B. Sandbrook

THE OBSERVER'S HANDBOOK FOR 1945

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The Royal Astronomical Society of Canada

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

THIRTY-SEVENTH YEAR OF PUBLICATION

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1944

1945 CALENDAR 1945

JANUARY

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

FEBRUARY

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

MARCH

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

APRIL

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

MAY

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

JUNE

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

JULY

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

AUGUST

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

SEPTEMBER

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

OCTOBER

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

NOVEMBER

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

DECEMBER

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

JULIAN DAY CALENDAR, 1945

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

Jan. 1	457	May 1	577	Sep. 1	700
Feb. 1	488	Jun. 1	608	Oct. 1	730
Mar. 1	516	Jul. 1	638	Nov. 1	761
Apr. 1	547	Aug. 1	669	Dec. 1	791

The Julian Day commences at noon.
Thus J.D. 2,431,457 = Jan. 1.5 G.C.T.

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TABLES IN RECENT OBSERVER'S HANDBOOKS

PRINTED IN CANADA

PREFACE

The HANDBOOK for 1945 is the 37th issue. No new features have been introduced, but all the old ones have been continued.

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,
Richmond Hill, Ont., December 1944.

C. A. CHANT

ANNIVERSARIES AND FESTIVALS 1945

New Year's Day	Mon.	Jan. 1
Epiphany	Sat.	Jan. 6
Septuagesima Sunday		Jan. 28
Quinquagesima (Shrove Sunday)		Feb. 11
Ash Wednesday		Feb. 14
St. David	Thu.	Mar. 1
St. Patrick	Sat.	Mar. 17
Palm Sunday		Mar. 25
Good Friday		Mar. 30
Easter Sunday		Apr. 1
St. George	Mon.	Apr. 23
Rogation Sunday		May 6
Ascension Day	Thu.	May 10
Pentecost (Whit Sunday)		May 20
Empire Day (Victoria Day)	Thu.	May 24
Birthday of the Queen Mother, Mary (1867)	Sat.	May 26
Trinity Sunday		May 27
Corpus Christi	Thu.	May 31
St. John Baptist (Midsummer Day)	Sun.	Jun. 24
Dominion Day	Sun.	Jul. 1
Birthday of Queen Elizabeth, (1900)	Sat.	Aug. 4
Labour Day	Mon.	Sep. 3
Hebrew New Year (Rosh Hashanah)	Sat.	Sep. 8
St. Michael (Michaelmas Day)	Sat.	Sep. 29
All Saints' Day	Thu.	Nov. 1
Remembrance Day	Sun.	Nov. 11
St. Andrew	Fri.	Nov. 30
First Sunday in Advent		Dec. 2
Ascension of King George VI (1936)	Tue.	Dec. 11
Birthday of King George VI (1895)	Fri.	Dec. 14
Christmas Day	Tue.	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	$= 1.60935 \times 10^5$ cm.	$= 1.60935$ km.
1 astronomical unit	$= 1.49504 \times 10^{13}$ cm.	$= 92{,}897{,}416$ miles
1 light year	$= 9.463 \times 10^{17}$ cm.	$= 5.880 \times 10^{12}$ miles $= 0.3069$ parsecs
1 parsec	$= 30.84 \times 10^{17}$ cm.	$= 19.16 \times 10^{12}$ miles $= 3.259$ l.y.
1 megaparsec	$= 30.84 \times 10^{23}$ cm.	$= 19.16 \times 10^{18}$ miles $= 3.259 \times 10^6$ l.y.

UNITS OF TIME

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

THE EARTH

Equatorial radius, a = 3963.35 miles; flattening, c = $(a-b)/a = 1/297.0$
Polar radius, b = 3950.01 miles
1° of latitude = $69.057 - 0.349 \cos 2\phi$ miles (at latitude ϕ)
1° of longitude = $69.232 \cos \phi - 0.0584 \cos 3\phi$ miles

Mass of earth = 6.6×10^{21} tons; velocity of escape from $\oplus$ = 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 $\oplus$ = 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, $G = 6.670 \times 10^{-8}$ c.g.s. units
Mass of the electron, $m = 9.035 \times 10^{-28}$ gm.; mass of the proton $= 1.662 \times 10^{-24}$ gm.
Planck's constant, $h = 6.55 \times 10^{-27}$ erg. sec.
Loschmidt's number = 2.705×10^{19} molecules/cu. cm. of gas at N.T.P.
Absolute temperature = $T°$ K = $T°$C + 273° = 5/9 ($T°$ F + 459°)

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

π = 3.141,592,653,6

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

Date	Apparent R.A.	Corr. to Sundial	Apparent Dec.
	h m s	m s	° ′
Jan. 1	18 44 28	+03 21	−23 03.1
" 4	18 57 42	+04 45	−22 47.0
" 7	19 10 52	+06 05	−22 26.8
" 10	19 23 58	+07 22	−22 02.6
" 13	19 36 59	+08 33	−21 34.5
" 16	19 49 54	+09 39	−21 02.7
" 19	20 02 44	+10 39	−20 27.3
" 22	20 15 26	+11 32	−19 48.3
" 25	20 28 02	+12 18	−19 06.1
" 28	20 40 30	+12 56	−18 20.8
" 31	20 52 51	+13 28	−17 32.4
Feb. 3	21 05 05	+13 52	−16 41.3
" 6	21 17 12	+14 08	−15 47.5
" 9	21 29 11	+14 18	−14 51.3
" 12	21 41 03	+14 21	−13 52.8
" 15	21 52 49	+14 17	−12 52.3
" 18	22 04 28	+14 06	−11 49.9
" 21	22 16 00	+13 49	−10 45.9
" 24	22 27 27	+13 26	−09 40.3
" 27	22 38 48	+12 57	−08 33.4
Mar. 2	22 50 04	+12 23	−07 25.4
" 5	23 01 15	+11 45	−06 16.5
" 8	23 12 23	+11 03	−05 06.8
" 11	23 23 27	+10 18	−03 56.4
" 14	23 34 28	+09 29	−02 45.6
" 17	23 45 28	+08 39	−01 34.5
" 20	23 56 25	+07 46	−00 23.4
" 23	00 07 20	+06 52	+00 47.7
" 26	00 18 15	+05 58	+01 58.6
" 29	00 29 10	+05 02	+03 09.0
Apr. 1	00 40 05	+04 08	+04 18.9
" 4	00 51 00	+03 14	+05 28.1
" 7	01 01 58	+02 21	+06 36.4
" 10	01 12 57	+01 31	+07 43.8
" 13	01 23 59	+00 43	+08 49.9
" 16	01 35 04	−00 02	+09 54.8
" 19	01 46 11	−00 44	+10 58.2
" 22	01 57 22	−01 22	+11 59.9
" 25	02 08 37	−01 57	+12 59.9
" 28	02 19 57	−02 27	+13 57.9
May 1	02 31 21	−02 53	+14 53.8
" 4	02 42 49	−03 14	+15 47.6
" 7	02 54 23	−03 30	+16 39.0
" 10	03 06 02	−03 40	+17 27.9
" 13	03 17 47	−03 46	+18 14.2
" 16	03 29 36	−03 46	+18 57.8
" 19	03 41 30	−03 41	+19 38.4
" 22	03 53 30	−03 32	+20 16.1
" 25	04 05 33	−03 17	+20 50.6
" 28	04 17 42	−02 59	+21 21.9
" 31	04 29 54	−02 36	+21 49.9
June 3	04 42 11	−02 09	+22 14.4
" 6	04 54 31	−01 39	+22 35.5
" 9	05 06 54	−01 05	+22 53.1
" 12	05 19 20	−00 29	+23 07.0
" 15	05 31 47	+00 08	+23 17.2
" 18	05 44 15	+00 47	+23 23.8
" 21	05 56 44	+01 26	+23 26.6
" 24	06 09 12	+02 05	+23 25.7
" 27	06 21 40	+02 43	+23 21.1
" 30	06 34 06	+03 19	+23 12.8

Date	Apparent R.A.	Corr. to Sundial	Apparent Dec.
	h m s	m s	° ′
July 3	06 46 31	+03 54	+23 00.9
" 6	06 58 53	+04 26	+22 45.3
" 9	07 11 12	+04 56	+22 26.2
" 12	07 23 28	+05 22	+22 03.6
" 15	07 35 39	+05 44	+21 37.6
" 18	07 47 46	+06 01	+21 08.3
" 21	07 59 48	+06 13	+20 35.7
" 24	08 11 45	+06 21	+20 00.0
" 27	08 23 36	+06 22	+19 21.4
" 30	08 35 23	+06 19	+18 39.8
Aug. 2	08 47 04	+06 10	+17 55.5
" 5	08 58 40	+05 56	+17 08.6
" 8	09 10 10	+05 37	+16 19.1
" 11	09 21 35	+05 13	+15 27.3
" 14	09 32 55	+04 43	+14 33.2
" 17	09 44 10	+04 08	+13 37.1
" 20	09 55 20	+03 29	+12 39.0
" 23	10 06 26	+02 45	+11 39.2
" 26	10 17 27	+01 57	+10 37.6
" 29	10 28 25	+01 05	+09 34.6
Sept. 1	10 39 21	+00 11	+08 30.2
" 4	10 50 13	−00 47	+07 24.5
" 7	11 01 03	−01 46	+06 17.7
" 10	11 11 52	−02 47	+05 10.0
" 13	11 22 39	−03 50	+04 01.6
" 16	11 33 25	−04 54	+02 52.4
" 19	11 44 10	−05 58	+01 42.8
" 22	11 54 56	−07 01	+00 32.9
" 25	12 05 43	−08 04	−00 37.2
" 28	12 16 31	−09 06	−01 47.3
Oct. 1	12 27 21	−10 05	−02 57.4
" 4	12 38 14	−11 02	−04 07.2
" 7	12 49 10	−11 56	−05 16.5
" 10	13 00 10	−12 46	−06 25.3
" 13	13 11 13	−13 32	−07 33.3
" 16	13 22 21	−14 14	−08 40.3
" 19	13 33 34	−14 50	−09 46.2
" 22	13 44 53	−15 21	−10 50.8
" 25	13 56 17	−15 47	−11 54.0
" 28	14 07 48	−16 05	−12 55.6
" 31	14 19 26	−16 17	−13 55.3
Nov. 3	14 31 11	−16 22	−14 53.1
" 6	14 43 03	−16 19	−15 48.7
" 9	14 55 03	−16 09	−16 41.9
" 12	15 07 11	−15 51	−17 32.6
" 15	15 19 25	−15 26	−18 20.5
" 18	15 31 48	−14 54	−19 05.5
" 21	15 44 17	−14 14	−19 47.5
" 24	15 56 54	−13 26	−20 26.2
" 27	16 09 38	−12 32	−21 01.5
" 30	16 22 29	−11 31	−21 33.3
Dec. 3	16 35 26	−10 23	−22 01.4
" 6	16 48 29	−09 10	−22 25.7
" 9	17 01 36	−07 53	−22 46.0
" 12	17 14 48	−06 31	−23 02.4
" 15	17 28 02	−05 06	−23 14.6
" 18	17 41 19	−03 39	−23 22.6
" 21	17 54 37	−02 10	−23 26.4
" 24	18 07 56	−00 41	−23 26.0
" 27	18 21 16	+00 49	−23 21.4
" 30	18 34 34	+02 17	−23 12.5

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.

