9 01	2 39	9 30	1 56	10 13	——	——	——	——
20	3 18	8 54	2 51	9 20	2 14	9 57	1 04	11 04	——	——
30	3 28	8 43	3 05	9 06	2 33	9 38	1 43	10 26	1 07	11 00
Aug. 9	3 39	8 30	3 20	8 50	2 52	9 16	2 15	9 53	1 53	10 15
19	3 50	8 16	3 34	8 32	3 12	8 53	2 42	9 23	2 26	9 38
29	4 00	8 00	3 47	8 14	3 29	8 31	3 06	8 53	2 54	9 05
Sept. 8	4 10	7 44	3 59	7 55	3 46	8 08	3 28	8 26	3 19	8 34
18	4 19	7 28	4 11	7 36	4 01	7 46	3 47	8 00	3 40	8 07
28	4 28	7 13	4 22	7 18	4 15	7 25	4 05	7 35	4 01	7 39
Oct. 8	4 35	6 59	4 32	7 02	4 28	7 06	4 22	7 12	4 18	7 15
18	4 43	6 46	4 42	6 47	4 40	6 49	4 37	6 51	4 36	6 53
28	4 51	6 36	4 52	6 34	4 53	6 34	4 53	6 34	4 52	6 34
Nov. 7	5 00	6 27	5 02	6 24	5 05	6 21	5 07	6 19	5 08	6 18
17	5 08	6 21	5 12	6 17	5 17	6 12	5 21	6 07	5 23	6 06
27	5 16	6 18	5 22	6 13	5 28	6 06	5 34	6 00	5 37	5 57
Dec. 7	5 24	6 18	5 31	6 12	5 38	6 04	5 45	5 57	5 48	5 54
17	5 31	6 21	5 38	6 14	5 45	6 06	5 53	5 58	5 57	5 55
27	5 36	6 26	5 43	6 19	5 51	6 11	5 59	6 03	6 02	6 00
Jan. 1	5 38	6 29	5 45	6 22	5 52	6 15	6 00	6 07	6 03	6 04

The above table gives the local mean time of the beginning of morning twilight, and of the ending of evening twilight, for various latitudes. To obtain the corresponding standard time, the method used is the same as for correcting the sunrise and sunset tables, as described on page 10. The entry —— in the above table indicates that at such dates and latitudes, twilight lasts all night. This table, taken from the American Ephemeris, is computed for *astronomical* twilight, i.e., for the time at which the sun is 108° from the zenith (or 18° below the horizon).

TIMES OF MOONRISE AND MOONSET, 1946

Date Jan.	Latitude 40° Moonrise	Latitude 40° Moonset	Latitude 45° Moonrise	Latitude 45° Moonset	Latitude 50° Moonrise	Latitude 50° Moonset	Latitude 52° Moonrise	Latitude 52° Moonset
	h m	h m	h m	h m	h m	h m	h m	h m
1	5 40	15 20	5 57	15 04	6 17	14 43	6 27	14 34
2	6 38	16 06	6 59	15 47	7 19	15 24	7 30	15 13
3 ●	7 33	16 58	7 52	16 39	8 15	16 16	8 26	16 04
4	8 23	17 56	8 41	17 39	9 03	17 17	9 14	17 07
5	9 07	19 00	9 23	18 44	9 42	18 25	9 52	18 17
6	9 45	20 05	9 59	19 54	10 15	19 39	10 22	19 31
7	10 19	21 12	10 30	21 04	10 41	20 54	10 46	20 49
8	10 50	22 20	10 56	22 16	11 03	22 10	11 07	22 18
9	11 20	23 29	11 22	23 28	11 24	23 28	11 26	23 28
10 ◗	11 48	.. ..	11 46	.. ..	11 44	.. ..	11 44	.. ..
11	12 18	0 39	12 13	0 42	12 06	0 46	12 03	0 48
12	12 50	1 49	12 42	1 57	12 31	2 06	12 25	2 10
13	13 28	3 02	13 15	3 14	12 59	3 28	12 53	3 34
14	14 11	4 15	13 56	4 31	13 36	4 48	13 27	4 58
15	15 03	5 27	14 46	5 44	14 24	6 06	14 13	6 17
16	16 04	6 33	15 45	6 50	15 22	7 14	15 11	7 25
17 ⊕	17 09	7 29	16 52	7 47	16 30	8 10	16 21	8 19
18	18 17	8 18	18 03	8 33	17 45	8 52	17 36	9 01
19	19 25	8 58	19 14	9 10	19 00	9 26	18 54	9 32
20	20 31	9 31	20 23	9 40	20 14	9 52	20 09	9 56
21	21 34	10 00	21 30	10 06	21 24	10 13	21 23	10 16
22	22 34	10 26	22 34	10 29	22 33	10 32	22 33	10 32
23	23 33	10 51	23 37	10 50	23 40	10 49	23 42	10 48
24	.. ..	11 16	.. ..	11 11	.. ..	11 06	.. ..	11 03
25 ☾	0 32	11 41	0 38	11 33	0 46	11 24	0 49	11 20
26	1 31	12 08	1 40	11 58	1 52	11 45	1 57	11 39
27	2 29	12 39	2 43	12 26	2 58	12 10	3 05	12 02
28	3 29	13 16	3 45	12 59	4 03	12 39	4 13	12 30
29	4 27	13 58	4 45	13 40	5 06	13 18	5 17	13 07
30	5 23	14 47	5 42	14 29	6 05	14 06	6 16	13 55
31	6 15	15 44	6 34	15 26	6 57	15 04	7 08	14 53

Date Feb.	Latitude 40° Moonrise	Latitude 40° Moonset	Latitude 45° Moonrise	Latitude 45° Moonset	Latitude 50° Moonrise	Latitude 50° Moonset	Latitude 52° Moonrise	Latitude 52° Moonset
	h m	h m	h m	h m	h m	h m	h m	h m
1 ●	7 03	16 47	7 19	16 30	7 40	16 11	7 49	16 01
2	7 44	17 53	7 58	17 40	8 15	17 24	8 23	17 16
3	8 20	19 02	8 31	18 52	8 44	18 41	8 50	18 36
4	8 52	20 11	9 00	20 05	9 09	19 58	9 12	19 56
5	9 23	21 21	9 26	21 19	9 30	21 17	9 32	21 17
6	9 51	22 31	9 51	22 33	9 50	22 35	9 50	22 37
7	10 20	23 41	10 16	23 48	10 12	23 55	10 09	23 59
8 ◗	10 52	.. ..	10 43	.. ..	10 34	.. ..	10 30	.. ..
9	11 27	0 52	11 15	1 03	11 01	1 16	10 54	1 21
10	12 08	2 04	11 52	2 17	11 34	2 35	11 25	2 44
11	12 55	3 14	12 37	3 31	12 15	3 52	12 05	4 02
12	13 50	4 20	13 32	4 39	13 08	5 02	12 57	5 13
13	14 52	5 19	14 34	5 38	14 12	6 00	14 01	6 11
14	15 58	6 10	15 43	6 27	15 23	6 47	15 14	6 56
15 ⊕	17 06	6 53	16 53	7 06	16 38	7 23	16 30	7 31
16	18 13	7 28	18 04	7 39	17 52	7 51	17 47	7 57
17	19 17	7 59	19 12	8 06	19 05	8 14	19 02	8 18
18	20 20	8 26	20 18	8 30	20 15	8 34	20 14	8 36
19	21 20	8 52	21 22	8 52	21 24	8 52	21 24	8 52
20	22 20	9 16	22 25	9 13	22 31	9 10	22 33	9 07
21	23 19	9 41	23 27	9 35	23 38	9 27	23 42	9 24
22	.. ..	10 08	.. ..	9 58	.. ..	9 47	.. ..	9 41
23 ☾	0 18	10 37	0 29	10 24	0 44	10 09	0 50	10 02
24	1 17	11 11	1 32	10 55	1 50	10 37	1 58	10 28
25	2 15	11 50	2 32	11 33	2 54	11 11	3 03	11 01
26	3 12	12 36	3 30	12 18	3 54	11 54	4 05	11 43
27	4 05	13 29	4 24	13 10	4 48	12 48	4 59	12 35
28	4 54	14 29	5 12	14 12	5 34	13 51	5 45	13 40

TIMES OF MOONRISE AND MOONSET, 1946

Date Mar.	Lat. 40° Moonrise	Lat. 40° Moonset	Lat. 45° Moonrise	Lat. 45° Moonset	Lat. 50° Moonrise	Lat. 50° Moonset	Lat. 52° Moonrise	Lat. 52° Moonset
	h m	h m	h m	h m	h m	h m	h m	h m
1	5 38	15 34	5 54	15 20	6 13	15 02	6 21	14 53
2	6 16	16 44	6 29	16 32	6 44	16 19	6 51	16 12
3 ●	6 51	17 54	7 00	17 46	7 10	17 39	7 15	17 34
4	7 22	19 05	7 27	19 02	7 33	18 59	7 36	18 56
5	7 52	20 17	7 53	20 18	7 54	20 20	7 55	20 20
6	8 21	21 29	8 19	21 35	8 15	21 41	8 13	21 45
7	8 53	22 43	8 46	22 52	8 37	23 04	8 34	23 09
8	9 27	23 55	9 16	.. ..	9 03	.. ..	8 57	.. ..
9	10 06	.. ..	9 52	0 09	9 35	0 25	9 26	0 33
10 ☽	10 52	1 06	10 34	1 24	10 14	1 43	10 03	1 54
11	11 44	2 14	11 25	2 32	11 02	2 55	10 51	3 06
12	12 46	3 14	12 25	3 33	12 01	3 57	11 50	4 08
13	13 47	4 07	13 30	4 25	13 09	4 46	12 59	4 56
14	14 53	4 51	14 39	5 06	14 21	5 24	14 14	5 33
15	15 57	5 28	15 48	5 40	15 35	5 54	15 30	6 01
16	17 04	6 00	16 57	6 08	16 48	6 18	16 44	6 33
17 ⊕	18 07	6 27	18 04	6 33	17 59	6 39	17 57	6 41
18	19 07	6 53	19 08	6 55	19 08	6 57	19 09	6 57
19	20 07	7 18	20 11	7 16	20 16	7 14	20 18	7 13
20	21 07	7 42	21 15	7 37	21 24	7 31	21 27	7 28
21	22 07	8 08	22 18	7 59	22 30	7 49	22 36	7 45
22	23 06	8 36	23 20	8 25	23 37	8 10	23 45	8 04
23	.. ..	9 07	.. ..	8 53	.. ..	8 36	.. ..	8 27
24	0 05	9 45	0 21	9 27	0 42	9 07	0 51	8 56
25 ☾	1 02	10 27	1 21	10 09	1 43	9 45	1 54	9 34
26	1 57	11 16	2 16	10 57	2 39	10 34	2 51	10 22
27	2 47	12 13	3 05	11 54	3 28	11 32	3 37	11 21
28	3 32	13 15	3 48	12 58	4 09	12 38	4 19	12 29
29	4 12	14 21	4 26	14 08	4 42	13 52	4 51	13 45
30	4 47	15 31	4 57	15 21	5 10	15 11	5 17	15 05
31	5 19	16 42	5 26	16 37	5 34	16 31	5 38	16 27

Date Apr.	Lat. 40° Moonrise	Lat. 40° Moonset	Lat. 45° Moonrise	Lat. 45° Moonset	Lat. 50° Moonrise	Lat. 50° Moonset	Lat. 52° Moonrise	Lat. 52° Moonset
	h m	h m	h m	h m	h m	h m	h m	h m
1 ●	5 49	17 55	5 52	17 54	5 56	17 53	5 58	17 52
2	6 19	19 09	6 18	19 12	6 17	19 17	6 16	19 18
3	6 50	20 24	6 45	20 32	6 39	20 42	6 36	20 46
4	7 24	21 40	7 15	21 52	7 04	22 07	6 58	22 14
5	8 02	22 55	7 49	23 11	7 33	23 30	7 26	23 40
6	8 46	.. ..	8 30	.. ..	8 09	.. ..	8 00	.. ..
7	9 38	0 06	9 20	0 25	8 56	0 47	8 45	0 58
8 ☽	10 36	1 11	10 17	1 30	9 54	1 54	9 42	2 05
9	11 39	2 06	11 22	2 25	11 00	2 47	10 49	2 58
10	12 45	2 52	12 30	3 08	12 11	3 28	12 02	3 37
11	13 51	3 31	13 39	3 43	13 24	3 59	13 18	4 07
12	14 55	4 04	14 47	4 13	14 37	4 24	14 32	4 30
13	15 58	4 31	15 54	4 38	15 47	4 45	15 45	4 48
14	16 58	4 57	16 58	5 00	16 56	5 03	16 56	5 04
15	17 58	5 22	18 01	5 20	18 04	5 20	18 05	5 19
16 ⊕	18 58	5 45	19 04	5 41	19 12	5 37	19 15	5 34
17	19 57	6 10	20 07	6 03	20 19	5 54	20 24	5 51
18	20 57	6 37	21 10	6 26	21 26	6 14	21 33	6 08
19	21 57	7 07	22 12	6 53	22 31	6 37	22 41	6 29
20	22 55	7 42	23 12	7 25	23 34	7 06	23 46	6 56
21	23 50	8 19	.. ..	8 03	.. ..	7 41	.. ..	7 30
22	.. ..	9 08	0 09	8 49	0 33	8 24	0 45	8 13
23	0 41	10 01	1 00	9 42	1 24	9 18	1 35	9 06
24 ☾	1 27	10 59	1 45	10 43	2 07	10 20	2 17	10 10
25	2 08	12 03	2 23	11 48	2 42	11 30	2 52	11 22
26	2 44	13 09	2 56	12 58	3 11	12 44	3 19	12 38
27	3 16	14 18	3 25	14 11	3 36	14 02	3 41	13 58
28	3 47	15 29	3 52	15 26	3 57	15 22	4 00	15 20
29	4 16	16 42	4 17	16 43	4 18	16 45	4 19	16 45
30	4 46	17 57	4 43	18 03	4 39	18 10	4 37	18 13

TIMES OF MOONRISE AND MOONSET, 1946

Date May		Lat. 40° Moon-rise	Lat. 40° Moon-set	Lat. 45° Moon-rise	Lat. 45° Moon-set	Lat. 50° Moon-rise	Lat. 50° Moon-set	Lat. 52° Moon-rise	Lat. 52° Moon-set
		h m	h m	h m	h m	h m	h m	h m	h m
1	●	5 18	19 14	5 11	19 25	5 02	19 37	4 58	19 43
2		5 55	20 33	5 43	20 47	5 30	20 55	5 23	21 12
3		6 37	21 49	6 22	22 06	6 04	22 28	5 54	22 38
4		7 27	22 59	7 09	23 18	6 47	23 42	6 36	23 53
5		8 24	.. ..	8 05	.. ..	7 41	.. ..	7 29	.. ..
6		9 29	0 00	9 09	0 19	8 47	0 43	8 35	0 54
7		10 35	0 51	10 19	1 08	9 59	1 30	9 49	1 39
8	☽	11 43	1 32	11 29	1 47	11 13	2 05	11 06	2 12
9		12 48	2 07	12 38	2 18	12 27	2 31	12 21	2 37
10		13 51	2 37	13 46	2 44	13 38	2 55	13 35	2 57
11		14 52	3 03	14 50	3 06	14 47	3 11	14 46	3 13
12		15 52	3 27	15 53	3 27	15 55	3 28	15 55	3 28
13		16 51	3 53	16 56	3 47	17 02	3 44	17 04	3 42
14		17 50	4 14	17 59	4 09	18 09	4 01	18 13	3 57
15	○	18 50	4 40	19 01	4 31	19 16	4 19	19 22	4 14
16		19 49	5 09	20 03	4 56	20 23	4 41	20 31	4 34
17		20 48	5 42	21 05	5 26	21 27	5 07	21 37	4 58
18		21 45	6 20	22 03	6 02	22 27	5 40	22 39	5 29
19		22 37	7 03	22 57	6 44	23 21	6 21	23 33	6 09
20		23 25	7 54	23 44	7 35	.. ..	7 11	.. ..	6 59
21		.. ..	8 50	.. ..	8 32	0 07	8 10	0 18	7 59
22		0 07	9 51	0 23	9 35	0 44	9 16	0 53	9 06
23	☾	0 44	10 55	0 57	10 42	1 14	10 26	1 22	10 19
24		1 16	12 01	1 27	11 52	1 40	11 41	1 45	11 36
25		1 47	13 09	1 53	13 04	2 01	12 57	2 05	12 55
26		2 15	14 19	2 18	14 18	2 21	14 17	2 23	14 16
27		2 43	15 31	2 42	15 34	2 41	15 38	2 41	15 40
28		3 14	16 46	3 08	16 54	3 01	17 03	2 59	17 07
29		3 47	18 03	3 37	18 15	3 26	18 30	3 21	18 37
30	●	4 26	19 22	4 12	19 38	3 56	19 57	3 48	20 06
31		5 12	20 37	4 55	20 56	4 35	21 18	4 25	21 29

Date June		Lat. 40° Moon-rise	Lat. 40° Moon-set	Lat. 45° Moon-rise	Lat. 45° Moon-set	Lat. 50° Moon-rise	Lat. 50° Moon-set	Lat. 52° Moon-rise	Lat. 52° Moon-set
		h m	h m	h m	h m	h m	h m	h m	h m
1		6 07	21 45	5 48	22 04	5 24	22 28	5 13	22 40
2		7 10	22 42	6 51	23 01	6 27	23 23	6 15	23 34
3		8 19	23 30	8 01	23 45	7 39	.. ..	7 29	.. ..
4		9 28	.. ..	9 14	.. ..	8 56	0 05	8 47	0 13
5		10 37	0 08	10 26	0 20	10 12	0 35	10 06	0 42
6	☽	11 42	0 40	11 35	0 48	11 26	0 58	11 22	1 04
7		12 45	1 07	12 42	1 12	12 37	1 18	12 35	1 21
8		13 45	1 32	13 46	1 33	13 46	1 35	13 46	1 36
9		14 45	1 56	14 48	1 53	14 53	1 51	14 55	1 51
10		15 43	2 19	15 51	2 14	16 00	2 08	16 03	2 05
11		16 43	2 45	16 54	2 36	17 06	2 26	17 12	2 22
12		17 42	3 12	17 57	3 01	18 14	2 46	18 21	2 40
13		18 42	3 43	18 58	3 29	19 19	3 11	19 29	3 03
14	○	19 39	4 19	19 58	4 02	20 21	3 40	20 32	3 31
15		20 34	5 01	20 53	4 43	21 17	4 19	21 30	4 07
16		21 23	5 50	21 42	5 30	22 06	5 06	22 17	4 54
17		22 07	6 43	22 24	6 26	22 46	6 03	22 56	5 51
18		22 45	7 43	23 00	7 28	23 18	7 06	23 26	6 57
19		23 19	8 47	23 31	8 33	23 45	8 16	23 51	8 08
20		23 49	9 52	23 57	9 41	.. ..	9 28	.. ..	9 23
21		.. ..	10 57	.. ..	10 51	0 06	10 43	0 11	10 39
22	☾	0 17	12 04	0 22	12 01	0 26	11 58	0 29	11 57
23		0 45	13 13	0 45	13 14	0 45	13 16	0 46	13 17
24		1 12	14 24	1 09	14 29	1 04	14 36	1 03	14 40
25		1 43	15 38	1 35	15 48	1 26	16 00	1 23	16 06
26		2 17	16 54	2 06	17 09	1 52	17 26	1 46	17 34
27		2 59	18 10	2 44	18 28	2 26	18 49	2 17	19 00
28	●	3 49	19 23	3 31	19 42	3 09	20 06	2 57	20 17
29		4 49	20 26	4 29	20 45	4 05	21 09	3 53	21 20
30		5 56	21 20	5 37	21 37	5 14	21 57	5 03	22 07

TIMES OF MOONRISE AND MOONSET, 1946

DATE July		Latitude 40° Moon-rise	Latitude 40° Moon-set	Latitude 45° Moon-rise	Latitude 45° Moon-set	Latitude 50° Moon-rise	Latitude 50° Moon-set	Latitude 52° Moon-rise	Latitude 52° Moon-set
		h m	h m	h m	h m	h m	h m	h m	h m
1		7 07	22 04	6 51	22 17	6 31	22 34	6 22	22 41
2		8 18	22 38	8 05	22 49	7 50	23 03	7 43	23 06
3		9 27	23 09	9 19	23 15	9 08	23 23	9 03	23 26
4		10 33	23 35	10 28	23 37	10 22	23 41	10 19	23 42
5		11 36	23 59	11 34	23 59	11 33	23 59	11 33	23 58
6	☽	12 36	.. ..	12 38	.. ..	12 42	.. ..	12 43	.. ..
7		13 36	0 23	13 42	0 19	13 49	0 15	13 52	0 12
8		14 35	0 48	14 44	0 41	14 56	0 32	15 01	0 28
9		15 34	1 15	15 48	1 04	16 03	0 52	16 10	0 45
10		16 34	1 44	16 50	1 30	17 09	1 14	17 19	1 06
11		17 33	2 18	17 50	2 02	18 12	1 42	18 24	1 33
12		18 28	2 58	18 47	2 40	19 11	2 18	19 23	2 06
13		19 20	3 45	19 39	3 26	20 02	3 02	20 14	2 50
14	⊛	20 05	4 38	20 24	4 19	20 46	3 56	20 56	3 44
15		20 46	5 37	21 02	5 20	21 21	4 58	21 30	4 48
16		21 22	6 40	21 34	6 25	21 49	6 07	21 56	5 58
17		21 53	7 44	22 01	7 33	22 12	7 19	22 17	7 13
18		22 21	8 50	22 26	8 42	22 32	8 33	22 35	8 29
19		22 48	9 56	22 50	9 52	22 51	9 48	22 52	9 45
20		23 15	11 03	23 13	11 03	23 10	10 03	23 09	11 04
21	☾	23 43	12 12	23 38	12 16	23 30	12 21	23 26	12 24
22		.. ..	13 22	.. ..	13 31	23 53	13 41	23 47	13 46
23		0 15	14 35	0 05	14 48	.. ..	15 04	.. ..	15 11
24		0 52	15 49	0 38	16 06	0 22	16 26	0 14	16 35
25		1 37	17 01	1 20	17 20	1 00	17 44	0 49	17 55
26		2 31	18 08	2 12	18 27	1 48	18 52	1 37	19 04
27		3 34	19 06	3 15	19 27	2 51	19 47	2 39	19 58
28	●	4 43	19 54	4 26	20 10	4 04	20 29	3 54	20 37
29		5 56	20 34	5 42	20 45	5 24	20 59	5 16	21 06
30		7 07	21 06	6 56	21 14	6 43	21 24	6 38	21 29
31		8 16	21 35	8 09	21 39	8 01	21 44	7 57	21 46

DATE Aug.		Latitude 40° Moon-rise	Latitude 40° Moon-set	Latitude 45° Moon-rise	Latitude 45° Moon-set	Latitude 50° Moon-rise	Latitude 50° Moon-set	Latitude 52° Moon-rise	Latitude 52° Moon-set
		h m	h m	h m	h m	h m	h m	h m	h m
1		9 21	22 00	9 18	22 01	9 15	22 02	9 13	22 02
2		10 24	22 25	10 24	22 22	10 25	22 19	10 26	22 17
3		11 25	22 49	11 29	22 44	11 35	22 36	11 37	22 33
4	☽	12 25	23 16	12 33	23 06	12 43	22 54	12 47	22 50
5		13 24	23 42	13 37	23 31	13 51	23 16	13 57	23 09
6		14 24	.. ..	14 39	.. ..	14 47	23 42	15 06	23 33
7		15 23	0 17	15 40	0 01	16 02	.. ..	16 12	.. ..
8		16 20	0 55	16 39	0 36	17 03	0 15	17 14	0 04
9		17 13	1 38	17 33	1 19	17 57	0 55	18 09	0 44
10		18 02	2 30	18 20	2 11	18 43	1 48	18 55	1 34
11		18 44	3 27	19 00	3 08	19 21	2 46	19 31	2 35
12	⊛	19 22	4 29	19 35	4 13	19 51	3 54	19 59	3 45
13		19 54	5 34	20 04	5 21	20 17	5 07	20 22	4 59
14		20 24	6 41	20 30	6 32	20 38	6 22	20 42	6 16
15		20 52	7 48	20 54	7 43	20 58	7 37	20 59	7 34
16		21 19	8 56	21 17	8 55	21 16	8 53	21 15	8 53
17		21 46	10 04	21 41	10 07	21 35	10 10	21 32	10 13
18		22 16	11 14	22 07	11 22	21 57	11 30	21 52	11 34
19	☾	22 51	12 25	22 38	12 37	22 23	12 49	22 16	12 57
20		23 32	13 38	23 16	13 52	22 56	14 11	22 47	14 20
21		.. ..	14 49	.. ..	15 07	23 39	15 29	23 28	15 40
22		0 21	15 56	0 02	16 16	.. ..	16 40	.. ..	16 52
23		1 19	16 56	0 59	17 15	0 35	17 38	0 24	17 50
24		2 24	17 46	2 06	18 03	1 43	18 24	1 32	18 33
25		3 35	18 28	3 19	18 40	2 59	18 59	2 50	19 06
26	●	4 46	19 03	4 34	19 14	4 19	19 25	4 11	19 30
27		5 56	19 34	5 48	19 40	5 38	19 47	5 32	19 50
28		7 03	20 00	6 59	20 03	6 53	20 06	6 51	20 07
29		8 08	20 25	8 07	20 24	8 07	20 23	8 06	20 22
30		9 11	20 50	9 14	20 45	9 17	20 40	9 20	20 36
31		10 13	21 16	10 19	21 07	10 27	20 58	10 32	20 53

