THE OBSERVER'S HANDBOOK FOR 1944

PUBLISHED BY

The Royal Astronomical Society of Canada

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

THIRTY-SIXTH YEAR OF PUBLICATION

TORONTO
198 COLLEGE STREET
PRINTED FOR THE SOCIETY
BY THE UNIVERSITY OF TORONTO PRESS
1944

1944 CALENDAR 1944

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

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

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

JULIAN DAY CALENDAR, 1944

J.D. 2,431,000 plus the following:

Jan. 1 091	May 1 212	Sep. 1 335
Feb. 1 122	Jun. 1 243	Oct. 1 365
Mar. 1 151	Jul. 1 273	Nov. 1 396
Apr. 1 182	Aug. 1 304	Dec. 1 426

The Julian Day commences at noon.
Thus J.D. 2,431,091 = Jan. 1.5 G.C.T.

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CONTENTS

TABLES IN RECENT OBSERVER'S HANDBOOKS

PRINTED IN CANADA

PREFACE

The HANDBOOK for 1944 is the 36th issue. The times of moonrise and moonset, first printed for 1942, now include latitudes 40, 45, 50 and 52 degrees. Added this year are: (1) Table of precession for 50 years, to bring 1900-catalogue positions forward to 1950; (2) Table of representative bright variable stars, with maps of the fields of four naked-eye variables.

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.

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 1943.

ANNIVERSARIES AND FESTIVALS 1944

New Year's Day	Sat.	Jan.	1
Epiphany	Thu.	Jan.	6
Septuagesima Sunday		Feb.	6
Quinquagesima (Shrove Sunday)		Feb.	20
Ash Wednesday		Feb.	23
St. David	Wed.	Mar.	1
St. Patrick	Fri.	Mar.	17
Palm Sunday		Apr.	2
Good Friday		Apr.	7
Easter Sunday		Apr.	9
St. George	Sun.	Apr.	23
Rogation Sunday		May	14
Ascension Day	Thu.	May	18
Empire Day (Victoria Day)	Wed.	May	24
Birthday of the Queen Mother, Mary (1867)	Fri.	May	26
Pentecost (Whit Sunday)		May	28
Trinity Sunday		Jun.	4
Corpus Christi	Thu.	Jun.	8
St. John Baptist (Midsummer Day)	Sat.	Jun.	24
Dominion Day	Sat.	Jul.	1
Birthday of Queen Elizabeth (1900)	Fri.	Aug.	4
Labour Day	Mon.	Sep.	4
Hebrew New Year (Rosh Hashanah)	Mon.	Sep.	18
St. Michael (Michaelmas Day)	Fri.	Sep.	29
All Saints' Day	Wed.	Nov.	1
Remembrance Day	Sat.	Nov.	11
St. Andrew	Thu.	Nov.	30
First Sunday in Advent		Dec.	3
Ascension of King George VI (1936)	Mon.	Dec.	11
Birthday of King George VI (1895)	Thu.	Dec.	14
Christmas Day	Mon.	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 2ϕ miles (at latitude ϕ)
1° of longitude = 69.232 cos ϕ − 0.0584 cos 3ϕ 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	π = 3.141,592,653,6
= 3437′.75	No. of square degrees in the sky
= 206,265″	= 41,253

1944 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 41 08	+03 00	−23 06.5
" 4	18 54 23	+04 25	−22 51.4
" 7	19 07 34	+05 46	−22 32.2
" 10	19 20 40	+07 03	−22 09.0
" 13	19 33 42	+08 16	−21 41.9
" 16	19 46 39	+09 23	−21 11.0
" 19	19 59 30	+10 24	−20 36.5
" 22	20 12 14	+11 18	−19 58.5
" 25	20 24 52	+12 07	−19 17.0
" 28	20 37 23	+12 48	−18 32.4
" 31	20 49 46	+13 21	−17 44.8
Feb. 3	21 02 02	+13 47	−16 54.3
" 6	21 14 10	+14 06	−16 01.2
" 9	21 26 11	+14 17	−15 05.6
" 12	21 38 04	+14 21	−14 07.7
" 15	21 49 51	+14 18	−13 07.7
" 18	22 01 32	+14 09	−12 05.8
" 21	22 13 06	+13 54	−11 02.2
" 24	22 24 34	+13 32	−09 56.9
" 27	22 35 57	+13 05	−08 50.4
Mar. 1	22 47 14	+12 33	−07 42.6
" 4	22 58 27	+11 56	−06 33.9
" 7	23 09 36	+11 15	−05 24.3
" 10	23 20 40	+10 30	−04 14.1
" 13	23 31 42	+09 42	−03 03.4
" 16	23 42 41	+08 52	−01 52.5
" 19	23 53 39	+08 00	−00 41.3
" 22	00 04 35	+07 06	+00 29.8
" 25	00 15 30	+06 12	+01 40.7
" 28	00 26 25	+05 17	+02 51.3
" 31	00 37 20	+04 23	+04 01.4
Apr. 3	00 48 16	+03 29	+05 10.8
" 6	00 59 13	+02 36	+06 19.4
" 9	01 10 11	+01 44	+07 27.0
" 12	01 21 12	+00 56	+08 33.4
" 15	01 32 16	+00 09	+09 38.6
" 18	01 43 22	−00 33	+10 42.3
" 21	01 54 33	−01 13	+11 44.5
" 24	02 05 47	−01 48	+12 44.9
" 27	02 17 06	−02 19	+13 43.5
" 30	02 28 29	−02 46	+14 40.0
May 3	02 39 56	−03 08	+15 34.3
" 6	02 51 29	−03 25	+16 26.3
" 9	03 03 06	−03 37	+17 15.8
" 12	03 14 49	−03 45	+18 02.8
" 15	03 26 36	−03 46	+18 47.0
" 18	03 38 29	−03 43	+19 28.4
" 21	03 50 28	−03 34	+20 06.8
" 24	04 02 31	−03 21	+20 42.2
" 27	04 14 38	−03 03	+21 14.3
" 30	04 26 50	−02 41	+21 43.2
June 2	04 39 06	−02 15	+22 08.6
" 5	04 51 25	−01 46	+22 30.6
" 8	05 03 47	−01 13	+22 49.0
" 11	05 16 11	−00 39	+23 03.8
' 14	05 28 38	−00 02	+23 14.9
" 17	05 41 06	+00 37	+23 22.4
" 20	05 53 35	+01 16	+23 26.2
" 23	06 06 04	+01 55	+23 26.3
" 26	06 18 32	+02 34	+23 22.6
" 29	06 30 59	+03 11	+23 15.3

Date	Apparent R.A.	Corr. to Sundial	Apparent Dec.
	h m s	m s	° ′
July 2	06 43 24	+03 46	+23 04.2
" 5	06 55 46	+04 19	+22 49.6
" 8	07 08 06	+04 49	+22 31.3
" 11	07 20 22	+05 15	+22 09.6
" 14	07 32 34	+05 38	+21 44.5
" 17	07 44 42	+05 56	+21 16.0
" 20	07 56 46	+06 10	+20 44.2
" 23	08 08 44	+06 19	+20 09.3
" 26	08 20 38	+06 23	+19 31.4
" 29	08 32 26	+06 21	+18 50.5
Aug. 1	08 44 08	+06 14	+18 06.9
" 4	08 45 44	+06 01	+17 20.6
" 7	09 07 16	+05 42	+16 31.8
" 10	09 18 42	+05 19	+15 40.6
" 13	09 30 03	+04 50	+14 47.1
" 16	09 41 19	+04 17	+13 51.5
" 19	09 52 31	+03 38	+12 53.9
" 22	10 03 38	+02 56	+11 54.4
" 25	10 14 41	+02 09	+10 53.3
" 28	10 25 40	+01 19	+09 50.6
" 31	10 36 36	+00 25	+08 46.5
Sept. 3	10 47 28	−00 32	+07 41.2
" 6	10 58 18	−01 32	+06 34.7
" 9	11 09 07	−02 33	+05 27.3
" 12	11 19 54	−03 35	+04 19.0
" 15	11 30 40	−04 39	+03 10.1
" 18	11 41 27	−05 42	+02 00.6
" 21	11 52 13	−06 46	+01 50.7
" 24	12 02 59	−07 49	−00 19.4
" 27	12 13 47	−08 50	−01 29.6
" 30	12 24 37	−09 51	−02 39.7
Oct. 3	12 35 29	−10 48	−03 49.5
" 6	12 46 23	−11 23	−04 59.0
" 9	12 57 22	−12 35	−06 07.8
" 12	13 08 24	−13 22	−07 16.0
" 15	13 19 31	−14 05	−08 23.3
" 18	13 30 43	−14 42	−09 29.6
" 21	13 42 00	−15 15	−10 34.6
" 24	13 53 24	−15 41	−11 38.2
" 27	14 04 53	−16 01	−12 40.1
" 30	14 16 29	−16 15	−13 40.4
Nov. 2	14 28 12	−16 22	−14 38.6
" 5	14 40 02	−16 22	−15 34.7
" 8	14 51 59	−16 14	−16 28.5
" 11	15 04 05	−15 58	−17 19.9
" 14	15 16 18	−15 35	−18 08.5
" 17	15 28 38	−15 04	−18 54.3
" 20	15 41 07	−14 25	−19 37.1
" 23	15 53 42	−13 39	−20 16.7
" 26	16 06 25	−12 46	−20 52.9
" 29	16 19 13	−11 47	−21 25.6
Dec. 2	16 32 08	−10 42	−21 54.6
" 5	16 45 09	−09 31	−22 19.8
" 8	16 58 15	−08 14	−22 41.2
" 11	17 11 26	−06 54	−22 58.5
" 14	17 24 40	−05 29	−23 11.8
" 17	17 37 57	−04 02	−23 20.9
" 20	17 51 15	−02 33	−23 25.8
" 23	18 04 35	−01 03	−23 26.5
" 26	18 17 54	+00 26	−23 22.9
" 29	18 31 12	+01 55	−23 15.1

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. As a war-time measure daylight saving time is being used throughout Canada and the United States for the whole year. This is commonly referred to as Eastern War Time, Pacific War Time, etc.

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°**	m n.
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, 1944

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

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

TIMES OF MOONRISE AND MOONSET, 1944

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

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

TIMES OF MOONRISE AND MOONSET, 1944

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

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

TIMES OF MOONRISE AND MOONSET, 1944

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

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

TIMES OF MOONRISE AND MOONSET, 1944

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

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

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

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

THE PLANETS FOR 1944

By R. M. Petrie

MERCURY

Mercury is the smallest planet of the solar family and the one nearest to the sun. It never appears far from the sun in the sky and must be seen during morning or evening twilight. Its period of revolution is 88 days and this causes it to change rapidly from evening star (east of the sun) to morning star (west of the sun). Hence one must know when to look for the planet in order to avoid disappointment. The accompanying table lists the dates of the elongations; if one watches the twilight zone in a clear sky within one week of the tabulated dates the planet should be seen. The tabulated distance refers to the planet's apparent separation from the sun.

Elongations of Mercury During 1944

	Evening Star			*Morning Star*	
Date	*Distance*	*Mag.*	*Date*	*Distance*	*Mag.*
April 12.......	20°	+ 0.4	January 31....	25°	+ 0.1
August 10......	27°	+ 0.6	May 29.......	25°	+ 0.7
December 4....	21°	− 0.2	September 22..	18°	0.0

The most favourable evening elongation is that of April 12 when the planet sets 2 hours later than the sun and is due west of *Aldebaran* in *Taurus*. Mercury will be best seen as a morning star on September 22 when it rises nearly 2 hours before the sun. At that time it will be east of *Regulus* in *Leo* and close to the bright planet Jupiter. At these elongations Mercury is about 80,000,000 miles from the earth and shows a disc approximately 7″ in diameter and like a half-moon.

On September 23 there occurs a close conjunction of Mercury and Jupiter, noteworthy because it happens at the time of a favourable elongation of the former. Everyone should attempt to see this fine planetary display.

Occultations of Mercury on February 22 and July 21 will be visible in western Canada, and on December 16 in eastern Canada (see page 56).

VENUS

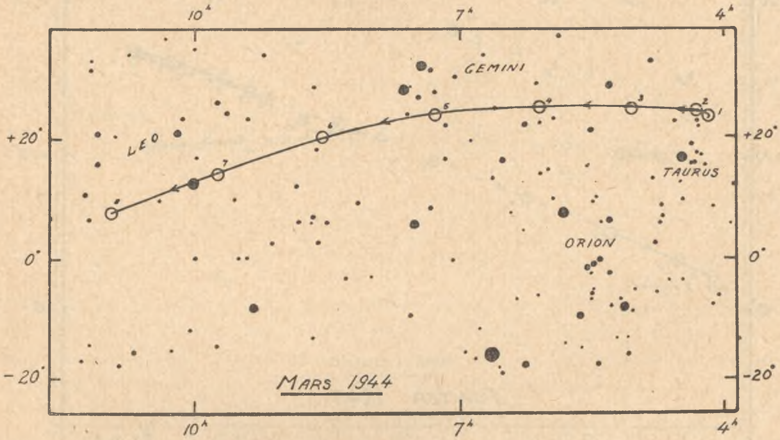
Venus, like Mercury, revolves within the orbit of the earth and, therefore, is seen only as a morning or evening star. It is easily observed however, since its elongations are greater than those of Mercury and take place more leisurely and because of its great brilliance. Venus is very similar to the earth in size and mass but does not possess a moon. It is surrounded by a dense and extensive atmosphere which is highly reflecting and renders the planet visible to the unaided eye in full daylight, at times of greatest brilliancy.

Venus will be a conspicuous morning star during the first part of the year, gradually drawing in to the sun and being lost in the twilight during the spring. On June 26 it passes behind the sun and then moves east of it, becoming an evening star. Near the end of the year it will be a bright evening star, low in the southwest some 45° from the sun and of stellar magnitude − 3.7.

On December 18 there is a close conjunction of Venus with the moon. An occultation will not be seen in Canada but the proximity of the two objects will present a fine spectacle.

MARS

The orbit of Mars lies outside that of the earth and we see it therefore, in the night sky well placed for observation. When close to the earth it is a conspicuous object with a deep red colour. At this time careful study with a telescope will reveal many surface features.



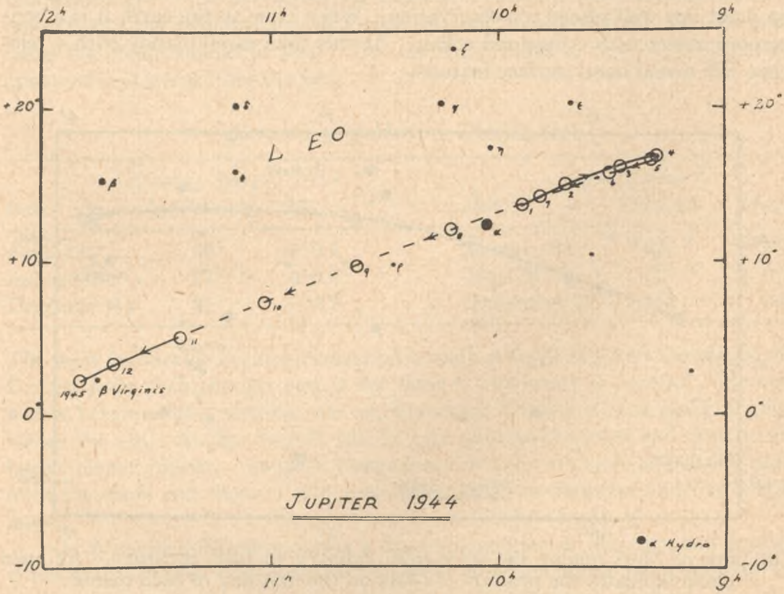
The path of Mars among the stars from January to July, inclusive. An open circle indicates the position of Mars on the first day of each month.

Mars will be a fine object in the night sky during the first part of the year. On March 13 it is in eastern quadrature with the sun and then sets about midnight. After this it moves slowly into the evening twilight and will not be seen easily for the rest of the year. On January 1 Mars is some 60,000,000 miles from the earth, is of magnitude − 1.0, and shows a disc 14″ in diameter. The accompanying chart shows the path of Mars among the constellations from the first of the year until the end of July.

JUPITER

Jupiter is the largest planet in the solar system and this year the brightest in our night skies. Near opposition its brilliance is unrivalled since Venus, which is sometimes brighter, is seen only in the twilight near the sun. Jupiter's great size and the markings on its surface as well as the interesting system of satellites render it an attractive study even with field glasses or small telescopes.

Jupiter will be a splendid object during the first part of the year moving through the constellation *Leo*. On February 11 opposition occurs when the planet will be at its brightest (mag. −2.1) and visible all night. Its distance from us is then a minimum of some 400,000,000 miles and its disc measures 42″ in diameter. During the spring Jupiter will be in the evening sky setting earlier each night and being lost in the twilight soon after eastern quadrature on May 8. Conjunction with the sun takes place on August 31 after which the planet moves into the morning sky. At this time Jupiter is approximately 600,000,000 miles away and is less than one-half its maximum brightness. During the fall Jupiter will be a morning star rising at midnight in December.



The path of Jupiter among the stars. The broken part of the curve represents the portion when the planet is not favourably placed for observation.

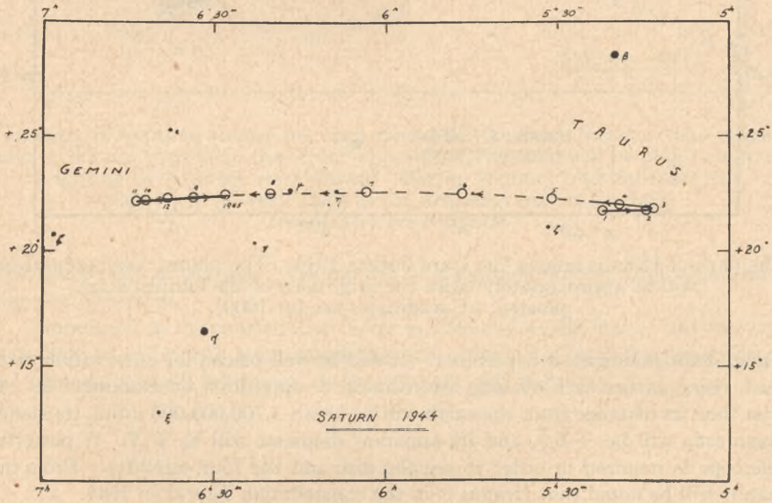
The path of Jupiter through *Leo* is shown in the diagram, a circle indicating its position on the first of each month and the broken line showing the part when the planet cannot be observed readily. It will be noted that Jupiter is close to the bright star *Regulus* at the first of the year, then moves westward to return and pass *Regulus* in July and at the year's end is close to β *Virginis*.