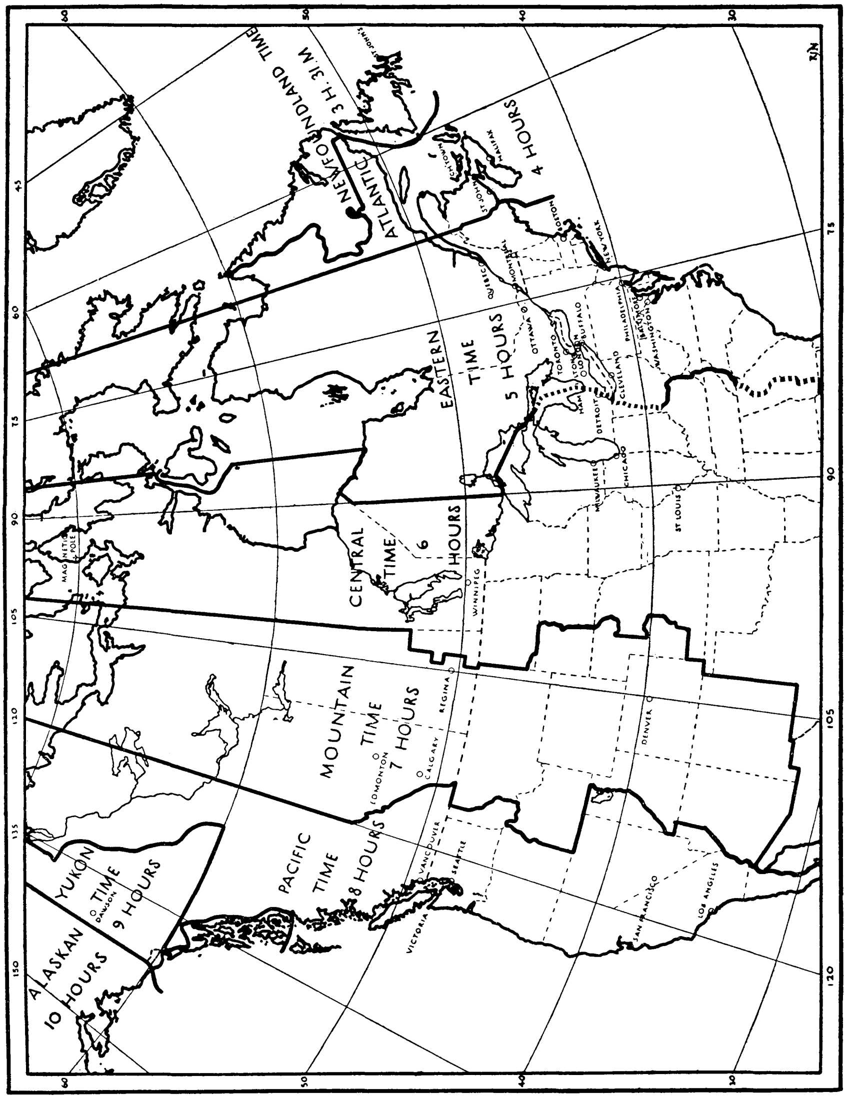
4. *Standard Time*—In everyday life we use still another kind of time. A moment's thought will show that in general two places will not have the same mean time; indeed, difference in longitude between two places is determined from their difference in time. But in travelling it is very inconvenient to 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, 1945

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

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

TIMES OF MOONRISE AND MOONSET, 1945

Date Mar.	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	20 28	8 07	20 28	8 08	20 30	8 09	20 30	8 10
2	21 25	8 32	21 29	8 30	21 34	8 27	21 36	8 27
3	22 23	8 58	22 30	8 53	22 39	8 46	22 42	8 44
4	23 21	9 25	23 31	9 18	23 44	9 08	23 49	9 03
5	.. ..	9 56	.. ..	9 45	.. ..	9 32	.. ..	9 25
6 ☾	0 20	10 31	0 33	10 17	0 49	10 01	0 56	9 53
7	1 20	11 12	1 36	10 56	1 54	10 37	2 03	10 27
8	2 19	11 59	2 86	11 42	2 56	11 21	3 06	11 11
9	3 15	12 55	3 33	12 38	3 54	12 17	4 04	12 07
10	4 09	13 58	4 25	13 43	4 44	13 23	5 54	13 14
11	4 56	15 06	5 10	14 55	5 27	14 39	5 35	14 31
12	5 39	16 22	5 50	16 11	6 03	16 01	6 09	15 54
13 ●	6 17	17 37	6 25	17 31	6 34	17 25	6 37	17 21
14	6 52	18 53	6 56	18 51	7 00	18 49	7 02	18 49
15	7 26	20 08	7 25	20 10	7 25	20 14	7 25	20 15
16	8 00	21 22	7 55	21 29	7 50	21 37	7 48	21 41
17	8 36	22 36	8 27	22 46	8 17	22 58	8 13	23 05
18	9 12	23 46	9 02	.. ..	8 48	.. ..	8 41	.. ..
19	9 55	.. ..	9 41	0 00	9 23	0 16	9 15	0 24
20 ☽	10 42	0 53	10 25	1 08	10 06	1 24	9 56	1 37
21	11 34	1 54	11 17	2 11	10 56	2 32	10 46	2 42
22	12 30	2 47	12 13	3 04	11 53	3 24	11 43	3 34
23	13 28	3 33	13 13	3 49	12 55	4 08	12 46	4 17
24	14 27	4 13	14 15	4 27	14 00	4 42	13 53	4 51
25	15 27	4 47	15 18	4 58	15 06	5 11	15 00	5 17
26	16 26	5 18	16 20	5 26	16 12	5 35	16 07	5 39
27	17 24	5 45	17 21	5 50	17 16	5 56	17 15	5 58
28 ○	18 21	6 11	18 21	6 13	18 21	6 15	18 21	6 16
29	19 19	6 36	19 21	6 35	19 25	6 32	19 27	6 33
30	20 16	7 01	20 22	6 57	20 30	6 52	20 33	6 50
31	21 14	7 28	21 24	7 20	21 35	7 12	21 40	7 08

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

TIMES OF MOONRISE AND MOONSET, 1945

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

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

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

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

TIMES OF MOONRISE AND MOONSET, 1945

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

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

TIMES OF MOONRISE AND MOONSET, 1945

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

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

THE PLANETS IN 1945

By C. A. Chant

THE SUN

In April 1944 there was a minimum of solar activity as indicated by an entire absence of sun-spots. A fresh cycle, with a change in polarity of the spots, is now well begun.

MERCURY

Mercury is the planet nearest the sun. If we except Pluto, whose size and mass are still uncertain, we can also say that Mercury's size and mass are the smallest and that its orbit has the greatest eccentricity and greatest inclination to the ecliptic. Mercury's period of revolution is 88 days and, being within the earth's orbit, the planet appears to move quickly from one side of the sun to the other several times during the year. Its greatest elongation (i.e., its maximum angular distance from the sun) varies between 18° and 28° and on these occasions it is visible to the naked eye for about two weeks.

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

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

Elongations of Mercury during 1945

Evening Star			Morning Star		
Date	*Distance*	*Mag.*	*Date*	*Distance*	*Mag.*
March 26......	19°	+0.2	Jan. 12........	24°	0.0
July 23........	27°	+0.6	May 11.......	26°	+0.7
Nov. 17........	22°	−0.1	Sept. 6........	18°	+0.1
			Dec. 26.......	22°	−0.1

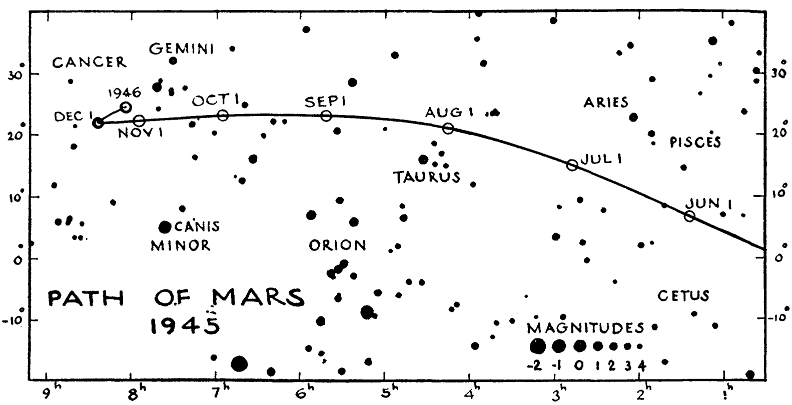
The most favourable elongations to observe are: in the evening, March 26; in the morning, Sept. 6. At these times Mercury is about 80 million miles from the earth and in the telescope looks like a half-moon about 7″ in diameter.

VENUS

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

On January 1, 1945, Venus is a brilliant evening star. On February 2 it arrives at greatest eastern elongation, 47° from the sun. Its stellar magnitude is −4.1, and in the telescope it looks like a half-moon with diameter 24″. Then it slowly moves in towards the sun. It attains greatest brilliancy on March 10, mag. −4.3. It is crescent-shaped with diameter 38″. It reaches inferior conjunction with the sun on April 15. Its distance from the earth now is but 93−67 or 26 million miles, but as it is directly towards the sun as seen from the earth it is invisible. Then it moves to the west of the sun and becomes a morning star. It attains greatest brilliancy on May 21, diameter 39″, and on June 24 arrives at greatest western elongation 46°, diameter 24″. It continues a morning star for the rest of the year, slowly diminishing in brightness as it gets farther and farther from the earth. It reaches superior conjunction with the sun about January 30, 1946.

With the exception of the sun and moon, Venus is the brightest object in the sky. Its surface is covered with dense clouds which reflect well the sun's light, but they prevent one from detecting any solid object on the planet's surface and thus enabling the determination of its rotation period; it is probably about 30 days.



MARS

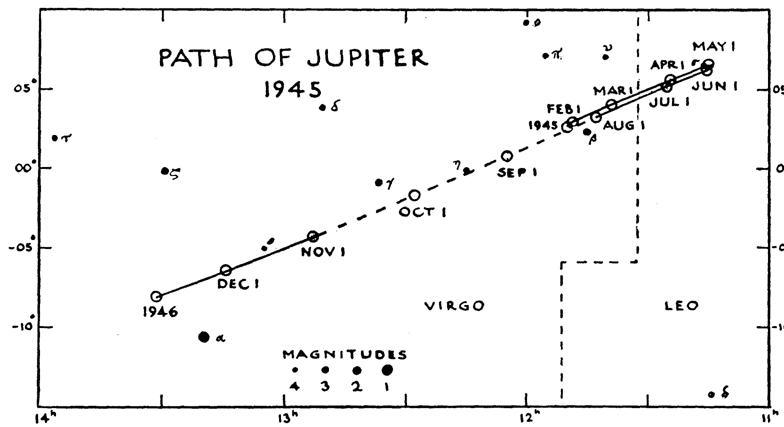
Next in order is Mars. Its orbit is outside that of the earth and hence its planetary phenomena occur quite differently from those of the two inferior planets. Its mean distance from the sun is 141 million miles and as the eccentricity of its orbit is 0.093 its distance from the sun ranges between 128 and 154 million miles. Its distance from the earth varies from 35 to 235 million miles and its brightness changes accordingly. When Mars is nearest it is conspicuous in its fiery red, but when farthest away it is no brighter than Polaris. Contrary to Venus, its atmosphere is very thin and features on the solid surface are distinctly visible. Hence its rotation period of 24h. 37m. has been accurately determined. For further details, see page 58.

Mars was in superior conjunction with the sun on November 14, 1944, and on January 1, 1945, is about 13° westerly from the sun. Thus it is unsuitably placed for observation. Moreover it is 225 million miles from the earth and is comparatively faint. By June 1 it is some 45° away from the sun but not in good position for observation. During August the planet is in Taurus, not far from Aldebaran. It continues to improve in brightness and position and on December 31 it rises about $1\frac{1}{4}$ hours after sunset.

In the accompanying map is shown the path of the planet for the latter half of the year.

JUPITER

Jupiter is the largest and most massive planet of the solar system; indeed its mean diameter is 87,000 miles and it is $2\frac{1}{2}$ times as massive as all the rest of the planets combined. Its mean distance from the sun is 483 million miles and

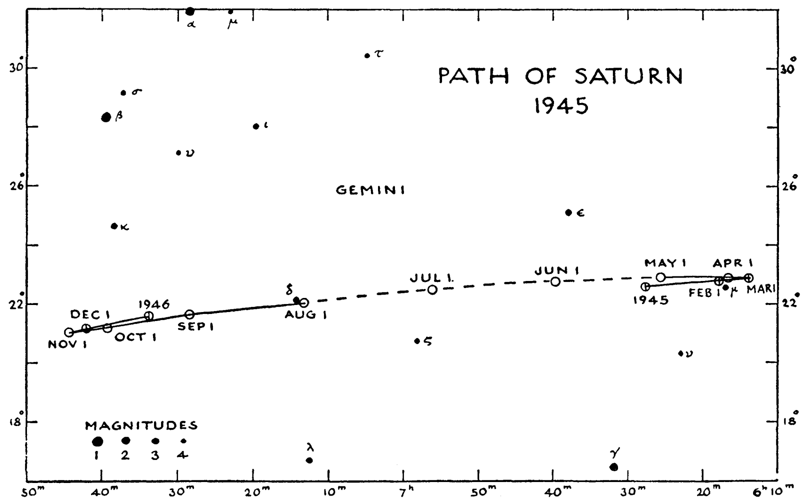


its revolution period is 11.9 years. The planet actually possesses 11 satellites, two of them discovered in 1938 (see p. 57). The spectroscope shows that the atmosphere is largely ammonia and methane. Formerly it was thought the surface temperature was high but instead it has been deduced to be −200°F.

Jupiter is a fine object for the telescope. Many details of the surface, as well as the flattening of the planet, due to the short rotation period, are clearly visible. On Jan. 1 it rises directly in the east about an hour before midnight and is visible the rest of the night. Its magnitude then is −1.7. On Mar. 13 it is in opposition with the sun and rises as the sun sets. Its magnitude then is −2.0. Its distance from the earth then is 412 million miles and its equatorial diameter is 44″. It is in conjunction with the sun October 1. In the adjoining map that portion of the path when the planet is not well placed for observation is shown by a broken line.

SATURN

Saturn was the outmost planet known until modern times. It is next in size to Jupiter, and its unique ring system makes it especially interesting in the telescope. The plane of the rings makes an angle of 27° with the plane of the planet's orbit; and twice during the planet's revolution period of $29\frac{1}{2}$ years the rings appear to open out widest; then they slowly close in until midway between the maxima the rings are presented edgewise to the earth and are invisible. They were invisible in 1936 and at a maximum in 1944. In 1945 they will be slowly closing in but will still be well observed. Their south face is presented now. On January 1 the apparent elevation of the rings is 25°.8; on December 31 it is 23°.0. Saturn has nine satellites.