TIMES OF MOONRISE AND MOONSET, 1946

Date Sept.		Lat. 40° Moonrise	Lat. 40° Moonset	Lat. 45° Moonrise	Lat. 45° Moonset	Lat. 50° Moonrise	Lat. 50° Moonset	Lat. 52° Moonrise	Lat. 52° Moonset
		h m	h m	h m	h m	h m	h m	h m	h m
1		11 13	21 43	11 23	21 32	11 36	21 18	11 42	21 11
2		12 13	22 14	12 27	22 00	12 44	21 42	12 52	21 33
3	☽	13 13	22 49	13 30	22 33	13 50	22 11	14 00	22 01
4		14 11	23 32	14 30	23 12	14 52	22 48	15 04	22 37
5		15 05	.. ..	15 25	23 59	15 51	23 35	16 02	23 22
6		15 55	0 19	16 14	.. ..	16 39	.. ..	16 50	.. ..
7		16 40	1 14	16 58	0 55	17 19	0 31	17 30	0 19
8		17 19	2 14	17 35	1 58	17 53	1 36	18 01	1 26
9		17 53	3 19	18 06	3 04	18 19	2 48	18 25	2 39
10		18 25	4 25	18 32	4 15	18 42	4 03	18 46	3 56
11	⊕	18 53	5 34	18 57	5 28	19 02	5 20	19 05	5 16
12		19 21	6 42	19 21	6 40	19 21	6 38	19 21	6 37
13		19 48	7 53	19 44	7 55	19 40	7 57	19 38	7 58
14		20 18	9 04	20 10	9 10	20 01	9 17	19 56	9 20
15		20 52	10 16	20 40	10 27	20 26	10 39	20 19	10 45
16		21 30	11 29	21 15	11 44	20 56	12 02	20 47	12 09
17		22 17	12 41	21 59	12 59	21 36	13 21	21 25	13 32
18	☾	23 12	13 49	22 52	14 09	22 27	14 33	22 15	14 45
19		.. ..	14 52	23 54	15 11	23 30	15 35	23 18	15 46
20		0 14	15 43	.. ..	16 01	.. ..	16 23	.. ..	16 34
21		1 36	16 27	1 04	16 42	0 42	16 59	0 32	17 09
22		2 30	17 03	2 17	17 15	2 00	17 28	1 52	17 34
23		3 40	17 34	3 30	17 41	3 18	17 51	3 12	17 55
24		4 48	18 01	4 41	18 05	4 34	18 10	4 31	18 11
25	●	5 53	18 26	5 51	18 26	5 48	18 27	5 47	18 27
26		6 57	18 51	6 59	18 47	7 00	18 44	7 01	18 42
27		7 59	19 16	8 04	19 09	8 10	19 01	8 14	18 57
28		9 01	19 42	9 09	19 32	9 20	19 19	9 26	19 14
29		10 02	20 12	10 14	19 58	10 29	19 41	10 36	19 34
30		11 02	20 42	11 18	20 29	11 37	20 09	11 46	19 59

Date Oct.		Lat. 40° Moonrise	Lat. 40° Moonset	Lat. 45° Moonrise	Lat. 45° Moonset	Lat. 50° Moonrise	Lat. 50° Moonset	Lat. 52° Moonrise	Lat. 52° Moonset
		h m	h m	h m	h m	h m	h m	h m	h m
1		12 01	21 24	12 19	21 06	12 42	20 42	12 53	20 31
2		12 56	22 09	13 16	21 49	13 41	21 25	13 53	21 12
3	☽	13 48	23 01	14 08	22 41	14 33	22 16	14 45	22 04
4		14 35	23 59	14 53	23 40	15 17	23 17	15 28	23 06
5		15 15	.. ..	15 32	.. ..	15 52	.. ..	16 02	.. ..
6		15 51	1 00	16 05	0 45	16 21	0 26	16 29	0 17
7		16 23	2 06	16 32	1 53	16 44	1 39	16 50	1 30
8		16 52	3 13	16 58	3 05	17 05	2 55	17 09	2 51
9		17 20	4 22	17 22	4 19	17 24	4 14	17 26	4 11
10	⊕	17 48	5 33	17 46	5 34	17 43	5 34	17 43	5 34
11		18 17	6 45	18 11	6 50	18 04	6 56	18 00	6 58
12		18 49	8 00	18 39	8 09	18 27	8 20	18 21	8 25
13		19 27	9 16	19 13	9 29	18 55	9 45	18 48	9 53
14		20 12	10 30	19 54	10 48	19 33	11 09	19 22	11 19
15		21 05	11 43	20 45	12 02	20 21	12 26	20 09	12 38
16		22 06	12 47	21 46	13 07	21 21	13 33	21 09	13 44
17	☾	23 10	13 43	22 55	14 01	22 32	14 25	22 21	14 35
18		.. ..	14 28	.. ..	14 42	23 46	15 04	23 39	15 13
19		0 21	15 06	0 06	15 18	.. ..	15 34	.. ..	15 41
20		1 30	15 37	1 19	15 46	1 05	15 57	0 58	16 02
21		2 37	16 05	2 29	16 10	2 20	16 17	2 16	16 19
22		3 42	16 30	4 38	16 31	3 34	16 33	3 32	16 34
23		4 45	16 54	4 46	16 52	4 46	16 49	4 46	16 48
24	●	5 48	17 18	5 51	17 13	5 56	17 06	5 57	17 03
25		6 49	17 44	6 57	17 35	7 06	17 24	7 10	17 19
26		7 51	18 11	8 02	18 00	8 15	17 44	8 22	17 37
27		8 51	18 43	9 06	18 29	9 24	18 09	9 32	18 00
28		9 51	19 20	10 08	19 02	10 31	18 40	10 41	18 29
29		10 48	20 03	11 08	19 43	11 32	19 18	11 44	19 06
30		11 42	20 51	12 02	20 31	12 27	20 05	12 40	19 54
31		12 30	21 46	12 49	21 27	13 14	21 02	13 26	20 51

TIMES OF MOONRISE AND MOONSET, 1946

Date Nov.		Lat. 40° Moonrise	Lat. 40° Moonset	Lat. 45° Moonrise	Lat. 45° Moonset	Lat. 50° Moonrise	Lat. 50° Moonset	Lat. 52° Moonrise	Lat. 52° Moonset
		h m	h m	h m	h m	h m	h m	h m	h m
1	☽	13 12	22 45	13 30	22 29	13 52	22 06	14 02	21 57
2		13 49	23 48	14 04	23 34	14 22	23 17	14 31	23 09
3		14 21	.. ..	14 33	.. ..	14 47	.. ..	14 53	.. ..
4		14 51	0 53	14 59	0 43	15 08	0 31	15 13	0 24
5		15 19	2 00	15 23	1 54	15 28	1 46	15 29	1 43
6		15 46	3 09	15 46	3 07	15 46	3 04	15 46	3 03
7		16 13	4 20	16 09	4 22	16 04	4 24	16 03	4 26
8		16 42	5 34	16 36	5 40	16 26	5 48	16 22	5 52
9	○	17 20	6 50	17 08	7 02	16 53	7 15	16 46	7 21
10		18 03	8 08	17 47	8 24	17 27	8 43	17 17	8 51
11		18 54	9 25	18 35	9 43	18 12	10 07	17 59	10 18
12		19 54	10 36	19 34	10 56	19 09	11 23	18 56	11 33
13		21 00	11 37	20 42	11 57	20 18	12 21	20 06	12 33
14		22 10	12 28	21 55	12 45	21 34	13 06	21 25	13 16
15	☾	23 22	13 08	23 09	13 22	22 52	13 39	22 46	13 47
16		.. ..	13 42	.. ..	13 52	.. ..	14 04	.. ..	14 10
17		0 30	14 10	0 21	14 17	0 10	14 25	0 05	14 28
18		1 34	14 36	1 30	14 38	1 24	14 41	1 21	14 43
19		2 38	14 59	2 37	14 58	2 36	14 57	2 35	14 57
20		3 40	15 23	3 43	15 19	3 46	15 13	3 47	15 11
21		4 41	15 47	4 47	15 40	4 55	15 30	4 59	15 26
22		5 42	16 14	5 52	16 03	6 04	15 49	6 10	15 43
23	●	6 43	16 42	6 57	16 29	7 12	16 12	7 21	16 04
24		7 43	17 19	7 59	17 02	8 21	16 40	8 30	16 30
25		8 41	17 59	9 00	17 40	9 24	17 16	9 36	17 04
26		9 37	18 46	9 57	18 26	10 22	18 00	10 34	17 48
27		10 26	19 38	10 46	19 18	11 11	18 53	11 23	18 41
28		11 10	20 35	11 29	20 17	11 52	19 55	12 03	19 44
29		11 48	21 36	12 04	21 21	12 25	21 02	12 34	20 53
30		12 22	22 38	12 35	22 27	12 51	22 12	12 58	22 05

Date Dec.		Lat. 40° Moonrise	Lat. 40° Moonset	Lat. 45° Moonrise	Lat. 45° Moonset	Lat. 50° Moonrise	Lat. 50° Moonset	Lat. 52° Moonrise	Lat. 52° Moonset
		h m	h m	h m	h m	h m	h m	h m	h m
1	☽	12 52	23 43	13 01	23 34	13 12	23 25	13 18	23 20
2		13 18	.. ..	13 25	.. ..	13 31	.. ..	13 34	.. ..
3		13 44	0 49	13 47	0 41	13 49	0 39	13 50	0 36
4		14 11	1 55	14 09	1 56	14 07	1 56	14 06	1 56
5		14 39	3 06	14 32	3 10	14 26	3 15	14 23	3 18
6		15 12	4 20	15 02	4 29	14 49	4 39	14 44	4 43
7		15 50	5 37	15 36	5 50	15 18	6 06	15 10	6 12
8	○	16 37	6 56	16 20	7 13	15 57	7 34	15 47	7 44
9		17 34	8 12	17 14	8 32	16 49	8 56	16 38	9 08
10		18 41	9 20	18 21	9 41	17 56	10 06	17 34	10 18
11		19 53	10 18	19 35	10 37	19 13	11 00	19 03	11 10
12		21 07	11 05	20 53	11 20	20 35	11 39	20 26	11 48
13		22 18	11 43	22 07	11 54	21 55	12 08	21 50	12 14
14		23 26	12 14	23 19	12 21	23 12	12 30	23 09	12 35
15	☾	.. ..	12 40	.. ..	12 44	.. ..	12 49	.. ..	12 51
16		0 31	13 05	0 28	13 05	0 26	13 05	0 24	13 05
17		1 33	13 28	1 34	13 25	1 36	13 21	1 38	13 19
18		2 34	13 52	2 39	13 45	2 45	13 38	2 49	13 33
19		3 35	14 18	3 43	14 07	3 54	13 55	4 00	13 50
20		4 35	14 47	4 48	14 33	5 03	14 17	5 10	14 09
21		5 35	15 20	5 51	15 03	6 11	14 42	6 20	14 33
22		6 35	15 58	6 53	15 39	7 16	15 15	7 27	15 04
23		7 31	16 42	7 51	16 22	8 16	15 57	8 28	15 44
24	●	8 23	17 32	8 43	17 13	9 08	16 47	9 22	16 35
25		9 09	18 28	9 28	18 11	9 52	17 46	10 03	17 35
26		9 47	19 29	10 06	19 12	10 27	18 52	10 37	18 43
27		10 23	20 31	10 38	20 18	10 55	20 02	11 03	19 54
28		10 54	21 33	11 05	21 24	11 17	21 13	11 24	21 07
29		11 21	22 37	11 29	22 31	11 37	22 24	11 41	22 22
30		11 46	23 42	11 50	23 39	11 55	23 38	11 56	23 37
31	☽	12 11	.. ..	12 12	.. ..	12 12	.. ..	12 12	.. ..

THE PLANETS IN 1946

By C. A. CHANT

The principal elements of the solar system are listed on page 58. In this and the following pages are given some of the special phenomena of the planets to be observed in 1946.

THE SUN

Mr. DeLisle Garneau reports that, following the minimum of sun-spots in April 1944, they became larger and more numerous at the end of March 1945 and a notable increase was evident in June. The sun will become still more active in 1946.

MERCURY

Mercury is exceptional in many ways. It is the planet nearest the sun and travels fastest in its orbit, its speed varying from 23 miles per sec. at aphelion to 35 miles per sec. at perihelion. With the exception of Pluto its orbit has the greatest eccentricity and the greatest inclination to the ecliptic. It receives from the sun most light and heat per square mile of the surface, the amount on the average being 6.7 times that received by the earth. If we except Pluto, whose size and mass are still uncertain, Mercury's size and mass are the smallest; but its period of rotation on its axis is longest of all!

Mercury's period of revolution is 88 days, and as its orbit is well within that of the earth, the planet, as seen from the earth, appears to move quickly from one side of the sun to the other several times in the year. It's greatest elongation (i.e., its maximum angular distance from the sun) varies between 18° and 28°, and on such occasions it is visible to the naked eye for about two weeks.

When the elongation of Mercury is east of the sun it is an evening star, setting soon after the sun. When the elongation is west, it is a morning star and rises shortly before the sun. Although its brightness when it is taken as a star is considerable it is always viewed in the twilight sky and one must look sharply to see it.

The most suitable times to observe Mercury are at an eastern elongation in the spring and at a western elongation in the autumn. The dates of greatest elongation this year, together with the planet's separation from the sun and its stellar magnitude, are given in the following table:

Maximum Elongations of Mercury during 1946

Elong. East—Evening Star			Elong. West—Morning Star		
Date	Distance	Mag.	Date	Distance	Mag.
March 9	18°	− 0.1	Apr. 23	27°	+ 0.6
July 5	26°	+ 0.7	Aug. 20	19°	+ 0.3
Oct. 31	24°	+ 0.1	Dec. 9	21°	0.0

The most favourable elongations to observe are: in the evening, March 9; in the morning, Aug. 20, but Dec. 9 will also be good. At these times Mercury is about 80 million miles from the earth and in a telescope looks likes a half-moon about 7″ in diameter.

VENUS

Venus is the next planet in order from the sun. In size and mass it is almost a twin of the earth. Venus being within the earth's orbit, its apparent motion is similar to Mercury's but much slower and more stately. The orbit of Venus is almost circular with radius of 67 million miles, and its orbital speed is 22 miles per sec.

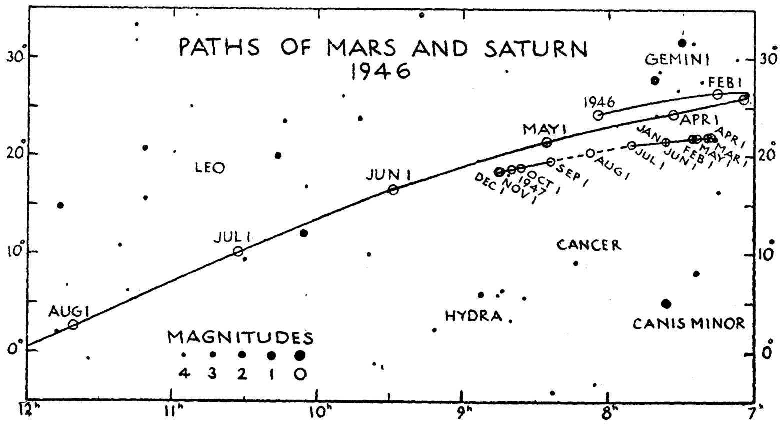
On January 1, 1946, Venus is a morning star but not well placed for observation. Its angular distance from the sun is not great and its altitude above the horizon at sunrise is small. Slowly it moves in towards the sun, and on Feb. 1 it is in superior conjunction. Its distance from the earth is now 93 + 67 or 160 million miles. Then it gradually draws away from the sun and in a month is a splendid evening star, and it remains such all summer. On June 1 Venus has a close conjunction with the moon and on Aug. 9 with Mars. On Sept. 8 it attains greatest elongation east, 46° from the sun. Its stellar magnitude is − 4.0 and in the telescope it looks like a half-moon with diameter 25″. In 35 days, on Oct. 14, it attains greatest brilliancy, mag. − 4.3. It is crescent-shaped with diameter 38″. Two weeks later, on Oct. 28, it is at a stationary point from which it quickly recovers and rapidly moves in toward the sun and on Nov. 17 it reaches inferior conjunction. Its distance from the earth is but 93 − 67 or 26 million miles, but as it is directly toward the sun, as seen from the earth, it is invisible. Then it moves to the west of the sun and becomes a morning star. It reaches a stationary point on Dec. 7 and attains greatest brilliancy on Dec. 23,—a beautiful Christmas morning-star!

With the exception of the sun and moon, Venus is the brightest object in the sky. Its brilliance is largely due to the dense clouds which cover the surface of the planet. They reflect well the sun's light; but they also prevent the astronomer from detecting any solid object on the surface of the body and thus enabling him to detect the planet's rotation period. It is probably about 30 days.

MARS

The orbit of Mars is outside that of the earth and consequently its planetary phenomena occur quite differently from those of the two inferior planets. Its mean distance from the sun is 141 million miles and the eccentricity of its orbit is 0.093. A simple computation shows that its distance from the sun ranges between 128 and 154 million miles. Its distance from the earth varies from 35 to 235 million miles and its brightness changes accordingly. When Mars is nearest it is conspicuous in its fiery red, but when farthest away it is no brighter than Polaris. Unlike Venus, its atmosphere is very thin, and features on the solid surface are distinctly visible. Hence its rotation period of 24h. 37m. has been accurately determined.

On Jan. 10 Mars is nearest the earth—approximately 60 million miles away. It is in the constellation Gemini, and its stellar magnitude is − 1.2. On Jan. 13 it is in opposition to the sun and so is on the meridian at midnight. The planet continues to retrograde until Feb. 22, when it begins to move eastward among the stars again. For about three months from Jan. 1 the planet will appear to be hovering about the star Pollux. See accompanying map. On April 19 it is in quadrature with the sun; at sunset the planet will be on the meridian. The planet will be in close conjunction with the moon on April 9 and Nov. 24 (see pp. 37 and 51).

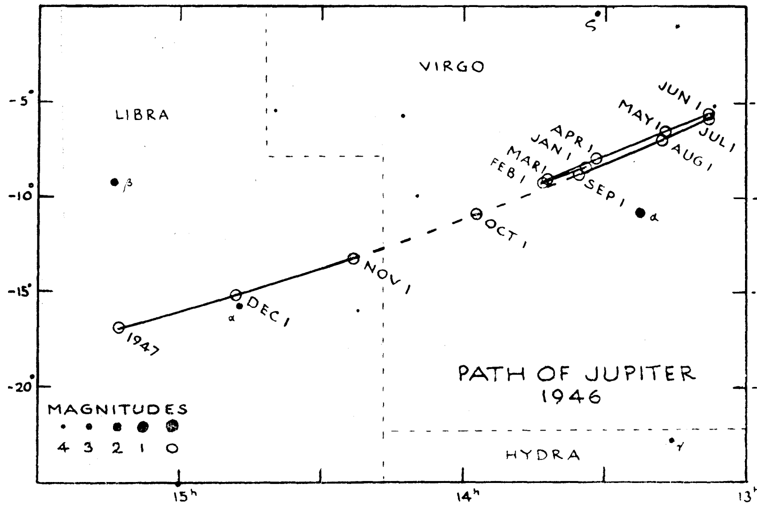


(In this chart the path of Mars is above, Saturn below)

JUPITER

Jupiter is the giant of the family of the sun. Its mean diameter is 87,000 miles and its mass is 2½ times that of all the rest of the planets combined. Its mean distance is 483 million miles and the revolution period is 11.9 years. This planet is known to possess 11 satellites, two of them discovered in 1938 (see p. 57). Not so long ago it was generally believed that the planet was still cooling down from its original high temperature, but from actual measurements it has been deduced that the surface is at about − 200°F. The spectroscope shows that the atmosphere is largely ammonia and methane.

Jupiter is a fine object for the telescope. Many details of the surface as well as the flattening of the planet, due to its short rotation period, are visible, and the phenomena of its satellites provide a continual interest. On Jan. 1 it is a fine morning star and is on the meridian about 7 a.m. Its stellar magnitude is − 1.5. On Apr. 12 it is in opposition with the sun. It rises as the sun sets and is visible all night long. Its mag. then is − 2.0. Its distance from the earth is 414 million miles and its equatorial diameter is 44″. Conjunction with the sun occurs on Oct. 31. In the accompanying map that portion of the path when the planet is not well placed for observation is shown by a broken line.



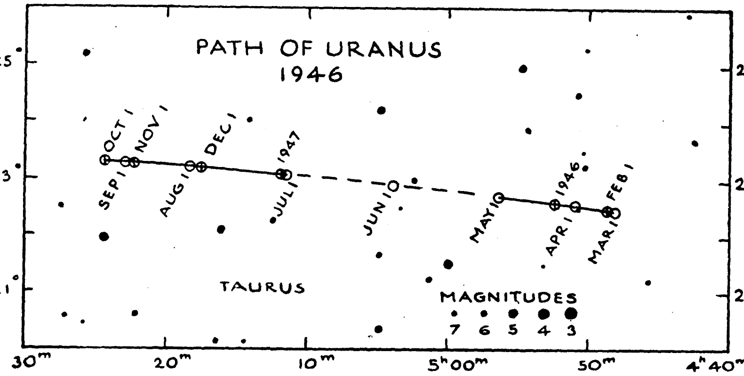
SATURN

Saturn was the outermost planet known until modern times. In size it is a good second to Jupiter. In addition to its family of nine satellites this planet has a unique system of rings, and it is one of the finest of celestial objects in a good telescope. The plane of the rings makes an angle of 27° with the plane of the planet's orbit, and twice during the planet's revolution period of 29½ years the rings appear to open out widest; then they slowly close in until, midway between the maxima, the rings are presented edgewise to the sun or the earth, at which times they are invisible. They were invisible in 1936 and at a maximum in 1944. In 1946 they will be slowly closing in but still quite visible. Their south face is presented now.

The planet is in Gemini all year. On Jan. 12 it is in opposition to the sun and is visible all night. On Apr. 8 it is in quadrature with the sun and is on the meridian at sunset. On July 21 it is in conjunction with the sun and on Nov. 1 it is again in quadrature but now is on the meridian at sunrise.

URANUS

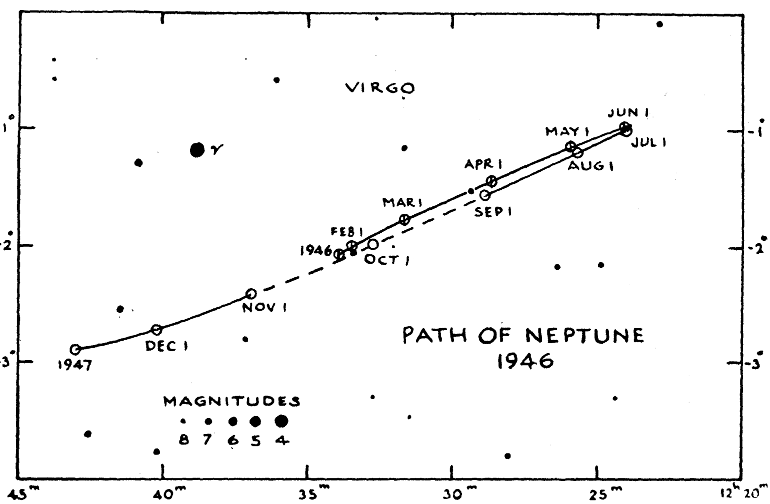
Uranus was discovered in 1781 by Sir William Herschel by means of a 6¼-in. mirror-telescope made by himself. The object did not look just like a star and he observed it again four days later. It had moved amongst the stars, and he assumed it to be a comet. Computation later showed that it was a planet nearly twice as far from the sun as Saturn. Its period of revolution is 84 years and it rotates on its axis in about 11 hours. Its four satellites are visible only in a large telescope. The spectroscope has revealed methane gas in its frigid atmosphere.



As shown by the chart, Uranus in 1946 is in Taurus not far from Aldebaran. On Dec. 7, 1945, it was in opposition with the sun, when its stellar mag. was + 5.9 and diam. 3″.8. On Mar. 4 it is in quadrature, on June 8 in conjunction, on Sept. 14 in quadrature and on Dec. 9 again in opposition.

NEPTUNE

Neptune was discovered in 1846 after its existence in the sky had been predicted from independent calculations by Leverrier in France and Adams in England. It caused a sensation at the time. Its distance from the sun is 2800 million miles and its period of revolution is 165 years. Its single satellite was discovered in 1846, soon after the planet.



During 1946 Neptune is still in the constellation Virgo. It is in opposition with the sun on Mar. 28. Its stellar magnitude is + 7.7 and hence is too faint for the naked eye. In the telescope it shows a greenish tint and a diameter of 2″.5. It is in conjunction with the sun on Oct. 1.

PLUTO

Pluto, the most distant known planet, was discovered at the Lowell Observatory in 1930, following prolonged mathematical calculations and observations by photography. Its mean distance from the sun is 3666 million miles and its revolution period is 248 years. It appears as a 15th mag. star in the constellation Cancer. Its position in 1946 at opposition on Feb. 5 will be R.A. $8^h\ 59^m.8$, Dec. + 23° 50′.

It will be recalled that in the production of the atomic bomb the basic source was the element Uranium and from it two "synthetic power atoms" were obtained which were given the names Neptunium and Plutonium.

THE SKY MONTH BY MONTH

By J. F. Heard

THE SKY FOR JANUARY, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During January the sun's R.A. increases from 18h 43m to 20h 56m and its Decl. changes from 23° 04′ S. to 17° 20′ S. The equation of time changes steadily from −3m 15s to −13m 35s. For changes in the length of the day, see p. 11. The earth is in perihelion, or nearest the sun, on January 2.