During the first part of the year there are several close conjunctions of Jupiter and the moon. On January 13 and April 30 the planet is occulted by the moon, the former date being most favourable for observation. Local circumstances of these occultations are given elsewhere in this Handbook (p. 57). Everyone should attempt to see such a splendid sight.

SATURN

Saturn is a fine object for telescopes of moderate aperture. In addition to the delicate surface markings its beautiful ring system makes it unique in the heavens. In 1944 Saturn reaches its maximum declination and its ring system is at its optimum projection for observation. Not for 30 years will observers in the northern hemisphere enjoy such favourable conditions for studying the rings.

Saturn will be a fine object at the beginning of the year, situated north of *Orion* between *Taurus* and *Gemini* (see chart). During the first three months it will be a conspicuous object in the evening sky, eastern quadrature occurring on March 10, when the planet sets about midnight. Thereafter it moves into the



The path of Saturn among the stars during 1944. The coordinates are for the equator and equinox of 1900.

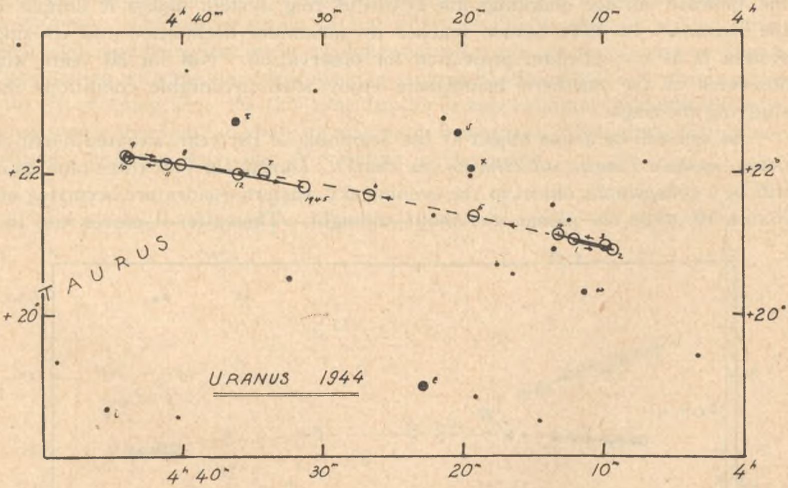
evening twilight coming to conjunction with the sun on June 21 when it is a maximum distance from us, about 930,000,000 miles. During the summer and fall Saturn will be a morning star, rising about midnight on October 3. For the remainder of the year it will rise earlier each night and become brighter, opposition occurring on December 28 when we are closest to Saturn some 750,000,000 miles away, and when the planet has its maximum brilliancy, mag. − 0.3.

During the year there will be several close conjunctions with the moon, the most favourable being on December 2 when the moon passes south of Saturn.

URANUS

Uranus was discovered in 1781 by Sir Wm. Herschel, being the first planet to be discovered in recent times. The planet is visible to a keen eye under the best of conditions, but it is usually necessary to employ field glasses and identify it by means of a star chart. Its typical green colour aids in identification.

Uranus is well placed for observation in the evening sky during the first three months of the year and then moves into the evening twilight, conjunction with the sun occurring on May 30. The planet then becomes a morning star



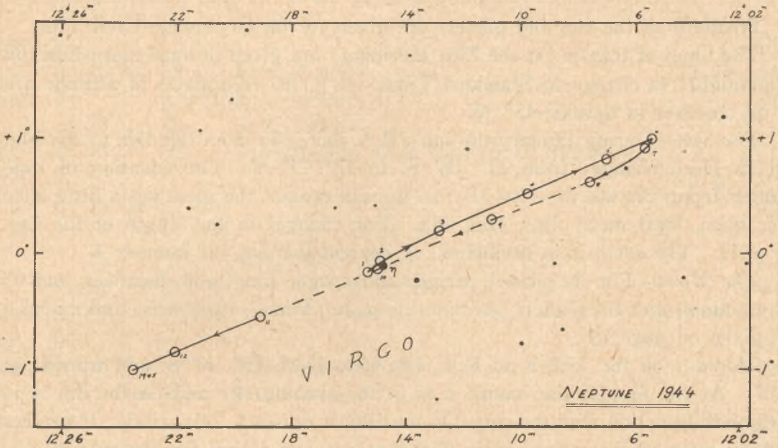
The path of Uranus among the stars during 1944. The planet, near opposition, will be approximately twice the brightness of the faintest stars plotted. (Coordinates are for 1900).

rising about midnight in September. It will be well placed for observation after that, rising earlier each evening and coming to opposition on December 3. At that time its distance from the earth will be about 1,700,000,000 miles, its stellar magnitude will be + 5.9, and its apparent diameter will be 3″.7. A powerful telescope is required in order to see the disc and the four satellites. From the map it will be noted that Uranus is in the constellation *Taurus* in 1944.

NEPTUNE

Neptune was discovered in recent times (as a consequence of studies of the perturbations of Uranus) and, like Uranus, shows only a starlike image except in the largest telescopes. Near opposition its magnitude is + 7.7 so that, while quite invisible to the unaided eye, it may be seen without difficulty in small telescopes. The chart will aid in locating the planet; when favourably placed for observation it will be about twice as bright as the faintest stars shown and will be green in colour.

Neptune will be best seen during late winter and spring since oppostion occurs on March 23 when it will be closest to us, the distance being some 2,700,000,000 miles. Its stellar magnitude at that time will be + 7.7 and the disc will be 2″.5 in diameter. During the summer Neptune moves into the evening twilight, conjunction with the sun taking place on September 27.



The path of Neptune among the stars during 1944. Stars brighter than magnitude + 8.5 are plotted so that, near opposition, Neptune will be about twice as bright as the faintest stars shown. During January and February the planet will be very close to the 4th mag. star η *Virginis*. (Coordinates are for 1900.)

Toward the end of the year Neptune will be a morning object, rising about midnight in December.

Neptune is in the constellation *Virgo* in 1944 and at the first of the year it is very close to η *Virginis*, a 4th magnitude star, which will be in the same field as the planet, for small telescopes, during January and February.

PLUTO

Pluto, discovered in March 1930, by the Lowell Observatory is the farthest planet from the sun. Because of its great distance from the sun and its small size, it can be observed only with the largest telescopes and by comparison with good star maps of the region. During 1944 Pluto is a yellowish 15th magnitude star in the constellation Cancer.

THE SKY MONTH BY MONTH

THE SKY FOR JANUARY, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time. The times of transit (at the 75th Meridian) 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 41m to 20h 54m and its Decl. changes from 23° 06′ S. to 17° 28′ S. The equation of time changes from –3m 00s to –13m 31s, i.e. the sun crosses the meridian a little later after noon, local mean time, each day. For changes in the length of the day, see p. 11. The earth is in perihelion, or nearest the sun, on January 4.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on page 18.

Mercury on the 15th is in R.A. 18h 45m, Decl. 19° 40′ S. and transits at 11.07. At the first of the month it is in the evening sky and on the 8th is in inferior conjunction with the sun. On the 19th it ceases to retrograde. It reaches greatest western elongation on the 31st but is poorly placed for observation.

Venus on the 15th is in R.A. 16h 52m, Decl. 20° 34′ S. and transits at 9.19. It is in the morning sky but becoming less well placed for observation, being only 20° above the south-eastern horizon at sunrise. It is in a gibbous phase, with a semi-diameter of 8″.

Mars on the 15th is in R.A. 4h 10m, Decl. 23° 48′ N. and transits at 20.33. It is high in the eastern sky at sunset, appearing as a red object of magnitude –0.5 between the Pleiades and Aldebaran. At the first of the month it is retrograding, but comes to a stationary point on the 10th, and then moves eastward among the stars. It is within 3° of Uranus on the 20th.

Jupiter on the 15th is in R.A. 9h 52m, Decl. 13° 59′ N. and transits at 2.18. It rises over two and a half hours after sunset and is in view the rest of the night. Jupiter is of stellar magnitude –2.0 and is retrograding all month. There is an occultation of Jupiter on the 13th visible in North America (see p. 56). 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. 5h 21m, Decl. 21° 48′ N. and transits at 21.43. It is in view most of the night as a zero magnitude object in Taurus. It is retrograding all month. The rings appear open, their plane making an angle of 26°.7 to the line of sight.

Uranus on the 15th is in R.A. 4h 13m, Decl. 21° 05′ N. and transits at 20.35.

Neptune on the 15th is in R.A. 12h 18m, Decl. 00° 24′ S. and transits at 4.43. It begins to retrograde on the 6th.

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. 2h 30m
Sat.	1			....		O234*
Sun.	2	15	04	☽ First Quarter..................................	23 54	d2O34
Mon.	3			Quadrantid meteors..............................		32O14
		17		☿ in Perihelion..................................		
Tue.	4	13		⊕ in Perihelion. Dist. from ☉, 91,342,000 mi.		31O24
Wed.	5			....	20 44	3O214
Thu.	6	13	22	☌ ♂ ☾ ♂ 7° 32′ N..............................		d21O*
		15	16	☌ ♅ ☾ ♅ 4° 38′ N..............................		
		18		♆ Stationary in R.A..............................		
Fri.	7	22	47	☌ ♄ ☾ ♄ 2° 25′ N..............................		4O213
Sat.	8	16		☌ ☿ ☉ Inferior..................................	17 33	41O23
Sun.	9			....		d42O3
Mon.	10	0		♂ Stationary in R.A..............................		423O1
		5	09	○ Full Moon......................................		
Tue.	11			....	14 22	431O2
Wed.	12			....		43O21
Thu.	13	6	09	☌ ♃ ☾ ♃ 0° 44′ S..............................		421O*
		19		Moon in Apogee. Dist. from ⊕, 252,200 mi....		
		23		☿ Greatest Hel. Lat. N..........................		
Fri.	14			....	11 11	O13**
Sat.	15			....		1O423
Sun.	16	10	20	☌ ♆ ☾ ♆ 3° 16′ S..............................		2O134
Mon.	17			....	08 01	23O4*
Tue.	18	10	32	☾ Last Quarter..................................		31O24
Wed.	19	17		☿ Stationary in R.A..............................		3O214
Thu.	20	16		☌ ♂ ♅ ♂ 2° 49′ N..............................	04 50	213O4
Fri.	21			....		O134*
Sat.	22	15	34	☌ ♀ ☾ ♀ 2° 02′ S..............................		1O423
Sun.	23	18	21	☌ ☿ ☾ ☿ 0° 08′ S..............................	01 39	42O13
Mon.	24			....		423O*
Tue.	25			Total eclipse of ☉, see p. 56....................	22 28	431O2
		10	24	● New Moon......................................		
Wed.	26	6		Moon in Perigree. Dist. from ⊕, 222,500 mi...		43O12
Thu.	27			....		4231O
Fri.	28			....	19 18	42O13
Sat.	29			....		41O23
Sun.	30			....		42O13
Mon.	31	14		☿ Greatest elongation W., 25° 07′..............	16 07	d21O4

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

THE SKY FOR FEBRUARY, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 54m to 22h 47m and its Decl. changes from 17° 28′ S. to 07° 43′ S. The equation of time changes from –13m 31s to a limit of –14m 21s on the 12th, and then returns to –12m 33s by 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. Times of moonrise and moonset are given on page 18.

Mercury on the 15th is in R.A. 20h 24m, Decl. 20° 28′ S. and transits at 10.49. It is in the morning sky all month but is not favourably placed for observation as it rises closer to sunrise each day. A daylight occultation of Mercury on the 22nd will be visible from Western Canada (see p. 56).

Venus on the 15th is in R.A. 19h 34m, Decl. 21° 16′ S. and transits at 9.59. It continues in the morning sky, but due to its southern declination is only about 13° above the south-eastern horizon at sunrise.

Mars on the 15th is in R.A. 4h 39m, Decl. 24° 39′ N. and transits at 19.01. It is high in the south-eastern sky at sunset, coming to the meridian over an hour after sunset. It is fading in brightness as it recedes from the earth, its stellar magnitude now being +0.3.

Jupiter on the 15th is in R.A. 9h 38m, Decl. 15° 18′ N. and on this date transits at 0.01 and at 23.57. This is the most favourable part of the year for observing Jupiter, for at opposition on the 11th its magnitude is –2.1. The planet rises about sunset and is visible all night. It is retrograding all month. A close conjunction with the moon occurs on the 9th. 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. 5h 16m, Decl. 21° 50′ N. and transits at 19.36. It is high in the south-eastern sky at sunset. It reaches a stationary point on the 20th, and then resumes its eastward motion among the stars.

Uranus on the 15th is in R.A. 4h 12m, Decl. 21° 01′ N. and transits at 18.32. Its retrograde motion ceases on the 12th, and on the 24th it is in quadrature to the sun.

Neptune on the 15th is in R.A. 12h 16m, Decl. 00° 13′ S. and transits at 2.40.

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

				FEBRUARY 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 1h 00m
	d	h	m		h m	
Tue.	1	2	08	☽ First Quarter........................		3O124
Wed.	2	19	47	☌ ♅ ☾ ♅ 4° 43′ N..................		3O24*
Thu.	3	1	22	☌ ♂ ☾ ♂ 7° 16′ N..................	12 56	321O4
Fri.	4	1	42	☌ ♄ ☾ ♄ 2° 38′ N..................		2O314
Sat.	5			....		1O234
Sun.	6	10		☿ in ☋..............................	09 46	O2134
Mon.	7			....		21O34
Tue.	8			....		3O421
Wed.	9	0	29	🌕 Full Moon..........................	06 35	34O2*
		6	27	☌ ♃ ☾ ♃ 0° 22′ S..................		
Thu.	10	2		Moon in Apogee. Dist. from ⊕, 252,500 mi....		4321O
Fri.	11	17		☍ ♃ ☉ Dist. from ⊕, 405,500,000 mi......		42O31
Sat.	12	8		♅ Stationary in R.A.....................	03 24	41O23
		16	07	☌ ♆ ☾ ♆ 3° 12′ S..................		
Sun.	13			....		4O213
Mon.	14			....		421O3
Tue.	15			....	00 14	43O1*
Wed.	16	16		☿ in Aphelion..........................		341O2
Thu.	17	2	42	☾ Last Quarter..........................	21 03	d32O4
Fri.	18			....		2O14*
Sat.	19			....		1O234
Sun.	20	12		♄ Stationary in R.A.....................	17 52	O2134
Mon.	21	14	54	☌ ♀ ☾ ♀ 0° 32′ S..................		21O34
Tue.	22	14	50	☌ ☿ ☾ ☿ 1° 03′ S..................		3O14*
		22		♀ in ☋..............................		
Wed.	23	18		Moon in Perigee. Dist. from ⊕, 221,700 mi....	14 42	31O24
		20	59	● New Moon..........................		
Thu.	24	10		□ ♅ ☉		32O14
Fri.	25			....		24O**
Sat.	26			....	11 31	41O23
Sun.	27			....		4O123
Mon.	28			....		421O3
Tue.	29			....	08 19	432O1

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

THE SKY FOR MARCH, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 47m to 0h 41m and its Decl. changes from 07° 43′ S. to 04° 25′ N. On March 20 at 12.49 E.S.T. the sun crosses the equator on its way north, enters the sign Aries, and Spring commences. This is the vernal equinox. The equation of time changes steadily from –12m 33s to –4m 04s. 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. Times of moonrise and moonset are given on page 19.

Mercury on the 15th is in R.A. 23h 32m, Decl. 04° 56′ S. and transits at 12.04. It reaches superior conjunction with the sun on the 17th, when it enters the evening sky. By the end of the month it is about 12° above the horizon at sunset, and sets about an hour and a quarter after the sun. Its stellar magnitude is –1.

Venus on the 15th is in R.A. 22h 00m, Decl. 13° 15′ S. and transits at 10.30. It is low in the morning sky, rising about an hour before the sun. Its phase is becoming more nearly full, and its semi-diameter has decreased to 6″.

Mars on the 15th is in R.A. 5h 31m, Decl. 25° 28′ N. and transits at 18.00. It is in quadrature on the 13th and appears in the western evening sky for the first half of the night. It is in conjunction with Saturn on the 7th. It is now slightly fainter than Saturn.

Jupiter on the 15th is in R.A. 9h 24m, Decl. 16° 22′ N. and transits at 21.50. It rises about three hours before sunset and is the brightest object in the sky, its magnitude being –2.0. It continues to retrograde all month. There is a close conjunction with the moon on the 7th. 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. 5h 18m, Decl. 21° 58′ N. and transits at 17.44. Quadrature with the sun occurs on the 10th, when the planet is on the meridian at sunset. Conjunction with Mars occurs on the 7th.

Uranus on the 15th is in R.A. 4h 13m, Decl. 21° 07′ N. and transits at 16.40.

Neptune on the 15th is in R.A. 12h 14m, Decl. 00° 05′ N. and transits at 0.43. In opposition to the sun on the 23rd, its stellar magnitude is 7.7.