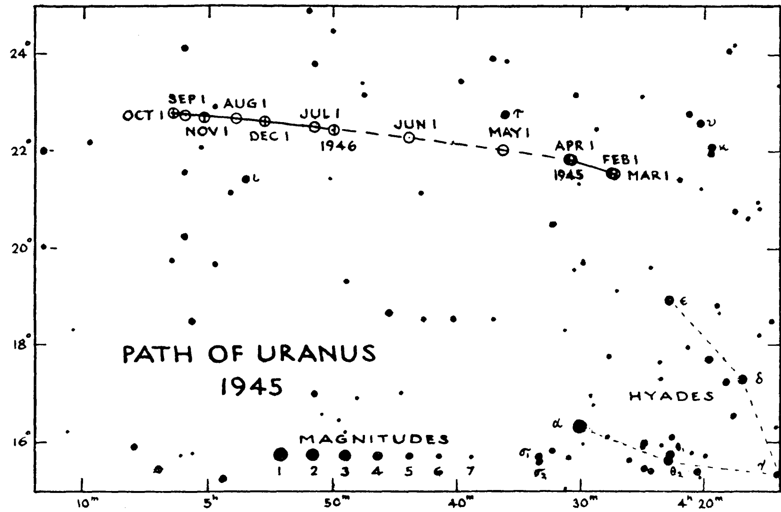
The planet is in Gemini all year. It can be well observed as an evening star during the first part of the year, and as a morning star for some months at the end of the year. (See map.) Its stellar magnitude at these times is about 0.0, and its polar diameter 18″.

Saturn is not in opposition to the sun during the calendar year 1945. It had that relation on December 28, 1944, and as its synodic period is 378 days it will attain it again early in 1946 (about January 9).

URANUS

Uranus was discovered in 1781 by Sir William Herschel by means of a $6\frac{1}{4}$-in. mirror telescope made by himself. The object did not look just like a star and on observing it another night he found it had changed its position. He thought it was a comet but computation made later showed that it was a planet nearly twice as far from the sun as Saturn. Its period of revolution is 84 years and it rotates on its axis in about 11 hours. Its four satellites are visible only in a large telescope. The spectroscope has revealed methane gas in its frigid atmosphere.

As shown by the chart Uranus in 1945 is not far from the Hyades cluster in Taurus. It is seen as an evening star during the first months of the year, is in conjunction with the sun on June 4, and is well placed as a morning star in late autumn and winter. Opposition occurs on December 7. Its distance from earth is then 1700 million miles, stellar magnitude +5.9, diameter 3″.8.



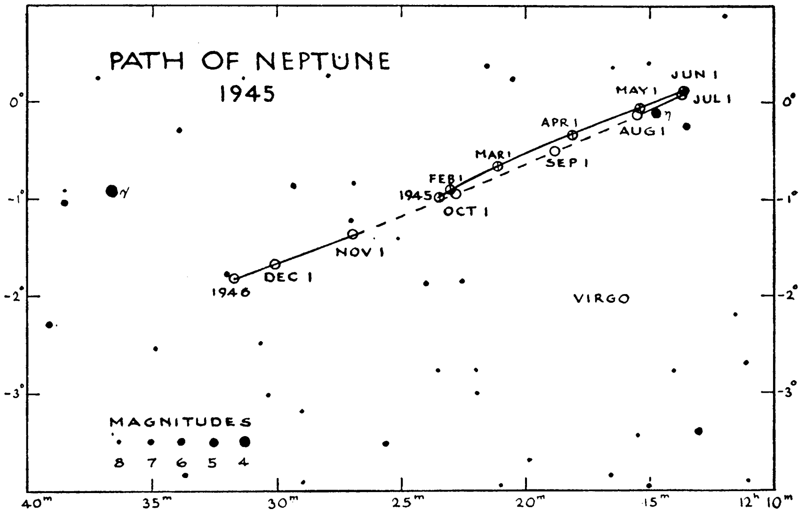
NEPTUNE

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

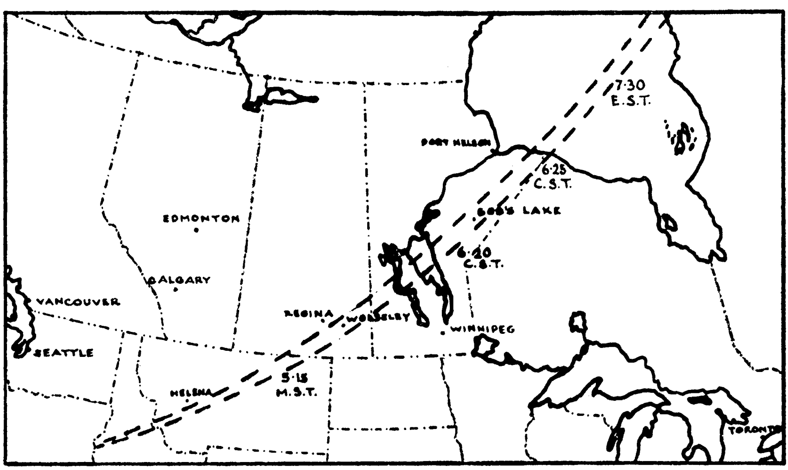
During 1945 Neptune is still in the constellation Virgo. (See chart.) It will be best seen in winter and spring as it is in opposition with the sun on March 25. Its stellar magnitude is +7.7 and hence is too faint for the naked eye. In the telescope it shows a greenish tint, and an angular diameter 2″.5. It is in conjunction with the sun, September 29.

PLUTO

Pluto, the most distant known planet, was discovered at the Lowell Observatory in 1930, following prolonged mathematical calculations and observations by photography. Its mean distance from the sun is 3666 millions of miles and its period is 248 years. It appears as a 15th magnitude star; its position in 1945 at opposition on January 31 will be R.A. 8h. 53.4 m., Dec. +23° 48′.



SOLAR ECLIPSE JULY 9, 1945



Path of Totality across Canada, see page 56

THE SKY MONTH BY MONTH

THE SKY FOR JANUARY, 1945

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 44m to 20h 57m and its Decl. changes from 23° 03′ S. to 17° 16′ S. The equation of time changes from − 3m 21s to − 13m 36s, 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 1.

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 p. 18.

Mercury on the 15th is in R.A. 18h 04m, Decl. 22° 11′ S. and transits at 10.28. It is in the morning sky all month, reaching greatest western elongation on the 12th. At this time it rises about an hour and a half before the sun and is about 11° above the south-eastern horizon at sunrise. It is in conjunction with the moon on the 12th. It ceases retrograding on the 2nd.

Venus on the 15th is in R.A. 22h 49m, Decl. 08° 30′ S. and transits at 15.13. It is a brilliant object of magnitude − 4 in the evening sky, setting over four hours after the sun. In a telescope it is approaching half-moon phase and has a diameter of 20″.

Mars on the 15th is in R.A. 18h 30m, Decl. 23° 56′ S. and transits at 10.53. It is separating from the sun 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 53m, Decl. 02° 14′ N. and transits at 4.15. It rises near the east point about five and a half hours after sunset and is visible the rest of the night as an object of magnitude − 1.8. It reaches a stationary point on the 12th when it begins to move westward among the stars. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 6h 26m, Decl. 22° 35′ N. and transits at 22.45. It is in view most of the night as a zero magnitude object in Gemini. It retrogrades all month and is in close conjunction with the moon on the 25th. The rings appear open, their plane making an angle of 26°.0 to the line of sight.

Uranus on the 15th is in R.A. 4h 31m, Decl. 21° 51′ N. and transits at 20.51. It retrogrades all month.

Neptune on the 15th is in R.A. 12h 26m, Decl. 01° 14′ S. and transits at 4.48. It begins to retrograde on the 8th.

Pluto—For information in regard to this planet, see p. 28.

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. 4h 00m
Mon. 1	18		⊕ in Perihelion. Dist. from ☉, 91,342,000 mi.	03 29	1O243
Tue. 2	9		☿ Stationary in R.A.		23O14
Wed. 3			Quadrantid meteors		321O4
Thu. 4	15	21	☌ ♃ ☾ ♃ 3° 55′ S.	00 18	d3O24
Fri. 5	9	30	☌ ♆ ☾ ♆ 4° 02′ S.		3O124
	15		Moon in Apogee. Dist. from ⊕, 251,300 mi.		
Sat. 6	7	47	☾ Last Quarter	21 08	21O34
Sun. 7					O2143
Mon. 8	5		♆ Stationary in R.A.		1O423
Tue. 9				17 57	24O31
Wed. 10					4321O
Thu. 11					43O12
Fri. 12	3	12	☌ ☿ ☾ ☿ 0° 10′ S.	14 46	43O2*
	15		♃ Stationary in R.A.		
	16	02	☌ ♂ ☾ ♂ 1° 51′ S.		
	22		☿ Greatest elongation W., 23° 40′.		
Sat. 13			Annular eclipse of ☉, see p. 56		421O3
Sun. 14	0	06	🌑 New Moon		4O13*
Mon. 15				11 35	41O23
Tue. 16					42O31
Wed. 17	9	02	☌ ♀ ☾ ♀ 3° 50′ N.		321O4
	12		Moon in Perigee. Dist. from ⊕, 228,200 mi.		
Thu. 18				08 25	3O124
Fri. 19					3O24*
Sat. 20	18	48	☽ First Quarter		d2O34
Sun. 21				05 14	O134*
Mon. 22					1O234
Tue. 23	7		☿ in ☋		2O314
	13	08	☌ ♅ ☾ ♅ 3° 22′ N.		
Wed. 24				02 03	321O4
Thu. 25	12	34	☌ ♄ ☾ ♄ 0° 30′ N.		3O412
	18		♀ in ☊		
Fri. 26	10		☌ ☿ ♂ ☿ 0° 22′ N.	22 53	341O2
Sat. 27					d42O*
Sun. 28	1	41	🌕 Full Moon		42O13
Mon. 29				19 42	41O23
Tue. 30					d4O13
Wed. 31	22	29	☌ ♃ ☾ ♃ 3° 43′ S.		4231O

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

THE SKY FOR FEBRUARY, 1945

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 57m to 22h 46m and its Decl. changes from 17° 16′ S. to 07° 48′ S. The equation of time changes from − 13m 36s to a limit of − 14m 21s on the 12th, and then to − 12m 35s at the end of the month. For changes in the length of the day, see p. 11.

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

Mercury on the 15th is in R.A. 21h 14m, Decl. 18° 11′S. and transits at 11.37. It is too close to the sun to be well observed this month. It reaches superior conjunction with the sun on the 28th, when it enters the evening sky.

Venus on the 15th is in R.A. 0h 42m, Decl. 06° 50′ N. and transits at 15.02. On the 2nd it reaches greatest eastern elongation when it sets about four and a half hours after the sun. Its magnitude is − 4. Venus may now be seen in daylight; look for it, due south, half way from the horizon to the zenith at time of transit. Through a telescope its shape changes from half-moon to crescent during the month; its diameter increases from 24″ to 34″ as the distance from the earth decreases.

Mars on the 15th is in R.A. 20h 11m, Decl. 20° 59′ S. and transits at 10.32. It is still too close to the sun in the morning sky to be well observed.

Jupiter on the 15th is in R.A. 11h 47m, Decl. 03° 03′ N. and transits at 2.07. It rises near the east point less than three hours after sunset. Its magnitude is − 1.9. It is retrograding all month. 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. 6h 18m, Decl. 22° 44′ N. and transits at 20.35. It is high in the eastern sky at sunset. There is a close conjunction with the moon on the 21st. It is retrograding all month.

Uranus on the 15th is in R.A. 4h 30m, Decl. 21° 48′ N. and transits at 18.47. Its retrograde motion ceases on the 15th, and on the 27th it is in quadrature with the sun.

Neptune on the 15th is in R.A. 12h 25m, Decl. 01° 03′ S. and transits at 2.45.

Pluto—For information in regard to this planet, see p. 28.