The Moon—For its phases, perigee and apogee times and distances, and its conjugations with the planets, see opposite page.

Mercury on the 15th is in R.A. 18h 34m, Decl. 23° 47′ S. and transits at 11.01. It is in the morning sky all month. On the 1st it rises about 1h 40m before the sun and is about 13° above the south-eastern horizon at sunrise, having a stellar magnitude of −0.1 As the month goes on it moves closer to the sun.

Venus on the 15th is in R.A. 19h 27m, Decl. 22° 38′ S. and transits at 11.53. At the beginning of the month it is in the morning sky but poorly placed for observation, rising about 20 minutes before the sun in the south-east. Since it is approaching superior conjunction it presents nearly the full disk in a telescope. Its magnitude is −3.4.

Mars on the 15th is in R.A. 07h 42m, Decl. 25° 41′ N. and transits at 00.05. It rises at about sunset and is visible all night. This is the best time for observation of Mars. Its stellar magnitude is −1.2 and its apparent diameter is 14½″. It is nearest the earth (about 59,400,000 miles) on the 10th and is in opposition on the 13th. It is in conjunction with Saturn on the 22nd.

Jupiter on the 15th is in R.A. 13h 39m, Decl. 08° 54′ S. and transits at 06.02. It rises about midnight and is about on the meridian at sunrise. Its magnitude is −1.6. It is in quadrature with the sun on the 16th. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 07h 32m, Decl. 21° 42′ N. and transits at 23.51. It is in Gemini, rising about sunset and remaining visible all night. It is now relatively bright (magnitude −0.2) and its rings are quite open, making an angle of 23° with the line of sight. It is in opposition on the 12th. It is retrograding at this time. On the 22nd it is in conjunction with Mars.

Uranus on the 15th is in R.A. 04h 50m, Decl. 22° 31′ N. and transits at 21.11.

Neptune on the 15th is in R.A. 12h 34m, Decl. 02° 03′ S. and transits at 04.57.

Pluto—For information in regard to this planet, see p. 29.

ASTRONOMICAL PHENOMENA MONTH BY MONTH

By Ruth J. Northcott

JANUARY

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 5h 30m
Tue. 1	10	08	☌ ☿ ☾ ☿ 0° 13′ N.		40123
Wed. 2	13		⊕ in Perihelion. Dist. from ⊙, 91,349,000 mi.		41032
	16	31	☌ ♀ ☾ ♀ 0° 13′ N.		
Thu. 3			Quadrantid meteors	03 54	32401
			Partial eclipse of ⊙, see p. 56.		
	7	30	● New Moon		
Fri. 4					31204
Sat. 5					30124
Sun. 6				00 43	10234
Mon. 7					20134
Tue. 8				21 32	0234*
Wed. 9					10324
Thu. 10	3		♂ nearest ⊕. Dist. from ⊕, 59,400,000 mi.		32014
	4		☿ in ☋		
	14		♆ Stationary in R.A.		
	15	27	☽ First Quarter		
Fri. 11				18 21	32104
Sat. 12	1		☍ ♄ ⊙ Dist. from ⊕, 749,600,000 mi.		34012
Sun. 13	20		☍ ♂ ⊙ Dist. from ⊕, 59,540,000 mi.		4102*
Mon. 14	7		Moon in Perigee. Dist. from ⊕, 227,600 mi.	15 10	42013
	9	38	☌ ♅ ☾ ♅ 1° 30′ N.		
Tue. 15					403**
Wed. 16	21		□ ♃ ⊙		41032
	23	17	☌ ♄ ☾ ♄ 1° 58′ S.		
Thu. 17	2	02	☌ ♂ ☾ ♂ 2° 17′ N.	12 00	43201
	9	46	○ Full Moon		
Fri. 18					43210
Sat. 19					34012
Sun. 20	10		☿ in Aphelion	08 49	1402*
Mon. 21					20143
Tue. 22	12		☌ ♂ ♄ ♂ 4° 23′ N.		1034*
	17	03	☌ ♆ ☾ ♆ 4° 00′ S.		
Wed. 23				05 38	d0234
Thu. 24	5	47	☌ ♃ ☾ ♃ 3° 34′ S.		32014
Fri. 25	0	00	☾ Last Quarter		32104
Sat. 26	2		Moon in Apogee. Dist. from ⊕, 251,300 mi.	02 28	30124
Sun. 27					13024
Mon. 28				23 17	20143
Tue. 29					14203
Wed. 30					40123
Thu. 31	11		♀ in Aphelion	20 06	d430*

THE SKY FOR FEBRUARY, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During February the sun's R.A. increases from 20h 56m to 22h 45m and its Decl. changes from 17° 20′ S. to 07° 54′ S. The equation of time changes from −13m 35s to a limit of −14m 21s on the 12th and then to −12m 37s at the end of the month. For changes in the length of the day, see p. 11.

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

Mercury on the 15th is in R.A. 22h 06m, Decl. 13° 38′ S. and transits at 12.31. It is too close to the sun all month for observation. It reaches superior conjunction on the 10th and passes into the evening sky.

Venus on the 15th is in R.A. 22h 06m, Decl. 13° 10′ S. and transits at 12.29. It is in superior conjunction on the 1st and then passes into the evening sky. However, it is too close to the sun all month for satisfactory observation.

Mars on the 15th is in R.A. 07h 04m, Decl. 26° 31′ N. and transits at 21.22. It rises about 4 hours before sunset and is visible till nearly sunrise. Its magnitude has faded to −0.4. It has been retrograding since the beginning of the year but on the 21st it resumes direct motion.

Jupiter on the 15th is in R.A. 13h 44m, Decl. 09° 12′ S. and transits at 04.05. It rises about an hour before midnight and is west of the meridian at sunrise Its magnitude is −1.7. On the 11th it begins to retrograde, or move westward among the stars. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 07h 22m, Decl. 22° 05′ N. and transits at 21.40. It is fairly well up at sunset and is visible all night.

Uranus on the 15th is in R.A. 04h 48m, Decl. 22° 27′ N. and transits at 19.07.

Neptune on the 15th is in R.A. 12h 33m, Decl. 01° 54′ S. and transits at 02.54.

Pluto—For information in regard to this planet, see p. 29.

FEBRUARY

75th Meridian Civil Time

	d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 4h 00m
Fri.	1	9		☌ ♀ ☉ Superior		4321O
		9	56	☌ ☿ ☾ ☿ 1° 05′ N.		
		22	38	☌ ♀ ☾ ♀ 2° 24′ N.		
		23	43	● New Moon		
Sat.	2					43O21
Sun.	3				16 56	431O2
Mon.	4					42O31
Tue.	5					421O3
Wed.	6				13 45	4O123
Thu.	7					1O234
Fri.	8	23	28	☽ First Quarter		d32O4
Sat.	9	5		Moon in Perigee. Dist. from ⊕, 230,100 mi.	10 34	3O214
		18		☿ Greatest Hel. Lat. S.		
Sun.	10	15	23	☌ ♅ ☾ ♅ 1° 24′ N.		31O24
		21		☌ ☿ ☉ Superior		
Mon.	11	15		♃ Stationary in R.A.		2O314
Tue.	12	21	24	☌ ♂ ☾ ♂ 2° 30′ N.	07 23	21O34
Wed.	13	4	20	☌ ♄ ☾ ♄ 1° 48′ S.		O1243
Thu.	14	18		☌ ☿ ♀ ☿ 0° 29′ S.		1O234
Fri.	15	23	28	○ Full Moon	04 13	234O1
Sat.	16					34O**
Sun.	17					431O2
Mon.	18				01 02	42O31
Tue.	19	1	23	☌ ♆ ☾ ♆ 3° 48′ S.		421O3
Wed.	20	7		♅ Stationary in R.A.	21 51	4O123
		15	16	☌ ♃ ☾ ♃ 3° 13′ S.		
Thu.	21	22		♂ Stationary in R.A.		41O23
Fri.	22	21		♀ Greatest Hel. Lat. S.		234O1
		23		Moon in Apogee. Dist. from ⊕, 251,200 mi.		
Sat.	23	21	36	☾ Last Quarter	18 41	3O4**
Sun.	24					31O24
Mon.	25					23O14
Tue.	26				15 30	21O34
Wed.	27					O2134
Thu.	28	6		♄ in ☊		1O234
		19		☿ in ☊		

Explanation of symbols and abbreviations on p. 4, of time on p. 8.

THE SKY FOR MARCH, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During March the sun's R.A. increases from 22h 45m to 00h 39m and its Decl. changes from 07° 54′ S. to 04° 13′ N. On March 21 at 00.33 E.S.T. the sun crosses the equator on its way north, enters the sign of Aries, and spring commences. This is the vernal equinox. The equation of time changes steadily from −12m 37s to −4m 12s. For changes in the length of the day, see p. 12.

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

Mercury on the 15th is in R.A. 00h 32m, Decl. 06° 42′ N. and transits at 13.01. On the 9th it reaches greatest eastern elongation and appears about 16° above the south-western horizon at sunset. Its stellar magnitude is −0.1. Then it approaches the sun and on the 26th is in inferior conjunction, passing into the morning sky. On the 16th it is at a stationary point and retrogrades for the rest of the month.

Venus on the 15th is in R.A. 00h 16m, Decl. 00° 25′ N. and transits at 12.49. It is becoming more favourably situated in the evening sky. By the 31st it is about 9° above the horizon at sunset just a little to the south of the sun's setting point. Its stellar magnitude is −3.4 and through a telescope it appears nearly full.

Mars on the 15th is in R.A. 07h 14m, Decl. 25° 28′ N. and transits at 19.43. It is well up in the eastern sky at sunset and sets about 2 hours before sunrise. Its stellar magnitude is +0.4. On the 18th it is in conjunction with Saturn for the second time within two months.

Jupiter on the 15th is in R.A. 13h 38m, Decl. 08° 34′ S. and transits at 02.09. It rises about 3 hours after sunset and is visible the rest of the night. Its magnitude is −1.9. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 07h 18m, Decl. 22° 16′ N. and transits at 19.46. It is high in the sky at sunset and is visible most of the night. On the 20th it is stationary in R.A. and resumes direct, or eastward, motion among the stars. On the 18th it is in conjunction with Mars.

Uranus on the 15th is in R.A. 04h 49m, Decl. 22° 29′ N. and transits at 17.17.

Neptune on the 15th is in R.A. 12h 30m, Decl. 01° 38′ S. and trnasits at 01.01.

Pluto—For information in regard to this planet, see p. 29.

MARCH

75th Meridian Civil Time

	d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 2h 30m
Fri.	1				12 19	23O14
Sat.	2					321O4
Sun.	3	13	01	● New Moon		3O142
		23	48	☌ ♀ ☾ ♀ 3° 53′ N.		
Mon.	4	11		□ ♅ ☉	09 09	d43O1
		15	16	☌ ☿ ☾ ☿ 6° 22′ N.		
Tue.	5	10		☿ in Perihelion		421O3
Wed.	6	20		Moon in Perigee. Dist. from ⊕, 227,900 mi.		4O213
Thu.	7				05 58	41O23
Fri.	8					423O1
Sat.	9	11		☿ Greatest elongation E., 18° 17′		4321O
		20	56	☌ ♅ ☾ ♅ 1° 09′ N.		
Sun.	10	7	03	☽ First Quarter	02 47	34O12
Mon.	11					34O2*
Tue.	12	5	50	☌ ♂ ☾ ♂ 1° 25′ N.	23 37	21O43
		8	32	☌ ♄ ☾ ♄ 1° 52′ S.		
		12		♂ Greatest Hel. Lat. N.		
Wed.	13					O2143
Thu.	14					1O234
Fri.	15	17		☿ Greatest Hel. Lat. N.	20 26	d2O14
Sat.	16	4		☿ Stationary in R.A.		321O4
Sun.	17	14	11	○ Full Moon		3O124
Mon.	18	4		☌ ☿ ♀ ☿ 4° 58′ N.	17 15	31O24
		8	18	☌ ♆ ☾ ♆ 3° 41′ S.		
		20		☌ ♂ ♄ ♂ 2° 58′ N.		
Tue.	19	19	42	☌ ♃ ☾ ♃ 3° 02′ S.		d2O34
Wed.	20	1		♄ Stationary in R.A.		4O13*
Thu.	21	0	33	☉ enters ♈, Spring commences. Long. of ☉, 0°.	14 04	41O23
Fri.	22	18		Moon in Apogee. Dist. from ⊕, 251,600 mi.		42O31
Sat.	23					4321O
Sun.	24				10 54	43O12
Mon.	25	17	37	☾ Last Quarter		431O2
Tue.	26	4		☌ ☿ ☉ Inferior		42O13
Wed.	27				07 43	42O13
Thu.	28	8		☍ ♆ ☉ Dist. from ⊕, 2,720,000,000 mi.		14O23
Fri.	29					2O314
Sat.	30				04 32	321O4
Sun.	31	23	56	☌ ☿ ☾ ☿ 7° 31′ N.		3O214

Explanation of symbols and abbreviations on p. 4, of time on p. 8.

THE SKY FOR APRIL, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During April the sun's R.A. increases from 00h 39m to 02h 30m and its Decl. changes from 04° 13′ N. to 14° 49′ N. The equation of time changes from −4m 12s at the first of the month to zero on the 15th so that on that day the sun crosses the meridian at mean noon. Then the apparent sun goes ahead of the mean sun and at the end of the month the equation of time is +2m 51s. For changes in the length of the day, see p. 12.

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

Mercury on the 15th is in R.A. 23h 59m, Decl. 01° 41′S. and transits at 10.28. It is in greatest western elongation on the 23rd but at this time it is only a few degrees above the horizon at sunrise and cannot be satisfactorily observed. On the 7th it reaches a stationary point and begins to move eastward among the stars.

Venus on the 15th is in R.A. 02h 40m, Decl. 15° 18′ N. and transits at 13.10 It is fairly conspicuous in the evening sky, being about 15° above the western horizon at sunset. Its stellar magnitude is −3.3 and seen through a telescope it is nearly full.

Mars on the 15th is in R.A. 07h 57m, Decl. 23° 06′ N. and transits at 18.24. It is about on the meridian at sunset and sets about 2 hours after midnight. Its magnitude is +0.9. There is a close conjunction with the moon on the night of the 8th-9th. Mars is in quadrature with the sun on the 18th.

Jupiter on the 15th is in R.A. 13h 25m, Decl. 07° 13′ S. and transits at 23.49. It rises at about sunset and is visible all night. It is at its brightest now with a magnitude of −2.0. It is in opposition on the 12th. For the configurations Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 07h 20m, Decl. 22° 14′ N. and transits at 17.47. It is just west of the meridian at sunset and sets soon after midnight. By this time its magnitude has faded to +0.3. The rings are still well open, making an angle of 22½° with the line of sight. It is in quadrature on the 8th of the month.

Uranus on the 15th is in R.A. 04h 53m, Decl. 22° 36′N. and transits at 15.20.

Neptune on the 15th is in R.A. 12h 27m, Decl. 01° 18′ S. and transits at 22.52.

Pluto—For information in regard to this planet, see p. 29.

APRIL

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 0h 45m
Mon. 1	23	37	● New Moon		31O24
Tue. 2	23	01	☌ ♀ ☾ ♀ 3° 47′ N.	01 21	2O314
Wed. 3	17		Moon in Perigee. Dist. from ⊕, 224,600 mi.		21O34
Thu. 4				22 10	dO243
Fri. 5					dO143
Sat. 6	4	45	☌ ♅ ☾ ♅ 0° 50′ N.		2341O
Sun. 7	15		☿ Stationary in R.A.	19 00	34O21
Mon. 8	3		☿ in ☋		431O2
	13		□ ♄ ☉		
	14	26	☌ ♄ ☾ ♄ 2° 06′ S.		
	15	04	☽ First Quarter		
Tue. 9	1	39	☌ ♂ ☾ ♂ 0° 12′ S.		42O1*
Wed. 10				15 49	421O3
Thu. 11					d4O23
Fri. 12	19		☍ ♃ ☉ Dist. from ⊕, 413,500,000 mi.		4O123
Sat. 13				12 38	2431O
Sun. 14	13	30	☌ ♆ ☾ ♆ 3° 44′ S.		3O241
Mon. 15	20	05	☌ ♃ ☾ ♃ 3° 07′ S.		31O24
Tue. 16	5	47	○ Full Moon	09 27	23O14
Wed. 17	21		♂ in Aphelion		21O34
Thu. 18	10		☿ in Aphelion		O1234
	20		□ ♂ ☉		
Fri. 19	8		Moon in Apogee. Dist. from ⊕, 252,100 mi.	06 16	O234*
Sat. 20	4		♀ in ☊		231O4
Sun. 21			Lyrid meteors		3O14*
Mon. 22				03 05	31O42
Tue. 23	4		☿ Greatest elongation W., 27° 18′		432O1
Wed. 24	10	18	☾ Last Quarter	23 54	421O3
Thu. 25					4O123
Fri. 26					41O23
Sat. 27				20 43	4231O
Sun. 28					432O1
Mon. 29	9	51	☌ ☿ ☾ ☿ 2° 08′ N.		341O2
Tue. 30				17 33	342O1

Explanation of symbols and abbreviations on p. 4, of time on p. 8.

THE SKY FOR MAY, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During May the sun's R.A. increases from 02h 30m to 04h 33m and its Decl. changes from 14° 49′ N. to 21° 56′ N. The equation of time is small all month. It changes from +2m 51s at the beginning of the month to a limit of +3m 46s on the 15th and then to +2m 29s at the end of the month. For changes in the length of the day, see p. 13.

The Moon—For its phases, perigee and apogee times and distances, and its conjunction with the planets, see opposite page.

Mercury on the 15th is in R.A. 02h 17m, Decl. 11° 32′ N. and transits at 10.50. It is too low in the morning sky all month for observation and reaches superior conjunction on the 31st.

Venus on the 15th is in R.A. 05h 11m, Decl. 24° 02′ N. and transits at 13.44 It is conspicuous in the evening sky, being about 20° above the western horizon at sunset. Its stellar magnitude is −3.3 and its disk is about 90% illuminated.

Mars on the 15th is in R.A. 08h 54m, Decl. 19° 17′ N. and transits at 17.24. It is in the western sky in the evening and sets about an hour after midnight Its magnitude has now faded to +1.3.

Jupiter on the 15th is in R.A. 13h 12m, Decl. 06° 00′ S. and transits at 21.39. It rises about 3 hours before sunset and is visible nearly all night. Its magnitude is −1.9. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 07h 29m, Decl. 21° 59′ N. and transits at 15.58. It is well west of the meridian at sunset and sets about midnight.

Uranus on the 15th is in R.A. 05h 00m, Decl. 22° 46′ N. and transits at 13.28.

Neptune on the 15th is in R.A. 12h 25m, Decl. 01° 03′ S. and transits at 20.52.

Pluto—For information in regard to this planet, see p. 29.

MAY

75th Meridian Civil Time

Day	d	h	m	Phenomena	Min. of Algol h	m	Config. of Jupiter's Sat. 0h 00m
Wed.	1	8	16	● New Moon...........................			21O43
Thu.	2	1		Moon in Perigee. Dist. from ⊕, 222,500 mi....			O1234
		21	30	☌ ♀ ☾ ♀ 2° 08′ N................			
Fri.	3	15	43	☌ ♅ ☾ ♅ 0° 34′ N................	14	22	1O234
Sat.	4			Eta Aquarid meteors........................			d2O14
Sun.	5			....			32O4*
Mon.	6	0	02	☌ ♄ ☾ ♄ 2° 23′ S................	11	11	31O24
Tue.	7	5	04	☌ ♂ ☾ ♂ 1° 53′ S................			d3O14
Wed.	8	0	13	☽ First Quarter........................			21O34
		17		☿ Greatest Hel. Lat. S..................			
Thu.	9			....	08	00	4O213
Fri.	10			....			41O23
Sat.	11	17	56	☌ ♆ ☾ ♆ 3° 52′ S................			42O13
Sun.	12	11		☌ ♀ ♅ ♀ 0° 55′ N................	04	49	432O*
		19	40	☌ ♃ ☾ ♃ 3° 24′ S................			
Mon.	13			....			431O2
Tue.	14			....			43O21
Wed.	15	21	52	○ Full Moon..........................	01	38	421O3
Thu.	16	14		Moon in Apogee. Dist. from ⊕, 252,400 mi....			4O213
Fri.	17			....	22	26	1O423
Sat.	18			....			2O134
Sun.	19			....			321O4
Mon.	20			....	19	15	d3O24
Tue.	21			....			3O124
Wed.	22			....			21O4*
Thu.	23	21		♀ in Perihelion........................	16	04	O134*
		23	02	☾ Last Quarter........................			
Fri.	24			....			1O243
Sat.	25			....			2O413
Sun.	26			....	12	53	2341O
Mon.	27	18		☿ in ☊.............................			d43O2
Tue.	28			....			43O2*
Wed.	29			....	09	42	421O*
Thu.	30	11		Moon in Perigee. Dist. from ⊕, 222,100 mi....			42O13
		13	53	☌ ☿ ☾ ☿ 1° 43′ N................			
				Partial eclipse of ☉, see p. 56................			
		15	49	● New Moon..........................			
Fri.	31	4	48	☌ ♅ ☾ ♅ 0° 24′ N................			41O23
		6		☌ ☿ ☉ Superior......................			

Explanation of symbols and abbreviations on p. 4, of time on p. 8.

THE SKY FOR JUNE, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During June the sun's R.A. increases from 04h 33m to 06h 37m and its Decl. changes from 21° 56′ N. to 23° 27′ N. at the solstice on the 22nd and then to 23° 10′ N. at the end of the month. The equation of time changes from +2m 29s at the beginning of the month to zero on the 14th and then to −3m 29s at the end of the month. For changes in the length of the day, see p. 13.

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

Mercury on the 15th is in R.A. 06h 42m, Decl. 25° 07′ N. and transits at 13.14. It is climbing higher in the evening sky all month and on the 30th it is about 15° above the horizon just north of west at sunset. Its magnitude is then +0.4. It is in conjunction with Saturn on the 23rd, passing 1° 30′ north.

Venus on the 15th is in R.A. 07h 54m, Decl. 22° 45′ N. and transits at 14.25. It is conspicuous in the evening sky about 22° above the western horizon at sunset. Its stellar magnitude is −3.4 and the disk is about 82% illuminated. There is a close conjunction with the moon on the evening of the 1st and a conjunction with Saturn on the 12th.

Mars on the 15th is in R.A. 09h 59m, Decl. 13° 42′ N. and transits at 16.26. It is approaching Regulus and well to the west at sunset. It sets at about midnight. Its magnitude is down to +1.6. Its closest approach to Regulus is on the 18th when it passes less than one degree north.

Jupiter on the 15th is in R.A. 13h 06m, Decl. 05° 35′ S. and transits at 19.32. It is about on the meridian at sunset and its magnitude is −1.8. On the 15th it resumes direct, or eastward, motion among the stars. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 13th is in R.A. 07h 43m, Decl. 21° 30′ N. and transits at 14.10. It is low in the western sky at sunset and sets about 2 hours later. It is in conjunction with Venus on the 12th and with Mercury on the 23rd.

Uranus on the 15th is in R.A. 05h 07m, Decl. 22° 57′ N. and transits at 11.35.

Neptune on the 15th is in R.A. 12h 24m, Decl. 00° 57′ S. and transits at 18.49.

Pluto—For information in regard to this planet, see p. 29.

JUNE

75th Meridian Civil Time

	d	h	m		Min. of Algol h	m	Config of Jupiter's Sat. 23h 15m
Sat.	1	9		☿ in Perihelion	06	31	24310
		18	36	☌ ♀ ☾ ♀ 0° 10′ S.			
Sun.	2	13	21	☌ ♄ ☾ ♄ 2° 39′ S.			30142
Mon.	3	22		☌ ☿ ♅ ☿ 1° 07′ N.			3024*
Tue.	4	13	35	☌ ♂ ☾ ♂ 3° 20′ S.	03	20	23104
Wed.	5						20134
Thu.	6	11	06	☽ First Quarter			10234
Fri.	7	23	14	☌ ♆ ☾ ♆ 3° 59′ S.	00	09	d0134
Sat.	8	19		☌ ♅ ☉			21304
		22	22	☌ ♃ ☾ ♃ 3° 40′ S.			
Sun.	9				20	57	30214
Mon.	10						31042
Tue.	11	16		☿ Greatest Hel. Lat. N.			d4230
Wed.	12	8		☌ ♀ ♄ ♀ 1° 42′ N.	17	46	42013
		17		Moon in Apogee. Dist. from ⊕, 252,300 mi.			
Thu.	13						41023
Fri.	14			Total eclipse of ☾, see p. 56.			40213
		13	42	○ Full Moon			
		16		♀ Greatest Hel. Lat. N.			
Sat.	15	4		♃ Stationary in R.A.	14	35	42130
Sun.	16						4301*
Mon.	17	18		♆ Stationary in R.A.			34102
Tue.	18				11	24	32401
Wed.	19						2034*
Thu.	20						10234
Fri.	21	19	45	☉ enters ♋, Summer commences. Long. of ☉, 90°	08	12	02134
Sat.	22	8	12	☾ Last Quarter			21034
Sun.	23	20		☌ ☿ ♄ ☿ 1° 30′ N.			3014*
Mon.	24				05	01	31024
Tue.	25						32014
Wed.	26						2034*
Thu.	27	18	01	☌ ♅ ☾ 0° 15′ N.	01	50	41023
		19		Moon in Perigee. Dist. from ⊕, 223,400 mi.			
		23		□ ♆ ☉			
Fri.	28			Partial eclipse of ☉, see p. 56.			40123
		23	06	● New Moon			
Sat.	29				22	39	42103
Sun.	30	4	55	☌ ♄ ☾ ♄ 2° 51′ S.			43201
		18	17	☌ ☿ ☾ ☿ 2° 53′ S.			