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. 0h 00m
Wed.	1	2	39	☌ ♅ ☾ ♅ 4° 37′ N.		431O2
		15	40	☽ First Quarter		
Thu.	2	3	16	☌ ♂ ☾ ♂ 6° 17′ N.		432O1
		7	35	☌ ♄ ☾ ♄ 2° 39′ N.		
Fri.	3				05 09	4231O
Sat.	4					d4O23
Sun.	5					O1243
Mon.	6				01 59	21O34
Tue.	7	6	00	☌ ♃ ☾ ♃ 0° 03′ S.		23O14
		10		☌ ♂ ♄ ♂ 3° 25′ N.		
Wed.	8	0		☿ Greatest Hel. Lat. S.	22 50	31O24
		2		Moon in Apogee. Dist. from ⊕, 252,400 mi.		
Thu.	9	19	28	🌕 Full Moon		d3O14
Fri.	10	12		□ ♄ ☉		231O4
		20	55	☌ ♆ ☾ ♆ 3° 05′ S.		
Sat.	11				19 37	dO234
Sun.	12					O1423
Mon.	13	8		□ ♂ ☉		241O3
Tue.	14				16 27	d42O1
Wed.	15					431O2
Thu.	16					43O21
Fri.	17	15	05	☾ Last Quarter	13 16	4231O
		16		☌ ☿ ☉ Superior		
Sat.	18					4O13*
Sun.	19					4O23*
Mon.	20	12	49	☉ enters ♈, Spring commences. Long. of ☉, 0°.	10 05	421O3
Tue.	21					2O341
Wed.	22	10	58	☌ ♀ ☾ ♀ 1° 34′ N.		31O24
Thu.	23	5		Moon in Perigee. Dist. from ⊕, 223,000 mi.	06 54	3O214
		10		☍ ♆ ☉ Dist. from ⊕, 2,719,000,000 mi.		
Fri.	24	6	36	🌑 New Moon		231O4
		15	39	☌ ☿ ☾ ☿ 4° 31′ N.		
Sat.	25					O134*
Sun.	26				03 44	1O234
Mon.	27	1		☿ in ☊		21O34
Tue.	28	12		♀ in Aphelion		2O314
		12	43	☌ ♅ ☾ ♅ 4° 23′ N.		
Wed.	29	17	45	☌ ♄ ☾ ♄ 2° 27′ N.	00 33	31O42
Thu.	30	13	19	☌ ♂ ☾ ♂ 4° 50′ N.		34O21
Fri.	31	7	34	☽ First Quarter	21 22	4321O
		16		☿ in Perihelion		

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

THE SKY FOR APRIL, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 0h 41m to 2h 32m and its Decl. changes from 4° 25′ N. to 14° 58′ N. The equation of time changes during the first half of the month from –4m 04s to 00m on the 15th, so that on the 15th the sun transits the meridian at local mean noon. By the end of the month the apparent solar time is 2m 54s ahead of the mean solar time. 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. Times of moonrise and moonset are given on page 19.

Mercury on the 15th is in R.A. 2h 42m, Decl. 18° 49′ N. and transits at 13.09. It is at greatest eastern elongation on the 12th when it is about 16° above the western horizon at sunset, and sets about 1h 45m after the sun. Its stellar magnitude at this time is zero. This is the most favourable time to observe Mercury in the evening sky. It begins to retrograde on the 22nd.

Venus on the 15th is in R.A. 00h 23m, Decl. 00° 47′ N. and transits at 10.51. It is approaching the sun in the morning sky and not well placed for observation.

Mars on the 15th is in R.A. 6h 40m, Decl. 25° 01′ N. and transits at 17.07. It sets in the north-west over six hours after the sun. It is growing fainter as the distance between Mars and the earth increases. It is moving through Gemini.

Jupiter on the 15th is in R.A. 9h 19m, Decl. 16° 44′ N. and transits at 19.43. It remains the brightest object in the evening sky, its stellar magnitude being –1.8. On the 13th it ceases retrograding and begins to move slowly eastward among the stars. An occultation of Jupiter by the moon occurs on the 30th (see p. 56). 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. 5h 27m, Decl. 22° 12′ N. and transits at 15.51. It appears as a star of magnitude +0.3 between ζ and β Tauri. It is high in the south-western sky at sunset and sets about five hours after the sun.

Uranus on the 15th is in R.A. 4h 18m, Decl. 21° 19′ N. and transits at 14.43.

Neptune on the 15th is in R.A. 12h 11m, Decl. 00° 25′ N. and transits at 22.34.

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. 23h 30m
Sat.	1			....		41023
Sun.	2			....		d4203
Mon.	3	8	39	☌♃☾ ♃ 0° 04′ S..............	18 11	4203*
Tue.	4	13		Moon in Apogee. Dist. from ⊕, 252,000 mi....		43102
Wed.	5			....		34012
Thu.	6			....	15 00	3210*
Fri.	7	1	54	☌♆☾ ♆ 3° 03′ S..............		2014*
Sat.	8	12	22	🌕 Full Moon..............		10234
Sun.	9			....	11 50	d0134
Mon.	10	22		☿ Greatest Hel. Lat. N..............		2034*
Tue.	11			....		31024
Wed.	12	5		☿ Greatest elongation E., 19° 36′..........	08 39	30124
Thu.	13	2		♃ Stationary in R.A..............		32104
Fri.	14			....		23401
Sat.	15	23	59	☾ Last Quarter..............	05 28	41023
Sun.	16			....		40213
Mon.	17			....		42103
Tue.	18			....	02 17	d430*
Wed.	19	19		♀ Greatest Hel. Lat. S..............		43012
Thu.	20	9		Moon in Perigee. Dist. from ⊕, 225,900 mi....	23 06	43210
Fri.	21			Lyrid meteors..............		42301
		6	18	☌♀☾ ♀ 3° 27′ N..............		
Sat.	22	4		☿ Stationary in R.A..............		14023
		15	43	● New Moon..............		
Sun.	23	10	46	☌☿☾ ☿ 7° 47′ N..............	19 55	02143
Mon.	24	14		♂ Greatest Hel. Lat. N..............		21034
Tue.	25	0	52	☌♅☾ ♅ 4° 08′ N..............		d304*
Wed.	26	7	24	☌♄☾ ♄ 2° 08′ N..............	16 44	3024*
Thu.	27			....		32104
Fri.	28	3	33	☌♂☾ ♂ 3° 04′ N..............		23014
Sat.	29			....	13 33	10324
Sun.	30	1	06	☽ First Quarter..............		04213
				....		
		16	30	☌♃☾ ♃ 0° 24′ S..............		

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

THE SKY FOR MAY, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 2h 32m to 4h 35m and its Decl. changes from 14° 58′ N. to 22° 00′ N. The equation of time is small throughout the month, increasing from +2m 54s to +3m 46s on the 15th and then diminishing to +2m 24s. 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. Times of moonrise and moonset are given on page 20.

Mercury on the 15th is in R.A. 2h 21m, Decl. 11° 19′ N. and transits at 10.48. It is at inferior conjunction with the sun on the 2nd, and enters the morning sky. It reaches greatest western elongation on the 29th, when it rises, as a star of magnitude 1, about an hour and a quarter before the sun. It is not very favourably placed for observation, being less than 10° above the horizon at sunrise. It ceases retrograding on the 14th.

Venus on the 15th is in R.A. 2h 41m, Decl. 14° 29′ N. and transits at 11.11. It is in the morning sky, rising slightly before the sun and not well placed for observation. Its stellar magnitude is –3.3.

Mars on the 15th is in R.A. 7h 52m, Decl. 22° 36′ N. and transits at 16.20. It sets in the north-west almost five hours after the sun. It is of stellar magnitude +1.7 and makes an interesting configuration with Castor and Pollux.

Jupiter on the 15th is in R.A. 9h 25m, Decl. 16° 13′ N. and transits at 17.51. It is in quadrature to the sun on the 8th, and by the end of the month sets less than five hours after the sun. Its stellar magnitude is –1.6. 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. 5h 40m, Decl. 22° 26′ N. and transits at 14.07. It is rapidly approaching the sun, and sets almost three hours after sunset.

Uranus on the 15th is in R.A. 4h 25m, Decl. 21° 35′ N. and transits at 12.52. Conjunction with the sun occurs on the 30th, when the planet passes into the morning sky.

Neptune on the 15th is in R.A. 12h 08m, Decl. 00° 39′ N. and transits at 20.34.

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

MAY

75th Meridian Civil Time

	d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 22h 45m
Mon.	1					21403
Tue.	2	6		Moon in Apogee. Dist. from ⊕, 251,400 mi.	10 22	43021
		12		☌☿☉ Inferior		
Wed.	3					4302*
Thu.	4			Eta Aquarid meteors		43210
		7	50	☌♆☾ ♆ 3° 10′ S.		
		9		☿ in ♉		
Fri.	5				07 11	42301
Sat.	6					41032
Sun.	7					40123
Mon.	8	2	28	🌕 Full Moon	04 00	42103
		14		□♃☉		
Tue.	9					2031*
Wed.	10					31024
Thu.	11	1		☌☿♀ ☿ 0° 38′ S.	00 49	dd304
Fri.	12					32014
Sat.	13				21 38	1024*
Sun.	14	15		☿ in Aphelion		01234
		19		☿ Stationary in R.A.		
Mon.	15	6	12	☾ Last Quarter		21034
Tue.	16				18 27	20134
Wed.	17	17		Moon in Perigee. Dist. from ⊕, 228,900 mi.		31042
Thu.	18					34012
Fri.	19				15 16	4320*
Sat.	20	8	10	☌☿☾ ☿ 1° 45′ N.		410**
Sun.	21	4	46	☌♀☾ ♀ 3° 59′ N.		40123
Mon.	22	1	12	🌑 New Moon	12 05	41203
		13	11	☌♅☾ ♅ 3° 57′ N.		
Tue.	23	22	37	☌♄☾ ♄ 1° 50′ N.		42013
Wed.	24					43102
Thu.	25				08 54	34012
Fri.	26	19	37	☌♂☾ ♂ 1° 11′ N.		3204*
Sat.	27					3104*
Sun.	28	5	13	☌♃☾ ♃ 0° 54′ S.	05 43	01234
Mon.	29	15		☿ Greatest elongation W., 24° 43′		12034
		19	06	☽ First Quarter		
Tue.	30	1		Moon in Apogee. Dist. from ⊕, 251,100 mi.		20134
		7		☌♅☉		
		23		♂ in Aphelion		
Wed.	31	14	56	☌♆☾ ♆ 3° 22′ S.	02 32	13024

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

THE SKY FOR JUNE, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 4h 35m to 6h 39m and its Decl. changes from 22° 00′ N. to 23° 27′ N. at the solstice on the 21st, and then to 23° 08′ N. The equation of time changes from +2m 24s to –3m 35s, being 00m on the 14th. 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. Times of moonrise and moonset are given on page 20.

Mercury on the 15th is in R.A. 4h 17m, Decl. 19° 46′ N. and transits at 10.47. It is poorly placed for observation in the morning sky, as it rises closer to the sun each day.

Venus on the 15th is in R.A. 5h 18m, Decl. 23° 05′ N. and transits at 11.47. It is in superior conjunction with the sun on the 26th, and enters the evening sky. It is too close to the sun for favourable observation this month.

Mars on the 15th is in R.A. 9h 06m, Decl. 18° 00′ N. and transits at 15.32. It sets in the north-west about three hours after the sun. It is still fading in brightness, its magnitude being +1.9. It is rapidly approaching Jupiter among the stars.

Jupiter on the 15th is in R.A. 9h 41m, Decl. 14° 55′ N. and transits at 16.05. It still dominates the early evening sky, an object of magnitude –1.4, setting about three and a half hours after the sun. 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. 5h 57m, Decl. 22° 34′ N. and transits at 12.22. It is too near the sun to be well observed this month. Conjunction with the sun occurs on the 21st.

Uranus on the 15th is in R.A. 4h 33m, Decl. 21° 52′ N. and transits at 10.58.

Neptune on the 15th is in R.A. 12h 08m, Decl. 00° 43′ N. and transits at 18.31. It reaches a stationary point on the 12th and again moves eastward among the stars. It is at quadrature to the sun on the 22nd.

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. 22h 15m
Thu.	1					3O124
Fri.	2				23 21	321O4
Sat.	3	23		☿ Greatest Hel. Lat. S.		d32O4
Sun.	4					4O32*
Mon.	5	17		☌ ♀ ♅ ♀ 0° 19′ S.	20 09	412O3
Tue.	6	13	58	○ Full Moon		42O13
Wed.	7					d41O2
Thu.	8				16 58	43O12
Fri.	9					4321O
Sat.	10					432O1
Sun.	11	19		Moon in Perigee. Dist. from ⊕, 229,400 mi.	13 47	4O32*
Mon.	12	17		♆ Stationary in R.A.		d1O3*
Tue.	13	10	56	☾ Last Quarter		2O134
Wed.	14				10 36	1O324
Thu.	15	1		♀ in ♌		3O124
Fri.	16					321O4
Sat.	17	0		☌ ☿ ♅ ☿ 1° 06′ S.	07 25	32O14
Sun.	18					1O324
Mon.	19	0	08	☌ ♅ ☾ ♅ 3° 53′ N.		dO243
		8	03	☌ ☿ ☾ ☿ 2° 57′ N.		
Tue.	20	8	15	☌ ♀ ☾ ♀ 2° 52′ N.	04 13	d2O13
		12	00	● New Moon		
		13	35	☌ ♄ ☾ ♄ 1° 34′ N.		
Wed.	21	8	03	☉ enters ♋, Summer commences. Long. of ☉, 90°		41O3*
		13		☌ ♄ ☉		
Thu.	22	21		☌ ♀ ♄ ♀ 1° 11′ N.		43O12
		22		□ ♆ ☉		
Fri.	23	0		☿ in ♌	01 02	4312O
Sat.	24	12	24	☌ ♂ ☾ ♂ 0° 42′ S.		432O1
		21	11	☌ ♃ ☾ ♃ 1° 26′ S.		
Sun.	25				21 51	41O2*
Mon.	26	19		Moon in Apogee. Dist. from ⊕, 251,300 mi.		4O123
		23		☌ ♀ ☉ Superior		
Tue.	27	9		☌ ☿ ♄ ☿ 1° 37′ N.		42O3*
		15		☿ in Perihelion		
		22	54	☌ ♆ ☾ ♆ 3° 33′ S.		
Wed.	28	12	27	☽ First Quarter	18 39	41O3*
Thu.	29					3O142
Fri.	30					312O4

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

THE SKY FOR JULY, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 6h 39m to 8h 44m and its Decl. changes from 23° 08′ N. to 18° 07′ N. The equation of time changes from –3m 35s to –6m 23s on the 27th and then back to –6m 14s. The earth reaches its greatest distance 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. Times of moonrise and moonset are given on page 21.

Mercury on the 15th is in R.A. 8h 40m, Decl. 20° 13′ N. and transits at 13.11. It is in superior conjunction with the sun on the 1st and enters the evening sky. On the 21st there is an occultation of Mercury, visible in western Canada (see p. 56). By the end of the month it is about 12° above the horizon at sunset. Its stellar magnitude is zero. It is in conjunction with Jupiter on the 29th.

Venus on the 15th is in R.A. 7h 58m, Decl. 21° 44′ N. and transits at 12.28. It is in the evening sky but sets shortly after the sun and so is not well placed for observation.

Mars on the 15th is in R.A. 10h 17m, Decl. 11° 52′ N. and transits at 14.44. It is about 20° above the horizon at sunset and sets about two hours after the sun. On the 5th it passes close to Jupiter, and on the 10th passes within less than a degree of Regulus.

Jupiter on the 15th is in R.A. 10h 01m, Decl. 13° 07′ N. and transits at 14.28. It is rapidly fading into the evening twilight, setting less than two hours after the sun. It forms an interesting configuration with Mars and Regulus, and is in conjunction with Mercury on the 29th. 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. 6h 14m, Decl. 22° 34′ N. and transits at 10.41. It is separating from the sun in the morning sky and by the middle of the month is about 14° above the horizon at sunrise.

Uranus on the 15th is in R.A. 4h 40m, Decl. 22° 06′ N. and transits at 9.07.

Neptune on the 15th is in R.A. 12h 09m, Decl. 00° 35′ N. and transits at 16.34.

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

JULY

75th Meridian Civil Time

	d	h	m		Min. of Algol h	Min. of Algol m	Config. of Jupiter's Sat. 21h 15m
Sat.	1	7		☌☿☉ Superior	15	28	32O14
Sun.	2	12		☌☿♀ ☿ 0° 46′ N			13O24
Mon.	3	1		⊕ in Aphelion. Dist. from ☉, 94,450,000 mi.			O1234
Tue.	4				12	17	21O34
Wed.	5	3		☌♂♃ ♂ 0° 15′ N			21O34
		23	27	○ Full Moon			
Thu.	6						3O142
Fri.	7	22		☿ Greatest Hel. Lat. N	09	06	d314O
Sat.	8	17		Moon in Perigee. Dist. from ⊕, 226,600 mi.			342O1
Sun.	9						413O2
Mon.	10				05	54	4O123
Tue.	11						421O3
Wed.	12	15	39	☾ Last Quarter			d42O3
Thu.	13				02	43	43O12
Fri.	14						341O2
Sat.	15				23	31	324O1
Sun.	16	9	07	☌♅☾ ♅ 3° 50′ N			31O24
Mon.	17						O1324
Tue.	18	3	11	☌♄☾ ♄ 1° 19′ N	20	20	21O34
		20		♀ in Perihelion			
Wed.	19			Annular eclipse of ☉, see p. 56			2O134
Thu.	20	0	42	● New Moon			O324*
		14	52	☌♀☾ ♀ 0° 34′ N			
Fri.	21	19	33	☌☿☾ ☿ 0° 43′ S	17	09	31O24
Sat.	22	14	44	☌♃☾ ♃ 1° 56′ S			32O14
Sun.	23	5	35	☌♂☾ ♂ 2° 27′ S			31O4*
Mon.	24	12		Moon in Apogee. Dist. from ⊕, 251,900 mi.	13	57	4O312
Tue.	25	7	10	☌♆☾ ♆ 3° 37′ S			412O3
Wed.	26						
Thu.	27				10	46	
Fri.	28			Delta Aquarid meteors			
		4	23	☽ First Quarter			
Sat.	29	12		☌☿♃ ☿ 0° 41′ S			
Sun.	30				07	34	
Mon.	31	8		☿ 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 July 26 to September 16.

THE SKY FOR AUGUST, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 8h 44m to 10h 40m and its Decl. changes from 18° 07′ N. to 8° 25′ N. The equation of time changes from –6m 14s to –0m 06s. 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. Times of moonrise and moonset are given on page 21.

Mercury on the 15th is in R.A. 11h 15m, Decl. 02° 05′ N. and transits at 13.41. It is in the evening sky all month, of about first magnitude. Although Mercury reaches its maximum elongation from the sun for the year, 27° east, on the 10th, this is not a favourable elongation, as Mercury is only 9° above the horizon at sunset.

Venus on the 15th is in R.A. 10h 31m, Decl. 10° 51′ N. and transits at 12.59. It is slowly separating from the sun in the evening sky, but is not well placed for observation.

Mars on the 15th is in R.A. 11h 28m, Decl. 04° 17′ N. and transits at 13.54. It is about 12° above the western horizon at sunset and is getting too close to the sun to be well observed.

Jupiter on the 15th is in R.A. 10h 26m, Decl. 10° 50′ N. and transits at 12.50. On the 31st it is in conjunction with the sun and passes from the evening to the morning sky.

Saturn on the 15th is in R.A. 6h 29m, Decl. 22° 27′ N. and transits at 8.54. It now rises almost four hours before the sun and is about 40° above the eastern horizon at sunrise.

Uranus on the 15th is in R.A. 4h 45m, Decl. 22° 16′ N. and transits at 7.10.