FEBRUARY

75th Meridian Civil Time

d		h	m		Min. of Algol h m	Config. of Jupiter's Sat. 2h 30m
Thu.	1	17	13	☌♆☾ ♆ 3° 57′ S.	16 31	43021
Fri.	2	11		Moon in Apogee. Dist. from ⊕, 251,700 mi.		34102
		13		☿ in Aphelion		
		17		♀ Greatest elongation E., 46° 52′		
Sat.	3					2014*
Sun.	4				13 21	2034*
Mon.	5	4	55	☾ Last Quarter		10234
Tue.	6					02134
Wed.	7				10 10	21304
Thu.	8					30214
Fri.	9					31024
Sat.	10	16	38	☌♂☾ ♂ 0° 05′ S.	06 59	23014
Sun.	11	14	10	☌☿☾ ☿ 0° 03′ N.		21403
Mon.	12	12	33	● New Moon		d4023
Tue.	13				03 48	40123
Wed.	14	7		Moon in Perigee. Dist. from ⊕, 224,700 mi.		42130
Thu.	15	15	07	☌♀☾ ♀ 8° 01′ N.		4301*
		18		♅ Stationary in R.A.		
Fri.	16				00 38	43102
Sat.	17					43201
Sun.	18				21 27	42103
Mon.	19	3	38	☽ First Quarter		0123*
		18	08	☌♅☾ ♅ 3° 16′ N.		
Tue.	20					0243*
Wed.	21	16	03	☌♄☾ ♄ 0° 35′ N.	18 16	d2104
Thu.	22	21		☿ Greatest Hel. Lat. S.		3014*
Fri.	23					31024
Sat.	24				15 06	32014
Sun.	25					21034
Mon.	26	19	07	○ Full Moon		01234
Tue.	27	22		□♅☉	11 54	0423*
Wed.	28	0	43	☌♃☾ ♃ 3° 25′ S.		24103
		12		♀ in Perihelion		
		16		☌☿☉ Superior		
		23	26	☌♆☾ ♆ 3° 48′ S.		

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

THE SKY FOR MARCH, 1945

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 46m to 00h 40m and its Decl. changes from 07° 48′ S. to 04° 19′ N. On March 20 at 18.38 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 35s to − 4m 08s. 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 p. 19.

Mercury on the 15th is in R.A. 00h 26m, Decl. 02° 58′ N. and transits at 12.59. It is at greatest eastern elongation on the 26th when it is about 17° above the western horizon at sunset and sets about 1h 50m after the sun. Its stellar magnitude at this time is zero. This is the most favourable time to observe Mercury in the evening sky.

Venus on the 15th is in R.A. 01h 49m, Decl. 17° 31′ N. and transits at 14.18. Although rapidly approaching the sun it continues to be conspicuous in the afternoon and evening sky, reaching its greatest brilliancy of − 4.3 on the 10th. Through a telescope it appears as a waning crescent. It reaches a stationary point on the 24th and commences to move westward among the stars. By the end of the month it sets about two and a half hours after the sun.

Mars on the 15th is in R.A. 21h 39m, Decl. 15° 14′ S. and transits at 10.10. It is rather poorly placed for observation in the morning sky.

Jupiter on the 15th is in R.A. 11h 34m, Decl. 04° 26′N. and transits at 00.04. It is in opposition with the sun on the 13th when it rises near the east point at sunset. This is the most favourable part of the year for observing Jupiter. Its stellar magnitude has brightened to − 2.0. It is retrograding all month. 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. 06h 17m, Decl. 22° 49′ N. and transits at 18.44. It is in quadrature with the sun on the 25th when it is close to the meridian at sunset. It ceases retrograding on the 5th and resumes its eastward motion among the stars. It is close to the moon on the 20th.

Uranus on the 15th is in R.A. 4h 31m, Decl. 21° 51′ N. and transits at 16.59.

Neptune on the 15th is in R.A. 12h 22m, Decl. 00° 47′ S. and transits at 0.52. At opposition on the 25th, its stellar magnitude is 7.7.

Pluto—For information in regard to this planet, see p. 28.

MARCH

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 1h 00m
Thu. 1			....		43201
Fri. 2	2		Moon in Apogee. Dist. from ⊕, 252,200 mi.....	08 44	43102
Sat. 3			....		d4301
Sun. 4			....		42103
Mon. 5	17		♄ Stationary in R.A........................	05 34	40213
Tue. 6	23	30	☾ Last Quarter........................		41023
Wed. 7			....		42013
Thu. 8			....	02 23	32014
Fri. 9			....		31024
Sat. 10	3		♀ Greatest brilliancy, mag.–4.3...........	23 12	30214
Sun. 11	16	03	☌ ♂ ☾ ♂ 1° 43′ N.................		21034
Mon. 12			....		02134
Tue. 13	7		☍ ♃ ☉ Dist. from ⊕, 412,200,000 mi....	20 02	10234
	22		☿ in ☊..............................		
	22	51	● New Moon..........................		
Wed. 14	16		Moon in Perigee. Dist. from ⊕, 222,300 mi....		20134
	16	56	☌ ☿ ☾ ☿ 5° 33′ N.................		
Thu. 15			....		3204*
Fri. 16	5	30	☌ ♀ ☾ ♀ 11° 46′ N.................	16 51	31042
Sat. 17			....		34021
Sun. 18	13		☿ in Perihelion........................		4210*
Mon. 19	1	34	☌ ♅ ☾ ♅ 3° 00′ N.................	13 40	4013*
Tue. 20	14	11	☽ First Quarter........................		41023
	18	38	☉ enters ♈, Spring commences. Long. of ☉, 0°.		
	21	54	☌ ♄ ☾ ♄ 0° 26′ N.................		
Wed. 21			....		42013
Thu. 22	6		♀ Greatest Hel. Lat. N..................	10 29	43210
Fri. 23			....		d3402
Sat. 24	9		♀ Stationary in R.A......................		34012
Sun. 25	0		□ ♄ ☉..................................	07 19	21304
	21		☍ ♆ ☉ Dist. from ⊕, 2,720,000,000 mi...		
Mon. 26	4		☿ Greatest elongation E., 18° 46′..........		20134
Tue. 27	0	13	☌ ♃ ☾ ♃ 3° 16′ S..................		10234
Wed. 28	4	21	☌ ♆ ☾ ♆ 3° 43′ S..................	04 08	20134
	12	44	○ Full Moon...........................		
	19		☿ Greatest Hel. Lat. N..................		
Thu. 29	7		Moon in Apogee. Dist. from ⊕, 252,600 mi....		23104
Fri. 30			....		d3024
Sat. 31			....	00 57	30124

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

THE SKY FOR APRIL, 1945

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 00h 40m to 02h 31m and its Decl. changes from 04° 19′N. to 14° 54′ N. The equation of time changes during the first half of the month from − 4m 08s 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 53s 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 p. 19.

Mercury on the 15th is in R.A. 01h 20m, Decl. 10° 19′ N. and transits at 11.44. At the beginning of the month it is about 16° above the horizon at sunset, setting about 1h 45m after the sun. Following its very favourable position at the first of the month it rapidly approaches the sun and is at inferior conjunction on the 13th, entering the morning sky. On the 3rd it is at a stationary point and then retrogrades until the 25th when it again moves eastward among the stars.

Venus on the 15th is in R.A. 01h 25m, Decl. 16° 17′ N. and transits at 11.50. Early in the month it may be seen about 23° above the western horizon at sunset. It rapidly approaches the sun and reaches inferior conjunction on the 15th, moving into the morning sky. By the end of the month it rises about an hour before the sun. It continues retrograding all month.

Mars on the 15th is in R.A. 23h 11m, Decl. 06° 37′ S. and transits at 9.39. It is not very well placed for observation in the morning sky, being about 12° above the south-eastern horizon at sunrise. Its stellar magnitude is + 1.3.

Jupiter on the 15th is in R.A. 11h 21m, Decl. 05° 47′ N. and transits at 21.45. It continues to be well placed for observation. It is retrograding all month and at sunset is about 32° above the south-eastern horizon. 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. 06h 23m, Decl. 22° 51′ N. and transits at 16.49. It is high in the south-western sky at sunset. It has faded slightly to magnitude + 0.3. It is close to the moon on the 17th.

Uranus on the 15th is in R.A. 4h 36m, Decl. 22° 01′ N. and transits at 15.01.

Neptune on the 15th is in R.A. 12h 19m, Decl. 00° 26′ S. and transits at 22.43.

Pluto—For information in regard to this planet, see p. 28.

APRIL

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 0h 00m
Sun. 1			....		23104
Mon. 2			....	21 46	24013
Tue. 3	6		☿ Stationary in R.A.		41023
Wed. 4			....		d4013
Thu. 5	14	18	☾ Last Quarter	18 35	d4210
Fri. 6			....		43012
Sat. 7			....		4302*
Sun. 8			....	15 25	42310
Mon. 9	14	07	☌ ♂ ☾ ♂ 3° 14′ N.		42013
Tue. 10			....		14023
Wed. 11			....	12 14	02143
Thu. 12	3		Moon in Perigee. Dist. from ⊕, 221,800 mi....		21034
	5	54	☌ ☿ ☾ ☿ 7° 53′ N.		
	7	29	● New Moon		
	7	58	☌ ♀ ☾ ♀ 12° 58′ N.		
Fri. 13	9		☌ ☿ ☉ Inferior		30214
Sat. 14	7		♂ Greatest Hel. Lat. S.	09 03	31024
Sun. 15	12		☌ ♀ ☉ Inferior		d3204
	12	16	☌ ♅ ☾ ♅ 2° 42′ N.		
Mon. 16			....		20134
Tue. 17	7	52	☌ ♄ ☾ ♄ 0° 07′ N.	05 52	10243
Wed. 18			....		02413
Thu. 19	2	46	☽ First Quarter		24103
Fri. 20			....	02 41	4301*
Sat. 21			Lyrid meteors		43102
	6		☿ in ☋		
Sun. 22			....	23 30	43201
Mon. 23	0	50	☌ ♃ ☾ ♃ 3° 21′ S.		4203*
Tue. 24	8	53	☌ ♆ ☾ ♆ 3° 48′ S.		41023
Wed. 25	10		Moon in Apogee. Dist. from ⊕, 252,500 mi....	20 19	40213
	18		☿ Stationary in R.A.		
Thu. 26	13		☌ ☿ ♀ ☿ 6° 16′ S.		24103
Fri. 27	5	33	○ Full Moon		3041*
Sat. 28			....	17 08	31024
Sun. 29			....		32014
Mon. 30			....		2034*

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

THE SKY FOR MAY, 1945

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 02h 31m to 04h 34m and its Decl. changes from 14° 54′ N. to 21° 58′N. The equation of time is small throughout the month, increasing from + 2m 53s to + 3m 46s on the 15th and then diminishing to + 2m 27s. 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 p. 20.

Mercury on the 15th is in R.A. 01h 49m, Decl. 07° 47′N. and transits at 10.20. It is at greatest western elongation on the 11th, when it rises as a star of magnitude 0.7 about 45 m. before the sun. It is not very well placed for observation, being only 8° above the horizon at sunrise.

Venus on the 15th is in R.A. 01h 07m, Decl. 07° 37′N. and transits at 9.36. It is separating from the sun in the morning sky and by the end of the month is about 18° above the horizon at sunrise. It reaches a stationary point on the 4th when it resumes its eastward motion among the stars. It attains greatest brilliancy on the 21st when its magnitude is − 4.2.

Mars on the 15th is in R.A. 00h 36m, Decl. 02° 32′ N. and transits at 9.06. It is getting farther from the sun in the morning sky, being about 18° above the horizon at sunrise. Watch Mars getting closer to Venus in Pisces.

Jupiter on the 15th is in R.A. 11h 16m, Decl. 06° 13′ N. and transits at 19.43. It is just east of the meridian at sunset. It ceases retrograding on the 15th and resumes its eastward motion among the stars. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc.. see p. 55.

Saturn on the 15th is in R.A. 06h 34m, Decl. 22° 47′ N. and transits at 15.02. It is about 34° above the western horizon at sunset. There is a close conjunction with the moon on the 14th.

Uranus on the 15th is in R.A. 4h 42m, Decl. 22° 14′ N. and transits at 13.10.

Neptune on the 15th is in R.A. 12h 17m, Decl. 00° 12′ S. and transits at 20.43.

Pluto—For information in regard to this planet, see p. 28.

			MAY 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 23h 30m
d	h	m		h m	
Tue. 1	13		☿ in Aphelion..........................	13 57	O1234
Wed. 2			....		21O34
Thu. 3			....		32O14
Fri. 4			Eta Aquarid meteors..........................		
	7		♀ Stationary in R.A..........................	10 47	d31O2
Sat. 5	1	02	☾ Last Quarter..........................		342O1
Sun. 6			....		4213O
Mon. 7			....	07 36	d4O23
Tue. 8	11	00	☌ ♂ ☾ ♂ 4° 07′ N..................		4O123
Wed. 9	5	53	☌ ♀ ☾ ♀ 7° 09′ N..................		421O3
	12		♂ in Perihelion..........................		
	18	02	☌ ☿ ☾ ☿ 2° 00′ N..................		
Thu. 10	13		Moon in Perigee. Dist. from ⊕, 223,200 mi....	04 25	423O1
Fri. 11	7		☿ Greatest elongation W., 26° 13′.........		341O2
	15	21	● New Moon..........................		
Sat. 12			....		d34O1
Sun. 13	1	07	☌ ♅ ☾ ♅ 2° 28′ N..................	01 14	213O4
Mon. 14	21	31	☌ ♄ ☾ ♄ 0′ 15′ S..................		O1234
Tue. 15	1		♃ Stationary in R.A..........................	22 02	O234*
Wed. 16			....		21O34
Thu. 17	8		♀ in ☊..........................		23O14
Fri. 18	17	12	☽ First Quarter..........................	18 51	31O24
Sat. 19			....		3O214
Sun. 20	5	53	☌ ♃ ☾ ♃ 3° 38′ S..................		231O4
Mon. 21	10		♀ Greatest brilliancy, mag. −4.2...........	15 40	4O13*
	14	12	☌ ♆ ☾ ♆ 3° 58′ S..................		
	21		☿ Greatest Hel. Lat. S..................		
Tue. 22	20		Moon in Apogee. Dist. from ⊕, 252,000 mi....		41O23
Wed. 23			....		421O3
Thu. 24			....	12 29	d42O1
Fri. 25			....		431O2
Sat. 26	20	49	○ Full Moon..........................		43O21
Sun. 27			....	09 18	4231O
Mon. 28			....		4O13*
Tue. 29			....		14O23
Wed. 30			....	06 07	d2O43
Thu. 31			....		2O314

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

THE SKY FOR JUNE, 1945

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 04h 34m to 06h 38m and its Decl. changes from 21° 58′ N. to 23° 27′N. at the solstice on the 21st, and then to 23° 09′ N. The equation of time changes from +2m 27s to 00m on the 14th and is − 3m 31s at the end of the month. For changes in the length of the day, see p. 13.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 20.