Explanation of symbols and abbreviations on p. 4, of time on p. 8.

THE SKY FOR JULY, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During July the sun's R.A. increases from 06h 37m to 08h 42m and its Decl. changes from 23° 10′ N. to 18° 14′ N. The equation of time changes −3m 29s to a limit of −6m 22s on the 27th and then to −6m 15s at the end of the month. The earth is in aphelion, farthest from the sun, on the 3rd. For changes in the length of the day, see p. 14.

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

Mercury on the 15th is in R.A. 09h 09m, Decl. 14° 11′ N. and transits at 13.38. It is well placed for observation early in the month, reaching greatest eastern elongation on the 5th with a stellar magnitude of +0.7. At that time it is about 15° above the horizon just north of west at sunset. Then it approaches the sun quite rapidly and by the end of the month it is near conjunction. On the 18th it is stationary in R.A. and begins to retrograde.

Venus on the 15th is in R.A. 10h 16m, Decl. 12° 21′ N. and transits at 14.47. It is conspicuous in the evening sky, about 19° above the western horizon at sunset. At the middle of the month it passes within about a degree of Regulus It now has stellar magnitude −3.5 and its disk is 72% illuminated.

Mars on the 15th is in R.A. 11h 04m, Decl. 06° 57′ N. and transits at 15.33. It is fairly low in the west at sunset and sets about 2½ hours later.

Jupiter on the 15th is in R.A. 13h 11m, Decl. 06° 13′ S. and transits at 17.39. It is about two hours west of the meridian at sunset and sets before midnight. Its magnitude has now faded to −1.6. It is in quadrature with the sun on the 11th. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 15th is in R.A. 07h 59m, Decl. 20° 50′ N. and transits at 12.27. It is too near the sun for observation, being in conjunction on the 21st.

Uranus on the 15th is in R.A. 05h 15m, Decl. 23° 06′ N. and transits at 09.44.

Neptune on the 15th is in R.A. 12h 25m, Decl. 01° 03′ S. and transits at 16.52.

Pluto—For information in regard to this planet, see p. 29.

JULY

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 22h 15m
Mon. 1	14	18	☌ ♀ ☾ ♀ 2° 36′ S.		43102
Tue. 2			....	19 27	43201
Wed. 3	1	59	☌ ♂ ☾ ♂ 4° 24′ S.		42103
	6		⊕ in Aphelion. Dist. from ☉, 94,452,000 mi.		
Thu. 4			....		d4023
Fri. 5	2		☿ in ☋	16 16	4023*
	6	36	☌ ♆ ☾ ♆ 3° 57′ S.		
	14		☿ Greatest elongation E., 26° 03′		
Sat. 6	0	15	☽ First Quarter		21034
	6	28	☌ ♃ ☾ ♃ 3° 44′ S.		
Sun. 7			....		32014
Mon. 8			....	13 05	31024
Tue. 9			....		d3014
Wed. 10	3		Moon in Apogee. Dist. from ⊕, 251,900 mi.		2104*
Thu. 11	5		☐ ♃ ☉	09 53	01234
Fri. 12			....		0243*
Sat. 13			....		21043
Sun. 14	4	22	○ Full Moon	06 42	42301
Mon. 15	9		☿ in Aphelion		43102
Tue. 16			....		43021
Wed. 17			....	03 30	42130
Thu. 18	17		☿ Stationary in R.A.		4013*
Fri. 19			....		41023
Sat. 20			....	00 19	d4203
Sun. 21	14	52	☾ Last Quarter		42301
	17		☌ ♄ ☉		
Mon. 22			....	21 08	31042
Tue. 23			....		30214
Wed. 24			....		21304
Thu. 25	5	33	☌ ♅ ☾ ♅ 0° 04′ N.	17 56	0134*
	22		Moon in Perigee. Dist. from ⊕, 226,000 mi.		
Fri. 26			....		10234
Sat. 27	20	43	☌ ♄ ☾ ♄ 3° 04′ S.		20134
Sun. 28			Delta Aquarid meteors	14 45	d204*
	6	53	● New Moon		
	16	32	☌ ☿ ☾ ☿ 9° 09′ S.		
Mon. 29			....		31024
Tue. 30			....		30412
Wed. 31	9	53	☌ ♀ ☾ ♀ 4° 53′ S.	11 33	24130
	17	43	☌ ♂ ☾ ♂ 4° 53′ S.		

Explanation of symbols and abbreviations on p. 4, of time on p. 8.

THE SKY FOR AUGUST, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During August the sun's R.A. increases from 08h 42m to 10h 38m and its Decl. changes from 18° 14′ N. to 08° 35′ N. The equation of time changes steadily from −6m 15s to −0m 16s. For changes in the length of the day see p. 14.

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

Mercury on the 15th is in R.A. 08h 28m, Decl. 16° 37′ N. and transits at 10.55. It is in inferior conjunction on the 2nd, passing into the morning sky. By the 20th it is at greatest western elongation with a stellar magnitude of +0.4. At this time it is about 16° above the eastern horizon at sunrise. On the 12th it is stationary in R.A. and resumes direct, or eastward, motion among the stars.

Venus on the 15th is in R.A. 12h 22m, Decl. 02° 49′ S. and transits at 14.51. It is still fairly conspicuous in the evening sky, being about 18° above the western horizon at sunset. Its stellar magnitude is −3.8 and the disk is about 60% illuminated. On the 9th Venus is in conjunction with Mars and on that evening the two planets will be less than a degree apart. On the evening of the 30th Venus passes about one-quarter of a degree north of Spica.

Mars on the 15th is in R.A. 12h 13m, Decl. 00° 56′ S. and transits at 14.41. It is about 15° above the western horizon at sunset and sets about an hour and a half later. On the 9th Mars and Venus are in conjunction, less than a degree apart.

Jupiter on the 15th is in R.A. 13h 25m, Decl. 07° 43′ S. and transits at 15.51. It is fairly low in the southwest at sunset and sets about 2½ hours later. Its magnitude is now −1.4. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 15th is in R.A. 08h 15m, Decl. 20° 03′ N. and transits at 10.42. It has now passed to the morning sky. It rises nearly two hours before the sun and stands about 17° above the eastern horizon at sunrise. Its magnitude has now faded to +0.5.

Uranus on the 15th is in R.A. 05h 21m, Decl. 23° 12′ N. and transits at 07.48.

Neptune on the 15th is in R.A. 12h 27m, Decl. 01° 20′ S. and transits at 14.53.

Pluto—For information in regard to this planet, see p. 29.

AUGUST

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 21h 00m
Thu. 1	16	08	☌♆☾ ♆ 3° 48′ S.		42O31
Fri. 2	10		☌☿☉ Inferior		41O23
	19	53	☌♃☾ ♃ 3° 32′ S.		
Sat. 3				08 22	42O13
Sun. 4	15	55	☽ First Quarter		421O3
	17		☿ Greatest Hel. Lat. S.		
Mon. 5					d43O2
Tue. 6	19		Moon in Apogee. Dist. from ⊕, 251,300 mi.	05 11	43O12
Wed. 7					3241O
Thu. 8					2O341
Fri. 9	9		☌♀♂ ♀ 0° 34′ S.	01 59	1O243
	17		♀ in ☋		
Sat. 10					dO134
Sun. 11				22 48	21O34
Mon. 12			Perseid meteors		d3O24
	2		☿ Stationary in R.A.		
	17	26	🌕 Full Moon		
Tue. 13					3O24*
Wed. 14				19 36	321O4
Thu. 15					2O14*
Fri. 16	3		☌♀♆ ♀ 2° 08′ S.		1O423
Sat. 17				16 25	4O213
Sun. 18					421O3
Mon. 19	20	17	☾ Last Quarter		43O1*
Tue. 20	15		☿ Greatest elongation W., 18° 31′	13 13	43O2*
	23		☌♂♆ ♂ 1° 08′ S.		
Wed. 21	14	19	☌♅☾ ♅ 0° 12′ S.		4321O
Thu. 22	5		Moon in Perigee. Dist. from ⊕, 229,000 mi.		423O1
Fri. 23	17		☿ in ☊	10 02	41O23
Sat. 24	10	59	☌♄☾ ♄ 3° 20′ S.		4O213
Sun. 25	5	44	☌☿☾ ☿ 3° 58′ S.		21O43
Mon. 26	16	07	● New Moon	06 51	3O14*
Tue. 27					31O24
Wed. 28	8		☿ in Perihelion		d32O4
Thu. 29	2	46	☌♆☾ ♆ 3° 37′ S.	03 39	23O14
	12	38	☌♂☾ ♂ 4° 40′ S.		
Fri. 30	5	35	☌♀☾ ♀ 6° 28′ S.		1O234
	13	06	☌♃☾ ♃ 3° 10′ S.		
Sat. 31					O1234

Explanation of symbols and abbreviations on p. 4, of time on p. 8.

THE SKY FOR SEPTEMBER, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During September the sun's R.A. increases from 10h 38m to 12h 26m. and its Decl. changes from 08° 35′ N. to 02° 52′ S. On the 23rd at 10.41 E.S.T. the sun crosses the equator on its way south, enters the sign of Libra, and winter commences. This is the autumnal equinox. The equation of time becomes zero during the 1st and changes steadily to + 10m 00s at the end of the month. For changes in the length of the day, see p. 15.

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

Mercury on the 15th is in R.A. 11h 32m, Decl. 04° 47′ N. and transits at 12.00. It is poorly placed for observation all month. On the 14th it is in superior conjunction.

Venus on the 15th is in R.A. 14h 16m, Decl. 17° 10′ S. and transits at 14.43. On the 8th it is at greatest eastern elongation, but yet not very favourably placed, and by mid-month it is only 10° above the south-western horizon at sunset and sets about an hour and twenty minutes after the sun. It has stellar magnitude −4.0 and is now approaching crescent shape with only 45% of the disk illuminated. On the 3rd Venus and Jupiter are in conjunction.

Mars on the 15th is in R.A. 13h 27m, Decl. 09° 01′ S. and transits at 13.53. It is almost too close to the sun for observation, being only about 11° above the south-western horizon at sunset and setting about an hour later. It is in conjunction with Jupiter on the 24th.

Jupiter on the 15th is in R.A. 13h 45m, Decl. 09° 46′ S. and transits at 14.09. It is only 12° above the horizon in the south-west at sunset and sets about an hour later. Its magnitude is −1.3. It is in conjunction with Venus on the 3rd, and with Mars on the 24th. For the configurations of Jupiter's satellites see opposite page.

Saturn on the 15th is in R.A. 08h 30m, Decl. 19° 17′ N. and transits at 08.55. It rises about 4 hours before the sun and has an altitude of about 44° at sunrise.

Uranus on the 15th is R.A. 05h 24m, Decl. 23° 15′ N. and transits at 05.49.

Neptune on the 15th is in R.A. 12h 31m, Decl. 01° 44′ S. and transits at 12.54.

Pluto—For information in regard to this planet, see p. 29.

SEPTEMBER

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 19h 30m
Sun. 1			....	00 28	21043
Mon. 2			....		d24O1
Tue. 3	9	49	☽ First Quarter........................	21 16	341O2
	14		Moon in Apogee. Dist. from ⊕, 251,100 mi....		
	22		☌ ♀ ♃ ♀ 3° 32′ S..................		
Wed. 4			....		d43O1
Thu. 5			....		423O*
Fri. 6			....	18 05	41O23
Sat. 7	15		☿ Greatest Hel. Lat. N..................		4O123
Sun. 8	10		♀ Greatest elongation E., 46° 17′..........		421O3
Mon. 9			....	14 53	42O31
Tue. 10			....		314O2
Wed. 11	4	59	○ Full Moon........................		3O214
Thu. 12			....	11 42	231O4
Fri. 13	4		♀ in Aphelion........................		dO34*
Sat. 14	17		☌ ☿ ☉ Superior......................		O1234
	23		□ ♅ ☉............................		
Sun. 15			....	08 31	21O34
Mon. 16	5		Moon in Perigee. Dist. from ⊕, 229,400 mi....		2O314
Tue. 17	20	42	☌ ♅ ☾ ♅ 0° 30′ S..................		31O24
Wed. 18	1	44	☾ Last Quarter........................	05 19	
Thu. 19			....		
Fri. 20	22	36	☌ ♄ ☾ ♄ 3° 38′ S..................		
Sat. 21			....	02 08	
Sun. 22			....		
Mon. 23	10	41	☉ enters ♎, Autumn commences. Long. of ☉, 180°	22 57	
Tue. 24	5		☌ ☿ ♆ ☿ 0° 44′ S..................		
	23		☌ ♂ ♃ ♂ 1° 05′ S..................		
Wed. 25	3	45	● New Moon........................		
	13	08	☌ ♆ ☾ ♆ 3° 30′ S..................		
	17	53	☌ ☿ ☾ ☿ 4° 18′ S..................		
Thu. 26	6		♂ in ♉............................	19 45	
Fri. 27	8	13	☌ ♃ ☾ ♃ 2° 43′ S..................		
	10	35	☌ ♂ ☾ ♂ 3° 43′ S..................		
	17		♅ Stationary in R.A....................		
Sat. 28	19	26	☌ ♀ ☾ ♀ 7° 14′ S..................		
Sun. 29			....	16 34	
Mon. 30			....		

Explanation of symbols and abbreviations on p. 4, of time on p. 8.
Jupiter being near the sun, phenomena of the satellites are not given from September 18 to November 16.

THE SKY FOR OCTOBER, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During October the sun's R.A. increases from 12h 26m to 14h 22m and its Decl. changes from 02° 52′ S. to 14° 10′ S. The equation of time changes steadily from +10m 00s to +16m 19s. For changes in the length of day, see p. 15.

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

Mercury on the 15th is in R.A. 14h 30m, Decl. 16° 28′ S. and transits at 12.59. It is in the evening sky all month but poorly placed for observation, even when it reaches greatest eastern elongation on the 31st.

Venus on the 15th is in R.A. 15h 43m, Decl. 25° 46′ S. and transits at 14.10. On the 13th it reaches greatest brilliancy (−4.3) but all month it is poorly placed for observation, being very low in the south-western sky at sunset. On the 28th it is stationary in R.A. and begins to retrograde.

Mars on the 15th is in R.A. 14h 46m, Decl. 16° 12′ S. and transits at 13.13. It is too close to the sun for observation.

Jupiter on the 15th is in R.A. 14h 09m, Decl. 11° 58′ S. and transits at 12.35. It is too close to the sun for observation. It is in conjunction with the sun on the 31st and passes into the morning sky. For the configurations of Jupiter's satellites see opposite page.

Saturn on the 15th is in R.A. 08h 41m, Decl. 18° 42′ N. and transits at 07.07. It rises just after midnight and has nearly reached the meridian at sunrise.

Uranus on the 15th is in R.A. 05h 24m, Decl. 23° 16′ N. and transits at 03.51

Neptune on the 15th is in R.A. 12h 35m, Decl. 02° 11′ S. and transits at 11.01.

Pluto—For information in regard to this planet, see p. 29.

OCTOBER

75th Meridian Civil Time

d	h	m		Min. of Algol h	m
Tue. 1	1		☿ in ♉		
	9		Moon in Apogee. Dist. from ⊕, 251,400 mi. . . .		
	23		☌ ♆ ☉		
Wed. 2			. . . .	13	22
Thu. 3	4	53	☽ First Quarter.		
Fri. 4			. . . .		
Sat. 5	14		♀ Greatest Hel. Lat. S.	10	11
Sun. 6			. . . .		
Mon. 7			. . . .		
Tue. 8			. . . .	07	00
Wed. 9			. . . .		
Thu. 10	7		☌ ☿ ♃ ☿ 2° 13′ S.		
	15	40	○ Full Moon.		
Fri. 11	8		☿ in Aphelion.	03	48
Sat. 12			. . . .		
Sun. 13	5		Moon in Perigee. Dist. from ⊕, 226,400 mi. . . .		
	15		♀ Greatest brilliancy, mag. −4.3.		
Mon. 14			. . . .	00	37
Tue. 15	2	31	☌ ♅ ☾ ♅ 0° 43′ S.		
Wed. 16			. . . .		
Thu. 17	8	28	☾ Last Quarter.	21	26
Fri. 18	7	34	☌ ♄ ☾ ♄ 3° 56′ S.		
Sat. 19			. . . .		
Sun. 20	20		☌ ☿ ♂ ☿ 2° 02′ S.	18	15
Mon. 21			. . . .		
Tue. 22			Orionid meteors.		
	22	06	☌ ♆ ☾ ♆ 3° 29′ S.		
Wed. 23			. . . .	15	03
Thu. 24	18	32	● New Moon.		
Fri. 25	3	40	☌ ♃ ☾ ♃ 2° 14′ S.		
Sat. 26	11	03	☌ ♂ ☾ ♂ 2° 13′ S.	11	52
	18	09	☌ ☿ ☾ ☿ 4° 18′ S.		
Sun. 27	6	02	☌ ♀ ☾ ♀ 7° 18′ S.		
Mon. 28	4		♀ Stationary in R.A.		
Tue. 29	4		Moon in Apogee. Dist. from ⊕, 252,000 mi. . . .	08	41
Wed. 30			. . . .		
Thu. 31	5		☿ Greatest elongation E., 23° 44′.		
	15		☌ ♃ ☉		
	16		☿ Greatest Hel. Lat. S.		
	19		☌ ☿ ♀ ☿ 3° 10′ N.		

Explanation of symbols and abbreviations on p. 4, of time on p. 8.
Jupiter being near the sun, phenomena of the satellites are not given from September 18 to November 16.

THE SKY FOR NOVEMBER, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During November the sun's R.A. increases from 14h 22m to 16h 26m and its Decl. changes from 14° 10′ S. to 21° 41′ S. The equation of time changes from +16m 19s to a limit of +16m 22s on the 3rd and then changes steadily to +11m 14s at the end of the month. For changes in the length of the day, see p. 16.

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

Mercury on the 15th is in R.A. 16h 16m, Decl. 22° 50′ S. and transits at 12.37. It reaches inferior conjunction on the 21st and is poorly placed for observation all month. On the 11th it is stationary and begins to retrograde, or move westward among the stars, and on the 30th it resumes direct motion again.

Venus on the 15th is in R.A. 15h 33m, Decl. 23° 15′ S. and transits at 11.54. It is poorly placed early in the month, being in inferior conjunction on the 17th. Then it rapidly moves higher in the morning sky and by the end of the month is about 15° above the south-eastern horizon at sunrise. It has stellar magnitude −3.9 and, in a telescope, is distinctly crescent-shaped with only about 5% of the disk illuminated.

Mars on the 15th is in R.A. 16h 16m, Decl. 21° 48′ S. and transits at 12.41. It is too close to the sun for observation.

Jupiter on the 15th is in R.A. 14h 35m, Decl. 14° 10′ S. and transits at 10.59. It is too close to the sun for observation most of the month, but by the 30th it may be seen as a morning star rising in the south-east about two hours before sunrise. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 15th is in R.A. 08h 46m, Decl. 18° 28′ N. and transits at 05.10. It rises before midnight and has passed the meridian before sunrise. It is in quadrature on the 1st. On the 20th it is stationary in R.A. and begins to retrograde.

Uranus on the 15th is in R.A. 05h 20m, Decl. 23° 13′ N. and transits at 01.45.

Neptune on the 15th is in R.A. 12h 39m, Decl. 02° 34′ S. and transits at 09.03.

Pluto—For information in regard to this planet, see p. 29.

NOVEMBER
75th Meridian Civil Time

d		h	m		Min. of Algol h m	Config. of Jupiter's Sat. 7h 45m
Fri.	1	9		□♄☉	05 30	
		23	40	☽ First Quarter		
Sat.	2					
Sun.	3					
Mon.	4				02 19	
Tue.	5					
Wed.	6	3		☌ ♀ ♂ ♀ 5° 10′ S.	23 07	
Thu.	7					
Fri.	8					
Sat.	9	2	10	⊛ Full Moon	19 56	
Sun.	10	8		Moon in Perigee. Dist. from ⊕, 223,300 mi.		
Mon.	11	4		☿ Stationary in R.A.		
		9	47	☌ ♅ ☾ ♅ 0° 46′ S.		
Tue.	12				16 45	
Wed.	13					
Thu.	14	15	08	☌ ♄ ☾ ♄ 4° 05′ S.		
		20		☌ ☿ ♂ ☿ 1° 01′ S.		
Fri.	15			Leonid meteors	13 34	
		17	35	☾ Last Quarter		
Sat.	16					43201
Sun.	17	14		☌ ♀ ☉ Inferior		41032
Mon.	18				10 23	d0243
Tue.	19	5	33	☌ ♆ ☾ ♆ 3° 33′ S.		20134
		17		☿ in ☊		
Wed.	20	19		♄ Stationary in R.A.		1034*
Thu.	21	12		☌ ☿ ☉ Inferior	07 12	30124
		22	27	☌ ♃ ☾ ♃ 1° 45′ S.		
Fri.	22	16	09	☌ ♀ ☾ ♀ 4° 06′ S.		31204
Sat.	23	3	47	☌ ☿ ☾ ☿ 0° 14′ S.		32014
				Partial eclipse of ☉, see p. 56.		
		12	24	● New Moon		
Sun.	24	8		☿ in Perihelion	04 01	1024*
		13	05	☌ ♂ ☾ ♂ 0° 28′S.		
Mon.	25	17		Moon in Apogee. Dist. from ⊕, 252,500 mi.		01243
Tue.	26					2403*
Wed.	27				00 50	41203
Thu.	28					43012
Fri.	29				21 39	43120
Sat.	30	20		☿ Stationary in R.A.		43201
		21		♀ in ☊		

Explanation of symbols and abbreviations on p. 4, of time on p. 8.
Jupiter being near the sun, phenomena of the satellites are not given from September 18 to November 16.

THE SKY FOR DECEMBER, 1946

The times of transit are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During December the sun's R.A. increases from 16h 26m to 18h 42m and its Decl. changes from 21° 41′ S. to 23° 27′ S. at the solstice on the 22nd, and then to 23° 05′ S. at the end of the month. The equation of time changes from +11m 14s to zero on the 25th and then to −3m 08s at the end of the month. For changes in the length of the day, see p. 16.

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

Mercury on the 15th is in R.A. 16h 03m, Decl. 19° 00′ S. and transits at 10.32. It is in the morning sky all month and on the 9th it is at greatest western elongation. At that time it is well placed for observation, having stellar magnitude −0.2 and standing about 16° above the south-eastern horizon at sunrise.

Venus on the 15th is in R.A. 15h 05m, Decl. 14° 40′ S. and transits at 09.32. It is a brilliant morning star, rising about 3 hours before the sun and standing about 24° above the south-western horizon at sunrise. It is at greatest brilliancy (−4.4) about mid-month. Venus should be easily seen in the daytime at this time by looking to the south at approximate altitude 30° at about 09.30. It is stationary in R.A. on the 6th and resumes eastward motion among the stars.

Mars on the 15th is in R.A. 17h 52m, Decl. 24° 11′ S. and transits at 12.19. It is too close to the sun for observation.

Jupiter on the 15th is in R.A. 15h 00m, Decl. 16° 01′ S. and transits at 09.26. It is a morning star rising about 3 hours before the sun in the south-east. Its magnitude is −1.3. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 13th is in R.A. 08h 44m, Decl. 18° 40′ N. and transits at 03.10. It rises about 5½ hours after sunset and is visible for the rest of the night. By this time its magnitude has brightened slightly to +0.3 and its rings now make an angle of 20° to the line of sight.

Uranus on the 15th is in R.A. 05h 15m, Decl. 23° 08′ N. and transits at 23.38.

Neptune on the 15th is in R.A. 12h 41m, Decl. 02° 49′ S. and transits at 07.07.

Pluto—For information in regard to this planet, see p. 29.

DECEMBER

75th Meridian Civil Time

Day	d	h	m	Phenomena	Min. of Algol h m	Config. of Jupiter's Sat. 7h 15m
Sun.	1	16	47	☽ First Quarter...........................		41302
Mon.	2			....	18 28	40123
Tue.	3			....		4203*
Wed.	4	14		☿ Greatest Hel. Lat. N..................		21403
Thu.	5			....	15 17	30142
Fri.	6	19		♀ Stationary in R.A......................		d3104
Sat.	7			....		32014
Sun.	8			Total eclipse of ☾, see p. 56..................	12 06	31024
		12	52	○ Full Moon..............................		
		19		Moon in Perigee. Dist. from ⊕, 221,600 mi....		
		19	01	☌ ♅ ☾ ♅ 0° 41′ S..........................		
Mon.	9	4		☿ Greatest elongation W., 20° 52′.........		01324
Tue.	10			....		21034
Wed.	11	22	56	☌ ♄ ☾ ♄ 4° 01′ S..........................	08 55	d2034
Thu.	12			Geminid meteors...........................		03142
		4		☍ ♅ ☉ Dist. from ⊕, 1688,000,000 mi....		
Fri.	13			....		31402
Sat.	14			....	05 44	34201
Sun.	15	5	57	☾ Last Quarter............................		43102
Mon.	16	12	30	☌ ♆ ☾ ♆ 3° 29′ S..........................		40312
Tue.	17			....	02 34	42103
Wed.	18			....		42013
Thu.	19	16	07	☌ ♃ ☾ ♃ 1° 13′ S..........................	23 23	4032*
		20	40	☌ ♀ ☾ ♀ 1° 18′ N..........................		
Fri.	20			....		43102
Sat.	21	17	21	☌ ☿ ☾ ☿ 0° 49′ N..........................		32401
Sun.	22	5	54	☉ enters ♑, Winter commences. Long. of ☉, 270°	20 12	3104*
		19		Moon in Apogee. Dist. from ⊕, 252,600 mi....		
Mon.	23	8	06	● New Moon................................		03124
		15		♀ Greatest brilliancy, mag. –4.4............		
		15	36	☌ ♂ ☾ ♂ 1° 15′ N..........................		
Tue.	24			....		12034
Wed.	25			....	17 01	20134
Thu.	26			....		10324
Fri.	27			....		d3024
Sat.	28	1		☿ in ☋....................................	13 50	32014
Sun.	29			....		31204
Mon.	30			....		4012*
Tue.	31	7	23	☽ First Quarter...........................	10 39	d4103

Explanation of symbols and abbreviations on p. 4, of time on p. 8.