Neptune on the 15th is in R.A. 2h 11m, Decl. 00° 16′ N. and transits at 14.35.

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

AUGUST

75th Meridian Civil Time

	d	h	m		Min. of Algol h	m
Tue.	1					
Wed.	2			....	04	23
Thu.	3			....		
Fri.	4	7	39	○ Full Moon..............................		
Sat.	5	17		Moon in Perigee. Dist. from ⊕, 223,700 mi....	01	12
Sun.	6			....		
Mon.	7			....	22	00
Tue.	8			....		
Wed.	9	14		♀ Greatest Hel. Lat. N..................		
Thu.	10	9		☿ Greatest elongation E., 27° 25′..........	18	49
		15		☿ in Aphelion..............................		
		21	52	☾ Last Quarter..........................		
Fri.	11			....		
Sat.	12			Perseid meteors............................		
		16	36	☌ ♅ ☾ ♅ 3° 44′ N..................		
Sun.	13	8		☌ ♀ ♃ ♀ 0° 34′ N..................	15	37
Mon.	14	15	03	☌ ♄ ☾ ♄ 1° 02′ N..................		
Tue.	15			....		
Wed.	16			....	12	26
Thu.	17			....		
Fri.	18	15	25	● New Moon..............................		
Sat.	19	8	42	☌ ♃ ☾ ♃ 2° 22′ S......................	09	14
		22	03	☌ ♀ ☾ ♀ 2° 21′ S......................		
Sun.	20	13	43	☌ ☿ ☾ ☿ 8° 15′ S......................		
		23	27	☌ ♂ ☾ ♂ 3° 53′ S......................		
Mon.	21	1		Moon in Apogee. Dist. from ⊕, 252,500 mi....		
		15	19	☌ ♆ ☾ ♆ 3° 36′ S......................		
Tue.	22			....	06	03
Wed.	23	13		☿ Stationary in R.A........................		
Thu.	24			....		
Fri.	25			....	02	52
Sat.	26	10		☌ ☿ ♀ ☿ 6° 07′ S......................		
		18	39	☽ First Quarter..........................		
Sun.	27			....	23	40
Mon.	28			....		
Tue.	29			....		
Wed.	30	23		☿ Greatest Hel. Lat. S....................	20	29
Thu.	31	1		☌ ♃ ⊙....................................		

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

THE SKY FOR SEPTEMBER, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 40m to 12h 28m and its Decl. changes from 08° 25′ N. to 03° 03′ S. The equation of time changes from –0m 06s to +10m 10s. On the 22nd the sun crosses the equator and enters Libra. This is the autumnal equinox. 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. Times of moonrise and moonset are given on page 22.

Mercury on the 15th is in R.A. 10h 39m, Decl. 07° 09′ N. and transits at 11.01. On the 6th it is in inferior conjunction with the sun and passes into the morning sky. The planet ceases retrograding on the 15th, when it reaches a stationary point, and then moves eastward among the stars. It is at greatest western elongation on the 22nd when it rises over an hour and a half before the sun and is about 16° above the horizon at sunrise. It is in very close conjunction with Jupiter on the 23rd.

Venus on the 15th is in R.A. 12h 52m, Decl. 04° 38′ S. and transits at 13.17. It is still not very favourably placed for observation. It sets about an hour after the sun.

Mars on the 15th is in R.A. 12h 41m, Decl. 03° 53′ S. and transits at 13.05. It is not favourably placed for observation in the evening sky.

Jupiter on the 15th is in R.A. 10h 51m, Decl. 08° 21′ N. and transits at 11.14. Toward the end of the month it can be seen as an object of magnitude –1.2, rising about an hour and a half before the sun. On the 23rd it is in conjunction with Mercury. 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. 6h 41m, Decl. 22° 17′ N. and transits at 7.04. It now rises in the north-east just before midnight and is a little east of the meridian at sunrise. It is close to the moon on the 11th.

Uranus on the 15th is in R.A. 4h 47m, Decl. 22° 20′ N. and transits at 5.10. It is in quadrature to the sun on the 5th, and begins a retrograde motion on the 18th.

Neptune on the 15th is in R.A. 12h 15m, Decl. 00° 09′ S. and transits at 12.37. It is in conjunction with the sun on the 27th, and passes into the morning sky.

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

		h	m	SEPTEMBER 75th Meridian Civil Time	Min. of Algol h m	Config. of Jupiter's Sat. 6h 15m
Fri.	1			....		
Sat.	2	15	21	🌕 Full Moon........................	17 17	
Sun.	3	1		Moon in Perigee. Dist. from ⊕, 220,000 mi....		
		3		☌ ♂ ♆ ♂ 0° 48′ S...................		
Mon.	4			....		
Tue.	5	14		□ ♅ ☉	14 06	
Wed.	6	10		☌ ♀ ♆ ♀ 0° 18′ S...................		
		17		☌ ☿ ☉ Inferior....................		
Thu.	7	19		♄ in Perihelion...................		
Fri.	8	23	46	☌ ♅ ☾ ♅ 3° 33′ N..................	10 54	
Sat.	9	7	03	☾ Last Quarter......................		
		18		☌ ☿ ♃ ☿ 4° 08′ S..................		
		21		☌ ♀ ♂ ♀ 0° 28′ N..................		
Sun.	10			....		
Mon.	11	1	23	☌ ♄ ☾ ♄ 0° 42′ N..................	07 43	
Tue.	12			....		
Wed.	13			....		
Thu.	14			....	04 32	
Fri.	15	6		☿ Stationary in R.A....................		
		19	48	☌ ☿ ☾ ☿ 4° 35′ S..................		
Sat.	16	2	30	☌ ♃ ☾ ♃ 2° 47′ S..................		4O312
Sun.	17	6		Moon in Apogee. Dist. from ⊕, 252,700 mi....	01 20	4321O
		7	37	🌑 New Moon........................		
		23	19	☌ ♆ ☾ ♆ 3° 34′ S..................		
Mon.	18	9		♅ Stationary in R.A....................		4321O
		18	34	☌ ♂ ☾ ♂ 4° 48′ S..................		
		23		☿ in ☊........................		
Tue.	19	5	54	☌ ♀ ☾ ♀ 4′ 41° S..................	22 09	43O12
Wed.	20			....		41O32
Thu.	21			....		24O13
Fri.	22	18		☿ Greatest elongation W., 17° 52′..........	18 57	12O43
		23	02	☉ enters ♎, Autumn commences. Long. of ☉, 180°		
Sat.	23	12		☌ ☿ ♃ ☿ 0° 06′ N..................		O1324
		14		☿ in Perihelion....................		
Sun.	24			....		312O4
Mon.	25	7	07	☽ First Quarter.....................	15 46	d32O4
Tue.	26			....		3O124
Wed.	27	0		☌ ♆ ☉		1O24*
Thu.	28			....	12 35	2O134
Fri.	29			....		12O43
Sat.	30			....		4O132

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

THE SKY FOR OCTOBER, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 28m to 14h 24m and its Decl. changes from 03° 03′ S. to 14° 19′ S. The equation of time increases from +10m 10s to +16m 21s, i.e. the sun transits the meridian before local mean noon each day. 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. Times of moonrise and moonset are given on page 22.

Mercury on the 15th is in R.A. 13h 06m, Decl. 05° 35′ S. and transits at 11.34. At the beginning of the month it may be glimpsed in the morning sky. It is at superior conjunction with the sun on the 20th, and passes into the evening sky.

Venus on the 15th is in R.A. 15h 12m, Decl. 18° 22′ S. and transits at 13.39. It is about 11° above the horizon at sunset, and sets about an hour and a quarter after the sun. It is of stellar magnitude –3.4. On the 29th it passes north of Antares.

Mars on the 15th is in R.A. 13h 56m, Decl. 11° 36′ S. and transits at 12.21. It is not favourably placed for observation this month.

Jupiter on the 15th is in R.A. 11h 14m, Decl. 06° 00′ N. and transits at 9.39. It is slowly separating from the sun in the morning sky, rising about three hours before the sun. It is about 30° above the south-eastern horizon at 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. 6h 46m, Decl. 22° 12′ N. and transits at 5.11. It is at quadrature to the sun on the 3rd when it rises in the north-east over an hour before midnight. It reaches a stationary point on the 23rd and then moves slowly westward among the stars.

Uranus on the 15th is in R.A. 4h 46m, Decl. 22° 18′ N. and transits at 3.11.

Neptune on the 15th is in R.A. 12h 19m, Decl. 00° 35′ S. and transits at 10.43.

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

				OCTOBER 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 6h 00m
	d	h	m		h m	
Sun.	1	12		Moon in Perigee. Dist. from ⊕, 222,000 mi....	09 23	d4310
		23	22	○ Full Moon....................		
Mon.	2			....		43201
Tue.	3	14		□♄☉..................................		4302*
		21		☿ Greatest Hel. Lat. N..................		
Wed.	4	15		♀ in ☋................................	06 12	4102*
Thu.	5			....		42013
Fri.	6	7	41	☌♅☾ ♅ 3° 19′ N......................		42103
Sat.	7	7		☌☿♆ ☿ 0° 30′ N......................	03 01	40123
Sun.	8	10	42	☌♄☾ ♄ 0° 21′ N......................		13402
		20	12	☾ Last Quarter..........................		
Mon.	9			....	23 49	32014
Tue.	10			....		31024
Wed.	11			....		d3024
Thu.	12			....	20 38	20134
Fri.	13	19	54	☌♃☾ ♃ 3° 13′ S......................		21034
Sat.	14	9		Moon in Apogee. Dist. from ⊕, 252,400 mi....		01234
Sun.	15	7	26	☌♆☾ ♆ 3° 37′ S......................	17 27	d1024
Mon.	16	14	58	☌☿☾ ☿ 4° 08′ S......................		32014
Tue.	17	0	35	● New Moon..............................		3410*
		15	30	☌♂☾ ♂ 5° 02′ S......................		
Wed.	18			....	14 16	43012
Thu.	19	14	40	☌♀☾ ♀ 5° 04′ S......................		4203*
Fri.	20	17		☌☿☉ Superior..........................		42103
Sat.	21			....	11 04	40123
Sun.	22			Orionid meteors..........................		41032
Mon.	23	0		♄ Stationary in R.A......................		43201
Tue.	24	17	48	☽ First Quarter..........................	07 53	34120
Wed.	25			....		3012*
Thu.	26			....		2034*
Fri.	27	7		☿ in ☋................................	04 42	21034
Sat.	28	21		☌☿♂ ☿ 0° 18′ S......................		01234
Sun.	29	21		Moon in Perigee. Dist. from ⊕, 223,800 mi....		10324
Mon.	30			....	01 31	32014
Tue.	31	8	35	○ Full Moon..............................		31204

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

THE SKY FOR NOVEMBER, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 24m to 16h 28m and its Decl. changes from 14° 19′ S. to 21° 45′ S. The equation of time increases from +16m 20s to its maximum for the year of +16m 23s on the 3rd, then drops to +11m 04s. 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. Times of moonrise and moonset are given on page 23.

Mercury on the 15th is in R.A. 16h 19m, Decl. 23° 18′ S. and transits at 12.45. It is in the evening sky all month, but is not very favourably placed for observation.

Venus on the 15th is in R.A. 17h 53m, Decl. 25° 15′ S. and transits at 14.18. It is about 13° above the south-western horizon at sunset, and sets about two hours after the sun. It is approaching the earth and is brightening slightly, its stellar magnitude being –3.5. Its semi-diameter has increased to 6″.8.

Mars on the 15th is in R.A. 15h 20m, Decl. 18° 27′ S. and transits at 11.43. It is in conjunction with the sun on the 14th and passes into the morning sky.

Jupiter on the 15th is in R.A. 11h 35m, Decl. 03° 56′ N. and transits at 7.57. It is a conspicuous morning object, of stellar magnitude –1.4, rising just north of the east point about five hours before the sun. 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. 6h 45m, Decl. 22° 14′ N. and transits at 3.07. It rises in the north-east about three hours after sunset. It is close to the moon on the 4th.

Uranus on the 15th is in R.A. 4h 41m, Decl. 22° 11′ N. and transits at 1.05.

Neptune on the 15th is in R.A. 12h 23m, Decl. 00° 58′ S. and transits at 8.45.

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

			NOVEMBER 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 5h 30m
d	h	m		h m	
Wed. 1			....	22 20	3O124
Thu. 2	16	30	☌ ♅ ☾ ♅ 3° 10′ N....................		1O234
Fri. 3			....		d24O3
Sat. 4	19	20	☌ ♄ ☾ ♄ 0° 05′ N....................	19 08	4O123
Sun. 5			....		41O32
Mon. 6	14		☿ in Aphelion..........................		432O1
Tue. 7	13	28	☾ Last Quarter..........................	15 57	4321O
Wed. 8	3		♀ in Aphelion..........................		43O12
	7		♂ in ☋..................................		
Thu. 9			....		413O2
Fri. 10	12	31	☌ ♃ ☾ ♃ 3° 36′ S....................	12 46	24O13
	22		Moon in Apogee. Dist. from ⊕, 251,900 mi....		
Sat. 11	15	57	☌ ♆ ☾ ♆ 3° 47′ S....................		O43**
Sun. 12			....		1O324
Mon. 13			....	09 35	23O14
Tue. 14	13		☌ ♂ ☉..................................		321O4
Wed. 15	14	26	☌ ♂ ☾ ♂ 4° 32′ S....................		3O124
	17	29	● New Moon..............................		
Thu. 16			Leonid meteors..........................	06 24	13O24
	23	36	☌ ☿ ☾ ☿ 5° 24′ S....................		
Fri. 17			....		2O134
Sat. 18	20	40	☌ ♀ ☾ ♀ 3° 21′ S....................		O43**
Sun. 19			....	03 13	dO423
Mon. 20			....		423O1
Tue. 21			....		4321O
Wed. 22			....	00 02	43O12
Thu. 23	2	53	☽ First Quarter.........................		431O2
Fri. 24			....	20 51	42O13
Sat. 25			....		421O3
Sun. 26	22		☿ Greatest Hel. Lat. S..................		d4O23
	23		Moon in Perigee. Dist. from ⊕, 227,100 mi....		
Mon. 27			....	17 40	dd4O1
Tue. 28			....		321O4
Wed. 29	19	52	○ Full Moon.............................		3O214
Thu. 30	1	06	☌ ♅ ☾ ♅ 3° 11′ N....................	14 29	31O24
	11		♀ Greatest Hel. Lat. S..................		

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

THE SKY FOR DECEMBER, 1944

Positions of the sun and planets are given for 0h Greenwich Civil Time.

The times of transit (at the 75th Meridian) 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 28m to 18h 44m and its Decl. changes from 21° 45′ S. to 23° 27′ S. at the solstice on the 21st, then to 23° 03′ S. The equation of time decreases steadily from +11m 04s to 0m on Christmas Day, and then to –3m 21s at the end of the year. 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. Times of moonrise and moonset are given on page 23.

Mercury on the 15th is in R.A. 18h 38m, Decl. 23° 30′ S. and transits at 13.01. It is at greatest eastern elongation on the 4th but is not well placed for observation. On the 13th it begins to move westward among the stars. It is at inferior conjunction with the sun on the 22nd. On the 16th an occultation of Mercury by the moon is visible in eastern Canada (see p. 56).

Venus on the 15th is in R.A. 20h 30m, Decl. 21° 14′ S. and transits at 14.56. It is brilliant in the evening sky, of magnitude –3.6, setting over three hours after the sun. In a telescope it is approaching half-moon phase, and has a diameter of 16″. It is close to the moon on the 18th.

Mars on the 15th is in R.A. 16h 50m, Decl. 22° 50′ S. and transits at 11.15. It is in the morning sky, but is still too close to the sun to be well observed.

Jupiter on the 15th is in R.A. 11h 48m, Decl. 02° 35′ N. and transits at 6.12. It is in quadrature to the sun on the 18th, when it rises close to the east point about midnight. Its magnitude has increased slightly to –1.6. 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. 6h 37m, Decl. 22° 24′ N. and transits at 1.02. Opposition with the sun occurs on the 28th, when the planet rises at sunset and is visible all night. The stellar magnitude has increased to –0.2. It is close to the moon on the 2nd.

Uranus on the 15th is in R.A. 4h 36m, Decl. 22° 01′ N. and transits at 22.57. At opposition on the 3rd, its stellar magnitude is 5.9, just visible without optical aid to an observer with keen eyes, against a clear sky.

Neptune on the 15th is in R.A. 12h 25m, Decl. 01° 12′ S. and transits at 6.49. It is in quadrature with the sun on the 28th.