Mercury on the 15th is in R.A. 05h 26m, Decl. 24° 03′ N. and transits at 11.58. It is poorly placed for observation this month, being in superior conjunction with the sun on the 15th. By the end of the month it is about 10° above the north-western horizon at sunset.

Venus on the 15th is in R.A. 02h 27m, Decl. 11° 36′ N. and transits at 8.55. It reaches greatest western elongation on the 24th when it rises over two hours before the sun and is about 24° above the eastern horizon at sunrise. Through a telescope it appears almost last-quarter phase and has a diameter of 24″.

Mars on the 15th is in R.A. 02h 03m, Decl. 11° 19′ N. and transits at 8.31. It rises about two and a half hours before the sun and is about 26° above the eastern horizon at sunrise. Its magnitude has brightened slightly to + 1.2. Early in the month Mars gets within about 5° of Venus, then they move farther apart.

Jupiter on the 15th is in R.A. 11h 21m, Decl. 05° 34′ N. and transits at 17.46. It is in quadrature with the sun on the 9th when it sets about midnight. 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. 06h 50m, Decl. 22° 34′ N. and transits at 13.16. It is rapidly approaching the sun and is not well placed for observation this month. A daylight occultation of Saturn is visible across Canada on the 11th (see p. 57).

Uranus on the 15th is in R.A. 4h 50m, Decl. 22° 28′ N. and transits at 11.16. Conjunction with the sun occurs on the 4th when the planet moves into the morning sky.

Neptune on the 15th is in R.A. 12h 16m, Decl. 00° 07′ S. and transits at 18.40. It reaches a stationary point on the 15th and again moves eastward among the stars. It is at quadrature with the sun on the 25th.

Pluto—For information in regard to this planet, see p. 28.

JUNE

75th Meridian Civil Time

	d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 22h 45m
Fri.	1					31O24
Sat.	2				02 56	3O124
Sun.	3	8	15	☾ Last Quarter		321O4
Mon.	4	1		☌ ♅ ☉	23 45	2O14*
Tue.	5					1O234
Wed.	6	6	51	☌ ♂ ☾ ♂ 4° 09′ N.		2O143
		16	17	☌ ♀ ☾ ♀ 2° 42′ N.		
Thu.	7	15		Moon in Perigee. Dist. from ⊕, 225,900 mi.	20 33	24O3*
Fri.	8					431O2
Sat.	9	8	55	☌ ☿ ☾ ☿ 2° 29′ N.		43O12
		14		□ ♃ ☉		
		14	04	☌ ♅ ☾ ♅ 2° 19′ N.		
		21		☿ in ♌		
		23	26	● New Moon		
Sun.	10	20		☌ ☿ ♅ ☿ 0° 11′ N.	17 22	4321O
Mon.	11	13	02	☌ ♄ ☾ ♄ 0° 34′ S.		42O1*
Tue.	12					41O23
Wed.	13				14 11	d4O13
Thu.	14	12		☿ in Perihelion		241O3
Fri.	15	5		♆ Stationary in R.A.		d3O42
		19		☌ ☿ ☉ Superior		
Sat.	16	16	22	☌ ♃ ☾ ♃ 3° 56′ S.	11 00	3O124
Sun.	17	9	05	☽ First Quarter		321O4
		21	09	☌ ♆ ☾ ♆ 4° 07′ S.		
Mon.	18					23O14
Tue.	19	12		Moon in Apogee. Dist. from ⊕, 251,400 mi.	07 49	1O234
Wed.	20	19		♀ in Aphelion		O2134
Thu.	21	13	52	☉ enters ♋, Summer commences. Long. of ☉, 90°		21O34
Fri.	22				04 37	3O14*
Sat.	23					3O42*
Sun.	24	6		☌ ☿ ♄ ☿ 2° 11′ N.		3421O
		14		♀ Greatest elongation W., 45° 46′		
		19		☿ Greatest Hel. Lat. N.		
Mon.	25			Partial eclipse of ☾, see p. 56	01 26	423O1
		10	08	○ Full Moon		
		11		□ ♆ ☉		
Tue.	26					41O23
Wed.	27				22 15	4O213
Thu.	28					421O3
Fri.	29					43O1*
Sat.	30				19 03	43O2*

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

THE SKY FOR JULY, 1945

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 06h 38m to 08h 43m and its Decl. changes from 23° 09 N. to 18° 11′ N. The equation of time changes from − 3m 31s to − 6m 22s on the 27th and then back to − 6m 14s. For changes in the length of the day, see p. 14. The earth reaches its greatest distance from the sun on the 5th.

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 p. 21.

Mercury on the 15th is in R.A. 09h 20m, Decl. 16° 09′ N. and transits at 13.51. Although it reaches its greatest elongation of the year on the 23rd, 27° east, this is not a very favourable elongation, as Mercury is only 11° above the western horizon at sunset.

Venus on the 15th is in R.A. 04h 25m, Decl. 18° 47′ N. and transits at 8.56. As a morning star it now exhibits a gibbous phase and is of magnitude − 3.8. It is over 30° above the eastern horizon at sunrise. During the month it moves through Taurus. It is in conjunction with the moon on the 5th and with Uranus on the 22nd.

Mars on the 15th is in R.A. 03h 28m, Decl. 18° 00′ N. and transits at 7.58. It rises about four hours before the sun and is about 40° above the horizon at sunrise. Near the end of the month it is moving between the Pleiades and the Hyades.

Jupiter on the 15th is in R.A. 11h 35m, Decl. 04° 03′ N. and transits at 16.02. It is about 26° above the south-western horizon at sunset and sets about two and a half hours after the sun. Its magnitude has faded slightly to − 1.4. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 15th is in R.A. 07h 07m, Decl. 22° 13′ N. and transits at 11.35. Conjunction with the sun occurs on the 6th but by the end of the month Saturn rises almost two hours before the sun and is about 16° above the eastern horizon at sunrise.

Uranus on the 15th is in R.A. 4h 57m, Decl. 22° 39′ N. and transits at 9.25. It is in conjunction with Venus on the 22nd.

Neptune on the 15th is in R.A. 12h 17m, Decl. 00° 14′ S. and transits at 16.43.

Pluto—For information in regard to this planet, see p. 28.

			JULY 75th Meridian Civil Time	Min. of Algol		Config. of Jupiter's Sat. 21h 45m
d	h	m		h	m	
Sun. 1			....			34210
Mon. 2	13	13	☾ Last Quarter........................			23041
Tue. 3			....	15	52	10234
Wed. 4	21		Moon in Perigee. Dist. from ⊕, 228,900 mi....			01234
Thu. 5	1	26	☌ ♂ ☾ ♂ 3° 24′ N..................			21034
	5		⊕ in Aphelion. Dist. from ☉, 94,452,000 mi.			
	21	27	☌ ♀ ☾ ♀ 0° 26′ N..................			
Fri. 6	16		☌ ♄ ☉..	12	41	20314
Sat. 7	1	23	☌ ♅ ☾ ♅ 2° 11′ N..................			31024
Sun. 8			....			dd304
Mon. 9	4	29	☌ ♄ ☾ ♄ 0° 51′ S..................	09	29	2304*
			Total exclipse of ☉, see p. 56.			
	8	35	● New Moon..........................			
Tue. 10			....			10423
Wed. 11	5	17	☌ ☿ ☾ ☿ 1° 53′ S..................			40123
Thu. 12			....	06	18	42103
Fri. 13	4		♀ Greatest Hel. Lat. S..................			42031
Sat. 14	7	12	☌ ♃ ☾ ♃ 4° 08′ S..................			43102
Sun. 15	5	41	☌ ♆ ☾ ♆ 4° 08′ S..................	03	07	43021
Mon. 16			....			4320*
Tue. 17	2	01	☽ First Quarter........................	23	55	410**
	7		Moon in Apogee. Dist. from ⊕, 251,200 mi....			
Wed. 18	5		☿ in ☋..............................			40123
Thu. 19			....			12043
Fri. 20	12		♅ in ☊..............................	20	44	20314
Sat. 21			....			31024
Sun. 22	5		☌ ♀ ♅ ♀ 2° 36′ S..................			30124
Mon. 23	15		☿ Greatest elongation E., 27° 01′..........	17	32	32104
Tue. 24	21	25	○ Full Moon..........................			d04**
Wed. 25			....			01234
Thu. 26			....	14	21	12043
Fri. 27			....			24013
Sat. 28			Delta Aquarid meteors..................			41302
	12		☿ in Aphelion..........................			
Sun. 29			....	11	10	43012
Mon. 30	1		Moon in Perigee. Dist. from ⊕, 229,300 mi....			43210
Tue. 31	17	30	☾ Last Quarter........................			43201

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

THE SKY FOR AUGUST, 1945

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 08h 43m to 10h 39m and its Decl. changes from 18° 11′ N. to 08° 30′ N. The equation of time changes from − 6m 14s to − 0m 11s. 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 p. 21.

Mercury on the 15th is in R.A. 10h 08m, Decl. 06° 22′ N. and transits at 12.31. It is in inferior conjunction with the sun on the 20th when it moves into the morning sky. By the end of the month it rises about 1h 15m before the sun and is about 12° above the horizon at sunrise. It reaches a stationary point on the 5th, retrograding until the 29th when it resumes its eastward motion among the stars.

Venus on the 15th is in R.A. 06h 51m, Decl. 21° 32′ N. and transits at 9.20. It is conspicuous in Gemini in the morning sky. It is in conjunction with the moon on the 4th and with Saturn on the 21st. Its magnitude has faded slightly to − 3.5.

Mars on the 15th is in R.A. 04h 56m, Decl. 22° 11′ N. and transits at 7.23. It rises just before midnight and is high in the south-eastern sky at sunrise. Early in the month it passes north of the Hyades. It is in close conjunction with Uranus on the 17th and with the moon on the 31st.

Jupiter on the 15th is in R.A. 11h 54m, Decl. 01° 51′ N. and transits at 14.20. It is approaching the sun in the evening sky, setting near the west point about an hour and a half 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. 07h 23m, Decl. 21° 46′ N. and transits at 9.49. It rises about three hours before the sun. It is in conjunction with Venus on the 21st.

Uranus on the 15th is in R.A. 5h 03m, Decl. 22° 48′ N. and transits at 7.28. It is in conjunction with Mars on the 17th.

Neptune on the 15th is in R.A. 12h 19m, Decl. 00° 32′ S. and transits at 14.44.

Pluto—For information in regard to this planet, see p. 28.

d	h	m	AUGUST 75th Meridian Civil Time	Min. of Algol h m	Config. of Jupiter's Sat. 20h 30m
Wed. 1			....	07 58	4O32*
Thu. 2	18	07	☌ ♂ ☾ ♂ 2° 12′ N..................		412O3
Fri. 3	10	17	☌ ♅ ☾ ♅ 2° 02′ N..................		42O13
Sat. 4	10	46	☌ ♀ ☾ ♀ 1° 10′ S..................	04 47	143O2
Sun. 5	17		☿ Stationary in R.A....................		3O124
	18	22	☌ ♄ ☾ ♄ 1° 08′ S..................		
Mon. 6			....		321O4
Tue. 7	19	32	🌑 New Moon..........................	01 34	32O14
Wed. 8			....		1O324
Thu. 9	1	50	☌ ☿ ☾ ☿ 8° 57′ S..................	22 24	ddO34
Fri. 10			....		2O134
Sat. 11	0	38	☌ ♃ ☾ ♃ 4° 14′ S..................		d1O24
	15	05	☌ ♆ ☾ ♆ 4° 03′ S..................		
Sun. 12			Perseid meteors............................	19 12	3O124
Mon. 13			....		3214O
Tue. 14	1		Moon in Apogee. Dist. from ⊕, 251,400 mi....		432O1
Wed. 15	19	26	🌓 First Quarter..........................	16 00	41O32
Thu. 16			....		d4O23
Fri. 17	10		☌ ♂ ♅ ♂ 0° 24′ S..................		42O3*
	20		☿ Greatest Hel. Lat. S..................		
Sat. 18			....	12 50	41O3*
Sun. 19			....		43O12
Mon. 20	10		☌ ☿ ☉ Inferior......................		3412O
Tue. 21	23		☌ ♀ ♄ ♀ 0° 41′ S..................	09 38	324O1
Wed. 22			....		1O342
Thu. 23	7	03	🌕 Full Moon..........................		O1234
Fri. 24			....	06 27	2O34*
Sat. 25	23		Moon in Perigee. Dist. from ⊕, 226,500 mi....		1O34*
Sun. 26			....		
Mon. 27			....	03 15	
Tue. 28			....		
Wed. 29	9		☿ Stationary in R.A....................		
	22	44	☾ Last Quarter..........................		
Thu. 30	17	11	☌ ♅ ☾ ♅ 1° 47′ N..................	00 04	
Fri. 31	8	07	☌ ♂ ☾ ♂ 0° 54′ N..................		