PHENOMENA OF JUPITER'S SATELLITES, 1946

By Charles E. Apgar, Westfield, New Jersey

JANUARY

d	h	m	Sat.	Phen.
1	04	12	I	OR
2	06	19	III	SI
6	03	26	III	OR
	04	14	II	SI
	06	38	II	TI
	06	52	II	Se
7	05	26	I	SI
	06	38	I	TI
8	02	43	I	ED
	03	42	II	OR
	06	06	I	OR
9	02	05	I	Se
	03	17	I	Te
13	02	38	III	ER
	05	18	III	OD
	06	47	II	SI
15	04	36	I	ED
	06	19	II	OR
16	01	48	I	SI
	03	01	I	TI
	03	59	I	Se
	05	11	I	Te
17	01	03	II	Te
	02	27	I	OR
20	04	07	III	ED
	06	34	III	ER
22	03	44	II	ED
	06	28	I	ED
23	03	41	I	SI
	04	54	I	SI
	05	52	I	Se
24	00	56	I	ED
	01	01	II	TI
	01	14	II	Se
	01	20	III	Te
	03	34	II	Te
	04	20	I	OR
25	01	32	I	Te
29	06	20	II	ED
30	05	34	I	SI
31	00	34	III	Se
	01	09	II	SI
	02	49	I	ED
	03	12	III	TI
	03	31	II	TI
	03	46	II	Se
	05	09	III	Te
	06	03	II	Te
	06	11	I	OR

FEBRUARY

d	h	m	Sat.	Phen.
1	01	14	I	TI
	02	14	I	Se
	03	24	I	Te
2	00	38	I	OR
	00	42	II	OR
7	02	08	III	SI
	03	41	II	SI
	04	31	III	Se
	04	42	I	ED
	05	59	II	TI
	06	19	II	Se
8	01	56	I	SI
	03	05	I	TI
	04	07	I	Se
	05	14	I	Te
9	02	28	I	OR
	03	11	II	OR

February—cont'd

d	h	m	Sat.	Phen.
	23	42	I	Te
14	06	05	III	SI
	06	14	II	SI
15	03	49	I	SI
	04	55	I	TI
	06	01	I	Se
16	00	50	II	ED
	01	03	I	ED
	04	17	I	OR
	05	39	II	OR
	23	22	I	TI
17	00	29	I	Se
	01	31	I	Te
18	00	07	II	Te
	00	27	III	OD
	02	19	III	OR
22	05	43	I	SI
23	02	56	I	ED
	03	26	II	ED
	06	05	I	OR
24	00	11	I	SI
	01	10	I	TI
	02	23	I	Se
	03	20	I	Te
	23	54	III	ED
	23	58	II	TI
25	00	31	I	OR
	00	40	II	Se
	02	17	III	ER
	02	29	II	Te
	04	03	III	OD
	05	53	III	OR

MARCH

d	h	m	Sat.	Phen.
2	04	49	I	ED
	06	02	II	ED
3	02	05	I	SI
	02	58	I	TI
	04	16	I	Se
	05	07	I	Te
	23	17	I	ED
4	00	36	II	SI
	02	18	I	OR
	02	18	II	TI
	03	13	II	Se
	03	52	III	ED
	04	50	II	Te
	22	45	I	Se
	23	33	I	Te
5	23	37	II	OR
7	23	11	III	Te
10	03	58	I	SI
	04	44	I	TI
11	01	10	I	ED
	03	09	II	SI
	04	04	I	OR
	04	37	II	TI
	05	46	II	Se
	22	27	I	SI
	23	10	I	TI
12	00	38	I	Se
	01	20	I	Te
	21	55	II	ED
	22	30	I	OR
13	01	57	II	OR
14	21	57	III	SI
15	00	16	III	Se
	00	51	III	TI

March—cont'd

d	h	m	Sat.	Phen.
	02	36	III	Te
18	03	04	I	ED
	05	42	II	SI
19	00	21	I	SI
	00	56	I	TI
	02	32	I	Se
	03	05	I	Te
	21	32	I	ED
20	00	15	I	OR
	00	31	II	ED
	04	15	II	OR
	21	01	I	Se
	21	31	I	Te
21	21	35	II	Se
	22	32	II	Te
22	01	55	III	SI
	04	13	III	TI
	04	13	III	Se
25	04	57	I	ED
26	02	14	I	SI
	02	40	I	TI
	04	26	I	Se
	04	50	I	Te
	23	25	I	ED
27	01	59	I	OR
	03	07	II	ED
	20	43	I	SI
	21	06	I	TI
	22	54	I	Se
	23	16	I	Te
28	20	25	I	OR
	21	31	II	SI
	22	16	II	TI
29	00	09	II	Se
	00	47	II	Te

APRIL

d	h	m	Sat.	Phen.
1	22	49	III	OR
2	04	08	I	SI
	04	25	I	TI
3	01	19	I	ED
	03	43	I	OR
	22	37	I	SI
	22	51	I	TI
4	00	48	I	Se
	01	00	I	Te
	19	47	I	ED
	22	08	I	OR
5	00	05	II	SI
	00	29	II	TI
	02	42	II	Se
	03	01	II	Te
6	21	56	II	OR
8	23	41	III	ED
9	01	59	III	ER
10	03	13	I	ED
11	00	31	I	SI
	00	34	I	TI
	02	43	I	Se
	02	44	I	Te
	21	41	I	ED
	23	52	I	OR
12	02	39	II	SI
	02	43	II	TI
	21	10	I	Te
	21	11	I	Se
13	21	37	II	OD
14	00	17	II	ER

April—con'td

d	h	m	Sat.	Phen.
16	03	40	III	ED
18	02	18	I	TI
	02	25	I	SI
	04	28	I	Te
	04	37	I	Se
	23	26	I	OD
19	01	46	I	ER
	22	03	III	Se
	20	44	I	TI
	20	54	I	SI
	22	54	I	Te
	23	05	I	Se
20	20	14	I	ER
	23	52	II	OD
21	02	53	II	ER
22	20	37	II	Te
	21	07	II	Se
25	04	03	I	TI
	04	20	I	SI
26	01	10	I	OD
	03	40	I	ER
	20	34	III	TI
	21	47	III	SI
	22	29	I	TI
	22	31	III	Te
	22	48	I	SI
27	00	01	III	Se
	00	39	I	Te
	01	00	I	Se
	19	36	I	OD
	22	08	I	ER
28	02	08	II	OD
	19	28	I	Se
29	20	18	II	TI
	21	04	II	SI
	22	52	II	Te
	23	41	II	Se

MAY

d	h	m	Sat.	Phen.
3	02	55	I	OD
3	23	53	III	TI
4	00	14	I	TI
	00	43	I	SI
	01	47	III	SI
	01	52	III	Te
	02	24	I	Te
	02	54	I	Se
	21	21	I	OD
5	00	02	I	ER
	20	50	I	Te
	21	23	I	Se
6	22	34	II	TI
	23	39	II	SI
7	01	08	II	Te
	02	16	II	Se
8	21	23	II	ER
11	01	59	I	TI
	02	38	I	SI
	03	13	III	TI
	23	06	I	OD
12	01	57	I	ER
	20	26	I	TI
	21	06	I	SI
	22	36	I	Te
	23	17	I	Se
13	20	25	I	ER
14	00	51	II	TI
	02	14	II	SI

May—cont'd

d	h	m	Sat.	Phen.
14	21	48	III	ER
15	19	52	II	OD
	23	59	II	ER
19	00	53	I	OD
	22	13	I	TI
	23	01	I	SI
20	00	23	I	Te
	01	11	I	Se
	22	20	I	ER
21	20	09	III	OD
	22	18	III	OR
	23	32	III	ED
22	01	46	III	ER
	22	12	II	OD
24	20	43	II	Se
27	00	00	I	TI
	00	56	I	SI
	21	07	I	OD
28	00	14	I	ER
	20	38	I	Te
	21	35	I	Se
	23	39	III	OD
29	01	52	III	OR
30	00	35	II	OD
31	20	42	II	SI
	21	19	II	Te
	23	18	II	Se

JUNE

	h	m	Sat.	Phen.
3	22	56	I	OD
4	20	17	I	TI
	21	19	I	SI
	22	27	I	Te
	23	29	I	Se
5	20	38	I	ER

June—cont'd

d	h	m	Sat.	Phen.
7	21	08	II	TI
	23	18	II	SI
	23	44	II	Te
8	21	40	III	SI
	23	50	III	Se
9	21	04	II	ER
11	00	45	I	OD
	22	07	I	TI
	23	14	I	SI
12	00	17	I	Te
	22	33	I	ER
14	23	35	II	TI
15	20	53	III	TI
	23	11	III	Te
16	23	39	II	ER
18	23	58	I	TI
19	21	04	I	OD
20	00	27	I	ER
	20	36	I	Te
	21	47	I	Se
23	21	10	II	OD
25	20	23	II	Se
26	21	39	III	ER
	22	57	I	OD
27	20	19	I	TI
	21	33	I	SI
	22	29	I	Te
	23	42	I	Se
28	20	51	I	ER
30	23	42	II	OD

JULY

d	h	m	Sat.	Phen.
2	20	25	II	SI
	20	30	II	Te
	22	59	II	Se

July—cont'd

d	h	m	Sat.	Phen.
3	20	38	III	OR
	23	28	III	ED
4	22	12	I	TI
	23	27	I	SI
5	22	46	I	ER
9	20	27	II	TI
	23	01	II	SI
	23	05	II	Te
10	22	10	III	OD
11	20	43	II	ER
12	21	13	I	OD
13	20	46	I	Te
	22	00	I	Se
20	20	31	I	TI
	21	46	I	SI
21	21	05	I	ER
	21	36	III	SI
25	20	48	II	OD
27	20	08	II	Se
28	20	29	III	TI
29	20	18	I	Se

AUGUST

d	h	m	Sat.	Phen.
3	20	11	II	SI
	20	24	II	Te
4	21	32	I	OD
5	20	04	I	SI
	21	04	I	Te
10	20	27	II	TI
12	20	19	II	ER
	20	52	I	TI
20	20	00	I	OD
21	19	30	I	Te
	20	31	I	Se
26	19	35	III	Se
28	19	19	I	TI

August—cont'd

d	h	m	Sat.	Phen.
	19	55	II	Se
	20	15	I	SI
29	19	38	I	ER

Jupiter being near the Sun, phenomena of the Satellites are not given from September 18 to November 16.

NOVEMBER

d	h	m	Sat.	Phen.
29	05	51	II	Se

DECEMBER

d	h	m	Sat.	Phen.
4	06	32	I	Se
5	05	29	III	Te
6	05	54	II	SI
11	06	16	I	SI
12	06	26	I	OR
15	06	38	II	OR
19	05	29	I	ED
20	04	47	I	Se
	05	34	I	Te
22	05	14	II	ED
24	04	35	II	Te
27	04	31	I	SI
	05	23	I	TI
	06	40	I	Se
28	04	55	I	OR
30	04	59	III	ER
	06	40	III	OD
31	04	49	II	TI
	05	29	II	Se

E—eclipse, O—occultation, T—transit, S—shadow, D—disappearance, R—reappearance, I—ingress, E—egress, 75th Meridian Civil Time. (For other times see p. 8)

METEORS OR SHOOTING STARS

The study of meteors gives scientists important information both as to the matter in interplanetary space and the nature of the upper atmosphere of the earth itself. In this study amateur observers without telescopic equipment have made invaluable contributions. For a number of years important work has been carried on by Canadian observers under the direction of Dr. Peter M. Millman, David Dunlap Observatory, now serving in the R.C.A.F. Any analysis of observations sent in by amateurs must await his return. However, reports of observations, either of fireballs or of systematic studies of meteor showers, may be sent to the Observatory. For complete instructions see *General Instructions for Meteor Observing*, obtainable for 15 cents postpaid from the office of this Society.

ECLIPSES 1946

In 1946 there will be *six* eclipses, comprising four partial solar eclipses and two total lunar eclipses.

I. *A Partial Eclipse of the Sun,* January 3, 1946, invisible in Canada. At maximum phase (Ross Sea, Antarctic) only 0.553 of the sun's diameter will be covered.

II. *A Partial Eclipse of the Sun,* May 30, 1946, invisible in Canada, visible in the South Pacific. Magnitude of greatest eclipse 0.886.

III. *A Total Eclipse of the Moon,* June 14, 1946, not visible in Canada, as it will occur when the moon is below our horizon; visible to most of the eastern hemisphere and to eastern South America.

IV. *A Partial Eclipse of the Sun,* June 29, 1946, visible only as a slight eclipse (maximum 0.180) on the night of June 28-29 from northern Canada.

V. *A Partial Eclipse of the Sun,* November 23, 1946, visible from most of Canada. The magnitude will range from about 0.15 of the sun's diameter obscured in British Columbia to 0.70 in Labrador. At Vancouver the eclipse will start shortly before sunrise and end about 9.00 a.m. P.S.T.; at Toronto it will last from 10:42 to 13:45 E.S.T., with maximum phase (0.54) at 12:13. For Montreal the corresponding times are 10:48 to 13:54, with maximum (0.61 obscuration), at 12:22 E.S.T.

VI. *A Total Eclipse of the Moon,* December 8, 1946, will be invisible from most of Canada. The middle of the eclipse will occur at 12:48 p.m. E.S.T. The eclipse will be visible in the extreme north-west of North America, in the Arctic regions, much of the Pacific Ocean and eastern hemisphere.

LUNAR OCCULTATIONS

Prepared by J. F. HEARD

When the moon passes between the observer and a star that star is said to be occulted by the moon and the phenomenon is known as a lunar occultation. The passage of the star behind the east limb of the moon is called the immersion and its appearance from behind the west limb the emersion. As in the case of eclipses, the times of immersion and emersion and the duration of the occultation are different for different places on the earth's surface. The tables given below, adapted from the 1946 Nautical Almanac, give the times of immersion or emersion or both for occultations of stars of magnitude 4.5 or brighter visible at Toronto and at Montreal and also at Vancouver and Calgary, at night.

LUNAR OCCULTATIONS

Emersions at the bright limb of the moon are given only in the case of stars brighter than magnitude 3.5. The terms *a* and *b* are for determining corrections to the times of the phenomena for stations within 300 miles of the standard stations. Thus if λ_0, ϕ_0, be the longitude and latitude of the standard station and λ, ϕ, the longitude and latitude of the neighbouring station than for the neighbouring station we have—

Standard Time of phenomenon = Standard Time of phenomenon at the standard station $+ a(\lambda - \lambda_0) + b(\phi - \phi_0)$

where $\lambda - \lambda_0$ and $\phi - \phi_0$ are expressed in degrees. The quantity *P* in the table is the position angle of the point of contact on the moon's disc reckoned from the north point towards the east.

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1946

Date	Star	Mag.	I or E	Age of Moon	Toronto E.S.T.	Toronto a	Toronto b	Toronto P	Montreal E.S.T.	Montreal a	Montreal b	Montreal P
				d	h m			°	h m			°
Jan. 14	ε Tau	3.6	I	10.7	0 16.1	.....	.....	140	0 14.4	−0.8	−3.0	126
Feb. 11	1 Gem	4.3	I	9.9	19 25.4	−1.5	+1.4	70	19 36.7	−1.6	+1.2	69
17	ν Vir	4.2	I	16.0	22 17.8	−0.7	−0.7	145	22 21.4	−0.9	−0.3	135
17	ν Vir	4.2	E	16.0	23 21.5	−1.5	+1.3	269	23 32.4	−1.5	+0.6	281
Apr. 22	λ Sgr	2.9	E	20.1	2 28.8	−2.0	+1.7	244	2 43.0	−1.9	+1.1	254
July 12	λ Sgr	2.9	E	13.9	21 03.0	−1.6	+1.0	273	21 13.5	−1.6	+0.6	281
Aug. 14	τ Aqr	4.2	I	16.9	3 42.4	−1.8	−1.1	92	3 49.7	−1.6	−1.5	97
14	τ Aqr	4.2	E	16.9	4 41.7	−0.3	+0.9	205	Sun	.....	.....	...
18	ξ' Cet	4.5	I	20.9	4 32.6	−2.5	−0.5	102	Sun	.....	.....	...
Oct. 7	τ Aqr	4.2	I	12.7	20 10.9	.....	.....	359	20 18.2	−0.5	+2.4	6
30	σ Sgr	2.1	E	5.9	17 42.3	−1.9	−0.4	262	17 52.0	−1.7	−0.7	260
Dec. 10	ε Gem	3.2	I	16.5	0 31.4	−1.7	+0.2	98	0 41.5	−1.7	+0.1	95
10	ε Gem	3.2	E	16.5	1 45.7	−1.8	+0.6	256	1 56.2	−1.7	0.0	263
10	κ Gem	3.7	I	17.4	21 35.6	−0.2	+1.4	82	21 40.1	−0.4	+1.5	83
10	κ Gem	3.7	E	17.4	22 35.5	−0.8	+1.1	276	22 42.2	−0.9	+1.0	276
15	ν Vir	4.2	I	21.8	05 57.1	−1.2	−1.5	141	06 02.3	−1.4	−1.2	128

LUNAR OCCULTATIONS VISIBLE AT VANCOUVER AND CALGARY, 1946

Date	Star	Mag.	I or E	Age of Moon	Vancouver P.S.T.	Vancouver a	Vancouver b	Vancouver P	Calgary M.S.T.	Calgary a	Calgary b	Calgary P
				d	h m			°	h m			°
Jan. 13	ε Tau	3.6	I	10.7	19 51.8	−1.4	+0.8	84	21 06.4	−1.5	+0.4	85
Feb. 17	ν Vir	4.2	E	16.0	Low	.....	.....	...	21 05.0	−0.2	+1.1	284
Mr.10-11	1 Gem	4.3	I	7.5	23 20.8	−0.6	−1.4	89	0 23.4	−0.4	−1.2	77
Apr. 19	β Scr	2.9	I	17.3	4 16.8	−1.8	−0.5	63	Sun	.....	.....	...
May 14	κ Vir	4.3	I	12.8	0 04.1	−1.1	−1.6	148	1 11.8	−1.1	−1.6	137
18	b Oph	4.3	I	16.8	0 42.3	−1.4	+0.3	114	1 56.4	−1.6	0.0	105
18	b Oph	4.3	E	16.8	2 06.0	−1.8	−0.2	274	3 21.2	−1.7	−0.7	278
Jun. 6–7	ν Vir	4.2	I	7.4	23 23.8	−0.7	−1.5	80	0 26.9	−0.4	−1.4	71
Aug. 3	κ Vir	4.3	I	6.7	20 35.3	−1.2	−1.5	91	21 42.8	−0.9	−1.6	85
7	b Oph	4.3	I	10.7	21 01.6	−1.9	0.0	72	22 17.0	−1.6	−0.5	69
13–14	τ Aqr	4.2	I	16.7	23 45.9	−1.0	+1.8	24	0 56.9	−1.0	+1.3	32
14	τ Aqr	4.2	E	16.7	0 46.2	−2.0	+0.2	280	2 03.5	−1.8	−0.1	270
18	ξ' Cet	4.5	I	20.9	0 50.4	−0.3	+2.2	31	1 56.9	−0.5	+2.0	39
18	ξ' Cet	4.5	E	20.9	1 47.1	−1.2	+1.3	269	3 00.2	−1.3	+1.2	259
Oct. 16	ε Gem	3.2	I	21.2	4 17.7	−1.2	+2.7	41	5 34.0	−1.5	+2.8	37
16	ε Gem	3.2	E	21.2	5 09.9	−1.7	−2.2	315	6 20.0	−1.3	−3.1	323
17	κ Gem	3.7	I	22.1	3 09.4	−0.6	+3.1	45	4 20.7	−0.9	+3.0	46
17	κ Gem	3.7	E	22.1	3 58.0	−1.6	−1.2	319	5 10.1	−1.5	−1.8	321
Dec. 9	ε Gem	3.2	I	16.5	21 05.3	+0.2	+2.6	37	22 08.6	−0.2	+2.4	45
9	ε Gem	3.2	E	16.5	21 47.4	−1.2	+0.1	308	22 58.0	−1.2	+0.2	301
13	η Leo	3.6	I	19.8	4 35.6	.....	.....	54	No. occn.	.....	.....	...
13	η Leo	3.6	E	19.8	5 10.9	.....	.....	359	No. occn.	.....	.....	...
15	ν Vir	4.2	I	21.8	2 14.1	−0.5	−1.7	167	3 17.0	−0.6	−1.0	156
15	ν Vir	4.2	E	21.8	2 58.6	−1.3	+2.8	248	4 14.0	−1.4	+1.6	263
28	τ Aqr	4.2	I	5.5	18 41.7	−0.3	+0.9	20	19 45.6	−0.4	+0.4	30

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

ORBITAL ELEMENTS (Jan. 1, 12^h, 1945)

Planet	Mean Distance from Sun (a) ⊕ = 1	Mean Distance from Sun (a) millions of miles	Period (P)	Eccentricity (e)	Inclination (i)	Long. of Node (☊)	Long. of Perihelion (π)	Mean Long. of Planet
					°	°	°	°
Mercury.......	.387	36.0	88.0days	.206	7.0	47.6	76.5	120.5
Venus.........	.723	67.2	224.7	.007	3.4	76.1	130.7	36.0
Earth..........	1.000	92.9	365.3	.017	....	.....	101.9	99.8
Mars...........	1.524	141.5	687.0	.093	1.9	49.1	334.9	267.4
Jupiter........	5.203	483.3	11.86yrs.	.048	1.3	99.8	13.3	164.4
Saturn.........	9.54	886.	29.46	.056	2.5	113.1	91.8	97.1
Uranus........	19.19	1783.	84.0	.047	0.8	73.7	169.7	76.8
Neptune.......	30.07	2793.	164.8	.009	1.8	131.1	44.1	184.0
Pluto..........	39.46	3666.	247.7	.249	17.1	109.5	223.4	158.3

PHYSICAL ELEMENTS

Object	Symbol	Mean Diameter miles	Mass ⊕ = 1	Density water = 1	Axial Rotation	Mean Surface Gravity ⊕ = 1	Albedo Bond's	Magnitude at Opposition or Elongation
Sun........	⊙	864,000	332,000	1.4	$24^d.7$ (equatorial)	27.9		− 26.7
Moon.......	☾	2,160	.0123	3.3	$27^d\ 7.7^h$	.16	.07	− 12.6
Mercury....	☿	3,010	.056	3.8	88^d	.27	.07	0±
Venus......	♀	7,580	.82	4.9	30^d ?	.85	.59	− 4±
Earth.......	⊕	7,918	1.00	5.5	$23^h\ 56^m$	1.00	.29	
Mars.......	♂	4,220	.108	4.0	$24^h\ 37^m$	.38	.15	− 2±
Jupiter.....	♃	87,000	318.	1.3	$9^h\ 50^m$±	2.6	.56?	− 2±
Saturn......	♄	72,000	95.	.7	$10^h 15^m$±	1.2	.63?	0±
Uranus.....	♅	31,000	14.6	1.3	$10^h.8$±	.9	.63?	+ 5.7
Neptune....	♆	33,000	17.2	1.3	16^h ?	1.0	.73?	+ 7.6
Pluto.......	♇	4,000?	.8 ?					+ 14

SATELLITES OF THE SOLAR SYSTEM

Name	Stellar Mag.	Mean Dist. from Planet		Revolution Period			Diameter Miles	Discoverer
		" *	Miles	d	h	m		
SATELLITE OF THE EARTH								
Moon	−12.6	530	238,857	27	07	43	2160	
SATELLITES OF MARS								
Phobos	12	8	5,800	0	07	39	10?	Hall, 1877
Deimos	13	21	14,600	1	06	18	5?	Hall, 1877
SATELLITES OF JUPITER								
V	13	48	112,600	0	11	57	100?	Barnard, 1892
Io	5	112	261,800	1	18	28	2300	Galileo, 1610
Europa	6	178	416,600	3	13	14	2000	Galileo, 1610
Ganymede	5	284	664,200	7	03	43	3200	Galileo, 1610
Callisto	6	499	1,169,000	16	16	32	3200	Galileo, 1610
VI	14	3037	7,114,000	250	16		100?	Perrine, 1904
VII	16	3113	7,292,000	260	01		40?	Perrine, 1905
X	18	3116	7,300,000	260			15?	Nicholson, 1938
XI	18	5990	14,000,000	692			15?	Nicholson, 1938
VIII	16	6240	14,600,000	739			40?	Melotte, 1908
IX	17	6360	14,900,000	758			20?	Nicholson, 1914
SATELLITES OF SATURN								
Mimas	12	27	115,000	0	22	37	400?	W. Herschel, 1789
Enceladus	12	34	148,000	1	08	53	500?	W. Herschel, 1789
Tethys	11	43	183,000	1	21	18	800?	G. Cassini, 1684
Dione	11	55	234,000	2	17	41	700?	G. Cassini, 1684
Rhea	10	76	327,000	4	12	25	1100?	G. Cassini, 1672
Titan	8	177	759,000	15	22	41	2600?	Huygens, 1655
Hyperion	13	214	920,000	21	06	38	300?	G. Bond, 1848
Iapetus	11	515	2,210,000	79	07	56	1000?	G. Cassini, 1671
Phoebe	14	1870	8,034,000	550			200?	W. Pickering, 1898
SATELLITES OF URANUS								
Ariel	16	14	119,000	2	12	29	600?	Lassell, 1851
Umbriel	16	19	166,000	4	03	28	400?	Lassell, 1851
Titania	14	32	272,000	8	16	56	1000?	W. Herschel, 1787
Oberon	14	42	364,000	13	11	07	900?	W. Herschel, 1787
SATELLITE OF NEPTUNE								
Triton	13	16	220,000	5	21	03	3000?	Lassell, 1846

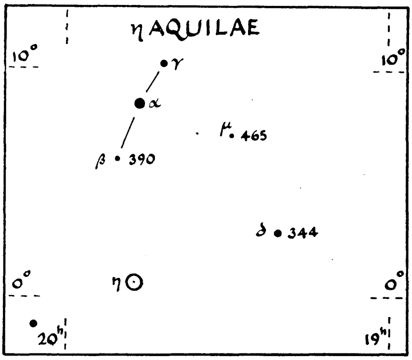
*As seen from the sun.