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

				DECEMBER 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 5h 00m
	d	h	m		h m	
Fri.	1			....		2O314
Sat.	2	2	57	☌♄☾ ♄ 0° 03′ N....................		21O34
Sun.	3	4		☍♅☉ Dist. from ⊕, 1,701,000,000 mi....	11 18	O1234
Mon.	4	21		☿ Greatest elongation E., 21° 09′..........		O234*
Tue.	5			....		321O4
Wed.	6			....	08 07	d3O21
Thu.	7	9	57	☾ Last Quarter........................		431O2
Fri.	8	3	31	☌♃☾ ♃ 3° 52′ S....................		42O31
		17		Moon in Apogee. Dist. from ⊕, 251,400 mi....		
Sat.	9	0	49	☌♆☾ ♆ 3° 58′ S....................	04 56	421O3
Sun.	10			....		4O123
Mon.	11			....		41O23
Tue.	12			Geminid meteors........................	01 45	d423O
Wed.	13	9		☿ Stationary in R.A....................		34O1*
Thu.	14	14	56	☌♂☾ ♂ 3° 24′ S....................	22 34	314O2
Fri.	15	9	34	● New Moon........................		2O14*
		23		☿ in ☊............................		
Sat.	16	12	02	☌☿☾ ☿ 0° 46′ S....................		21O34
Sun.	17			....	19 23	O1234
Mon.	18	9		□♃☉..................................		1O234
		19	00	☌♀☾ ♀ 0° 14′ S....................		
Tue.	19			....		23O14
Wed.	20	14		☿ in Perihelion........................	16 13	3O14*
Thu.	21	18	15	☉ enters ♑, Winter commences. Long. of ☉, 270.		31O24
Fri.	22	10	54	☽ First Quarter........................		23O14
		22		☌☿☉ Inferior........................		
Sat.	23	7		Moon in Perigee. Dist. from ⊕, 230,000 mi....	13 02	214O3
Sun.	24			....		4O123
Mon.	25			....		41O23
Tue.	26			....	09 51	423O1
Wed.	27	8	04	☌♅☾ ♅ 3° 18′ N....................		432O*
Thu.	28	1		□♆☉..................................		431O2
		22		☍♄☉ Dist. from ⊕, 747,500,000 mi.....		
Fri.	29	1		☌☿♂ ☿ 3° 39′ N....................	06 40	d43O1
		8	44	☌♄☾ ♄ 0° 15′ N....................		
		9	38	○ Full Moon........................		
Sat.	30	20		☿ Greatest Hel. Lat. N....................		421O3
Sun.	31			....		4O213

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

PHENOMENA OF JUPITER'S SATELLITES, 1944

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

JANUARY

d	h	m	Sat.	Phen.
1	02	16	I	ED
	05	28	I	OR
	23	37	I	SI
2	00	30	I	TI
	01	55	I	Se
	02	47	I	Te
	23	55	I	OR
3	21	14	I	Te
5	01	17	II	SI
	02	57	II	TI
	04	09	II	Se
	05	50	II	Te
	22	26	III	ED
	23	06	IV	TI
6	03	47	IV	Te
	05	22	III	OR
7	00	55	II	OR
8	04	09	I	ED
9	01	31	I	SI
	02	16	I	TI
	03	48	I	Se
	04	33	I	Te
	22	38	I	ED
10	01	41	I	OR
	20	43	I	TI
	22	16	I	Se
	23	00	I	Te
12	03	51	II	SI
	05	16	II	TI
	06	44	II	Se
13	02	23	III	ED
	22	59	II	ED
14	00	33	IV	ED
	03	13	II	OR
	05	27	IV	ER
15	06	03	I	ED
	21	18	II	Te
16	03	24	I	SI
	04	01	I	TI
	05	42	I	Se
	06	19	I	Te
	20	12	III	Se
	22	38	III	Te
17	00	31	I	ED
	03	26	I	OR
	21	53	I	SI
	22	28	I	TI
18	00	10	I	Se
	00	45	I	Te
	21	52	I	OR
19	06	26	II	SI
20	06	21	III	ED
21	01	34	II	ED
	05	29	II	OR
22	19	44	II	SI
	20	41	II	TI
	22	37	II	Se
	23	34	II	Te
23	05	18	I	SI
	05	46	I	TI
	20	33	III	SI
	22	24	III	TI
24	00	10	III	Se
	01	58	III	Te
	02	25	I	ED
	05	10	I	OR
	23	46	I	SI
25	00	12	I	TI
	02	04	I	Se

January—con't

d	h	m	Sat.	Phen.
	02	29	I	Te
	20	54	I	ED
	23	36	I	OR
26	20	32	I	Se
	20	55	I	Te
28	04	08	II	ED
29	22	19	II	SI
	22	57	II	TI
30	01	13	II	Se
	01	50	II	Te
31	00	31	III	SI
	01	41	III	TI
	02	09	IV	OR
	04	08	III	Se
	04	19	I	ED
	05	15	III	Te
	20	51	II	OR

FEBRUARY

d	h	m	Sat.	Phen.
1	01	40	I	SI
	01	56	I	TI
	03	58	I	Se
	04	13	I	Te
	22	48	I	ED
2	01	20	I	OR
	20	08	I	SI
	20	21	I	TI
	22	26	I	Se
	22	39	I	Te
3	19	46	I	OR
6	00	54	II	SI
	01	11	II	TI
	03	48	II	Se
	04	05	II	Te
7	04	29	III	SI
	04	57	III	TI
	06	13	I	ED
	20	00	II	ED
	23	04	II	OR
8	03	18	IV	SI
	03	34	I	SI
	03	39	I	TI
	04	09	IV	TI
	05	51	I	Se
	05	56	I	Te
9	00	42	I	ED
	03	04	I	OR
	22	02	I	SI
	22	05	I	TI
10	00	20	I	Se
	00	22	I	Te
	18	18	III	ED
	19	10	I	ED
	21	30	I	OR
	22	00	III	OR
11	18	48	I	Se
	18	48	I	Te
13	03	26	II	TI
	03	30	II	SI
	06	20	II	Te
	06	25	II	Se
14	22	26	II	OD
15	01	28	II	ER
	05	23	I	TI
	05	28	I	SI
16	02	30	I	OD
	04	54	I	ER

February—con't

d	h	m	Sat.	Phen.
	19	27	II	Te
	19	42	II	Se
	23	48	I	TI
	23	56	I	SI
17	02	06	I	Te
	02	14	I	Se
	20	56	I	OD
	21	40	III	OD
	23	23	I	ER
18	01	55	III	ER
	18	14	I	TI
	18	25	I	SI
	20	32	I	Te
	20	42	I	Se
20	05	41	II	TI
22	00	39	II	OD
	04	02	II	ER
23	04	14	I	OD
	18	48	II	TI
	19	24	II	SI
	21	42	II	Te
	22	19	II	Se
24	01	32	I	TI
	01	50	I	SI
	03	50	I	Te
	04	08	I	Se
	21	17	IV	SI
	22	40	I	OD
	23	01	IV	Te
25	00	57	III	OD
	01	18	I	ER
	02	04	IV	Se
	19	58	I	TI
	20	19	I	SI
	22	16	I	Te
	22	36	I	Se
26	19	46	I	ER
28	20	02	III	Se
29	02	54	II	OD

MARCH

d	h	m	Sat.	Phen.
1	21	04	II	TI
	22	01	II	SI
	23	58	II	Te
2	00	55	II	Se
	03	17	I	TI
	03	45	I	SI
3	00	24	I	OD
	03	12	I	ER
	04	15	III	OD
	19	54	II	ER
	21	43	I	TI
	22	13	I	SI
4	00	00	I	Te
	00	30	I	Se
	01	41	IV	OD
	18	51	I	OD
	21	41	I	ER
5	18	59	I	Se
6	20	25	III	SI
	21	41	III	Te
7	00	01	III	Se
8	23	22	II	TI
9	00	38	II	SI
	02	16	II	Te
	03	32	II	Se
10	02	10	I	OD

March—con't

d	h	m	Sat.	Phen.
	22	28	II	ER
	23	29	I	TI
11	00	08	I	SI
	01	45	I	Te
	02	25	I	Se
	20	36	I	OD
	23	36	I	ER
12	20	02	IV	Se
	20	12	I	Te
	20	53	I	Se
13	21	29	III	TI
14	00	24	III	SI
	01	04	III	Te
	03	59	III	Se
16	01	42	II	TI
	03	15	II	SI
17	03	56	I	OD
	20	36	II	OD
18	01	03	II	ER
	01	15	I	TI
	02	02	I	SI
	03	32	I	Te
	22	23	I	OD
19	01	31	I	ER
	19	28	II	Se
	19	42	I	TI
	20	31	I	SI
	21	58	I	Te
	22	48	I	Se
20	20	00	I	ER
	21	20	IV	OR
21	00	38	IV	ED
	00	56	III	TI
24	21	49	III	ER
	22	56	II	OD
25	03	02	I	TI
	03	37	II	ER
26	00	11	I	OD
	03	26	I	ER
	19	11	II	SI
	20	09	II	Te
	21	29	I	TI
	22	05	II	Se
	22	25	I	SI
	23	46	I	Te
27	00	42	I	Se
	21	55	I	ER
28	19	10	I	Se
29	00	09	IV	TI
31	21	42	III	OR
	22	13	III	ED

APRIL

d	h	m	Sat.	Phen.
1	01	18	II	OD
	01	49	III	ER
2	02	00	I	OD
	19	41	II	TI
	21	48	II	SI
	22	34	II	Te
	23	18	I	TI
3	00	20	I	SI
	00	42	II	Se
	01	35	I	Te
	02	36	I	Se
	20	27	I	OD
	23	50	I	ER
4	19	29	II	ER

April—con't

d	h	m	Sat.	Phen.
	20	02	I	Te
	21	05	I	Se
6	23	30	IV	ER
7	21	42	III	OD
8	01	20	III	OR
	02	13	III	ED
9	22	08	II	TI
10	00	26	II	SI
	01	02	II	Te
	01	08	I	TI
	02	14	I	SI
	22	18	I	OD
11	01	45	I	ER
	19	36	I	TI
	19	54	III	Se
	20	43	I	SI
	21	52	I	Te
	22	04	II	ER
	22	59	I	Se
12	20	14	I	ER
14	21	05	IV	Te
15	01	25	III	OD
17	00	38	II	TI
18	00	09	I	OD
	19	24	II	OD
	20	20	III	SI
	21	27	I	TI
	22	38	I	SI
	23	43	I	Te
	23	53	III	Se
19	00	38	II	ER
	00	54	I	Se
	22	09	I	ER
20	19	22	I	Se
23	00	51	IV	OD
25	21	54	II	OD
	22	52	III	Te
	23	19	I	TI
26	00	20	III	SI
	00	32	I	SI
	01	35	I	Te
	20	31	I	OD
27	00	05	I	ER
	20	04	I	Te
	21	17	I	Se
	21	53	II	Se

MAY

d	h	m	Sat.	Phen.
1	21	19	IV	SI
2	23	10	III	TI
3	00	26	II	OD
	22	25	I	OD
4	19	41	I	TI
	20	56	I	SI
	21	38	II	SI
	21	56	II	Te
	21	57	I	Te
	23	12	I	Se
5	00	31	II	Se
	20	29	I	ER
6	21	46	III	ER

May—con't

d	h	m	Sat.	Phen.
9	23	22	IV	OR
11	00	20	I	OD
	21	36	I	TI
	21	40	II	TI
	22	51	I	SI
	23	52	I	Te
12	00	15	II	SI
	00	34	II	Te
	22	24	I	ER
13	20	38	III	OR
	21	40	II	ER
	22	11	III	ED
18	19	56	IV	Se
	23	31	I	TI
19	20	45	I	OD
20	20	16	I	Te
	21	04	III	OD
	21	30	I	Se
26	22	42	I	OD
27	19	57	I	TI
	21	09	I	SI
	21	32	II	OD
	22	13	I	Te
	23	25	I	Se
28	20	44	I	ER
29	21	43	II	Se
31	20	16	III	SI

JUNE

d	h	m	Sat.	Phen.
3	21	54	I	TI
	22	16	IV	TI
	23	03	I	SI
4	22	39	I	ER
5	21	28	II	SI
	21	59	II	Te
11	21	08	I	OD
12	20	38	I	Te
	21	43	I	Se
	21	50	II	TI
14	21	16	II	ER
18	21	41	III	ER
19	20	21	I	TI
	21	21	I	SI
20	20	58	I	ER
25	21	45	III	OR
28	21	42	II	OD
30	21	30	II	Se

JULY

d	h	m	Sat.	Phen.
5	21	05	I	Te
12	20	48	I	TI
13	20	11	III	SI
	20	41	III	Te
20	20	09	I	OD
21	20	14	I	Se

Jupiter being near the Sun, phenomena of the Satellites are not given from July 26 to September 16.

SEPTEMBER

d	h	m	Sat.	Phen.
24	05	22	II	Te

OCTOBER

d	h	m	Sat.	Phen.
1	05	19	II	TI
3	04	47	I	ED
4	04	46	I	Te
8	05	19	IV	ER
10	05	20	II	OR
11	04	29	I	TI
18	05	44	I	SI
22	03	53	III	SI
26	04	06	II	Se
	04	55	I	ED
	05	46	II	Te
27	04	23	I	Se
	05	15	I	Te

NOVEMBER

d	h	m	Sat.	Phen.
2	03	18	IV	SI
	03	50	II	SI
	04	50	III	OR
	05	41	II	TI
3	04	00	I	SI
	04	57	I	TI
4	03	04	II	OR
	04	30	I	OR
9	05	01	III	ER
	05	51	III	OD
10	05	54	I	SI
11	02	50	IV	OR
	03	10	I	ED
	05	49	II	OR
12	02	38	I	Se
	03	41	I	Te
16	05	38	III	ED
18	03	26	II	ED
	05	02	I	ED
19	02	16	I	SI
	03	23	I	TI
	04	32	I	Se
	05	38	I	Te
20	02	53	I	OR
	03	11	II	Te
	03	29	III	Te
25	06	01	II	ED
26	04	10	I	SI
	05	19	I	TI
	06	25	I	Se
27	03	00	III	Se
	03	03	II	TI
	03	33	II	Se

November—con't

d	h	m	Sat.	Phen.
	04	31	III	TI
	04	48	I	OR
	05	49	II	Te
28	02	03	I	Te

DECEMBER

d	h	m	Sat.	Phen.
3	06	03	I	SI
4	03	17	I	ED
	03	19	II	SI
	03	41	III	SI
	05	40	II	TI
	06	06	II	Se
5	01	44	I	TI
	02	47	I	Se
	03	59	I	Te
6	02	57	IV	TI
	03	15	II	OR
	05	48	IV	Te
8	01	38	III	OR
11	05	09	I	ED
	05	51	II	SI
12	02	25	I	SI
	03	39	I	TI
	04	41	I	Se
	05	53	I	Te
13	03	06	I	OR
	05	53	II	OR
14	01	11	IV	ED
	04	54	IV	ER
15	00	45	III	ER
	02	34	III	OD
	05	38	III	OR
19	04	19	I	SI
	05	33	I	TI
	06	34	I	Se
20	01	30	I	ED
	03	07	II	ED
	04	59	I	OR
21	01	02	I	Se
	02	15	I	Te
22	00	27	II	Se
	01	26	III	ED
	02	50	II	Te
	04	42	III	ER
	06	31	III	OD
26	05	12	I	SI
27	03	23	I	ED
	05	43	II	ED
	06	51	I	OR
28	00	41	I	SI
	01	54	I	TI
	02	56	I	Se
	04	07	I	Te
29	00	13	II	SI
	01	19	I	OR
	02	37	II	TI
	03	00	II	Se
	05	21	II	Te
	05	23	III	ED
31	00	17	II	OR

ECLIPSES FOR 1944

During 1944 there will be only two eclipses, both of the sun. Neither of these eclipses will be visible in Canada.

I. *A Total Eclipse of the Sun,* January 25, 1944, visible as total in the south-eastern Pacific, northern Peru, Brazil, the central Atlantic, Sierra Leone and French West Africa. The partial phase will be visible from most of South America; a small region of the United States bordering the Gulf of Mexico at sunrise; and parts of Africa and south-western Europe at sunset. In eastern Brazil a duration of totality of almost four minutes will occur near local apparent noon.

II. *An Annular Eclipse of the Sun,* July 20, 1944, will be visible as a central eclipse in eastern Africa at sunrise, in India and northern Burma, and towards sunset in the East Indies. The partial phase will be visible over southern Asia, the Indian Ocean and much of Australia.

During 1944 there will also be four lunar appulses. While these penumbral lunar eclipses are not usually included with eclipses, the appulse of December 29 will be of such great magnitude as to be practically a grazing eclipse. It will be visible from north-western North America to Australia, Asia and eastern Europe.

LUNAR OCCULTATIONS

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 1944 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.† 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 then for the neighbouring station we have—

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

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, 1944

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. 4	μ Cet	4.4	I	8.9	19 56.9	−1.2	+2.3	31	20 07.4	−1.2	+1.9	33
13	Jupiter	−2.0	I	17.3	6 54.0	−0.5	−2.0	117	6 53.0	−0.4	−1.8	109
13	Jupiter	−2.0	E	17.3	7 58.3	−0.2	−1.7	285	7 55.5	0.0	−1.8	292
31	ξ^2 Cet	4.3	I	6.3	17 35.7	−1.8	+0.8	72	17 47.3	−1.8	+0.5	75
Mar. 15	γ Lib	4.0	I	20.2	1 15.2	−1.5	+1.8	77	1 29.7	−2.2	+2.6	61
15	γ Lib	4.0	E	20.2	2 14.9	−0.7	−1.0	332	2 15.4	−0.2	−1.9	348
30	ν Gem	4.1	I	6.7	23 18.0	−0.1	−2.0	115	23 15.1	−0.1	−1.7	105
Apr. 15	ο Sgr	3.9	E	21.9	2 59.2	−1.1	+0.7	288	3 07.2	−1.2	+0.4	296
29	δ Cnc	4.2	I	7.2	21 40.4	−1.2	−1.3	91	21 44.9	−1.1	−1.1	79
30	Jupiter †	−1.7	I	8.0	14 46.6	−0.8	+0.9	106	14 53.7	−1.0	+1.0	103
30	Jupiter †	−1.7	E	8.0	16 02.5	−1.3	+1.1	275	16 12.6	−1.5	+0.7	281
Aug. 10	ξ^2 Cet	4.3	I	21.1	0 36.7	−0.1	+2.2	34	0 41.5	−0.2	+2.2	36
10	ξ^2 Cet	4.3	E	21.1	1 29.2	−0.9	+1.2	277	1 37.3	−1.1	+1.2	273
15	ζ Gem	4.1	E	26.2	3 53.8	.....	.....	190	Graze	.....	.....	...
Dec. 16	Mercury †	0.9	I	1.1	10 55.8	−1.5	+1.0	83	11 06.7	−1.6	+1.0	75
16	Mercury †	0.9	E	1.1	12 07.1	−1.6	+0.1	292	12 15.9	−1.6	−0.2	298
27	δ Tau	3.9	I	11.7	2 44.7	−0.6	−1.1	84	2 46.0	−0.5	−0.9	75

LUNAR OCCULTATIONS VISIBLE AT VANCOUVER AND CALGARY, 1944

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 n			°
Jan. 13	Jupiter	−2.0	I	17.3	3 04.9	−0.9	−2.9	156	4 10.4	−1.0	−2 2	141
13	Jupiter	−2.0	E	17.3	4 04.3	−2.1	+0.1	249	5 19.5	−1.5	−1.0	264
Feb. 22	Mercury†	−0.2	I	28.2	11 21.9	−2.0	−0.3	103	12 38.9	−1.9	−1.0	109
22	Mercury†	−0.2	E	28.2	12 32.8	−1.1	+0.4	222	13 41.3	−0.7	+0.4	213
Mar. 30	ν Gem	4.1	I	6.7	19 34.1	−1.4	−2.9	134	20 41.7	−1.1	−2.3	123
Apr. 27	ξ Gem	3.9	I	5.3	19 58.4	−1.0	−1.5	96	21 04.4	−0.8	−1.3	85
30	Jupiter†	−1.7	E	8.0	Low	.....	.....	...	13 40.8	−0.4	+0.3	315
July 21	Mercury†	−0.2	I	1.8	17 06.6	−0.8	−2.4	118	18 10.1	−0.6	−2.2	107
21	Mercury†	−0.2	E	1 8	18 25.4	−0.4	−2.0	282	19 24.7	−0.1	−2.1	292
Oct. 3–4	μ Cet	4.4	I	16.8	22 53.0	−0.7	+1.7	64	0 03.1	−1.0	+1.4	71
3–4	μ Cet	4.4	E	16.8	23 59.1	−1.0	+1.5	243	1 10.7	−1.1	+1.4	236
Nov. 2	δ Tau	3.9	I	16.3	3 58.2	−1.3	−0.1	67	5 08.4	−1.0	−0 3	62
2	δ Tau	3.9	E	16.3	5 06.6	−0.9	−1.2	268	6 11.7	−0.6	−1.6	275
27	μ Cet	4.4	I	12.3	19 59.0	−1 1	+1.3	81	21 12.1	−1.4	+0.8	90
Dec.26–7	δ Tau	3.9	I	11.7	22 49.3	−1.5	+0.6	65	00 02.8	−1.3	+0.2	65
27	68 Tau	4.2	I	11.7	0 50.8	.....	.....	1	No. occ.	.....	.....	...