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

Jupiter being near the sun, phenomena of the satellites are not given from August 26 to October 16.

THE SKY FOR SEPTEMBER, 1945

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 39m to 12h 27m and its Decl. changes from 08° 30′ N. to 02° 57′ S. On the 23rd the sun crosses the equator on its way south and enters Libra. This is the autumnal equinox. The equation of time changes from − 0m 11s to + 10m 05s. 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 p. 22.

Mercury on the 15th is in R.A. 10h 38m, Decl. 10° 18′ N. and transits at 11.06. It is best seen in the morning sky on the 6th, when it reaches greatest western elongation and is about 16° above the horizon at sunrise. Its stellar magnitude is zero.

Venus on the 15th is in R.A. 09h 24m, Decl. 15° 42′ N. and transits at 9.50. It is still conspicuous in the morning sky, rising about three hours before the sun. On the 23rd it passes less than half a degree north of Regulus.

Mars on the 15th is in R.A. 06h 18m, Decl. 23° 30′ N. and transits at 6.43. It rises about an hour before midnight and is visible the rest of the night. It moves out of Taurus into Gemini during the month. There is a close conjunction with the moon on the 28th.

Jupiter on the 15th is in R.A. 12h 18m, Decl. 00° 42′ S. and transits at 12.41. It is too close to the sun to be well observed this month.

Saturn on the 15th is in R.A. 07h 37m, Decl. 21° 19′ N. and transits at 8.01. It rises shortly after midnight and is high in the south-eastern sky at dawn. Its magnitude has faded to + 0.4.

Uranus on the 15th is in R.A. 5h 05m, Decl. 22° 52′ N. and transits at 5.29. It is in quadrature with the sun on the 10th and begins a retrograde motion on the 23rd.

Neptune on the 15th is in R.A. 12h 23m, Decl. 00° 57′ S. and transits at 12.46. It is in conjunction with the sun on the 29th and passes into the morning sky.

Pluto—For information in regard to this planet, see p. 28.

SEPTEMBER

75th Meridian Civil Time

d		h	m			Min. of Algol h m
Sat.	1					20 52
Sun.	2	5	57	☌♄☾	♄ 1° 29′ S.	
Mon.	3	5	41	☌♀☾	♀ 2° 35′ S.	
Tue.	4	16	49	☌☿☾	☿ 4° 09′ S.	17 41
Wed.	5	20		☿	in ♌	
Thu.	6	7		☿	greatest elongation W., 18° 01′	
		8	43	🌑	New Moon	
Fri.	7	11		♀	in ♌	14 30
		19	04	☌♃☾	♃ 4° 15′ S.	
Sat.	8	0	22	☌♆☾	♆ 3° 56′ S.	
		13		♂	in ♌	
Sun.	9					
Mon.	10	6		□♅☉		11 18
		11		☿	in Perihelion	
		19		Moon in Apogee.	Dist. from ⊕, 252,000 mi.	
Tue.	11					
Wed.	12					
Thu.	13					08 07
Fri.	14	12	38	☽	First Quarter	
Sat.	15					
Sun.	16					04 55
Mon.	17					
Tue.	18					
Wed.	19					01 44
Thu.	20	18		☿	Greatest Hel. Lat. N.	
Fri.	21	15	46	🌕	Full Moon	22 33
Sat.	22	23		Moon in Perigee.	Dist. from ⊕, 223,500 mi.	
Sun.	23	2		☌♃♆	♃ 0° 20′ S.	
		2		♅	Stationary in R.A.	
		4	50	☉ enters ♎,	Autumn commences. Long. of ☉, 180°	
Mon.	24					19 21
Tue.	25					
Wed.	26	23	39	☌♅☾	♅ 1° 31′ N.	
Thu.	27					16 10
Fri.	28	6	24	☾	Last Quarter	
		18	39	☌♂☾	♂ 0° 12′ S.	
Sat.	29	11		☌♆☉		
		15	26	☌♄☾	♄ 1° 53′ S.	
Sun.	30	18		☌☿♆	☿ 0° 01′ S.	12 59

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 August 26 to October 16.

THE SKY FOR OCTOBER, 1945

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 27m to 14h 23m and its Decl. changes from 02° 57′ S. to 14° 15′ S. The equation of time changes from + 10m 05s to + 16m 19s, 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 p. 22.

Mercury on the 15th is in R.A. 13h 51m, Decl. 11° 32′ S. and transits at 12.20. It is not favourably placed for observation this month, being in superior conjunction with the sun on the 2nd.

Venus on the 15th is in R.A. 11h 43m, Decl. 03° 23′ N. and transits at 10.11. It is slowly approaching the sun in the morning sky, rising about 2h 25m before the sun. It passes close to Neptune on the 24th and to Jupiter on the 30th.

Mars on the 15th is in R.A. 07h 26m, Decl. 22° 50′ N. and transits at 5.53. It is in quadrature with the sun on the 11th when it is on the meridian at sunrise. Its magnitude has brightened to + 0.5. It is in conjunction with Saturn on the 26th and with the moon on the 27th.

Jupiter on the 15th is in R.A. 12h 41m, Decl. 03° 15′ S. and transits at 11.07. It is in conjunction with the sun on the 1st and moves into the morning sky. By the end of the month it rises over two hours before the sun and is about 21° above the south-eastern horizon at sunrise. Its stellar magnitude is − 1.2. It is in conjunction with Venus on the 30th. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 15th is in R.A. 07h 45m, Decl. 21° 01′ N. and transits at 6.11. It is in quadrature with the sun on the 18th when it is close to the meridian at sunrise. It is in conjunction with Mars on the 26th.

Uranus on the 15th is in R.A. 5h 05m, Decl. 22° 51′ N. and transits at 3.31.

Neptune on the 15th is in R.A. 12h 27m, Decl. 01° 23′ S. and transits at 10.52.

Pluto—For information in regard to this planet, see p. 28.

OCTOBER

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 7h 00m
Mon. 1	5		☌♃☉		
	16		☌☿♃ ☿ 0° 14′ N.		
Tue. 2	6		☌☿☉ Superior		
Wed. 3	6	39	☌♀☾ ♀ 3° 39′ S.	09 47	
Thu. 4					
Fri. 5	8	54	☌♆☾ ♆ 3° 54′ S.		
	13	27	☌♃☾ ♃ 4° 13′ S.		
Sat. 6	0	22	🌑 New Moon	06 36	
	3	05	☌☿☾ ☿ 4° 22′ S.		
Sun. 7					
Mon. 8	8		Moon in Apogee. Dist. from ⊕, 252,500 mi.		
Tue. 9				03 25	
Wed. 10					
Thu. 11	3		♀ in Perihelion		
	21		□♂☉		
Fri. 12				00 13	
Sat. 13					
Sun. 14	4		☿ in ☋	21 02	
	4	38	☽ First Quarter		
Mon. 15					
Tue. 16					31O24
Wed. 17				17 51	32O14
Thu. 18	3		□♄☉		31O4*
Fri. 19					O3142
Sat. 20				14 40	124O3
Sun. 21	0	32	🌕 Full Moon		42O13
	9		Moon in Perigee. Dist. from ⊕, 221,700 mi.		
Mon. 22			Orionid meteors		4O32*
Tue. 23				11 28	431O2
Wed. 24	7	18	☌♅☾ ♅ 1° 20′ N.		432O1
	11		☿ in Aphelion		
	15		☌♀♆ ♀ 0° 11′ N.		
Thu. 25					4312O
Fri. 26	2		☌♂♄ ♂ 1° 24′ N.	08 17	4O12*
	23	48	☌♄☾ ♄ 2° 12′ S.		
Sat. 27	0	25	☌♂☾ ♂ 0° 48′ S.		412O3
	17	30	☾ Last Quarter		
Sun. 28	11		♃ Greatest Hel. Lat. N.		24O13
Mon. 29				05 06	1O234
Tue. 30	3		☌♀♃ ♀ 0° 31′ N.		d3O24
Wed. 31					32O14

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 August 26 to October 16.

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 23m to 16h 27m and its Decl. changes from 14° 15′ S. to 21° 43′ S. The equation of time increases from + 16m 19s to its maximum for the year of + 16m 22s on the 3rd, then drops to + 11m 09s. 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 p. 23.

Mercury on the 15th is in R.A. 16h 51m, Decl. 25° 09′ S. and transits at 13.16. It reaches greatest eastern elongation on the 17th, but it is poorly placed for observation since it is only 7° above the south-western horizon at sunset. It starts to retrograde on the 27th.

Venus on the 15th is in R.A. 14h 07m, Decl. 11° 17′ S. and transits at 10.32. It is approaching the sun in the morning sky, rising almost two hours before the sun. It passes about three degrees north of Spica on the 6th.

Mars on the 15th is in R.A. 08h 14m, Decl. 21° 49′ N. and transits at 4.38. It rises nearly five hours after sunset and is visible the rest of the night. It is occulted by the moon on the 23rd; the emersion is visible in eastern Canada (see p. 57).

Jupiter on the 15th is in R.A. 13h 05m, Decl. 05° 42′ S. and transits at 9.29. It is separating from the sun in the morning sky, rising over three 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. 07h 47m, Decl. 20° 59′ N. and transits at 4.11. It rises in the north-east about four hours after sunset. It reaches a stationary point on the 6th and begins to move slowly westward among the stars.

Uranus on the 15th is in R.A. 5h 01m, Decl. 22° 46′ N. and transits at 1.25.

Neptune on the 15th is in R.A. 12h 31m, Decl. 01° 46′ S. and transits at 8.54.

Pluto—For information in regard to this planet, see p. 28.

	NOVEMBER 75th Meridian Civil Time				Min. of Algol		Config. of Jupiter's Sat. 6h 30m
d	h	m			h	m	
Thu. 1	16	41	☌♆☾	♆ 3° 59′ S.	01	55	312O4
	23		♀	Greatest Hel. Lat. N.			
Fri. 2	7	19	☌♃☾	♃ 4° 11′ S.			3O124
	14	51	☌♀☾	♀ 3° 36′ S.			
Sat. 3					22	44	d1O34
Sun. 4	11		Moon in Apogee.	Dist. from ⊕, 252,700 mi.			2O143
	18	11	🌑	New Moon			
Mon. 5							1O243
Tue. 6	11		♄	Stationary in R.A.	19	32	43O12
	12	07	☌☿☾	☿ 4° 49′ S.			
Wed. 7							342O*
Thu. 8							4321O
Fri. 9					16	21	43O12
Sat. 10							41O23
Sun. 11							42O13
Mon. 12	18	34	☽	First Quarter	13	10	41O23
Tue. 13	19		☿	Greatest Hel. Lat. S.			d4O12
Wed. 14							324O*
Thu. 15			Leonid meteors		09	59	321O4
Fri. 16							3O124
Sat. 17	15		☿	Greatest elongation E., 22° 25′.			1O234
Sun. 18	21		Moon in Perigee.	Dist. from ⊕, 221,900 mi.	06	48	2O134
Mon. 19	10	13	🌕	Full Moon			1O34*
Tue. 20	16	29	☌♅☾	♅ 1° 19′ N.			O3124
Wed. 21					03	37	321O4
Thu. 22							d32O4
Fri. 23	8	06	☌♄☾	♄ 2° 20′ S.			34O12
	22	20	☌♂☾	♂ 0° 34′ S.			
Sat. 24					00	26	41O32
Sun. 25							42O13
Mon. 26	8	28	☾	Last Quarter	21	15	412O3
Tue. 27	9		☿	Stationary in R.A.			4O132
Wed. 28							d431O
Thu. 29	0	18	☌♆☾	♆ 4° 06′ S.	18	04	432O1
Fri. 30	0	25	☌♃☾	♃ 4° 06′ S.			34O2*

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

THE SKY FOR DECEMBER, 1945

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 27m to 18h 43m and its Decl. changes from 21° 43′ S. to 23° 27′ S. at the solstice on the 22nd, then to 23° 04′ S. The equation of time decreases steadily from + 11m 09s to 00m on Christmas Day, and then to – 3m 15s 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 p. 23.