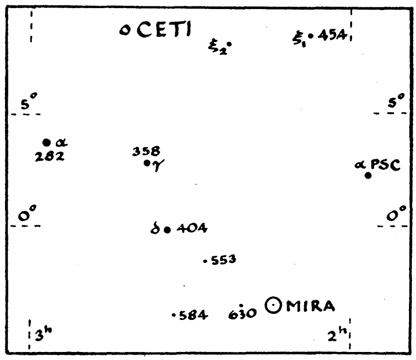
Satellites Io, Europa, Ganymede, Callisto are usually denoted I, II, III, IV, respectively, in order of distance from the planet.

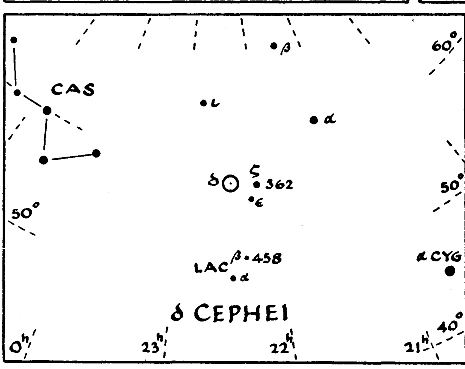
VARIABLE STARS

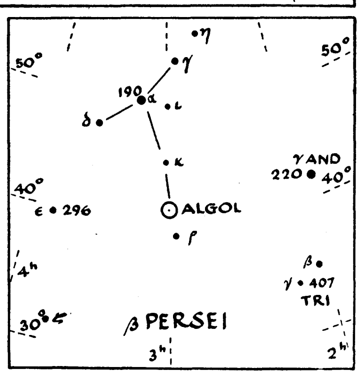
Much pleasure may be derived from the estimation of the brightness of variable stars. Maps of the fields of four bright variable stars are given below. In each case the magnitudes of several suitable comparison stars are given. These magnitudes are given as magnitudes, tenths and hundredths, with the decimal point omitted. Thus a star 362 is of magnitude 3.62. To determine the brightness of the variable at any time, carefully estimate the brightness as some fraction of the interval between two comparison stars, one brighter and one fainter than the variable. The result may then be expressed in magnitudes and tenths. Record the magnitude and time of observation. When a number of observations have been made, a graph may be plotted showing the magnitude estimate as ordinates against the date (days and tenths of a day) as abscissae. Such studies of naked-eye estimates of brightness will at once reveal the differences in variation between the different kinds of variable. For each short period variable the observations made on any one cycle may be carried forward one, two or any number of periods to form a combined light curve.

For the two cepheids, good mean curves may be readily found by observing the variables once a night on as many nights as possible. For Algol, which changes rapidly for a few hours before and after minimum, estimates should be made at quarter or half hour intervals around the times of minimum as tabulated on pages 31-53. Mira may be observed for a couple of months as it rises from the naked-eye limit to 2nd or 3rd magnitude maximum and fades again.









REPRESENTATIVE BRIGHT VARIABLE STARS

Name	Design.	Max.	Min.	Sp.	Period	Type	Date	Discoverer
η Aql	194700	3.7	4.4	G4	7.17652	Cep	1784	Pigott
N Aql	184300	-0.2	10.9	Q	Irr.	Nova	1918	Bower
ε Aur	045443	3.3	4.1	F5p	9833.	Ecl	1821	Fritsch
δ Cep	222557	3.6	4.3	G0	5.36640	Cep	1784	Goodricke
U Cep	005381	6.8	9.2	A0	2.49293	Ecl	1880	W. Ceraski
o Cet[1]	0214*03*	2.0	10.1	M5e	331.8	LPV	1596	Fabricius
RR Cet	012700	8.4	9.0	F0	0.55304	Clus	1906	Oppolzer
R CrB	154428	5.8	13.8	cG0e	Irr.	RCrB	1795	Pigott
χ Cyg	194632	4.2	14.0	M7e	412.9	LPV	1686	Kirch
P Cyg	201437a	3.5	6.0	B1qk	Irr.	Nova	1600	Blaeu
SS Cyg	213843	8.1	12.0	Pec.	Irr.	SSCyg	1896	Wells
XX Cyg	200158	11.4	12.1	A	0.13486	Clus	1904	L. Ceraski
ζ Gem	065820	3.7	4.1	cG1	10.15353	Cep	1847	Schmidt
η Gem	060822	3.3	4.2	M2	235.58	LPV	1865	Schmodt
R Gem	070122a	6.5	14.3	Se	370.1	LPV	1848	Hind
U Gem	074922	8.8	13.8	Pec.	Irr.	SSCyg	1855	Hind
α Her	171014	3.1	3.9	M5	Irr.	SemiR	1795	W. Herschel
R Hya	1324*22*	3.5	10.1	M7e	414.7	LPV	1670	Montanari
R Leo	094211	5.0	10.5	M7e	310.3	LPV	1782	Koch
β Lyr	184633	3.4	4.3	B5e	12.92504	Ecl	1784	Goodricke
RR Lyr	192242	7.2	8.0	A5	0.56685	Clus	1901	Fleming
α Ori[2]	054907	0.2	1.2	M2	2070.Irr.	SemiR	1840	J. Herschel
U Ori	054920	5.4	12.2	M7e	376.9	LPV	1885	Gore
β Per[3]	030140	2.3	3.5	B8	2.86731	Ecl	1669	Montanari
ρ Per	025838	3.3	4.1	M4	Irr.	Irr.	18	54Schmidt
R Sge	200916	8.6	10.4	cG7	70.84	SemiR	1859	Baxendell
R Sct	1842*05*	4.5	9.0	K5e	141.5	SemiR	1795	Pigott
λ Tau	035512	3.8	4.1	B3	3.95294	Ecl	1848	Baxendell
RV Tau	044126	9.4	12.5	K0	78.60	SemiR	1905	L. Ceraski
SU Tau	054319	9.5	15.4	G0e	Irr.	RCrB	1908	Cannon
α UMi[4]	012288	2.3	2.4	cF7	3.96858	Cep	1911	Hertzsprung
N Her	180445	1.5	14.0	Q	Irr.	Nova	1934	Prentice
N Lac	221255	2.2	—	Q	Irr.	Nova	1936	Peltier

[1]oCet (Mira); [2]αOri (Betelgeuse); [3]βPer (Algol); [4]αUMi (Polaris).

The designation (Harvard) gives the 1900 position of the variable; here the first two figures give the hours, and the next two figures the minutes of R.A., while the last two figures give the declination in degrees, italicised for southern declinations. Thus the position of the fourth star of the list, δ Cep (222557) is R.A. 22h 25m, Dec. + 57°. The period is in days and decimals of a day. The type is based on the classification of Gaposchkin and Gaposchkin's comprehensive text-book, *Variable Stars*. The abbreviations here used are: Ecl, Eclipsing Binaries; LPV, Long Period Variables; Semi R, Semiregular; Cep, Cepheids; Clus, cluster type; Nova; SS Cyg and R Cr B, irregular variables of which SS Cygni and R Coronae Borealis are prototypes; and Irr, other irregular variables.

DOUBLE AND MULTIPLE STARS

By Frank S. Hogg

A number of the stars which appear as single to the unaided eye may be separated into two or more components by field glasses or a small telescope. Such objects are spoken of as *double* or *multiple stars*. With larger telescopes pairs which are still closer together may be resolved, and it is found that, up to the limits of modern telescopes, over ten per cent. of all the stars down to the ninth magnitude are members of double stars.

The possibility of resolving a double star of any given separation depends on the diameter of the telescope objective. Dawes' simple formula for this relation is $d'' = 4.5/A$, where d is the separation, in seconds of arc, of a double star that can be just resolved, and A is the diameter of the objective in inches. Thus a one-inch telescope should resolve a double star with a distance of $4''.5$ between its components, while a ten-inch telescope should resolve a pair $0''.45$ apart. It should be noted that this applies only to stars of comparable brightness. If one star is markedly brighter than its companion, the glare from the brighter makes it impossible to separate stars as close as the formula indicates. This formula may be applied to the observation of double stars to test the quality of the seeing and telescope.

It is obvious that a star may appear double in one of two ways. If the components are at quite different distances from the observer, and merely appear close together in the sky the stars form an *optical* double. If, however, they are in the same region of space, and have common proper motion, or orbital motion about one another, they form a *physical* double. An examination of the probability of stars being situated sufficiently close together in the sky to appear as double shows immediately that almost all double stars must be physical rather than optical.

Double stars which show orbital motion are of great astrophysical importance, in that a careful determination of their elliptical orbits and parallaxes furnishes a measure of the gravitational attraction between the two components, and hence the mass of the system.

In the case of many unresolvable close doubles, the orbital motion may be determined by means of the spectroscope. In still other doubles, the observer is situated in the orbital plane of the binary, and the orbital motion is shown by the fluctuations in light due to the periodic eclipsing of the components. Such doubles are designated as *spectroscopic* binaries and *eclipsing* variables.

The accompanying table provides a list of double stars, selected on account of their brightness, suitability for small telescopes, or particular astrophysical interest. The data are taken chiefly from Aitken's *New General Catalogue of Double Stars*, and from the Yale *Catalogue of Bright Stars*. Successive columns give the star, its 1950 equatorial coordinates, the magnitudes and spectral classes of its components, their separation, in seconds of arc, and the approximate distance of the double star in light years. The last column gives, for binary stars of well determined orbits, the period in years, and the mean separation of the components in astronomical units. For stars sufficiently bright to show colour differences in the telescope used, the spectral classes furnish an indication of the colour. Thus O and B stars are bluish white, A and F white, G yellow, K orange and M stars reddish.

A good reference work in the historical, general, and mathematical study of double stars is Aitken's *The Binary Stars*.

REPRESENTATIVE DOUBLE STARS

Star	α 1950	δ	Mag. and Spect.	d	D	Remarks
	h m	° ′		″	L.Y.	
π And	00 34.2	+33 27	4.4B3; 8.5	36	470	†
η Cas	00 46.0	+57 33	3.6F8; 7.2M0	8	18	526y; 66AU
α UMi	01 48.8	+89 02	var. F8; 8.8	19	470	Polaris
γ Ari	01 50.8	+19 03	4.8A0; 4.8A0	8.3	150	
α Pis	01 59.4	+02 31	5.2A2; 4.3A2	2.4	130	††
γ And	02 00.8	+42 05	2.3K0; 5.4A0; 6.6	10, 0.7	410	56y; 23AU
6 Tri	02 09.5	+30 04	5.4G4; 7.0F3	3.6	330	††
η Per	02 47.0	+55 41	3.9K0; 8.5	28	540	
32 Eri	03 51.8	−03 06	5.0A; 6.3G5	6.7	300	
β Ori	05 12.1	−08 15	0.3B8; 7.0	9	540	†
θ Ori	05 32.8	−05 25	5.4;6.8; 6.8; 7.9; O	13, 17	540	Trapezium
β Mon	06 26.4	−07 00	4.7B2; 5.2; 5.6	7, 25	470	†
12 Lyn	06 41.8	+59 30	5.3A2; 6.2; 7.4	1.7, 8	180	†
α CMa	06 43.0	−16 39	−1.6A0; 8.5F	11	9	50y; 20AU
δ Gem	07 17.1	+22 05	3.5F0; 8.0M0	6.8	58	†
α Gem	07 31.4	+32 00	2.0A0; 2.8A0; 9M10	4, 70	47	340y; 79AU
ζ Cnc	08 09.3	+17 48	5.6G0; 6.0; 6.2	1, 5	78	60y; 21AU
γ Leo	10 17.2	+20 06	2.6K0; 3.8G5	4	160	400y
ξ UMa	11 15.5	+31 48	4.4G0; 4.9G0	2	25	††60y; 20AU
ι Leo	11 21.3	+10 48	4.1F3; 6.8F3	2	69	
γ Vir	12 39.1	−01 10	3.6F0; 3.7F0	6	34	171y; 42AU
α CVn	12 53.7	+38 35	2.9A0; 5.4A0	20	140	††
ζ UMa	13 21.9	+55 11	2.4A2; 4.0A2	14	78	††
π Boo	14 38.4	+16 38	4.9A0; 5.1A0	6	360	†
ε Boo	14 42.8	+27 17	2.7K0; 5.1A0	3	220	
ξ Boo	14 49.1	+19 18	4.8G5; 6.7	3	22	151y; 31AU
δ Ser	15 32.4	+10 42	4.2F0; 5.2F0	4	170	
ξ Sco	16 01.6	−11 14	5.1F3; 4.8; 7G7	1, 7	84	44.7y; 19AU
α Her	17 12.4	+14 27	var.M5; 5.4G	5	540	†
δ Her	17 13.0	+24 54	3.2A0; 8.1G2	11	100	† Optical
ε Lyr	18 42.7	+39 37	5.1, 6.0A3; 5.1, 5.4A5	3, 2	200	Pairs 207″
β Cyg	19 28.7	+27 51	3.2K0; 5.4B9	34	410	†
α Cap	20 14.9	−12 40	3.8G5; 4.6G0	376		Optical
γ Del	20 44.3	+15 57	4.5G5; 5.5F8	10	110	
61 Cyg	21 04.6	+38 30	5.6K5; 6.3K5	23	11	
β Cep	21 28.1	+70 20	var.B1; 8.0A3	14	540	†
ζ Aqr	22 26.2	−00 17	4.4F2; 4.6F1	3	140	
δ Cep	22 27.3	+58 10	var.G0; 7.5A0	41	650	
8 Lac	22 33.6	+39 23	5.8B3; 6.5B5	22	1100	†
σ Cas	23 56.5	+55 29	5.1B2; 7.2B3	3	820	

† or ††, one, or two of the components are themselves very close visual double or, more generally, spectroscopic binaries.

THE BRIGHTEST STARS *

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

The accompanying table contains the principal facts regarding 259 stars brighter than apparent magnitude 3.51 which it is thought may be of interest to our amateur members. The various columns should be self-explanatory but some comments may be in order.

The first column gives the name of the star and if it is preceded by the sign || such means that the star is a visual double and the combined magnitude is entered in the fourth column. Besides the 48 thus indicated there are 12 others on the list with faint companions but for these it is not thought that there is any physical connection. In the case of the 20 stars variable in light this fourth column shows their maximum and minimum magnitudes. The 19 first magnitude stars are set up in bold face type.

In the fifth column are given the types as revised at various observatories—principally at our own, but omitting the *s* and *n* designations descriptive of the line character. The annual proper motion follows in the next column and this may not necessarily be correct to the third decimal place.

The parallaxes are taken from the Yale Catalogue of Stellar Parallaxes 1935, the mean of the trigonometric and spectroscopic being adopted. The few negative trigonometric parallaxes were adjusted by Dyson's tables before being combined with the spectroscopic. The distance is given also in light years in the eighth column as to the lay mind that seems a fitting unit. The absolute magnitudes in the ninth column are the magnitudes the stars would have if all were at a uniform distance of 32.6 light years ($\pi = 0.''1$). At that distance the sun would appear as a star of magnitude 4.8.

The radial velocities in the last column have been taken from Vol. 18 of the Lick Publications. An asterisk * following the velocity means that such is variable. In these cases the velocity of the system, if known, is given; otherwise a mean velocity for the observations to date is set down.

Of the 258 stars or star systems here listed 146 are south and 113 north of the equator. This is to be expected from the fact that the northern half of the sky includes less of the Milky Way than the southern.

The number in each spectral class, apart from the one marked peculiar, is as follows: O, 3; B, 74; A, 55; F, 22; G, 43, K, 42 and M, 19. The B-stars are intrinsically luminous and appear in this list out of all proportion to their total number. The stars in Classes A and K are by far the most numerous but the revision of types throws many originally labelled K back into the G group.

From the last column we see that 98 velocities are starred, indicating that 38 per cent of the bright stars, or at least one in every three, are binary in character. For visual binaries the proportion has usually been listed as one in nine. Our list shows one in six but it is only natural to expect that we would observe a higher proportion among the nearby stars, such as these are on the average.

Other relationships can be established from the list if our amateur members care to study it.

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*This feature of the HANDBOOK, first appearing in the 1925 edition, was prepared and frequently revised by the late Dr. W. E. Harper (1878-1940).

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
α Andr........	0 6	+28 49	2.2	A1	.217	.034	96	−0.1	−13.0*
β Cass........	6	+58 52	2.4	F2	.561	.080	41	1.9	+11.4
γ Pegs........	11	+14 54	2.9	B2	.015	.005	652	−3.6	+ 5.0*
β Hydi........	23	−77 32	2.9	G0	2.243	.162	21	4.0	+22.8
α Phoe........	24	−42 35	2.4	G5	.448	.040	81	0.4	+74.6*
δ Andr........	37	+30 35	3.5	K3	.167	.026	125	0.6	− 7.1*
α Cass........	38	+56 16	2.2–2.8	G8	.062	.018	181	−1.5	− 3.8
β Ceti........	41	−18 16	2.2	G7	.233	.052	63	0.8	+13.1
||γ Cass........	54	+60 27	2.2	B0e	.031	.035	93	−0.1	− 6.8
||β Phoe........	1 04	−46 59	3.4	G4	.043	.020	163	−0.1	− 1.2
β Andr........	07	+35 21	2.4	M0	.219	.041	79	0.5	+ 0.1
δ Cass........	23	+59 59	2.8–2.9	A3	.308	.050	65	1.3	+ 6.8
γ Phoe........	26	−43 34	3.4	M1	.223	.008	407	−2.1	+25.7*
α **Erid**........	36	−57 29	0.6	B9	.093	.046	71	−1.1	+19.
||α U. Min......	49	+89 02	2.3–2.4	F7	.043	.008	407	−3.4	−17.4*
ε Cass........	51	+63 25	3.4	B5	.043	.011	296	−1.4	− 8.1
β Arie........	52	+20 34	2.7	A3	.150	.066	49	1.8	− 0.6*
α Hydi........	57	−61 49	3.0	A7	.255	.080	41	2.5	+ 7.0*
||γ Andr........	2 01	+42 05	2.3	K0	.073	.020	163	−1.2	−11.7
α Arie........	04	+23 14	2.2	K2	.242	.045	72	0.5	−14.3
β Tria........	07	+34 45	3.1	A6	.161	.029	112	0.4	+10.4*
||o Ceti........	17	− 3 12	1.7–9.6	M6e	.239	.013	251	−2.7	+57.8*
||θ Erid........	56	−40 30	3.4	A2	.068	.032	102	0.9	+11.9*
α Ceti........	3 00	+ 3 54	2.8	M1	.080	.018	181	−0.9	−25.7
γ Pers........	01	+53 19	3.1	F9	.012	.017	192	−0.7	+ 1.0*
ρ Pers........	02	+38 39	3.3–4.1	M6	.176	.024	136	0.3	+28.2
β Pers........	05	+40 46	2.1–3.2	B8	.011	.033	99	−0.3	+ 5.7*
α Pers........	21	+49 41	1.9	F4	.041	.017	192	−2.0	− 2.4
δ Pers........	39	+47 38	3.1	B5	.047	.012	272	−1.5	−10. *
||η Taur........	45	+23 57	3.0	B5p	.053	.014	233	−1.3	+10.3
γ Hydi........	48	−74 24	3.2	M3	.124	.008	407	−2.3	+16.0
ζ Pers........	51	+31 44	2.9	B1	.023	.008	407	−2.6	+20.9
||ε Pers........	54	+39 52	3.0	B2	.041	.006	543	−3.1	− 6 *
γ Erid........	56	−13 39	3.2	M0	.133	.012	272	−1.6	+61.7
λ Taur........	58	+12 21	3.8–4.2	B3	.015	.008	407	−2.2	+13.0*
α Reti........	4 14	−62 36	3.4	G5	.070	.016	204	−0.6	+35.6

α U. Min., *Polaris:* RA. 1h 46.2 m; Dec. + 89° 01′ (1946)

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km /sec.
α **Taur**.......	4 33	+16 24	1.1	K8	.205	.060	54	0.0	+54.1
α Dora.......	33	−55 09	3.5	A0p	......	..	.....	......	+25.6
π^3 Orio........	47	+ 6 52	3.3	F5	.474	.124	26	3.8	+24.6
ι Auri........	54	+33 05	2.9	K4	.030	.026	163	−0.6	+17.6
ε Auri........	58	+43 45	3.1–3.8	F2	.015	006	543	−2.7	−4.1 *
η Auri........	5 03	+41 10	3.3	B3	.082	013	251	−1.1	+ 7.8
ε Leps........	03	−22 26	3.3	K5	.074	.016	204	−0.7	+ 1.0
β Erid........	05	− 5 09	2.9	A1	.117	.055	59	1.6	− 7
μ Leps........	11	−16 16	3.3	A0p	.053	.020	163	−0.2	+27.7
||β **Orio**........	12	− 8 15	0.3	B8p	.005	.006	543	−5.8	+23.6*
||α **Auri**........	13	+45 57	0.2	G1	.439	.078	42	−0.3	+30 2
||η Orio........	22	− 2 26	3.4	B0	.009	.006	543	−2.7	+19.5*
γ Orio........	22	+ 6 18	1.7	B2	.019	.015	217	−2.4	+18.0
β Taur........	23	+28 34	1.8	B8	.180	.028	116	−1.0	+ 8.0
β Leps........	26	−20 48	3.0	G2	.095	.018	181	−0.7	−13.5
||δ Orio........	29	− 0 20	2.4–2.5	B0	.006	.007	466	−3.4	+19.9*
α Leps........	31	−17 51	2.7	F6	.006	.012	272	−2.1	+24.7
ι Orio........	33	− 5 56	2.9	O8	.007	.021	155	−0.5	+21.5*
ε Orio........	34	− 1 14	1.8	B0	.004	.008	407	−3.7	+25.8
ζ Taur........	35	+21 07	3.0	B3e	.028	.010	326	−2.0	+16.4*
||ζ Orio........	38	− 1 58	1.8	B0	.012	.011	296	−3.0	+18.8
α Colm.......	38	−34 06	2.8	B8	.036	.022	148	−0.6	+34.6
κ Orio........	45	− 9 41	2.2	B0	.009	.006	543	−3.9	+20.1
β Colm.......	49	−35 47	3.2	K0	.397	.026	125	0.3	+89.4
α **Orio**........	52	+ 7 24	0.5–1.1	M2	.032	.012	272	−4.1	+21.0*
β Auri........	56	+44 57	2.1–2.2	A0p	.046	.052	63	0.7	−18.1*
||θ Auri........	56	+37 13	2.7	A1	.106	.029	112	0.0	+28.6
η Gemi.......	6 12	+22 31	3.2–4.2	M2	.062	.014	233	−1.1	+21.4*
ζ C Maj......	18	−30 02	3.1	B3	.012	.013	251	−0.7	+33.1*
μ Gemi.......	20	+22 32	3.2	M3	.129	.016	204	−0.8	+54.8
β C Maj......	20	−17 56	2.0	B1	.003	.014	233	−2.3	+34.4*
α **Cari**........	23	−52 40	−0.9	F0	.022	.005	652	−7.4	+20.5
γ Gemi.......	35	+16 27	1.9	A2	.066	.050	65	0.4	−11.3*
ν Pupp.......	36	−43 09	3.2	B8	.021	.023	148	0.0	+28.2*
ε Gemi.......	41	+25 12	3.2	G9	.020	.009	362	−2.0	+ 9.9
ξ Gemi.......	42	+12 57	3.4	F5	.230	.054	60	2.1	+25.1
||α **C Maj**......	43	−16 39	−1.6	A2	1.315	.386	8	1.3	− 7.5*
α Pict........	48	−61 53	3.3	A5	.271	.....	.....	......	+20.6