†Daylight Occultation

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, Richmond Hill, Ontario.

At the present time Dr. Millman is absent from the Observatory serving in the R.C.A.F. Hence 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 and put on record here. For complete instructions by Dr. Millman concerning visual observations of meteors see the JOURNAL of the Royal Astronomical Society of Canada, vol. 31, p. 255, 1937; and for meteor photography, vol. 31, p. 295, 1937; or *General Instructions for Meteor Observing,* obtainable for 15 cents postpaid.

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

ORBITAL ELEMENTS (Jan. 1, 0^h, 1938)

Planet	Mean Distance from Sun (a) ⊕ = 1	Mean Distance from Sun (a) millions of miles	Period (P)	Eccen-tri-city (e)	In-clina-tion (i)	Long. of Node (☊)	Long. of Peri-helion (π)	Long. of Planet
					°	°	°	°
Mercury	.387	36.0	88.0 days	.206	7.0	47.6	76.5	96.3
Venus	.723	67.2	224.7	.007	3.4	76.1	130.7	259.3
Earth	1.000	92.9	365.3	.017	....	.....	101.9	99.5
Mars	1.524	141.5	687.0	.093	1.9	49.1	334.9	7.3
Jupiter	5.203	483.3	11.86 yrs.	.048	1.3	99.8	13.3	311.8
Saturn	9.54	886.	29.46	.056	2.5	113.1	91.8	11.5
Uranus	19.19	1783.	84.0	.047	0.8	73.7	169.7	46.7
Neptune	30.07	2793.	164.8	.009	1.8	131.1	44.1	168.6
Pluto	39.46	3666.	247.7	.249	17.1	109.5	223.4	148.0

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 " *	Mean Dist. from Planet Miles	Revolution Period d	h	m	Diameter Miles	Discoverer
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

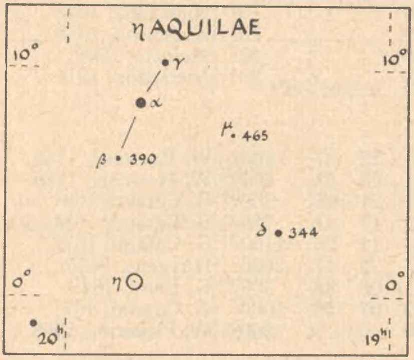
*As seen from the sun.

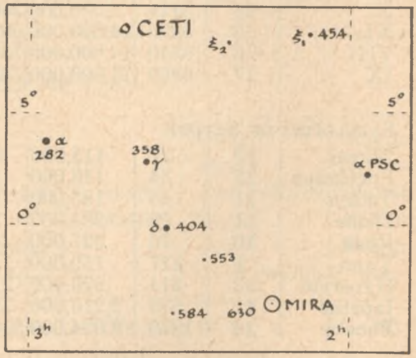
Satellites Io, Europa, Ganymede, Callisto are usually denoted I, II, III, IV, respectively, in order of distance from the planet.

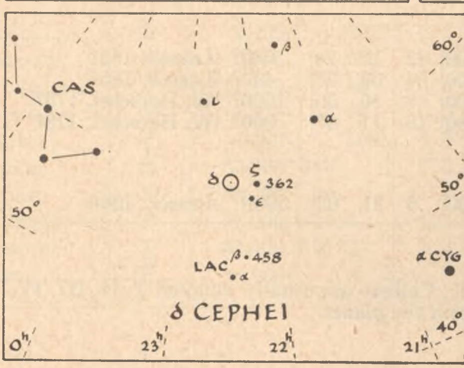
VARIABLE STARS

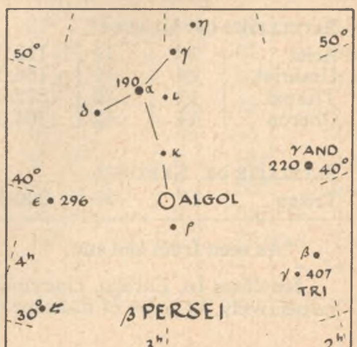
Much pleasure may be derived from the estimation of the brightness of variable stars. Maps of the fields of four bright variable stars are given below. In each case the magnitudes of several suitable comparison stars are given. These magnitudes are given as magnitudes, tenths and hundredths, with the 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 1900 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 1900	δ	Mag. and Spect.	d	D	Remarks
	h m	° ′		″	L.Y.	
π And	00 31.5	+33 10	4.4B3; 8.5	36	470	†
η Cas	00 43.0	+57 17	3.6F8; 7.2M0	8	18	526y; 66AU
α UMi	01 22.6	+88 46	var. F8; 8.8	19	470	Polaris
γ Ari	01 48.1	+18 48	4.8A0; 4.8A0	8.3	150	
α Pis	01 56.9	+02 17	5.2A2; 4.3A2	2.4	130	††
γ And	01 57.8	+41 51	2.3K0; 5.4A0; 6.6	10, 0.7	410	56y; 23AU
6 Tri	02 06.6	+29 50	5.4G4; 7.0F3	3.6	330	††
η Per	02 43.4	+55 29	3.9K0; 8.5	28	540	
32 Eri	03 49.3	−03 15	5.0A; 6.3G5	6.7	300	
β Ori	05 09.7	−08 19	0.3B8; 7.0	9	540	†
θ Ori	05 30.4	−05 27	5.4;6.8; 6.8; 7.9; O	13, 17	540	Trapezium
β Mon	06 24.0	−06 58	4.7B2; 5.2; 5.6	7, 25	470	†
12 Lyn	06 37.4	+59 33	5.3A2; 6.2; 7.4	1.7, 8	180	†
α CMa	06 40.7	−16 35	−1.6A0; 8.5F	11	9	50y; 20AU
δ Gem	07 14.2	+22 10	3.5F0; 8.0M0	6.8	58	†
α Gem	07 28.2	+32 06	2.0A0; 2.8A0; 9M10	4, 70	47	340y; 79AU
ζ Cnc	08 06.5	+17 57	5.6G0; 6.0; 6.2	1, 5	78	60y; 21AU
γ Leo	10 14.5	+20 21	2.6K0; 3.8G5	4	160	400y
ξ UMa	11 12.9	+32 06	4.4G0; 4.9G0	2	25	††60y; 20AU
ι Leo	11 18.7	+11 05	4.1F3; 6.8F3	2	69	
γ Vir	12 36.6	−00 54	3.6F0; 3.7F0	6	34	171y; 42AU
α CVn	12 51.4	+38 51	2.9A0; 5.4A0	20	140	††
ζ UMa	13 19.9	+55 27	2.4A2; 4.0A2	14	78	††
π Boo	14 36.0	+16 51	4.9A0; 5.1A0	6	360	†
ε Boo	14 40.6	+27 30	2.7K0; 5.1A0	3	220	
ξ Boo	14 46.8	+19 31	4.8G5; 6.7	3	22	151y; 31AU
δ Ser	15 30.0	+10 52	4.2F0; 5.2F0	4	170	
ξ Sco	15 58.9	−11 06	5.1F3; 4.8; 7G7	1, 7	84	44.7y; 19AU
α Her	17 10.1	+14 30	var.M5; 5.4G	5	540	†
δ Her	17 10.9	+24 57	3.2A0; 8.1G2	11	100	† Optical
ε Lyr	18 41.0	+39 32	5.1, 6.0A3; 5.1, 5.4A5	3, 2	200	Pairs 207″
β Cyg	19 26.7	+27 45	3.2K0; 5.4B9	34	410	†
α Cap	20 12.3	−12 50	3.8G5; 4.6G0	376		Optical
γ Del	20 42.0	+15 46	4.5G5; 5.5F8	10	110	
61 Cyg	21 02.4	+38 15	5.6K5; 6.3K5	23	11	
β Cep	21 27.4	+70 07	var.B1; 8.0A3	14	540	†
ζ Aqr	22 23.7	−00 32	4.4F2; 4.6F1	3	140	
δ Cep	22 25.5	+57 54	var.G0; 7.5A0	41	650	
8 Lac	22 31.4	+39 07	5.8B3; 6.5B5	22	1100	†
σ Cas	23 53.9	+55 12	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. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
α Andr........	0 3	+28 32	2.2	A1	.217	.034	96	−0.1	−13.0*
β Cass........	4	+58 36	2.4	F2	.561	.080	41	1.9	+11.4
γ Pegs........	8	+14 38	2.9	B2	.015	.005	652	−3.6	+ 5.0*
β Hydi........	20	−77 49	2.9	G0	2.243	.162	21	4.0	+22.8
α Phoe........	21	−42 51	2.4	G5	.448	.040	81	0.4	+74.6*
δ Andr........	34	+30 19	3.5	K3	.167	.026	125	0.6	− 7.1*
α Cass........	35	+55 50	2.2–2.8	G8	.062	.018	181	−1.5	− 3.8
β Ceti........	39	−18 32	2.2	G7	.233	.052	63	0.8	+13.1
‖γ Cass........	51	+60 11	2.2	B0e	.031	.035	93	−0.1	− 6.8
‖β Phoe........	1 2	−47 15	3.4	G4	.043	.020	163	−0.1	− 1.2
β Andr........	4	+35 5	2.4	M0	.219	.041	79	0.5	+ 0.1
δ Cass........	19	+59 43	2.8–2.9	A3	.308	.050	65	1.3	+ 6.8
‖α U. Min......	23	+88 46	2.3–2.4	F7	.043	.008	407	−3.4	−17.4*
γ Phoe........	24	−43 50	3.4	M1	.223	.008	407	−2.1	+25.7*
α **Erid**........	34	−57 44	0.6	B9	.093	.046	71	−1.1	+19.
ε Cass........	47	+63 11	3.4	B5	.043	.011	296	−1.4	− 8.1
β Arie........	49	+20 19	2.7	A3	.150	.066	49	1.8	− 0.6*
α Hydi........	56	−62 3	3.0	A7	.255	.080	41	2.5	+ 7.0*
‖γ Andr........	58	+41 51	2.3	K0	.073	.020	163	−1.2	−11.7
α Arie........	2 2	+22 59	2.2	K2	.242	.045	72	0.5	−14.3
β Tria........	4	+34 31	3.1	A6	.161	.029	112	0.4	+10.4*
‖o Ceti........	14	− 3 26	1.7–9.6	M6e	.239	.013	251	−2.7	+57.8*
‖θ Erid........	54	−40 42	3.4	A2	.068	.032	102	0.9	+11.9*
α Ceti........	57	+ 3 42	2.8	M1	.080	.018	181	−0.9	−25.7
γ Pers........	58	+53 7	3.1	F9	.012	.017	192	−0.7	+ 1.0*
ρ Pers........	59	+38 27	3.3–4.1	M6	.176	.024	136	0.3	+28.2
β Pers........	3 2	+40 34	2.1–3.2	B8	.011	.033	99	−0.3	+ 5.7*
α Pers........	17	+49 30	1.9	F4	.041	.017	192	−2.0	− 2.4
δ Pers........	36	+47 28	3.1	B5	.047	.012	272	−1.5	−10. *
‖η Taur........	41	+23 48	3.0	B5p	.053	.014	233	−1.3	+10.3
ζ Pers........	48	+31 35	2.9	B1	.023	.008	407	−2.6	+20.9
γ Hydi........	49	−74 33	3.2	M3	.124	.008	407	−2.3	+16.0
‖ε Pers........	51	+39 43	3.0	B2	.041	.006	543	−3.1	− 6 *
γ Erid........	53	−13 47	3.2	M0	.133	.012	272	−1.6	+61.7
λ Taur........	55	+12 12	3.8–4.2	B3	.015	.008	407	−2.2	+13.0*
α Reti........	4 13	−62 43	3.4	G5	.070	.016	204	−0.6	+35.6

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
α **Taur**.......	4 30	+16 18	1.1	K8	.205	.060	54	0.0	+54.1
α Dora.......	32	−55 15	3.5	A0p	......	......	.....	......	+25.6
π^3 Orio........	44	+ 6 47	3.3	F5	.474	.124	26	3.8	+24.6
ι Auri........	50	+33 0	2.9	K4	.030	.020	163	−0.6	+17.6
ε Auri........	55	+43 41	3.1–3.8	F2	.015	.006	543	−2.7	−4.1 *
η Auri........	5 0	+41 6	3.3	B3	.082	013	251	−1.1	+ 7.8
ε Leps........	1	−22 30	3.3	K5	.074	.016	204	−0.7	+ 1.0
β Erid........	3	− 5 13	2.9	A1	.117	.055	59	1.6	− 7
μ Leps........	8	−16 19	3.3	A0p	.053	.020	163	−0.2	+27.7
||α **Auri**........	9	+45 54	0.2	G1	.439	.078	42	−0.3	+30.2
||β **Orio**........	10	− 8 19	0.3	B8p	.005	.006	543	−5.8	+23.6*
||η Orio........	19	− 2 29	3.4	B0	.009	.006	543	−2.7	+19.5*
γ Orio........	20	+ 6 16	1.7	B2	.019	.015	217	−2.4	+18.0
β Taur........	20	+28 31	1.8	B8	.180	.028	116	−1.0	+ 8.0
β Leps........	24	−20 50	3.0	G2	.095	.018	181	−0.7	−13.5
||δ Orio........	27	− 0 22	2.4–2.5	B0	.006	.007	466	−3.4	+19.9*
α Leps........	28	−17 54	2.7	F6	.006	.012	272	−2.1	+24.7
ι Orio........	31	− 5 59	2.9	O8	.007	.021	155	−0.5	+21.5*
ε Orio........	31	− 1 16	1.8	B0	.004	.008	407	−3.7	+25.8
ζ Taur........	32	+21 5	3.0	B3e	.028	.010	326	−2.0	+16.4*
||ζ Orio........	36	− 2 0	1.8	B0	.012	.011	296	−3.0	+18.8
α Colm.......	36	−34 8	2.8	B8	.036	.022	148	−0.6	+34.6
κ Orio........	43	− 9 42	2.2	B0	.009	.006	543	−3.9	+20.1
β Colm.......	47	−35 48	3.2	K0	.397	.026	125	0.3	+89.4
α **Orio**........	50	+ 7 23	0.5–1.1	M2	.032	.012	272	−4.1	+21.0*
β Auri........	52	+44 56	2.1–2.2	A0p	.046	.052	63	0.7	−18.1*
||θ Auri........	53	+37 12	2.7	A1	.106	.029	112	0.0	+28.6
η Gemi.......	6 9	+22 32	3.2–4.2	M2	.062	.014	233	−1.1	+21.4*
ζ C Maj......	16	−30 01	3.7	B3	.012	.013	251	−0.7	+33.1*
μ Gemi.......	17	+22 34	3.2	M3	.129	.016	204	−0.8	+54.8
β C Maj......	18	−17 54	2.0	B1	.003	.014	233	−2.3	+34.4*
α **Cari**........	22	−52 38	−0.9	F0	.022	.005	652	−7.4	+20.5
γ Gemi.......	32	+16 29	1.9	A2	.066	.050	65	0.4	−11.3*
ν Pupp.......	35	−43 6	3.2	B8	.021	.023	148	0.0	+28.2*
ε Gemi.......	38	+25 14	3.2	G9	.020	.009	362	−2.0	+ 9.9
ξ Gemi.......	40	+13 0	3.4	F5	.230	.054	60	2.1	+25.1
||α **C Maj**......	41	−16 35	−1.6	A2	1.315	.386	8	1.3	− 7.5*
α Pict........	47	−61 50	3.3	A5	.271	.....	.....	......	+20.6

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
τ Pupp.	6 47	−50 30	2.8	G8	.091	.025	130	−0.2	+36.4*
‖ε C Maj.	55	−28 50	1.6	B1	.005	.010	326	−3.4	+27.4
ζ Gemi.	58	+20 43	3.7–4.3	G0p	.007	.005	652	−2.8	+ 6.7*
o^2 C Maj.	59	−23 41	3.1	B5p	.006	.007	466	−2.7	+48.6
δ C Maj.	7 4	−26 14	2.0	G4p	.003	.006	543	−4.1	+34.3*
L^2 Pupp.	10	−44 29	3.4–6.2	M5e	.332	.018	181	−0.3	+53.0
π Pupp.	14	−36 55	2.7	K5	.004	.018	181	−1.0	+15.8
η C Maj.	20	−29 6	2.4	B5p	.007	.012	272	−2.2	+40.4
β C Min.	22	+ 8 29	3.1	B8	.063	.022	148	−0.2	+23 *
σ Pupp.	26	−43 6	3.3	M0	.191	.016	204	−0.7	+88.1*
α_1 Gemi.	28	+32 6	2.0	A2	.201	.074	44	1.4	+ 6.0*
‖α **C Min**.	28	+32 6	2.8	A0	.209	.074	44	2.2	− 1.2*
α_2 Gemi.	34	+ 5 29	0.5	F5	1.242	.316	10	3.0	− 3.0*
β **Gemi**.	39	+28 16	1.2	G9	.623	.105	31	1.3	+ 3.3
ξ Pupp.	45	−24 37	3.5	K1	.004	.006	543	−2.6	+ 3.7*
ζ Pupp.	8 0	−39 43	2.3	O8	.032	.004	815	−4.7	−24.
ρ Pupp.	3	−24 1	2.9	F6	.097	.025	130	−0.1	+46.6
‖γ Velr.	6	−47 3	2.2	OW9	.002	. . . . .	. . . . .	. . . . .	+ 3.5
‖ε Cari.	20	−59 11	1.7	K0	.030	.010	326	−3.3	+11.5
o U Maj.	22	+61 3	3.5	G2	.166	.014	233	−0.8	+19.8
‖ε Hyda.	41	+ 6 47	3.5	F9	.193	.012	272	−1.1	+36.8*
‖δ Velr.	42	−54 21	2.0	A0	.093	.030	109	−0.6	+ 2.2
ζ Hyda.	50	+ 6 20	3.3	G7	.101	.026	125	0.3	+22.6
‖ι U Maj.	52	+48 26	3.1	A4	.500	.060	54	2.0	+12.6
λ Velr.	9 4	−43 2	2.2	K4	.024	.016	204	−1.8	+18.4
β Cari.	12	−69 18	1.8	A0	.192	. . . . .	. . . . .	. . . . .	− 5.
ι Cari.	14	−58 51	2.2	F0	.023	. . . . .	. . . . .	. . . . .	+13.3
α Lync.	15	+34 49	3.3	K8	.214	.022	148	0.0	+37.4
κ Velr.	19	−54 35	2.6	B3	.017	.017	192	−1.2	+21.7*
α Hyda.	23	− 8 14	2.2	K4	.036	.018	181	−1.5	− 4.4
θ U Maj.	26	+52 8	3.3	F7	1.096	.072	45	2.6	+15.8
N Velr.	28	−56 36	3.4–4.2	K5	.038	.022	148	0.1	−13.9
ε Leon.	40	+24 14	3.1	G0	.045	.009	362	−2.1	+ 5.1
‖υ Cari.	45	−64 36	3.1	F0	.019	. . . . .	. . . . .	. . . . .	+13.6
α **Leon**.	10 3	+12 27	1.3	B6	.244	.046	71	−0.4	+ 2.6
q Cari.	14	−60 50	3.4	K5	.043	.014	233	−0.9	+ 8.6