Mercury on the 15th is in R.A. 16h 24m, Decl. 18° 43′ S. and transits at 10.47. It is in inferior conjunction with the sun on the 7th and moves into the morning sky. It reaches greatest western elongation on the 26th when it rises about 1h 48m before the sun and is about 14° above the south-eastern horizon at sunrise. It reaches a stationary point on the 17th.

Venus on the 15th is in R.A. 16h 38m, Decl. 21° 35′ S. and transits at 11.06. It is poorly placed for observation in the morning sky, being only 8° above the south-eastern horizon at sunrise. Its phase is nearly full and its angular diameter has decreased to 10″.

Mars on the 15th is in R.A. 08h 22m, Decl. 22° 42′ N. and transits at 2.48. It rises about three hours after sunset and is visible the rest of the night as a red object of magnitude – 0.7. It starts retrograding on the 5th. It is in conjunction with the moon on the 21st.

Jupiter on the 15th is in R.A. 13h 25m, Decl. 07° 38′ S. and transits at 7.50. It rises over five hours before the sun and is just east of the meridian at sunrise. Its stellar magnitude has brightened slightly to – 1.4. It passes north of Spica on the 10th. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 15th is in R.A. 07h 42m, Decl. 21° 15′ N. and transits at 2.07. It rises in the north-east about two and a half hours after sunset and is visible the rest of the night. It retrogrades all month. The magnitude has brightened slightly to 0.0.

Uranus on the 15th is in R.A. 4h 55m, Decl. 22° 38′ N. and transits at 23.17. At opposition on the 7th, 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 33m, Decl. 02° 01′ S. and transits at 6.58. It is in quadrature with the sun on the 30th.

Pluto—For information in regard to this planet, see p. 28.

	d	h	m	DECEMBER 75th Meridian Civil Time	Min. of Algol h	m	Config. of Jupiter's Sat. 6h 15m
Sat.	1	15		Moon in Apogee. Dist. from ⊕, 252,400 mi.			1O42*
Sun.	2	20		☿ in ♌	14	53	2O143
Mon.	3	4	21	☌ ♀ ☾ ♀ 2° 02′ S.			12O34
Tue.	4	13	06	● New Moon			O1324
Wed.	5	0	23	☌ ☿ ☾ ☿ 0° 22′ S.	11	42	31O24
		14		♂ Stationary in R.A.			
Thu.	6						32O14
Fri.	7	5		☌ ☿ ☉ Inferior			3O24*
		11		☿ in Perihelion			
		16		☍ ♅ ☉ Dist. from ⊕, 1,694,000,000 mi.			
Sat.	8				08	31	dO24*
Sun.	9						2O413
Mon.	10						421O3
Tue.	11				05	20	4O123
Wed.	12			Geminid meteors			413O2
		6	05	☽ First Quarter			
		22		☌ ☿ ♀ ☿ 2° 08′ N.			
Thu.	13						432O1
Fri.	14				02	09	431O*
Sat.	15						43O12
Sun.	16				22	58	42O13
Mon.	17	2		☿ Stationary in R.A.			241O3
		8		Moon in Perigee. Dist. from ⊕, 224,100 mi.			
		17		☿ Greatest Hel. Lat. N.			
Tue.	18	1	52	☌ ♅ ☾ ♅ 1° 25′ N.			O4123
		17		♃ in Aphelion			
				Total eclipse of ☾, see p. 56			
		21	17	○ Full Moon			
Wed.	19				19	48	13O24
Thu.	20	16	17	☌ ♄ ☾ ♄ 2° 13′ S.			32O14
Fri.	21	7	05	☌ ♂ ☾ ♂ 0° 44′ N.			31O4*
Sat.	22	0	04	☉ enters ♑, Winter commences. Long. of ☉, 270°	16	37	3O124
Sun.	23						2O34*
Mon.	24						21O34
Tue.	25				13	26	O1243
Wed.	26	3	00	☾ Last Quarter			1O342
		8	24	☌ ♆ ☾ ♆ 4° 08′ S.			
		10		☿ Greatest elongation W., 22° 12′.			
Thu.	27	16	18	☌ ♃ ☾ ♃ 3° 54′ S.			342O1
Fri.	28	0		♀ in ♉	10	14	4312O
Sat.	29	6		Moon in Apogee. Dist. from ⊕, 251,800 mi.			43O12
Sun.	30	10		□ ♆ ☉			d41O3
Mon.	31				07	04	d42O3

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

PHENOMENA OF JUPITER'S SATELLITES, 1945

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.
2	00	30	III	TI
	03	26	III	Te
3	05	16	I	ED
4	02	34	I	SI
	03	45	I	TI
	04	49	I	Se
	05	59	I	Te
	23	44	I	ED
5	02	46	II	SI
	03	09	I	OR
	05	05	II	TI
	05	33	II	Se
6	00	26	I	Te
7	02	47	II	OR
8	03	09	IV	SI
	06	37	IV	Se
	23	31	III	SI
9	02	42	III	Se
	04	17	III	TI
11	04	28	I	SI
	05	35	I	TI
	06	43	I	Se
12	01	37	I	ED
	04	59	I	OR
	05	18	II	SI
	22	56	I	SI
13	00	03	I	TI
	01	11	I	Se
	02	16	I	Te
	23	26	I	OR
14	00	11	II	ED
	05	15	II	OR
15	23	28	II	Te
16	03	28	III	SI
	06	39	III	Se
17	00	20	IV	OD
	02	01	IV	OR
18	06	21	I	SI
19	03	30	I	ED
	06	47	I	OR
20	00	32	III	OR
	00	49	I	SI
	01	52	I	TI
	03	04	I	Se
	04	05	I	Te
21	01	14	I	OR
	02	47	II	ED
	22	32	I	Te
22	23	08	II	TI
	23	55	II	Se
23	01	51	II	Te
25	00	27	IV	Se
26	05	23	I	ED
27	00	26	III	ER
	01	13	III	OD
	02	43	I	SI
	03	40	I	TI
	04	06	III	OR
	04	58	I	Se
	05	53	I	Te
	23	52	I	ED
28	03	02	I	OR
	05	22	II	ED
	22	06	I	TI
	23	26	I	Se
29	00	20	I	Te
	23	41	II	SI
30	01	29	II	TI
	02	28	II	Se

January—cont'd

d	h	m	Sat.	Phen.
30	04	13	II	Te
31	23	15	II	OR

FEBRUARY

d	h	m	Sat.	Phen.
3	01	12	III	ED
	04	23	III	ER
	04	36	I	SI
	04	43	III	OD
	05	26	I	TI
4	01	45	I	ED
	04	48	I	OR
	23	04	I	SI
	23	53	I	TI
5	01	20	I	Se
	02	07	I	Te
	23	14	I	OR
6	02	14	II	SI
	03	48	II	TI
	05	02	II	Se
	06	32	II	Te
	21	27	III	Te
7	21	16	II	ED
8	01	34	II	OR
10	05	09	III	ED
	06	30	I	SI
	22	27	IV	TI
	23	47	IV	Te
11	03	38	I	ED
	06	33	I	OR
12	00	58	I	SI
	01	39	I	TI
	03	14	I	Se
	03	52	I	Te
	22	06	I	ED
13	01	00	I	OR
	04	48	II	SI
	06	06	II	TI
	21	42	I	Se
	22	01	III	TI
	22	19	I	Te
	22	28	III	Se
14	00	51	III	Te
	23	51	II	ED
15	03	52	II	OR
16	20	52	II	Se
	21	58	II	Te
18	05	31	I	ED
19	01	14	IV	ED
	02	52	I	SI
	03	23	I	TI
	04	23	IV	ER
	05	07	I	Se
	05	37	I	Te
20	00	00	I	ED
	02	44	I	OR
	21	20	I	SI
	21	50	I	TI
	23	18	III	SI
	23	36	I	Se
21	00	04	I	Te
	01	22	III	TI
	02	26	III	Se
	04	13	III	Te
	21	10	I	OR
22	02	27	II	ED
23	20	38	II	SI
	21	29	II	TI

February—cont'd

d	h	m	Sat.	Phen.
23	23	26	II	Se
24	00	13	II	Te
26	04	46	I	SI
	05	08	I	TI
27	01	53	I	ED
	04	28	I	OR
	23	14	I	SI
	23	34	I	TI
28	01	29	I	Se
	01	48	I	Te
	03	16	III	SI
	04	40	III	TI
	20	22	I	ED
	22	54	I	OR

MARCH

d	h	m	Sat.	Phen.
1	05	02	II	ED
	19	58	I	Se
	20	14	I	Te
2	23	13	II	SI
	23	44	II	TI
3	02	00	II	Se
	02	28	II	Te
	21	00	III	OR
4	21	32	II	OR
6	03	47	I	ED
7	01	08	I	SI
	01	17	I	TI
	03	23	I	Se
	03	32	I	Te
	19	16	IV	ED
	22	16	I	ED
	22	47	IV	OR
8	00	38	I	OR
	19	36	I	SI
	19	43	I	TI
	21	52	I	Se
	21	58	I	Te
9	19	04	I	OR
10	01	47	II	SI
	01	58	II	TI
	04	35	II	Se
	04	43	II	Te
	21	02	III	ED
11	00	16	III	OR
	20	55	II	ED
	23	46	II	OR
13	05	41	I	ED
14	03	01	I	TI
	03	02	I	SI
	05	15	I	Te
	05	17	I	Se
15	00	07	I	OD
	02	25	I	ER
	21	27	I	TI
	21	31	I	SI
	23	41	I	Te
	23	46	I	Se
16	02	59	IV	TI
	03	06	IV	SI
	04	47	IV	Te
	20	53	I	ER
17	04	12	II	TI
	04	22	II	SI
18	00	38	III	OD
	04	07	III	ER
	23	15	II	OD

March—cont'd

d	h	m	Sat.	Phen.
19	02	19	II	ER
20	20	04	II	Te
	20	27	II	Se
21	04	45	I	TI
	04	56	I	SI
22	01	51	I	OD
	04	19	I	ER
	23	11	I	TI
	23	25	I	SI
23	01	25	I	Te
	01	40	I	Se
	20	17	I	OD
	22	48	I	ER
24	19	51	I	Te
	20	08	I	Se
25	03	54	III	OD
26	01	29	II	OD
	04	54	II	ER
27	19	34	II	TI
	20	15	II	SI
	22	20	II	Te
	23	03	II	Se
28	19	10	III	SI
	20	40	III	Te
	22	14	III	Se
29	03	36	I	OD
30	00	56	I	TI
	01	19	I	SI
	03	10	I	Te
	03	34	I	Se
	22	02	I	OD
31	00	42	I	ER
	19	22	I	TI
	19	48	I	SI
	21	36	I	Te
	22	02	I	Se

APRIL

d	h	m	Sat.	Phen.
1	19	10	I	ER
	19	17	IV	Te
	21	07	IV	SI
	23	50	IV	Se
2	03	45	II	OD
3	21	50	II	TI
	22	50	II	SI
4	00	36	II	Te
	01	38	II	Se
	21	03	III	TI
	23	09	III	SI
5	00	01	III	Te
	02	12	III	Se
	20	46	II	ER
6	02	40	I	TI
	03	13	I	SI
	23	47	I	OD
7	02	36	I	ER
	21	07	I	TI
	21	42	I	SI
	23	21	I	Te
	23	57	I	Se
8	21	05	I	ER
10	01	24	IV	OD
	03	48	IV	OR
11	00	07	II	TI
	01	26	II	SI
	02	54	II	Te
12	00	25	III	TI

April—cont'd

d	h	m	Sat.	Phen.
12	03	08	III	SI
	03	25	III	Te
	23	21	II	ER
14	01	32	I	OD
	22	53	I	TI
	23	36	I	SI
15	01	07	I	Te
	01	51	I	Se
	19	58	III	ER
	19	59	I	OD
	23	00	I	ER
16	19	34	I	Te
	20	19	I	Se
18	02	27	II	TI
19	21	30	II	OD
20	01	56	II	ER
21	03	19	I	OD
	20	07	II	Se
22	00	40	I	TI
	01	31	I	SI
	02	54	I	Te
	20	26	III	OR
	20	56	III	ED
	21	46	I	OD
	23	57	III	ER
23	00	54	I	ER
	20	00	I	SI
	21	21	I	Te
	22	14	I	Se
26	23	51	II	OD
27	01	30	IV	ED
28	19	56	II	SI
	20	47	II	Te
	22	43	II	Se
29	02	28	I	TI
	20	54	III	OD
	23	35	I	OD
	23	59	III	OR
30	00	55	III	ED
	20	55	I	TI
	21	54	I	SI
	23	09	I	Te

MAY

d	h	m	Sat.	Phen.
1	00	08	I	Se
	21	18	I	ER
4	02	14	II	OD
	23	09	IV	TI
5	02	00	IV	Te
	20	25	II	TI
	22	33	II	SI
	23	12	II	Te
6	01	20	II	Se
7	00	30	III	OD
	01	24	I	OD