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
τ Pupp..	6 49	−50 33	2.8	G8	.091	.025	130	−0.2	+36.4*
‖ε C Maj.	57	−28 54	1.6	B1	.005	.010	326	−3.4	+27.4
ζ Gemi.......	7 01	+20 39	3.7–4.3	G0p	.007	.005	652	−2.8	+ 6.7*
o^2 C Maj......	01	−23 45	3.1	B5p	.006	.007	466	−2.7	+48.6
δ C Maj......	06	−26 19	2.0	G4p	.003	.006	543	−4.1	+34.3*
L^2 Pupp.......	12	−44 33	3.4–6.2	M5e	.332	.018	181	−0.3	+53.0
π Pupp.......	15	−37 00	2.7	K5	.004	.018	181	−1.0	+15.8
η C Maj......	22	−29 12	2.4	B5p	.007	.012	272	−2.2	+40.4
β C Min......	24	+ 8 23	3.1	B8	.063	.022	148	−0.2	+23 *
σ Pupp.......	28	−43 12	3.3	M0	.191	.016	204	−0.7	+88.1*
α_1 Gemi.......	31	+32 00	2.0	A2	.201	.074	44	1.4	+ 6.0*
α_2 Gemi.......	31	+32 00	2.8	A0	.209	.074	44	2.2	− 1.2*
‖α **C Min**......	37	+5 21	0.5	F5	1.242	.316	10	3.0	− 3.0*
β **Gemi**......	42	+28 09	1.2	G9	.623	.105	31	1.3	+ 3.3
ξ Pupp.......	47	−24 44	3.5	K1	.004	.006	543	−2.6	+ 3.7*
ζ Pupp.......	8 02	−39 52	2.3	O8	.032	.004	815	−4.7	−24.
ρ Pupp.......	05	−24 10	2.9	F6	.097	.025	130	−0.1	+46.6
‖γ Velr.........	08	−47 12	2.2	OW9	.002	......	......	......	+ 3.5
‖ε Cari........	21	−59 21	1.7	K0	.030	.010	326	−3.3	+11.5
o U Maj......	26	+60 53	3.5	G2	.166	.014	233	−0.8	+19.8
‖δ Velr........	43	−54 32	2.0	A0	.093	.030	109	−0.6	+ 2.2
‖ε Hyda.......	44	+ 6 36	3.5	F9	.193	.012	272	−1.1	+36.8*
ζ Hyda.......	53	+ 6 08	3.3	G7	.101	.026	125	0.3	+22.6
‖ι U Maj......	56	+48 14	3.1	A4	.500	.060	54	2.0	+12.6
λ Velr........	9 06	−43 14	2.2	K4	.024	.016	204	−1.8	+18.4
β Cari........	13	−69 31	1.8	A0	.192	......	......	......	− 5.
ι Cari........	16	−59 04	2.2	F0	.023	......	......	......	+13.3
α Lync.......	18	+34 36	3.3	K8	.214	.022	148	0.0	+37.4
κ Velr........	21	−54 48	2.6	B3	.017	.017	192	−1.2	+21.7*
α Hyda.......	25	− 8 26	2.2	K4	.036	.018	181	−1.5	− 4.4
θ U Maj......	30	+51 54	3.3	F7	1.096	.072	45	2.6	+15.8
N Velr........	30	−56 49	3.4–4.2	K5	.038	.022	148	0.1	−13.9
ε Leon........	43	+24 00	3.1	G0	.045	.009	362	−2.1	+ 5.1
‖υ Cari........	46	−64 50	3.1	F0	.019	......	......	......	+13.6
α **Leon**.......	10 06	+12 13	1.3	B6	.244	.046	71	−0.4	+ 2.6
q Cari........	15	−61 05	3.4	K5	.043	.014	233	−0.9	+ 8.6

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′				″	″		km./sec.
‖γ Leo	10 17	+20 06	2.3	G8	.347	.024	136	−0.8	−36.8
μ U Maj	19	+41 45	3.2	K4	.082	.031	105	0.7	−20.3*
θ Cari	41	−64 08	3.0	B0	.022	.007	466	−2.8	+24. *
η Cari	43	−59 25	1.0–7.4	Pec	.007	.....	.....	......	−25.0
‖μ Velr	45	−49 09	2.8	G5	.079	.033	99	0.4	+ 6.9
ν Hyda	47	−15 56	3.3	K3	.218	.020	163	−0.2	− 1.0
β U Maj	59	+56 39	2.4	A3	.089	.045	72	0.7	−12.1*
α U Maj	11 01	+62 01	2.0	G5	.137	.036	91	−0.2	− 8.6*
ψ U Maj	07	+44 46	3.2	K0	.067	.035	93	0.9	− 3.6
δ Leon	11	+20 47	2.6	A2	.208	.058	56	1.4	−23.2
θ Leon	12	+15 42	3.4	A2	.103	.025	130	0.4	+ 7.8
λ Cent	33	−62 45	3.3	B9	.045	.031	105	0.8	+ 7.9
β Leon	47	+14 51	2.2	A2	.507	.084	39	1.8	− 2.3
γ U Maj	51	+53 58	2.5	A0	.095	.035	93	0.2	−11.1
δ Cent	12 06	−50 27	2.9	B3e	.040	.015	217	−1.2	+ 9.
ε Corv	08	−22 30	3.2	K2	.063	.024	136	0.1	+ 4.9
δ Cruc	12	−58 28	3.1	B3	.045	.017	192	−0.7	+26.4
δ U Maj	13	+57 19	3.4	A0	.113	.050	65	1.9	−12.
γ Corv	13	−17 16	2.8	B8	.159	.024	136	−0.3	− 4.2*
$α^1$ Cruc	24	−62 49	1.6	B1	.048	.022	148	−1.7	−12.2*
$α^2$ Cruc	24	−62 49	2.1	B3	.048	.022	148	−1.2	+ 0.3*
‖δ Corv	27	−16 14	3.1	A0	.249	.026	125	0.2	+ 8.7
γ Cruc	28	−56 50	1.5	M4	.270	.....	.....	......	+21.3
β Corv	32	−23 07	2.8	G5	.059	.027	121	0.0	− 7.7
α Musc	34	−68 52	2.9	B5	.040	.015	217	−1.2	+18.
‖γ Cent	39	−48 41	2.4	A0	.200	.032	102	−0.1	− 7.5
‖γ Virg	39	− 1 10	2.9	F0	.561	.080	41	2.4	−19.6
‖β Musc	43	−67 50	3.3	B3	.039	.011	296	−1.5	+42. *
β Cruc	45	−59 25	1.5	B1	.054	.007	466	−4.3	−20. *
ε U Maj	52	+56 14	1.7	A2	.117	.067	49	0.8	−11.9*
‖$α^2$ C. Ven	54	+38 35	2.8	A1	.233	.030	109	0.2	− 3.5
ε Virg	13 00	+11 14	3.0	G6	.270	.037	88	0.8	−14.0
γ Hyda	16	−22 54	3.3	G7	.085	.028	116	0.5	− 5.4
ι Cent	18	−36 27	2.9	A2	.351	.049	67	1.4	+ 0.1
‖$ζ^1$ U. Maj	22	+55 11	2.4	A2p	.131	.042	78	0.5	− 9.9*
α **Virg**	23	−10 54	1.2	B2	.051	.018	181	−2.5	+ 1.6*
ζ Virg	32	− 0 20	3.4	A2	.285	.038	86	1.3	−13.1

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
ε Cent........	13 37	−53 13	2.6	B2	.039	.012	272	−2.0	− 5.6
η U. Maj......	46	+49 34	1.9	B3	.116	.015	217	−2.2	−10.9
μ Cent	47	−42 13	3.3	B3e	.026	.009	362	−1.9	+12.6
ζ Cent........	52	−47 02	3.1	B3	.080	.013	251	−1.3	*
η Boot........	52	+18 39	2.8	G1	.370	.100	33	2.8	− 0.2*
β Cent.......	14 00	−60 08	0.9	B3	.039	.026	125	−2.0	−12. *
π Hyda........	04	−26 26	3.5	K3	.164	.037	88	1.3	+27.2
θ Cent........	04	−36 07	2.3	G8	.745	.056	58	1.0	+ 1.3
α Boot.......	13	+19 26	0.2	K0	2.287	.102	32	0.2	− 5.1
γ Boot........	30	+38 32	3.0	A3	.182	.063	52	2.0	−35.5
η Cent........	32	−41 56	2.6	B3	.046	.012	272	−2.0	− 0.2*
||**α Cent.......**	36	−60 38	0.1	G0	3.682	.768	4	4.5	−22.2*
α Circ........	38	−64 46	3.4	F0	.308	.063	52	2.4	+ 7.4
α Lupi........	39	−46 10	2.9	B2	.033	.009	362	−2.3	+ 7.3*
||ε Boot........	43	+27 17	2.7	G8	.045	.019	172	−0.9	−16.4
||α^2 Libr........	48	−15 47	2.9	F1	.128	.056	58	1.6	−10. *
β U. Min......	51	+74 22	2.2	K4	.028	.030	109	−0.4	+16.9
β Lupi........	55	−42 56	2.8	B3	.067	.012	272	−1.8	− 0.3*
κ Cent........	56	−41 54	3.4	B2	.034	.011	296	−1.4	+ 9.1*
σ Libr........	15 01	−25 05	3.4	M4	.091	.020	163	−0.1	− 4.3
ζ Lupi........	09	−51 55	3.5	G5	.125	.027	121	0.7	− 9.7
γ Tr. Au......	14	−68 30	3.1	A0	.064	.....	.....	......	0.
β Libr........	14	− 9 12	2.7	B8	.100	.015	217	−1.4	−37. *
δ Lupi........	18	−40 28	3.4	B3	.031	.012	272	−1.2	+ 1.6
γ U. Min......	21	+72 01	3.1	A2	.016	.022	148	−0.2	− 3.9*
ι Drac........	24	+59 08	3.5	K3	.010	.030	109	0.9	−11.1
||γ Lupi........	32	−41 00	3.0	B3	.038	.013	251	−1.4	+ 6.
α Cor. B......	33	+26 53	2.3	A0	.160	.054	60	1.0	+ 1.0*
α Serp........	42	+ 6 35	2.8	K3	.142	.043	76	1.0	+ 3.0
β Tr. Au......	51	−63 17	3.0	F0	.436	.096	34	2.9	− 0.3
π Scor........	56	−25 58	3.0	B3	.037	.012	272	−1.6	− 3.0*
δ Scor........	57	−22 29	2.5	B1	.039	.011	296	−2.3	−16. *
||β Scor........	16 03	−19 40	2.8	B3	.029	.016	204	−1.2	− 9.3*
δ Ophi........	12	− 3 34	3.3	K8	.159	.030	109	0.7	−19.8
ε Ophi........	16	− 4 34	3.3	G9	.088	.031	105	0.8	−10.3
||σ Scor........	18	−25 28	3.1	B1	.033	.009	362	−2.1	− 0.4*
||η Drac........	23	+61 38	2.9	G5	.062	.038	86	0.8	−14.3

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
||α **Scor**........	16 26	−26 19	1.2	M1	.032	.019	172	−2.4	− 3.2*
β Herc........	28	+21 36	2.8	G4	.104	.020	163	−0.7	−25.8*
τ Scor........	33	−28 07	2.9	B1	.037	.009	362	−2.3	+ 0.6
ζ Ophi........	34	−10 28	2.7	B0	.023	.008	407	−2.8	−19. *
||ζ Herc........	39	+31 42	3.0	G0	.601	.105	31	3.1	−70.8*
α Tr. Au......	43	−68 56	1.9	K5	.031	.025	130	−1.1	− 3.7
ε Scor........	47	−34 12	2.4	G9	.665	.038	86	0.3	− 2.5
μ^1 Scor........	48	−37 58	3.1	B3p	.030	.011	296	−1.7	*
ζ Arae........	54	−55 55	3.1	K5	.046	.028	116	0.3	− 6.0
κ Ophi........	55	+ 9 27	3.1–4.0	K3	.290	.042	78	1.2	−55.6
||η Ophi........	17 08	−15 40	2.6	A2	.095	.047	69	1.0	− 1.0
η Scor........	08	−43 11	3.4	A7	.294	.066	49	2.5	−28.4
ζ Drac........	09	+65 47	3.2	B8	.023	.028	116	0.4	−14.1
||α^1 Herc........	12	+14 27	3.1–3.9	M7	.030	.008	407	−2.4	−32.5
δ Herc........	13	+24 54	3.2	A2	.164	.036	91	1.0	−39. *
π Herc........	13	+36 52	3.4	K3	.021	.018	181	−0.3	−25.7
θ Ophi........	19	−24 57	3.4	B2	.031	.008	407	−2.1	− 3.6
β Arae........	21	−55 29	2.8	K1	.036	.023	142	−0.4	− 0.4
υ Scor........	27	−37 15	2.8	B3	.042	.010	326	−2.2	+18. *
α Arae........	28	−49 50	3.0	B3e	.090	.015	217	−1.1	− 2.2
β Drac........	29	+52 20	3.0	G0	.012	.007	466	−2.8	−20.1
λ Scor........	30	−37 04	1.7	B2	.036	.016	204	−2.3	0. *
α Ophi........	33	+12 35	2.1	A0	.264	.060	54	1.0	+15. *
θ Scor........	34	−42 58	2.0	F0	.012	.024	136	−1.1	+ 1.4
κ Scor........	39	−39 00	2.5	B3	.028	.009	362	−2.7	−10. *
β Ophi........	41	+ 4 35	2.9	K2	.157	.030	109	0.3	−11.9
ι^1 Scor........	44	−40 06	3.1	F8	.004	.008	407	−2.4	−27.6*
||μ Herc........	44	+27 45	3.5	G5	.817	.114	28	3.8	−16.1
G Scor........	46	−37 02	3.2	K2	.069	.029	112	0.5	+24.7
ν Ophi........	56	− 9 46	3.5	G7	.118	.022	148	0.2	+12.4
γ Drac........	55	+51 30	2.4	K5	.026	.026	125	−0.5	−27.8
γ Sgtr........	18 03	−30 26	3.1	K0	.202	.030	109	0.5	+22.3*
η Sgtr........	14	−36 47	3.2	M4	.216	.030	109	0.6	+ 0.5
δ Sgtr........	18	−29 51	2.8	K4	.052	.033	99	0.4	−20.0
η Serp........	19	− 2 55	3.4	G9	.898	.050	65	1.9	+ 8.9
ε Sgtr........	21	−34 25	2.0	A0	.139	.020	163	−1.5	−10.8
λ Sgtr........	25	−25 27	2.9	K1	.196	.036	91	0.7	−43.3
α **Lyra**.......	35	+38 44	0.1	A1	.348	.140	23	0.8	−13.8

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
φ Sgtr........	18 43	−27 03	3.3	B8	.150	.015	217	−0.8	+21.5*
||β Lyra........	48	+33 18	3.4–4.1	B2p	.011	.006	543	−2.7	−19.0*
σ Sgtr........	52	−26 22	2.1	B3	.067	.021	155	−1.3	−10.7
γ Lyra........	57	+32 37	3.3	B9p	.008	.016	204	−0.7	−21.5*
||ζ Sgtr........	59	−29 57	2.7	A2	.019	.035	93	0.4	+22.1
ζ Aqil.........	19 03	+13 47	3.0	A0	.103	.038	86	0.9	−25. *
τ Sgtr........	04	−27 45	3.4	K0	.268	.036	91	1.2	+45.4*
π Sgtr........	07	−21 06	3.0	F2	.041	.017	192	−0.8	− 9.8
δ Drac........	13	+67 34	3.2	G8	.135	.028	116	0.4	+24.8
δ Aqil........	23	+ 3 01	3.4	A3	.267	.052	63	2.0	−32.3*
||β¹ Cygn.......	29	+27 51	3.2	K0	.010	.010	326	−1.8	−23.9*
||δ Cygn.......	43	+45 00	3.0	A1	.067	.023	116	0.2	−20.
γ Agil........	44	+10 29	2.8	K3	.018	.018	181	−0.9	− 2.0
α **Aqil**........	48	+ 8 44	0.9	A2	.659	.184	18	2.2	−26.1
θ Aqil........	20 09	− 0 58	3.4	A0	.035	.018	181	−0.3	−28.6*
||β Capr........	18	−14 56	3.2	F8	.042	.022	148	−0.1	−19.0*
γ Cygn.......	20	+40 06	2.3	F8	.006	.008	407	−3.2	− 7.6
α Pavo.......	22	−56 54	2.1	B3	.087	.014	233	−2.2	+ 1.8*
α Indi........	34	−47 28	3.2	G2	.072	.034	96	0.9	− 1.1
α **Cygn**.......	40	+45 06	1.3	A2p	.004	.002	1630	−7.2	− 6.3*
ε Cygn.......	44	+33 47	2.6	G7	.485	.040	81	0.6	−10.5*
ζ Cygn.......	21 11	+30 01	3.4	G6	.061	.018	181	−0.3	+16.9*
α Ceph.......	17	+62 22	2.6	A2	.163	.076	43	2.0	− 8.
β Ceph.......	28	+70 20	3.3–3.4	B1	.013	.006	543	−2.8	− 7.2
β Aqar........	29	− 5 48	3.1	G1	.020	.008	407	−2.4	+ 6.7
ε Pegs........	42	+ 9 39	2.5	K2	.028	.014	233	−1.8	+ 5.2
δ Capr........	44	−16 21	3.0	A3	.395	.062	53	2.0	− 6.4*
γ Grus........	51	−37 36	3.2	B8	.114	.020	163	−0.3	− 2.1
α Aqar........	22 03	− 0 34	3.2	G0	.019	.006	543	−2.9	+ 7.6
α Grus........	05	−47 12	2.2	B5	.202	.036	91	0.0	+11.8
α Tucn.......	15	−60 31	2.9	K5	.088	.019	172	−0.7	+42.2*
β Grus........	40	−47 09	2.2	M6	.131	.010	326	−2.8	+ 1.6
η Pegs........	41	+29 58	3.1	G1	.039	.016	204	−0.9	+ 4.4*
α **Psc. A**......	55	−29 53	1.3	A3	.367	.118	28	1.7	+ 6.5
β Pegs........	23 01	+27 49	2.6	M3	.235	.020	163	−0.9	+ 8.6
α Pegs........	02	+14 56	2.6	A0	.077	.033	99	0.2	− 4. *
γ Ceph.......	37	+77 21	3.4	K1	.167	.062	53	2.4	−42.0

STAR CLUSTERS

The star clusters for this observing list have been selected to include the more conspicuous members of the two main classes—open clusters and globular clusters. Most of the data are from Shapley's *Star Clusters* and from Trumpler's catalogue in Lick Bulletin No. 420. In the following table *N.G.C.* indicates the serial number of the cluster in the New General Catalogue of Clusters and Nebulae; *M*, its number in Messier's catalogue; *Con.*, the constellation in which it is located; α and δ, its right ascension and declination; *Cl.*, the kind of cluster, *Op* for open or galactic and *Gl* for globular; *Diam.*, the apparent diameter in minutes of arc; *Mag. B.S.*, the magnitude of the fifth brightest star in the case of open clusters, the mean of the 25 brightest for globulars; *No.*, the number of stars in the open clusters down to the limiting magnitudes of the photographs on which the particular clusters were studied; *Int. mag.*, the total apparent magnitude of the globular clusters; and *Dist.*, the distance in light years.

N.G.C.	M	Con.	α 1950	δ	Cl.	Diam.	Mag.	No.	Int.	Dist.
			h m	° ′		′	B.S.		mag.	l.y.
869		h Per	02 15.5	+56 55	Op	30	7			4,300
884		χPer	02 18.9	+56 53	Op	30	7			4,300
1039	34	Per	02 38.3	+42 35	Op	30	9	80		1,500
Pleiades	45	Tau	03 44.5	+23 58	Op	120	4.2	250		490
Hyades		Tau	04 17	+15 30	Op	400	4.0	100		120
1912	38	Aur	05 25.3	+35 48	Op	18	9.7	100		2,800
2099	37	Aur	05 49.0	+32 33	Op	24	9.7	150		2,700
2168	35	Gem	06 05.7	+24 21	Op	29	9.0	120		2,700
2287	41	C Ma	06 44.9	−20 42	Op	32	9	50		1,300
2632	44	Cnc	08 37.2	+20 10	Op	90	6.5	350		490
5139		ωCen	13 23.7	−47 03	Gl	23	12.9		3	22,000
5272	3	C Vn	13 39.9	+28 38	Gl	10	14.2		4.5	40,000
5904	5	Ser	15 15.9	+02 16	Gl	13	14.0		3.6	35,000
6121	4	Scr	16 20.5	−26 24	Gl	14	13.9		5.2	24,000
6205	13	Her	16 39.9	+36 33	Gl	10	13.8		4.0	34,000
6218	12	Oph	16 44.6	−01 51	Gl	9	14.0		6.0	36,000
6254	10	Oph	16 54.5	−04 02	Gl	8	14.1		5.4	36,000
6341	92	Her	17 15.6	+43 12	Gl	8	13.9		5.1	36,000
6494	23	Sgr	17 54.0	−19 01	Op	27	10.2	120		2,200
6611	16	Ser	18 16.0	−13 48	Op	8	10.6	55		6,700
6656	22	Sgr	18 33.3	−23 57	Gl	17	12.9		3.6	22,000
7078	15	Peg	21 27.6	+11 57	Gl	7	14.3		5.2	43,000
7089	2	Aqr	21 30.9	−01 04	Gl	8	14.6		5.0	45,000
7092	39	Cyg	21 30.5	+48 13	Op	32	6.5	25		1,000
7654	52	Cas	23 22.0	+61 19	Op	13	11.0	120		4,400

GALACTIC NEBULAE

The galactic nebulae here listed have been selected to include the most readily observable representatives of planetary nebulae such as the Ring Nebula in Lyra, diffuse bright nebulae like the Orion nebula and dark absorbing nebulosities such as the Coal Sack. These objects are all located in our own galactic system. The first five columns give the identification and position as in the table of clusters. In the *Cl* column is given the classification of the nebula, planetary nebulae being listed as *Pl*, diffuse nebulae as *Dif*, and dark nebulae as *Drk*. *Size* indicates approximately the greatest apparent diameter in minutes of arc; and *m n* is the magnitude of the planetary nebula and *m* * is the magnitude of its central star. The distance is given in light years, and the name of the nebulae is added for the better known objects.

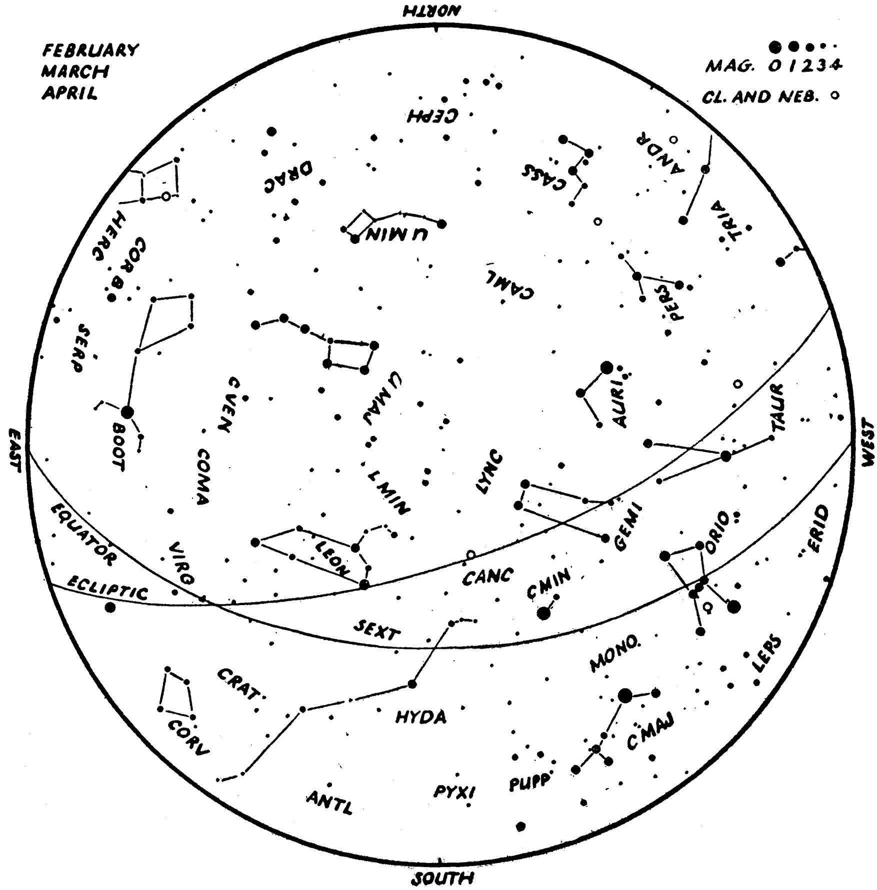
N.G.C.	M	Con	α 1950 h m	δ ° ′	Cl	Size ′	m n	m *	Dist. l.y.	Name
650	76	Per	01 38.3	+51 20	Pl	1.5	11	17	15,000	
1952	1	Tau	05 31.5	+21 59	Pl	6	11	16	10,000	Crab
1976	42	Ori	05 32.5	−05 25	Dif	30			1,800	Orion
B33		Ori	05 38.0	−02 29	Drk	4			300	Horsehead
2261		Mon	06 36.4	+08 47	Dif	2				Hubble's var
2392		Gem	07 26.2	+21 02	Pl	0.3	8	10	2,800	
2440		Pup	07 39.6	−18 05	Pl	0.9	11	16	8,600	
3587	97	UMa	11 11.8	+55 17	Pl	3.3	11	14	12,000	Owl
		Cru	12 48	−63	Drk	300			300	Coalsack
6210		Her	16 42.4	+23 54	Pl	0.3	10	12	5,600	
B72		Oph	17 20.5	−23 36	Drk	20			400	S nebula
6514	20	Sgr	17 59.3	−23 02	Dif	24			3,200	Trifid
B86		Sgr	17 59.9	−27 52	Drk	5				
6523	8	Sgr	18 00.6	−24 23	Dif	50			3,600	Lagoon
6543		Dra	17 58.6	+66 38	Pl	0.4	9	11	3,500	
6572		Oph	18 10.2	+06 50	Pl	0.2	9	12	4,000	
B92		Sgr	18 12.7	−18 15	Drk	15				
6618	17	Sgr	18 18.0	−16 12	Dif	26			3,000	Horseshoe
6720	57	Lyr	18 52.0	+32 58	Pl	1.4	9	14	5,400	Ring
6826		Cyg	19 43.5	+50 24	Pl	0.4	9	11	3,400	
6853	27	Vul	19 57.4	+22 35	Pl	8	8	13	3,400	Dumb-bell
6960		Cyg	20 43.6	+30 32	Dif	60				Network
7000		Cyg	20 57.0	+44 07	Dif	100				N. America
7009		Aqr	21 01.4	−11 34	Pl	0.5	8	12	3,000	
7662		And	23 23.4	+42 12	Pl	0.3	9	13	3,900	

EXTRA-GALACTIC NEBULAE

Among the hundreds of thousands of systems far beyond our own galaxy relatively few are readily seen in small telescopes. The following list contains a selection of the closer brighter objects of this kind. The first five columns give the catalogue numbers, constellation and position on the celestial sphere. In the column *Cl*, *E* indicates an elliptical nebula, *I* an irregular object, and *Sa, Sb, Sc* spiral nebulae, in which the spiral arms become increasingly dominant compared with the nucleus as we pass from *a* to *c*. The remaining columns give the apparent magnitude of the nebula, its distance in light years and the radial velocity in kilometers per second. As these objects have been selected on the basis of ease of observation, the faint, very distant objects which have spectacularly large red shifts, corresponding to large velocities of recession, are not included.