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′				″	″		km./sec.
‖γ Leo.........	10 14	+20 21	2.3	G8	.347	.024	136	−0.8	−36.8
μ U Maj......	16	+42 0	3.2	K4	.082	.031	105	0.7	−20.3*
θ Cari........	39	−63 52	3.0	B0	.022	.007	466	−2.8	+24. *
η Cari........	41	−59 10	1.0–7.4	Pec	.007	.....	.....	......	−25.0
‖μ Velr........	42	−48 54	2.8	G5	.079	.033	99	0.4	+ 6.9
ν Hyda.......	45	−15 40	3.3	K3	.218	.020	163	−0.2	− 1.0
β U Maj......	56	+56 55	2.4	A3	.089	.045	72	0.7	−12.1*
α U Maj......	58	+62 17	2.0	G5	.137	.036	91	−0.2	− 8.6*
ψ U Maj......	11 4	+45 2	3.2	K0	.067	.035	93	0.9	− 3.6
δ Leon........	9	+21 4	2.6	A2	.208	.058	56	1.4	−23.2
θ Leon........	9	+15 59	3.4	A2	.103	.025	130	0.4	+ 7.8
λ Cent........	31	−62 28	3.3	B9	.045	.031	105	0.8	+ 7.9
β Leon........	44	+15 8	2.2	A2	.507	.084	39	1.8	− 2.3
γ U Maj......	49	+54 15	2.5	A0	.095	.035	93	0.2	−11.1
δ Cent........	12 3	−50 10	2.9	B3e	.040	.015	217	−1.2	+ 9.
ε Corv........	5	−22 4	3.2	K2	.063	.024	136	0.1	+ 4.9
δ Cruc........	10	−58 12	3.1	B3	.045	.017	192	−0.7	+26.4
δ U Maj......	10	+57 35	3.4	A0	.113	.050	65	1.9	−12.
γ Corv........	11	−16 59	2.8	B8	.159	.024	136	−0.3	− 4.2*
α¹ Cruc........	21	−62 33	1.6	B1	.048	.022	148	−1.7	−12.2*
α² Cruc........	21	−62 32	2.1	B3	.048	.022	148	−1.2	+ 0.3*
‖δ Corv........	25	−15 58	3.1	A0	.249	.026	125	0.2	+ 8.7
γ Cruc........	26	−56 33	1.5	M4	.270	.....	.....	......	+21.3
β Corv........	29	−22 51	2.8	G5	.059	.027	121	0.0	− 7.7
α Musc.......	31	−68 35	2.9	B5	.040	.015	217	−1.2	+18.
‖γ Cent........	36	−48 24	2.4	A0	.200	.032	102	−0.1	− 7.5
‖γ Virg........	36	− 0 54	2.9	F0	.561	.080	41	2.4	−19.6
‖β Musc.......	40	−67 34	3.3	B3	.039	.011	296	−1.5	+42. *
β Cruc........	42	−59 9	1.5	B1	.054	.007	466	−4.3	−20. *
ε U Maj......	50	+56 30	1.7	A2	.117	.067	49	0.8	−11.9*
‖α² C. Ven......	51	+38 51	2.8	A1	.233	.030	109	0.2	− 3.5
ε Virg........	57	+11 30	3.0	G6	.270	.037	88	0.8	−14.0
γ Hyda.......	13 13	−22 39	3.3	G7	.085	.028	116	0.5	− 5.4
ι Cent........	15	−36 11	2.9	A2	.351	.049	67	1.4	+ 0.1
‖ζ¹ U. Maj......	20	+55 27	2.4	A2p	.131	.042	78	0.5	− 9.9*
α **Virg**........	20	−10 38	1.2	B2	.051	.018	181	−2.5	+ 1.6*
ζ Virg........	30	− 0 5	3.4	A2	.285	.038	86	1.3	−13.1

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
ε Cent........	13 34	−52 57	2.6	B2	.039	.012	272	−2.0	− 5.6
η U. Maj......	44	+49 49	1.9	B3	.116	.015	217	−2.2	−10.9
μ Cent	44	−41 59	3.3	B3e	.026	.009	362	−1.9	+12.6
ζ Cent........	49	−46 48	3.1	B3	.080	.013	251	−1.3	*
η Boot........	50	+18 54	2.8	G1	.370	.100	33	2.8	− 0.2*
β **Cent**.......	57	−59 53	0.9	B3	.039	.026	125	−2.0	−12. *
π Hyda.......	14 1	−26 12	3.5	K3	.164	.037	88	1.3	+27.2
θ Cent........	1	−35 53	2.3	G8	.745	.056	58	1.0	+ 1.3
α **Boot**.......	11	+19 42	0.2	K0	2.287	.102	32	0.2	− 5.1
γ Boot........	28	+38 45	3.0	A3	.182	.063	52	2.0	−35.5
η Cent........	29	−41 43	2.6	B3	.046	.012	272	−2.0	− 0.2*
‖α **Cent**.......	33	−60 25	0.1	G0	3.682	.768	4	4.5	−22.2*
α Circ........	34	−64 32	3.4	F0	.308	.063	52	2.4	+ 7.4
α Lupi........	35	−46 58	2.9	B2	.033	.009	362	−2.3	+ 7.3*
‖ε Boot........	41	+27 30	2.7	G8	.045	.019	172	−0.9	−16.4
‖$α^2$ Libr.........	45	−15 38	2.9	F1	.128	.056	58	1.6	−10. *
β U. Min......	51	+74 34	2.2	K4	.028	.030	109	−0.4	+16.9
β Lupi........	52	−42 44	2.8	B3	.067	.012	272	−1.8	− 0.3*
κ Cent........	53	−41 42	3.4	B2	.034	.011	296	−1.4	+ 9.1*
σ Libr........	58	−24 53	3.4	M4	.091	.020	163	−0.1	− 4.3
ζ Lupi........	15 5	−51 43	3.5	G5	.125	.027	121	0.7	− 9.7
γ Tr. Au......	10	−68 19	3.1	A0	.064	.....	.....	.....	0.
β Libr........	12	− 9 1	2.7	B8	.100	.015	217	−1.4	−37. *
δ Lupi........	15	−40 17	3.4	B3	.031	.012	272	−1.2	+ 1.6
γ U. Min......	21	+72 11	3.1	A2	.016	.022	148	−0.2	− 3.9*
ι Drac........	23	+59 19	3.5	K3	.010	.030	109	0.9	−11.1
‖γ Lupi........	28	−40 50	3.0	B3	.038	.013	251	−1.4	+ 6.
α Cor. B......	30	+27 3	2.3	A0	.160	.054	60	1.0	+ 1.0*
α Serp........	39	+ 6 44	2.8	K3	.142	.043	76	1.0	+ 3.0
β Tr. Au......	46	−63 7	3.0	F0	.436	.096	34	2.9	− 0.3
π Scor........	53	−25 50	3.0	B3	.037	.012	272	−1.6	− 3.0*
δ Scor........	54	−22 20	2.5	B1	.039	.011	296	−2.3	−16. *
‖β Scor........	16 0	−19 32	2.8	B3	.029	.016	204	−1.2	− 9.3*
δ Ophi........	9	− 3 26	3.3	K8	.159	.030	109	0.7	−19.8
ε Ophi........	13	− 4 27	3.3	G9	.088	.031	105	0.8	−10.3
‖σ Scor........	15	−25 21	3.1	B1	.033	.009	362	−2.1	− 0.4*
‖η Drac........	23	+61 44	2.9	G5	.062	.038	86	0.8	−14.3

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
‖α **Scor**........	16 23	−26 12	1.2	M1	.032	.019	172	−2.4	− 3.2*
β Herc........	26	+21 42	2.8	G4	.104	.020	163	−0.7	−25.8*
τ Scor........	30	−28 1	2.9	B1	.037	.009	362	−2.3	+ 0.6
ζ Ophi........	32	−10 22	2.7	B0	.023	.008	407	−2.8	−19. *
‖ζ Herc........	38	+31 47	3.0	G0	.601	.105	31	3.1	−70.8*
α Tr. Au......	38	−68 51	1.9	K5	.031	.025	130	−1.1	− 3.7
ε Scor........	44	−34 7	2.4	G9	.665	.038	86	0.3	− 2.5
μ¹ Scor........	45	−37 53	3.1	B3p	.030	.011	296	−1.7	*
ζ Arae........	50	−55 50	3.1	K5	.046	.028	116	0.3	− 6.0
κ Ophi........	53	+ 9 32	3.1–4.0	K3	.290	.042	78	1.2	−55.6
‖η Ophi........	17 5	−15 36	2.6	A2	.095	.047	69	1.0	− 1.0
η Scor........	5	−43 6	3.4	A7	.294	.066	49	2.5	−28.4
ζ Drac........	8	+65 50	3.2	B8	.023	.028	116	0.4	−14.1
‖α¹ Herc........	10	+14 30	3.1–3.9	M7	.030	.008	407	−2.4	−32.5
δ Herc........	11	+24 57	3.2	A2	.164	.036	91	1.0	−39. *
π Herc........	12	+36 55	3.4	K3	.021	.018	181	−0.3	−25.7
θ Ophi........	16	−24 54	3.4	B2	.031	.008	407	−2.1	− 3.6
β Arae........	17	−55 26	2.8	K1	.036	.023	142	−0.4	− 0.4
υ Scor........	24	−37 13	2.8	B3	.042	.010	326	−2.2	+18. *
α Arae........	24	−49 48	3.0	B3e	.090	.015	217	−1.1	− 2.2
λ Scor........	27	−37 2	1.7	B2	.036	.016	204	−2.3	0. *
β Drac........	28	+52 23	3.0	G0	.012	.007	466	−2.8	−20.1
θ Scor........	30	−42 56	2.0	F0	.012	.024	136	−1.1	+ 1.4
α Ophi........	30	+12 38	2.1	A0	.264	.060	54	1.0	+15. *
κ Scor........	36	−38 58	2.5	B3	.028	.009	362	−2.7	−10. *
β Ophi........	38	+ 4 37	2.9	K2	.157	.030	109	0.3	−11.9
ι¹ Scor........	41	−40 5	3.1	F8	.004	.008	407	−2.4	−27.6*
‖μ Herc........	43	+27 47	3.5	G5	.817	.114	28	3.8	−16.1
G Scor........	43	−37 1	3.2	K2	.069	.029	112	0.5	+24.7
ν Ophi........	54	− 9 46	3.5	G7	.118	.022	148	0.2	+12.4
γ Drac........	54	+51 30	2.4	K5	.026	.026	125	−0.5	−27.8
γ Sgtr........	59	−30 26	3.1	K0	.202	.030	109	0.5	+22.3*
η Sgtr........	18 11	−36 48	3.2	M4	.216	.030	109	0.6	+ 0.5
δ Sgtr........	15	−29 52	2.8	K4	.052	.033	99	0.4	−20.0
η Serp........	16	− 2 55	3.4	G9	.898	.050	65	1.9	+ 8.9
ε Sgtr........	18	−34 26	2.0	A0	.139	.020	163	−1.5	−10.8
λ Sgtr........	22	−25 29	2.9	K1	.196	.036	91	0.7	−43.3
α **Lyra**.......	34	+38 41	0.1	A1	.348	.140	23	0.8	−13.8

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
φ Sgtr........	18 39	−27 6	3.3	B8	.150	.015	217	−0.8	+21.5*
‖β Lyra........	46	+33 15	3.4–4.1	B2p	.011	.006	543	−2.7	−19.0*
σ Sgtr........	49	−26 25	2.1	B3	.067	.021	155	−1.3	−10.7
γ Lyra........	55	+32 33	3.3	B9p	.008	.016	204	−0.7	−21.5*
‖ζ Sgtr........	56	−30 1	2.7	A2	.019	.035	93	0.4	+22.1
τ Sgtr........	19 1	−27 49	3.4	K0	.268	.036	91	1.2	+45.4*
ζ Aqil........	1	+13 43	3.0	A0	.103	.038	86	0.9	−25. *
π Sgtr........	4	−21 11	3.0	F2	.041	.017	192	−0.8	− 9.8
δ Drac........	13	+67 29	3.2	G8	.135	.028	116	0.4	+24.8
δ Aqil........	21	+ 2 55	3.4	A3	.267	.052	63	2.0	−32.3*
‖β¹ Cygn.......	27	+27 45	3.2	K0	.010	.010	326	−1.8	−23.9*
γ Agil........	42	+10 22	2.8	K3	.018	.018	181	−0.9	− 2.0
‖δ Cygn.......	42	+44 53	3.0	A1	.067	.023	116	0.2	−20.
α **Aqil**........	46	+ 8 36	0.9	A2	.659	.184	18	2.2	−26.1
θ Aqil........	20 6	− 1 7	3.4	A0	.035	.018	181	−0.3	−28.6*
‖β Capr........	15	−15 6	3.2	F8	.042	.022	148	−0.1	−19.0*
α Pavo........	18	−57 3	2.1	B3	.087	.014	233	−2.2	+ 1.8*
γ Cygn.......	19	+39 56	2.3	F8	.006	.008	407	−3.2	− 7.6
α Indi........	31	−47 38	3.2	G2	.072	.034	96	0.9	− 1.1
α **Cygn**.......	38	+44 55	1.3	A2p	.004	.002	1630	−7.2	− 6.3*
ε Cygn.......	42	+33 36	2.6	G7	.485	.040	81	0.6	−10.5*
ζ Cygn.......	21 9	+29 49	3.4	G6	.061	.018	181	−0.3	+16.9*
α Ceph.......	16	+62 10	2.6	A2	.163	.076	43	2.0	− 8.
β Aqar........	26	− 6 1	3.1	G1	.020	.008	407	−2.4	+ 6.7
β Ceph.......	27	+70 7	3.3–3.4	B1	.013	.006	543	−2.8	− 7.2
ε Pegs........	39	+ 9 25	2.5	K2	.028	.014	233	−1.8	+ 5.2
δ Capr........	42	−16 35	3.0	A3	.395	.062	53	2.0	− 6.4*
γ Grus........	48	−37 50	3.2	B8	.114	.020	163	−0.3	− 2.1
α Aqar........	22 1	− 0 48	3.2	G0	.019	.006	543	−2.9	+ 7.6
α Grus........	2	−47 27	2.2	B5	.202	.036	91	0.0	+11.8
α Tucn.......	12	−60 45	2.9	K5	.088	.019	172	−0.7	+42.2*
β Grus........	37	−47 24	2.2	M6	.131	.010	326	−2.8	+ 1.6
η Pegs........	38	+29 42	3.1	G1	.039	.016	204	−0.9	+ 4.4*
α **Psc. A**......	52	−30 9	1.3	A3	.367	.118	28	1.7	+ 6.5
β Pegs........	59	+27 32	2.6	M3	.235	.020	163	−0.9	+ 8.6
α Pegs........	59	+14 40	2.6	A0	.077	.033	99	0.2	− 4. *
γ Ceph.......	23 35	+77 4	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 1900 h m	δ ° ′	Cl.	Diam. ′	Mag. B.S.	No.	Int. mag.	Dist. l.y.
869		h Per	02 12.0	+56 41	Op	30	7			4,300
884		χPer	02 15.4	+56 39	Op	30	7			4,300
1039	34	Per	02 35.6	+42 21	Op	30	9	80		1,500
Pleiades	45	Tau	03 41.5	+23 48	Op	120	4.2	250		490
Hyades		Tau	04 14	+15 23	Op	400	4.0	100		120
1912	38	Aur	05 22.0	+35 45	Op	18	9.7	100		2,800
2099	37	Aur	05 45.8	+32 31	Op	24	9.7	150		2,700
2168	35	Gem	06 02.7	+24 21	Op	29	9.0	120		2,700
2287	41	C Ma	06 42.7	−20 38	Op	32	9	50		1,300
2632	44	Cnc	08 34.3	+20 20	Op	90	6.5	350		490
5139		ωCen	13 20.8	−46 47	Gl	23	12.9		3	22,000
5272	3	C Vn	13 37.6	+28 53	Gl	10	14.2		4.5	40,000
5904	5	Ser	15 13.5	+02 27	Gl	13	14.0		3.6	35,000
6121	4	Scr	16 17.5	−26 17	Gl	14	13.9		5.2	24,000
6205	13	Her	16 38.1	+36 39	Gl	10	13.8		4.0	34,000
6218	12	Oph	16 42.0	−01 46	Gl	9	14.0		6.0	36,000
6254	10	Oph	16 51.9	−03 57	Gl	8	14.1		5.4	36,000
6341	92	Her	17 14.1	+43 15	Gl	8	13.9		5.1	36,000
6494	23	Sgr	17 51.0	−19 00	Op	27	10.2	120		2,200
6611	16	Ser	18 13.2	−13 49	Op	8	10.6	55		6,700
6656	22	Sgr	18 30.3	−23 59	Gl	17	12.9		3.6	22,000
7078	15	Peg	21 25.2	+11 44	Gl	7	14.3		5.2	43,000
7089	2	Aqr	21 28.3	−01 16	Gl	8	14.6		5.0	45,000
7092	39	Cyg	21 28.6	+48 00	Op	32	6.5	25		11,000
7654	52	Cas	23 19.8	+61 03	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.

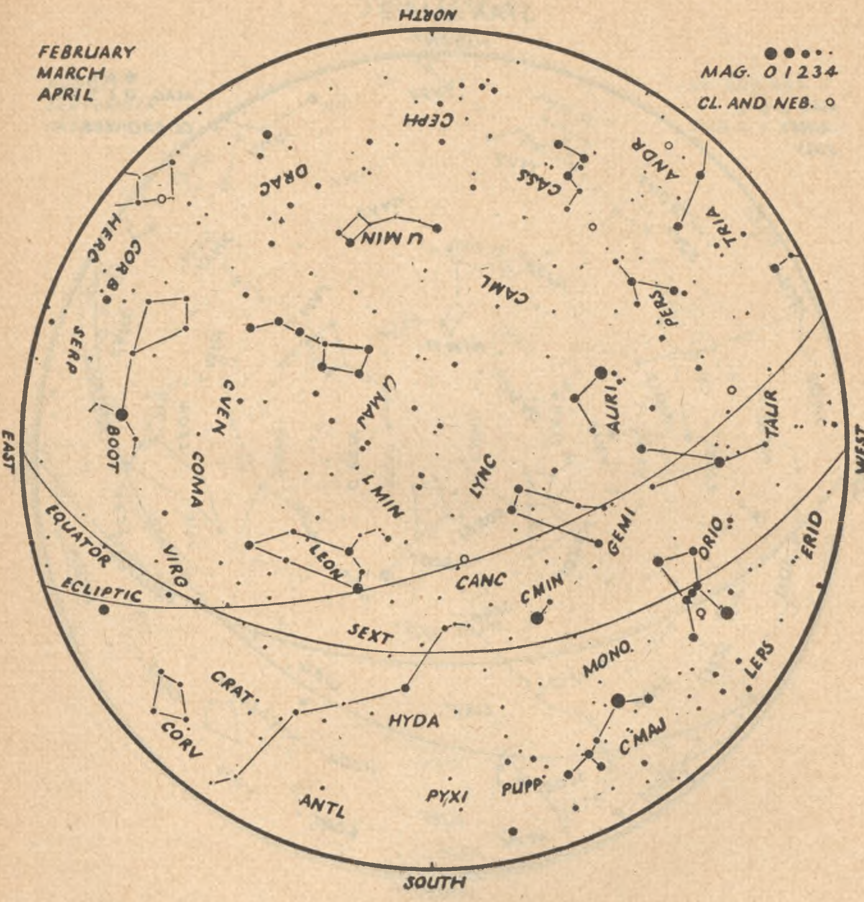
N.G.C.	M	Con	α 1900 h m	δ ° ′	Cl	Size ′	m n	m *	Dist. l.y.	Name
650	76	Per	01 36.0	+51 04	Pl	1.5	11	17	15,000	
1952	1	Tau	05 28.5	+21 57	Pl	6	11	16	10,000	Crab
1976	42	Ori	05 30.4	−05 27	Dif	30			1,800	Orion
B33		Ori	05 35.9	−02 31	Drk	4			300	Horsehead
2261		Mon	06 33.7	+08 49	Dif	2				Hubble's var
2392		Gem	07 23.3	+21 07	Pl	0.3	8	10	2,800	
2440		Pup	07 37.5	−17 58	Pl	0.9	11	16	8,600	
3587	97	UMa	11 09.0	+55 34	Pl	3.3	11	14	12,000	Owl
		Cru	12 45	−63	Drk	300			300	Coalsack
6210		Her	16 40.3	+23 59	Pl	0.3	10	12	5,600	
B72		Oph	17 17.5	−23 32	Drk	20			400	S nebula
6514	20	Sgr	17 56.3	−23 02	Dif	24			3,200	Trifid
B86		Sgr	17 56.8	−27 52	Drk	5				
6523	8	Sgr	17 57.6	−24 23	Dif	50			3,600	Lagoon
6543		Dra	17 58.6	+66 38	Pl	0.4	9	11	3,500	
6572		Oph	18 07.2	+06 50	Pl	0.2	9	12	4,000	
B92		Sgr	18 09.8	−18 16	Drk	15				
6618	17	Sgr	18 15.0	−16 13	Dif	26			3,000	Horseshoe
6720	57	Lyr	18 49.9	+32 54	Pl	1.4	9	14	5,400	Ring
6826		Cyg	19 42.1	+50 17	Pl	0.4	9	11	3,400	
6853	27	Vul	19 55.3	+22 27	Pl	8	8	13	3,400	Dumb-bell
6960		Cyg	20 41.5	+30 21	Dif	60				Network
7000		Cyg	20 55.2	+43 56	Dif	100				N. America
7009		Aqr	20 58.7	−11 46	Pl	0.5	8	12	3,000	
7662		And	23 21.1	+41 59	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 1900 h m	δ ° ′	Cl	Dimens. ′ ′	Mag.	Distance l.y.	Vel. km/sec
221	32	And	00 37.2	+40 19	E	3×3	8.8	800,000	− 185
224	31	And	00 37.3	+40 43	Sb	160×40	5.0	800,000	− 220
SMC		Tuc	00 51	−72 54	I	220×220	1.5	100,000	+ 170
598	33	Tri	01 28.2	+30 09	Sc	60×40	7.0	700,000	− 70
LMC		Dor	05 21	−69 30	I	430×530	0.5	90,000	+ 280
3031	81	UMa	09 47.3	+69 32	Sb	16×10	8.3	2,400,000	− 30
3034	82	UMa	09 47.5	+70 10	I	7× 2	9.0	2,600,000	+ 290
3368	96	Leo	10 41.5	+12 21	Sa	7× 4	10.0	5,700,000	+ 940
3623	65	Leo	11 13.7	+13 38	Sb	8× 2	9.9	5,000,000	+ 800
3627	66	Leo	11 15.0	+13 32	Sb	8× 2	9.1	4,300,000	+ 650
4258		CVn	12 14.0	+47 52	Sb	20× 6	8.7	4,600,000	+ 500
4374	84	Vir	12 20.0	+13 26	E	3× 2	9.9	6,000,000	+1050
4382	85	Com	12 20.4	+18 45	E	4× 2	10.0	3,700,000	+ 500
4472	49	Vir	12 24.7	+08 33	E	5× 4	10.1	5,700,000	+ 850
4565		Com	12 31.4	+26 32	Sb	15× 1	11.0	7,600,000	+1100
4594		Vir	12 34.8	−11 04	Sa	7× 2	9.2	7,200,000	+1140
4649	60	Vir	12 38.6	+12 06	E	4× 3	9.5	7,500,000	+1090
4736	94	CVn	12 46.2	+41 40	Sb	5× 4	8.4	3,000,000	+ 290
4826	64	Com	12 51.8	+22 13	Sb	8× 4	9.2	1,300,000	+ 150
5005		CVn	13 06.3	+37 36	Sc	5× 2	11.1	6,600,000	+ 900
5055	63	CVn	13 11.3	+42 34	Sb	8× 3	9.6	3,600,000	+ 450
5194	51	CVn	13 25.7	+47 43	Sc	12× 6	7.4	3,000,000	+ 250
5236	83	Hya	13 31.4	−29 21	Sc	10× 8	8	2,900,000	+ 500
6822		Sgr	19 39.6	−15 01	I	20×10	11	1,000,000	− 150
7331		Peg	22 32.5	+33 54	Sb	9× 2	10.4	5,200,000	+ 500

STAR MAP I

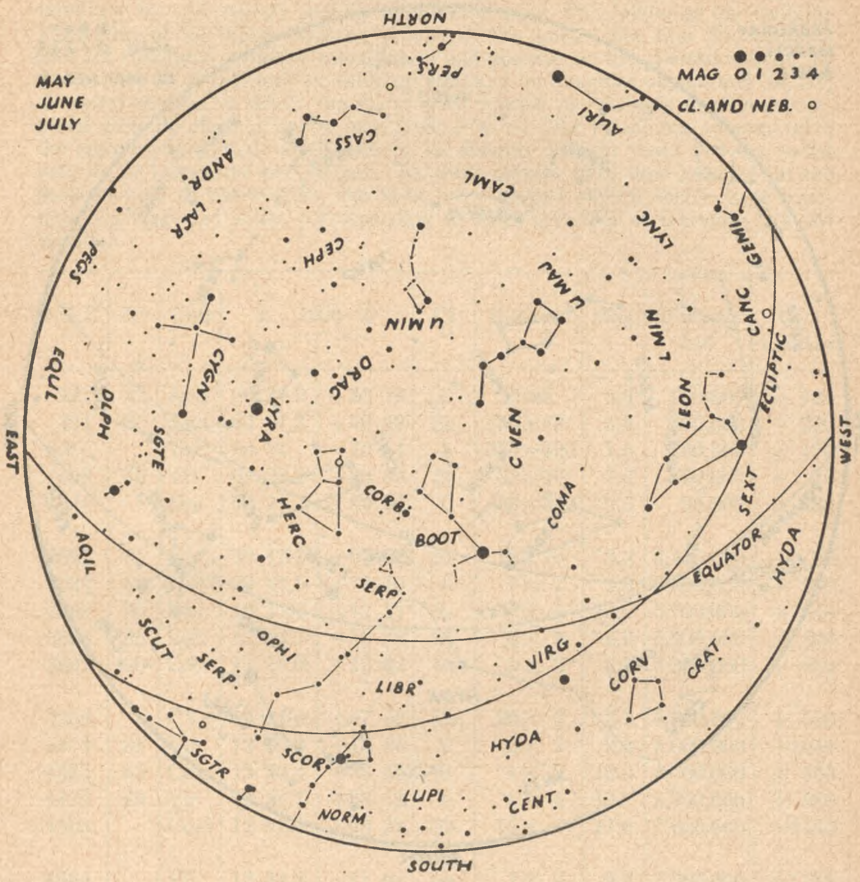


The above map represents the evening sky at

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

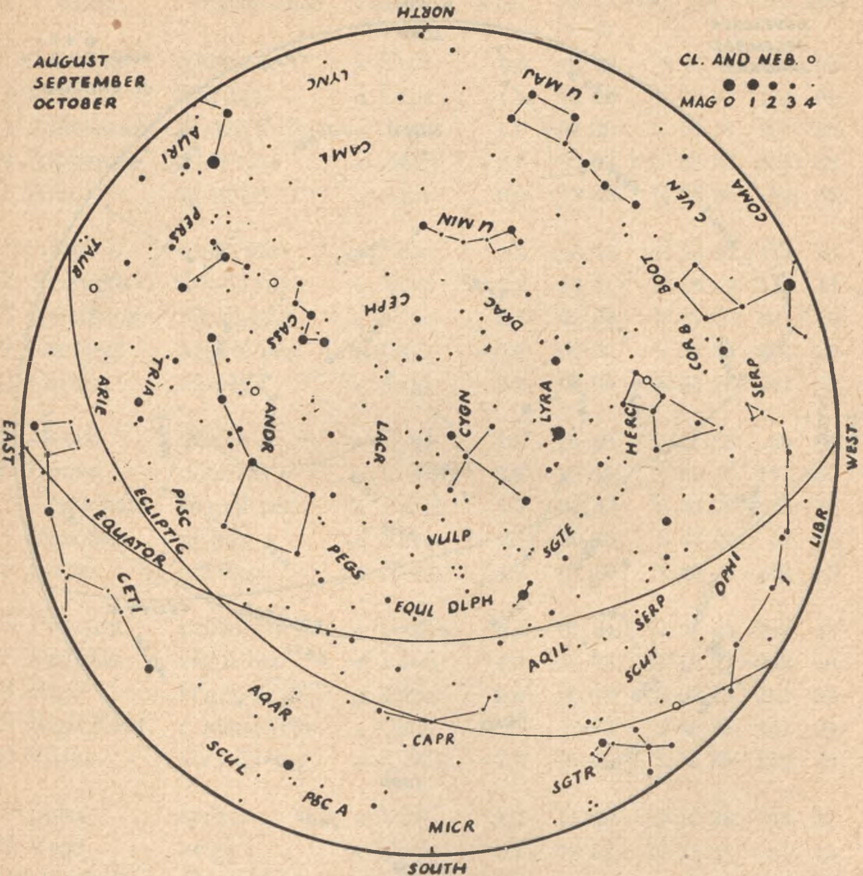


The above map represents the evening sky at

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

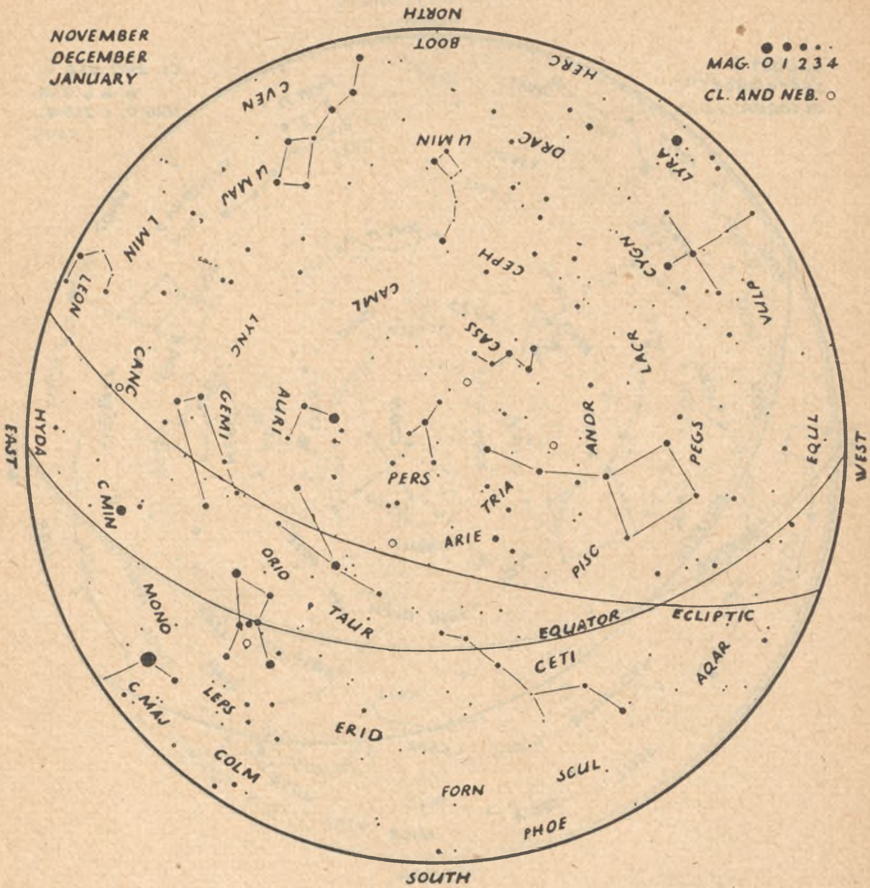


The above map represents the evening sky at

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. 1900 h m	Dec. ° ′	SHA 1943 ° ′
1	Achernar	ā′ker-när	α Erid	0.6	01 34	S 57 44	336 06
2	Acrux	ă′krŭks	α Cruc	1.1	12 21	S 62 33	174 09
3	Aldebaran	ăl-dĕb′ă-răn	α Taur	1.1	04 30	N 16 18	291 50
4	Alpheratz	ăl-fē′răts	α Andr	2.2	00 03	N 28 32	358 38
5	Altair	ăl-tä′ĭr	α Aqil	0.9	19 46	N 08 36	63 00
6	Antares	ăn-ta′rēz	α Scor	1.2	16 23	S 26 12	113 36
7	Arcturus	ärk-tŭ′rŭs	α Boot	0.2	14 11	N 19 42	146 44
8	Betelgeuse	bĕt-ĕl-gûz′	α Orio	0.8*	05 50	N 07 23	271 59
9	Canopus	ka-nō′-pûs	α Cari	−0.9	06 22	S 52 38	264 20
10	Capella	kä-pĕl′ä	α Auri	0.2	05 09	N 45 54	281 53
11	Deneb	dĕn′ĕb	α Cygn	1.3	20 38	N 44 55	50 08
12	Dubhe	dōōb′hĕ	α U Maj	2.0	10 58	N 62 17	194 57
13	Fomalhaut	fō′măl-hôt	α Psc A	1.3	22 52	S 30 09	16 22
14	Peacock	pē′kŏk	α Pavo	2.1	20 18	S 57 03	54 43
15	Pollux	pŏl′ŭks	β Gemi	1.2	07 39	N 28 16	244 33
16	Procyon	prō′sĭ-ŏn	α C Min	0.5	07 34	N 05 29	245 55
17	Regulus	rĕg′ū-lūs	α Leon	1.3	10 03	N 12 27	208 40
18	Rigel	rī′gĕl, rī′jĕl	β Orio	0.3	05 10	S 08 19	282 03
19	Rigil Kent.	r. kĕn-tô′rŭs	α Cent	0.1	14 33	S 60 25	141 04
20	Sirius	sĭr′ĭ-ŭs	α C Maj	−1.6	06 41	S 16 35	259 20
21	Spica	spī′kä	α Virg	1.2	13 20	S 10 38	159 27
22	Vega	vē′gä	α Lyra	0.1	18 34	N 38 41	81 15
30	Denebola	dĕn-ĕb′ō-lä	β Leon	2.2	11 44	N 15 08	183 28
39	Benetnasch	bĕ-nĕt′nash	η U Maj	1.9	13 44	N 49 49	153 41
47	Polaris	pō-lā′rĭs	α U Min	2.3	01 23	N 88 46	333 54

*No. 8. Magnitude varies from 0.5 to 1.1
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 δ = +85°	+80°	+75°	+70°	+60°	+50°	+40°	+30°	+20°	+10°	0°	−10°	−20°	−30°	Prec. in Dec.	R.A.
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.

	Mean Temperature, Fahrenheit.												Average Annual.		
Station.	Jan.	Feb.	Ma.	Ap.	May	Ju.	Jul.	Aug.	Sep.	Oc.	No.	De.	M	H	L
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.

	Mean Precipitation. (Unit = one tenth of an inch)												Year.		
Station	Jan.	Feb.	Ma.	Ap.	May	Ju.	Jul.	Aug.	Sep.	Oc.	No.	De.	M	W	D
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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1890-1943

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