N.G.C.	M	Con	α 1950 h m	δ ° ′	Cl	Dimens. ′ ′	Mag.	Distance l.y.	Vel. km/sec
221	32	And	00 39.9	+40 36	E	3×3	8.8	800,000	− 185
224	31	And	00 40.0	+41 00	Sb	160×40	5.0	800,000	− 220
SMC		Tuc	00 53	−72 38	I	220×220	1.5	100,000	+ 170
598	33	Tri	01 31.0	+30 24	Sc	60×40	7.0	700,000	− 70
LMC		Dor	05 21	−69 27	I	430×530	0.5	90,000	+ 280
3031	81	UMa	09 51.5	+69 18	Sb	16×10	8.3	2,400,000	− 30
3034	82	UMa	09 51.8	+69 58	I	7×2	9.0	2,600,000	+ 290
3368	96	Leo	10 44.1	+12 05	Sa	7×4	10.0	5,700,000	+ 940
3623	65	Leo	11 16.3	+13 22	Sb	8×2	9.9	5,000,000	+ 800
3627	66	Leo	11 17.6	+13 16	Sb	8×2	9.1	4,300,000	+ 650
4258		CVn	12 16.5	+47 34	Sb	20×6	8.7	4,600,000	+ 500
4374	84	Vir	12 22.5	+13 09	E	3×2	9.9	6,000,000	+1050
4382	85	Com	12 22.9	+18 28	E	4×2	10.0	3,700,000	+ 500
4472	49	Vir	12 27.2	+08 16	E	5×4	10.1	5,700,000	+ 850
4565		Com	12 33.9	+26 16	Sb	15×1	11.0	7,600,000	+1100
4594		Vir	12 37.4	−11 20	Sa	7×2	9.2	7,200,000	+1140
4649	60	Vir	12 41.1	+11 50	E	4×3	9.5	7,500,000	+1090
4736	94	CVn	12 48.6	+41 24	Sb	5×4	8.4	3,000,000	+ 290
4826	64	Com	12 54.3	+21 57	Sb	8×4	9.2	1,300,000	+ 150
5005		CVn	13 08.6	+37 20	Sc	5×2	11.1	6,600,000	+ 900
5055	63	CVn	13 13.6	+42 18	Sb	8×3	9.6	3,600,000	+ 450
5194	51	CVn	13 27.8	+47 27	Sc	12×6	7.4	3,000,000	+ 250
5236	83	Hya	13 34.2	−29 36	Sc	10×8	8	2,900,000	+ 500
6822		Sgr	19 42.4	−14 53	I	20×10	11	1,000,000	− 150
7331		Peg	22 34.8	+33 59	Sb	9×2	10.4	5,200,000	+ 500

STAR MAP I

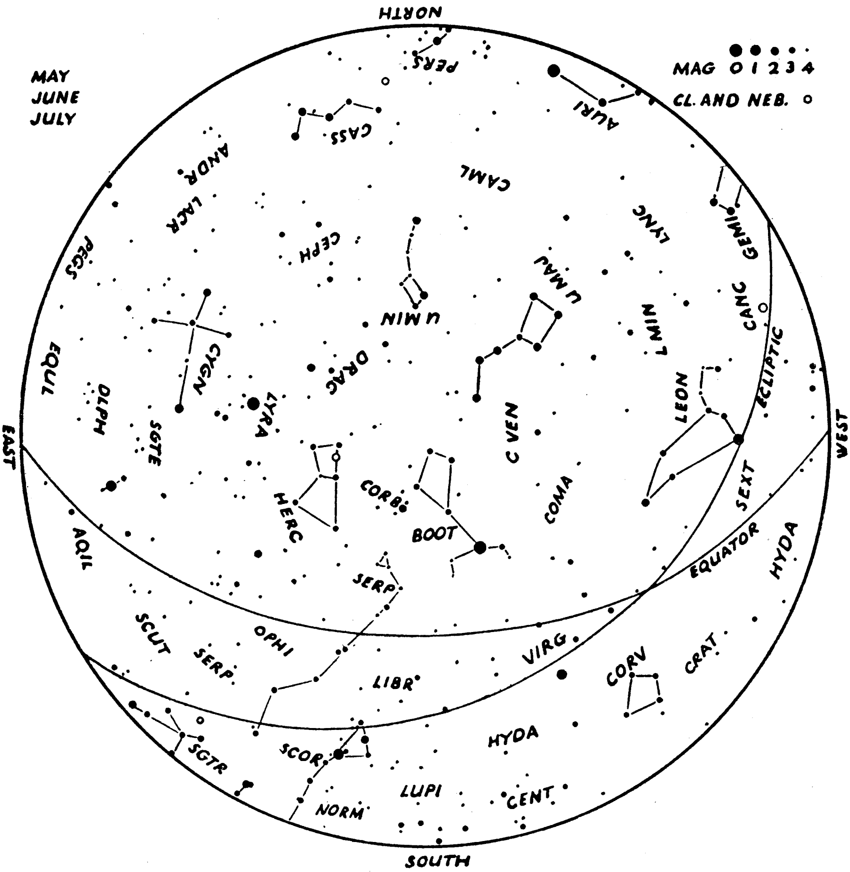


The above map represents the evening sky at

Midnight	Feb.	6
11 p.m.	"	21
10 "	Mar.	7
9 "	"	22
8 "	Apr.	6
7 "	"	21

The centre of the map is the zenith, the circumference the horizon. To identify the stars hold the map so that the part of the horizon you are facing is down.

STAR MAP 2

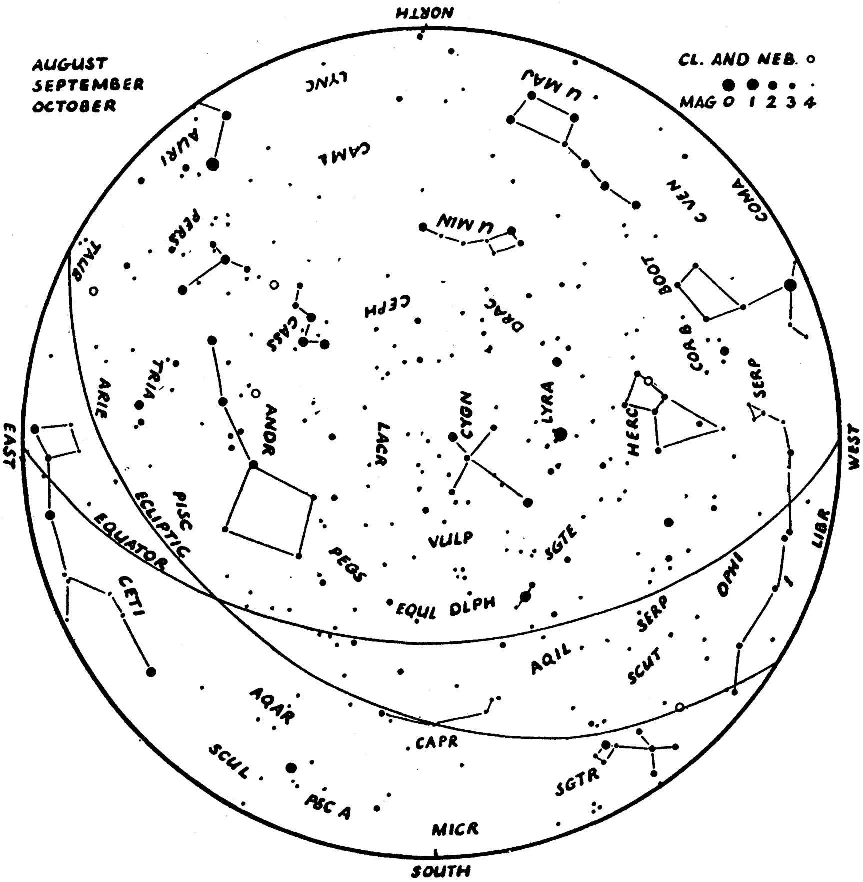


The above map represents the evening sky at

Midnight...........	May 8
11 p.m............	" 24
10 "	June 7
9 "	" 22
8 "	July 6

The centre of the map is the zenith, the circumference the horizon. To identify the stars hold the map so that the part of the horizon you are facing is down.

STAR MAP 3

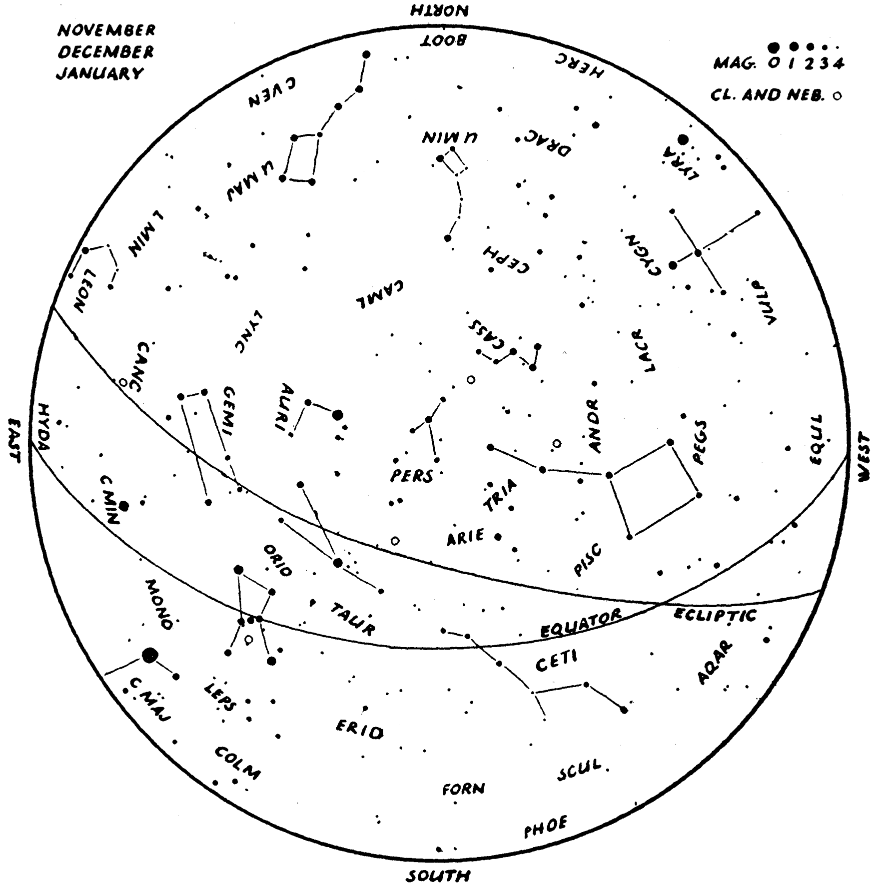


The above map represents the evening sky at

Midnight...........	Aug. 5
11 p.m.............	" 21
10 "	Sept. 7
9 "	" 23
8 "	Oct. 10
7 "	" 26
6 "	Nov. 6
5 "	" 21

The centre of the map is the zenith, the circumference the horizon. To identify the stars hold the map so that the part of the horizon you are facing is down.

STAR MAP 4



The above map represents the evening sky at

Midnight	Nov.	6
11 p.m.	"	21
10 "	Dec.	6
9 "	"	21
8 "	Jan.	5
7 "	"	20
6 "	Feb.	6

The centre of the map is the zenith, the circumference the horizon. To identify the stars hold the map so that the part of the horizon you are facing is down.

CHIEF STARS USED IN AERIAL NAVIGATION

No.	Name	Pronunciation	Constell. Name	Mag.	R.A. 1950 h m	Dec. ° ′	SHA 1946 ° ′
1	Achernar	ā'ker-när	α Erid	0.6	01 36	S 57 29	336 05
2	Acrux	ă'krŭks	α Cruc	1.1	12 24	S 62 49	174 06
3	Aldebaran	ăl-dĕb'ä-răn	α Taur	1.1	04 33	N 16 25	291 48
4	Alpheratz	ăl-fē'răts	α Andr	2.2	00 06	N 28 49	358 36
5	Altair	ăl-tä'ĭr	α Aqil	0.9	19 48	N 08 44	62 58
6	Antares	ăn-ta'rēz	α Scor	1.2	16 26	S 26 20	113 29
7	Arcturus	ärk-tū'rŭs	α Boot	0.2	14 13	N 19 26	146 42
8	Betelgeuse	bĕt-ĕl-gûz'	α Orio	0.8*	05 52	N 07 24	271 56
9	Canopus	ka-nō'-pûs	α Cari	−0.9	06 23	S 52 40	264 19
10	Capella	kä-pĕl'ä	α Auri	0.2	05 13	N 45 57	281 50
11	Deneb	dĕn'ĕb	α Cygn	1.3	20 40	N 45 06	50 06
12	Dubhe	dōōb'hĕ	α U Maj	2.0	11 01	N 62 01	194 54
13	Fomalhaut	fō'măl-hôt	α Psc A	1.3	22 55	S 29 53	16 20
14	Peacock	pē'kŏk	α Pavo	2.1	20 22	S 56 54	54 39
15	Pollux	pŏl'ŭks	β Gemi	1.2	07 42	N 28 09	244 30
16	Procyon	prō'sĭ-ŏn	α C Min	0.5	07 37	N 05 21	245 53
17	Regulus	rĕg'ū-lŭs	α Leon	1.3	10 06	N 12 13	208 38
18	Rigel	rī'gĕl, rī'jĕl	β Orio	0.3	05 12	S 08 15	282 01
19	Rigil Kent.	r. kĕn-tô'rŭs	α Cent	0.1	14 36	S 60 38	141 01
20	Sirius	sĭr'ĭ-ŭs	α C Maj	−1.6	06 43	S 16 38	259 18
21	Spica	spī'kä	α Virg	1.2	13 23	S 10 54	159 25
22	Vega	vē'gä	α Lyra	0.1	18 35	N 38 44	81 13
30	Denebola	dĕn-ĕb'ō-lä	β Leon	2.2	11 46	N 14 51	183 26
39	Benetnasch	bĕ-nĕt'nash	η U Maj	1.9	13 46	N 49 34	153 39
47	Polaris	pō-lā'rĭs	α U Min	2.3	01 49	N 89 02	333 26

*No. 8. Magnitude varies from 0.5 to 1.1

No. 47. Polaris: 194 position given on page 65.

Abbreviations: 1, Achar; 3, Aldeban; 4, Alphaz; 13, Fomalt; 19, Rikent; 39, Benesch.

Pronunciation Key

ā as in fate	ē as in we	ī as in ice	ō as in go	ū as in unite
ă " fat	ĕ " met	ĭ " ill	ŏ " odd	ŭ " up
ä " arm	ë " water	ōō " food	ô " orb	û " urn

TABLE OF PRECESSION FOR 50 YEARS

R.A.	Prec. in Dec.	Precession in Right Ascension														Prec. in Dec.	R.A.
		δ = +85°	+80°	+75°	+70°	+60°	+50°	+40°	+30°	+20°	+10°	0°	−10°	−20°	−30°		
h m	′	m	m	m	m	m	m	m	m	m	m	m	m	m	m	′	h m
0 00	+ 16.7	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	− 16.7	12 00
0 30	+ 16.6	+ 4.22	3.38	3.10	2.96	2.81	2.73	2.68	2.64	2.61	2.59	2.56	2.53	2.51	2.48	− 16.6	11 30
1 00	+ 16.1	+ 5.85	4.19	3.64	3.36	3.06	2.90	2.80	2.73	2.67	2.61	2.56	2.51	2.45	2.39	− 16.1	11 00
1 30	+ 15.4	+ 7.43	4.98	4.15	3.73	3.30	3.07	2.92	2.81	2.72	2.64	2.56	2.49	2.40	2.31	− 15.4	10 30
2 00	+ 14.5	+ 8.92	5.72	4.64	4.09	3.52	3.22	3.03	2.88	2.76	2.66	2.56	2.46	2.36	2.24	− 14.5	10 00
2 30	+ 13.2	+10.31	6.40	5.09	4.42	3.73	3.37	3.13	2.95	2.81	2.68	2.56	2.44	2.31	2.17	− 13.2	9 30
3 00	+ 11.8	+11.56	7.02	5.50	4.73	3.92	3.50	3.22	3.02	2.85	2.70	2.56	2.42	2.27	2.11	− 11.8	9 00
3 30	+ 10.2	+12.66	7.57	5.86	4.99	4.09	3.61	3.30	3.07	2.88	2.72	2.56	2.40	2.24	2.05	− 10.2	8 30
4 00	+ 8.3	+13.58	8.03	6.16	5.21	4.23	3.71	3.37	3.12	2.91	2.73	2.56	2.39	2.21	2.00	− 8.3	8 00
4 30	+ 6.4	+14.32	8.40	6.40	5.39	4.34	3.79	3.42	3.16	2.93	2.74	2.56	2.38	2.19	1.97	− 6.4	7 30
5 00	+ 4.3	+14.85	8.66	6.58	5.52	4.42	3.84	3.46	3.18	2.95	2.75	2.56	2.37	2.17	1.94	− 4.3	7 00
5 30	+ 2.2	+15.18	8.82	6.68	5.60	4.47	3.88	3.49	3.20	2.96	2.75	2.56	2.37	2.16	1.92	− 2.2	6 30
6 00	+ 0.0	+15.29	8.88	6.72	5.62	4.49	3.89	3.50	3.20	2.97	2.76	2.56	2.36	2.16	1.92	0.0	6 00
12 00	− 16.7	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 2.56	+ 16.7	24 00
12 30	− 16.6	+ 0.90	1.82	2.02	2.16	2.31	2.39	2.44	2.48	2.51	2.53	2.56	2.59	2.61	2.64	+ 16.6	23 30
13 00	− 16.1	− 0.73	+ 0.93	1.48	1.77	2.06	2.22	2.32	2.39	2.45	2.51	2.56	2.61	2.67	2.73	+ 16.1	23 00
13 30	− 15.4	− 2.31	+ 0.14	0.97	1.39	1.82	2.05	2.20	2.31	2.40	2.49	2.56	2.64	2.72	2.81	+ 15.4	22 30
14 00	− 14.5	− 3.80	− 0.60	+ 0.46	1.03	1.60	1.90	2.09	2.24	2.36	2.46	2.56	2.66	2.76	2.88	+ 14.5	22 00
14 30	− 13.2	− 5.19	− 1.28	+ 0.03	0.70	1.39	1.75	1.99	2.17	2.31	2.44	2.56	2.68	2.81	2.95	+ 13.2	21 30
15 00	− 11.8	− 6.44	− 1.90	− 0.38	+ 0.40	1.20	1.62	1.90	2.11	2.27	2.42	2.56	2.70	2.85	3.02	+ 11.8	21 00
15 30	− 10.2	− 7.54	− 2.45	− 0.74	+ 0.13	1.03	1.51	1.81	2.05	2.24	2.40	2.56	2.72	2.88	3.07	+ 10.2	20 30
16 00	− 8.3	− 8.46	− 2.91	− 1.04	− 0.09	+ 0.89	1.41	1.75	2.00	2.21	2.39	2.56	2.73	2.91	3.12	+ 8.3	20 00
16 30	− 6.4	− 9.20	− 3.27	− 1.28	− 0.27	+ 0.78	1.33	1.70	1.97	2.19	2.38	2.56	2.74	2.93	3.16	+ 6.4	19 30
17 00	− 4.3	− 9.73	− 3.54	− 1.45	− 0.40	+ 0.70	1.28	1.66	1.94	2.17	2.37	2.56	2.75	2.95	3.18	+ 4.3	19 00
17 30	− 2.2	−10.06	− 3.70	− 1.56	− 0.47	+ 0.65	1.25	1.63	1.92	2.16	2.37	2.56	2.75	2.96	3.20	+ 2.2	18 30
18 00	− 0.0	−10.17	− 3.75	− 1.60	− 0.50	+ 0.63	1.23	1.62	1.92	2.16	2.36	2.56	2.76	2.97	3.20	+ 0.0	18 00

Temperature and Precipitation at Canadian and United States Stations

Prepared by Andrew Thomson.

Station.	Jan.	Feb.	Ma.	Ap.	May	Ju.	Jul.	Aug.	Sep.	Oc.	No.	De.	M	H	L
	Mean Temperature, Fahrenheit.												Average Annual.		
Victoria, B.C.	39	40	44	49	53	57	60	60	56	51	45	41	49	86	19
Vancouver, B.C.	36	39	43	48	53	60	63	63	57	50	43	38	50	86	13
Edmonton, Alta	6	12	22	40	51	57	62	59	50	41	26	14	37	89	−41
Calgary, Alta	11	14	25	40	49	56	61	59	50	42	26	20	38	91	−34
Regina, Sask.	−4	−2	14	37	50	59	64	61	51	39	21	8	33	94	−40
Winnipeg, Man.	−3	2	16	38	52	62	62	64	54	41	22	6	35	94	−38
Toronto, Ont.	23	22	30	42	53	63	69	67	60	48	37	27	45	92	−12
Ottawa, Ont.	12	13	25	42	55	65	69	66	59	46	33	17	42	93	−24
Montreal, Que.	14	15	26	41	55	65	70	67	59	47	33	20	43	90	−18
Halifax, N.S.	23	23	30	39	49	58	65	64	58	49	39	28	44	89	−9
Churchill, Man.	−19	−17	−6	15	29	42	53	52	41	26	7	−10	18	81	−46
Aklavik, N.W.T.	−18	−16	−12	8	31	49	56	50	38	19	−4	−14	16	83	−52
St. John's, Nfld.	23	22	28	35	43	51	59	60	54	45	37	29	41	83	−6
New York, N.Y.	31	31	37	49	60	68	73	73	56	56	44	35	52	95	2
Washington, D.C.	33	35	42	53	64	72	76	75	68	57	45	36	55	98	4
Chicago, Ill.	25	28	36	48	59	68	74	73	66	55	41	30	50	95	−10
Denver, Colo.	29	32	39	47	57	67	72	71	63	51	39	32	50	97	−13
San Francisco	50	51	53	54	56	57	57	58	60	59	55	51	55	91	37

M, *H* and *L* are the mean and the averages of the highest and of the lowest temperatures each year at the station, over the total time since the station was installed.

Station	Jan.	Feb.	Ma.	Ap.	May	Ju.	Jul.	Aug.	Sep.	Oc.	No.	De.	M	W	D
	Mean Precipitation. (Unit = one tenth of an inch)												Year.		
Victoria, B.C.	45	30	23	12	10	9	4	6	15	28	43	47	271	510	173
Vancouver, B.C.	88	57	52	32	28	23	13	16	38	58	85	86	575	676	378
Edmonton, Alta	9	7	7	9	17	31	33	24	13	7	7	8	171	278	82
Calgary, Alta	5	6	7	7	24	32	26	27	13	6	7	5	164	346	79
Regina, Sask.	4	3	5	7	20	32	25	19	12	7	5	4	141	272	101
Winnipeg, Man.	9	8	11	13	22	31	31	23	23	15	11	9	206	302	102
Toronto, Ont.	28	25	25	25	29	27	30	29	30	24	28	26	325	436	176
Ottawa, Ont.	30	25	26	22	28	32	33	30	27	28	25	29	335	444	232
Montreal, Que.	37	32	35	25	30	35	37	35	35	33	35	37	407	530	292
Halifax, N.S.	56	45	50	45	42	37	39	45	36	53	54	54	555	678	388
Churchill, Man.	6	10	11	10	10	20	18	25	26	13	12	9	168		
Aklavik, N.W.T.	7	8	6	7	8	7	16	14	10	8	10	5	105	150	98
St. John's, Nfld.	54	51	45	42	36	36	37	36	38	54	61	49	538	691	427
New York, N.Y.	36	41	35	33	32	34	42	43	34	35	30	35	430	587	331
Washington, D.C.	35	35	37	33	36	42	46	39	33	28	24	32	422	614	307
Chicago, Ill.	19	23	26	28	35	34	33	32	32	25	24	20	327	461	244
Denver, Colo.	4	6	10	21	22	14	17	14	10	11	6	7	141	228	79
San Francisco	44	42	31	17	8	2	0	0	4	11	24	39	220	390	91

M, *W* and *D* indicate the mean, the greatest and the least total precipitation in one year from Jan. 1 to Dec. 31 recorded at a station, records being available for varying periods from 30 to 50 years.

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1890-1946

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