May—cont'd

d	h	m	Sat.	Phen.
7	20	23	II	ER
	22	45	I	TI
	23	49	I	SI
8	00	59	I	Te
	02	02	I	Se
	19	51	I	OD
	23	13	I	ER
9	20	31	I	Se
10	22	02	III	Se
12	22	52	II	TI
13	01	10	II	SI
	01	39	II	Te
	21	46	IV	ER
14	22	58	II	ER
15	00	35	I	TI
	21	42	I	OD
16	01	08	I	ER
	20	12	I	SI
	21	17	I	Te
	22	26	I	Se
17	21	20	III	Te
	23	04	III	SI
20	01	21	II	TI
21	20	22	II	OD
22	23	34	I	OD
23	19	52	II	Se
	20	55	I	TI
	22	07	I	SI
	23	09	I	Te
24	00	20	I	Se
	21	32	I	ER
	22	02	III	TI
25	01	08	III	Te
28	22	52	II	OD
30	19	59	II	Te
	22	29	II	Se
	22	48	I	TI
31	00	02	I	SI
	23	27	I	ER

JUNE

d	h	m	Sat.	Phen.
1	20	43	I	Se
4	20	52	III	ED
	23	48	III	ER
6	22	20	II	SI
	22	34	II	Te
7	21	26	IV	SI
	21	50	I	OD
	23	13	IV	Se
8	20	25	I	SI
	21	24	I	Te
	22	38	I	Se
11	22	47	III	OR
13	22	23	II	TI

June—cont'd

d	h	m	Sat.	Phen.
15	21	05	I	TI
	22	13	IV	OR
	22	20	I	SI
	22	33	II	ER
	23	19	I	Te
16	21	46	I	ER
22	21	52	III	Se
	23	01	I	TI
23	20	11	I	OD
24	20	56	I	Se
29	21	06	III	Te
	22	33	II	OD
30	22	08	I	OD

JULY

d	h	m	Sat.	Phen.
1	20	38	I	SI
	21	41	I	Te
	22	17	II	Se
6	22	09	III	TI
8	21	24	I	TI
	22	09	II	SI
9	22	01	I	ER
10	22	07	IV	TI
16	20	35	I	OD
17	20	06	I	Te
	20	50	III	ED
	21	08	I	Se
19	20	23	IV	ED
	20	57	IV	ER
24	19	58	II	OD
	20	37	III	OD
	20	50	I	SI
25	20	20	I	ER
27	20	37	IV	Te

AUGUST

d	h	m	Sat.	Phen.
2	20	18	II	Te
9	20	17	II	TI
22	19	34	III	ER

Jupiter being near the Sun, phenomena of the Satellites are not given from August 26 to October 16

OCTOBER

d	h	m	Sat.	Phen.
23	05	39	I	Te
30	05	27	I	TI

NOVEMBER

d	h	m	Sat.	Phen.
3	05	10	II	SI
12	05	56	II	OR
13	05	08	III	Se
	05	19	III	TI
14	06	06	I	ED
15	05	26	I	Se
	06	09	I	Te
19	04	27	II	ED
22	05	08	I	SI
	05	56	I	TI
23	05	29	I	OR
28	03	55	II	TI
	04	50	II	Se
30	04	21	I	ED

DECEMBER

d	h	m	Sat.	Phen.
1	03	42	I	Se
	04	11	III	OD
	04	36	I	Te
5	04	44	II	SI
	06	39	II	TI
7	03	36	II	OR
	06	14	I	ED
8	03	23	I	SI
	04	22	III	ED
	04	23	I	TI
	05	35	I	Se
	06	34	I	Te
9	03	55	I	OR
14	06	20	II	OR
15	05	17	I	SI
	06	21	I	TI
16	05	51	I	OR
17	03	01	I	Te
19	02	56	III	TI
	05	14	III	Te
21	04	05	II	ED
23	03	58	II	Te
	04	29	I	ED
24	02	47	I	TI
	03	50	I	Se
	04	58	I	Te
26	02	21	III	SI
	04	49	III	Se
28	06	41	II	ED
30	04	01	II	TI
	04	19	II	Se
	06	22	I	ED
	06	36	II	Te
31	03	32	I	SI
	04	43	I	TI
	05	44	I	Se
	06	54	I	Te

METEORS OR SHOOTING STARS

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

ECLIPSES DURING 1945

There will be four eclipses in 1945, two of the sun and two of the moon.

1. *An Annular Eclipse of the Sun,* January 14, will be invisible in Canada. The central path crosses the southern Indian and Pacific Oceans. The eclipse will be seen as partial in eastern Africa and Australia, New Zealand and Antarctica.

2. *A Partial Eclipse of the Moon,* on June 25, will be invisible from Canada, visible from the Pacific, Indian and Antarctic oceans, Asia, Australia, and southeast Africa.

3. *A Total Eclipse of the Sun,* on July 9, will be visible in some phase over most of North America, Europe and parts of Asia and Africa. The path of totality crosses western Canada, as shown in the map on page 29. Wolseley and Grenfell, Sask., and God's Lake, Man., will be near the centre of the path of totality. Yorkton and Melville, Sask., will be respectively just outside and inside the northern edge of the path. The path also crosses eastern Europe and western Asia. Unfortunately in Canada the eclipse will occur when the sun is low in the morning sky. The duration of totality will be from one-half to three-quarters of a minute in Canada. This will be the last total solar eclipse visible in Canada until 1954.

The Circumstances of the Solar Eclipse are (75th Meridian Civil Time):

	E.S.T.	Longitude	Latitude
Eclipse begins................	July 9d 05h 59.6m	86° 06′ W	27° 38′ N
Central eclipse begins..........	" 9 07 13.8	115° 57′ W	44° 23′ N
Central eclipse at local apparent noon......................	" 9 08 25.1	20° 02′ W	70° 03′ N
Central eclipse ends...........	" 9 09 40.9	72° 33′ E	41° 43′ N
Eclipse ends..................	" 9 10 55.2	43° 25′ E	24° 48′ N

4. *A Total Eclipse of the Moon,* on December 19, will be well visible from all over Canada. The beginning will be visible from western Asia, Europe, Africa and the Americas; the ending visible from parts of Asia, Europe and Africa, and from the Americas.

The Circumstances of this Lunar Eclipse are (75th Meridian Civil Time):

Moon enters penumbra...............	December 18d 18h 38.4m
Moon enters umbra..................	" 18 19 37.5
Total eclipse begins.................	" 18 20 40.5
Middle of eclipse.....................	" 18 21 20.3
Total eclipse ends....................	" 18 22 00.2
Moon leaves umbra..................	" 18 23 03.1
Moon leaves penumbra...............	" 19 00 02.3

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 1945 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—

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

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

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1945

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			°
Feb. 6	θ Lib	4.3	I	23.2	4 46.8	−2.3	+2.3	65	Graze	.....	.....	...
6	θ Lib	4.3	E	23.2	5 37.5	−0.3	−1.8	346	Graze	.....	.....	...
20	ζ Tau	3.0	I	8.4	22 24.9	.....	.....	21	No. occ.	.....	.....	...
20	ζ Tau	3.0	E	8.4	22 55.8	.....	.....	334	No. occ.	.....	.....	...
Mar. 18	68 Tau	4.2	I	4.9	22 30.7	−0.1	−1.5	98	22 28.6	0.0	−1.2	88
21	δ Gem	3.5	I	8.0	23 52.8	−1.0	−0.6	66	23 57.9	−1.0	−0.2	52
22	δ Gem	3.5	E	8.0	0 45.7	+0.2	−2.3	314	0 39.1	+0.5	−2.7	328
May 20	ν Vir	4.2	I	9.2	Sun	.....	.....	...	19 29.2	−2.7	+1.0	75
Jun. 11	Saturn †	0.3	I	1.6	12 13.0	−2.1	−1.7	135	12 21.9	−2.0	−1.6	130
11	Saturn †	0.3	E	1.6	13 06.4	−1.6	+3.2	218	13 21.3	−1.8	+2.3	225
Sep. 28	η Gem f	3.9	I	21.7	0 39.0	−0.4	+0.9	108	0 43.7	−0.6	+0.9	110
28	η Gem f	3.9	E	21.7	1 31.3	−0.1	+2.3	229	1 36.5	−0.2	+2.4	226
Nov. 23	Mars	−0.2	E	19.2	Low	.....	.....	...	21 35.4	+0.1	+1.1	279
Dec. 25	ν Vir	4.2	I	20.7	4 57.6	−0.5	−3.2	172	4 57.4	−1.0	−2.1	155
25	ν Vir	4.2	E	20.7	5 53.1	−2.9	+0.8	254	6 07.4	−2.1	−0.5	271

LUNAR OCCULTATIONS VISIBLE AT VANCOUVER AND CALGARY, 1945

Date	Star	Mag.	I or E	Age of Moon	Vancouver P.S.T.	Vancouver a	Vancouver b	Vancouver P	Calgary M.S.T.	Calgary a	Calgary b	Calgary P
				d	h m			°	h m			°
Mar. 18	68 Tau	4.2	I	4.9	18 49.5	−1.4	−1.2	96	19 59.1	−1.1	−1.2	91
21	δ Gem	3.5	I	8.0	19 45.8	−1.7	+0.1	85	21 01.1	−1.6	−0.1	77
21	δ Gem	3.5	E	8.0	21 05.3	−1.4	−1.4	286	22 14.1	−1.0	−1.9	297
May 13	ζ Tau	3.0	I	2.3	Sun	.....	.....	...	20 25.4	+0.2	−2.1	121
June 11	Saturn †	0.3	I	1.6	8 31.0	−0.1	+1.7	73	9 35.6	−0.4	+1.7	79
11	Saturn †	0.3	E	1.6	9 31.1	−0.6	+1.3	273	10 39.6	−0.8	+1.4	268
Sep. 26	ε Tau	3.6	I	20.0	4 12.5	−1.0	+2.5	28	5 25.5	−1.1	+2.1	30
26	ε Tau	3.6	E	20.0	5 06.2	−1.8	−1.7	296	Sun	.....	.....	...
28	μ Gem	3.2	I	21.9	1 08.4	−0.8	+0.5	126	2 18.0	−1.3	−0.1	136
28	μ Gem	3.2	E	21.9	1 51.1	+0.1	+2.9	214	2 55.0	+0.1	+3.6	205
Dec. 25	ν Vir	4.2	I	20.7	Graze	.....	.....	...	2 22.0	.....	.....	185
25	ν Vir	4.2	E	20.7	Graze	.....	.....	...	2 46.5	.....	.....	226

†Daylight Occultations.

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

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

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

PHYSICAL ELEMENTS

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

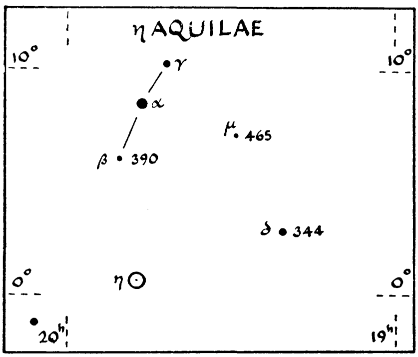
*As seen from the sun.

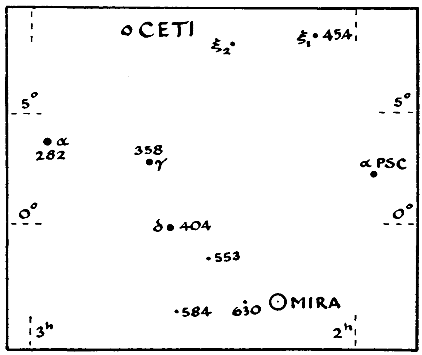
Satellites Io, Europa, Ganymede, Callisto are usually denoted I, II, III, IV, respectively, in order of distance from the planet.

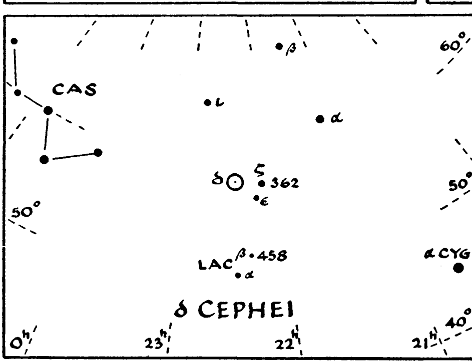
VARIABLE STARS

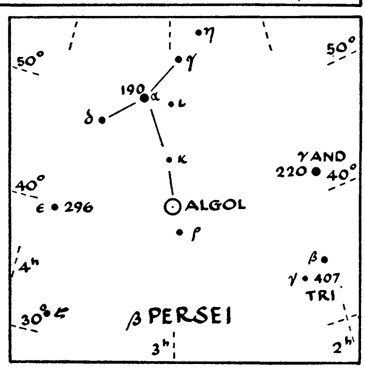
Much pleasure may be derived from the estimation of the brightness of variable stars. Maps of the fields of four bright variable stars are given below. In each case the magnitudes of several suitable comparison stars are given. These magnitudes are given as magnitudes, tenths and hundredths, with the 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.









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

α U. Min., *Polaris:* RA. 1h 45.6 m; Dec. + 89° 00′ (1945)

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	3.1	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 1900 ° ′	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		χ Per	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		ω Cen	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		1,000
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.

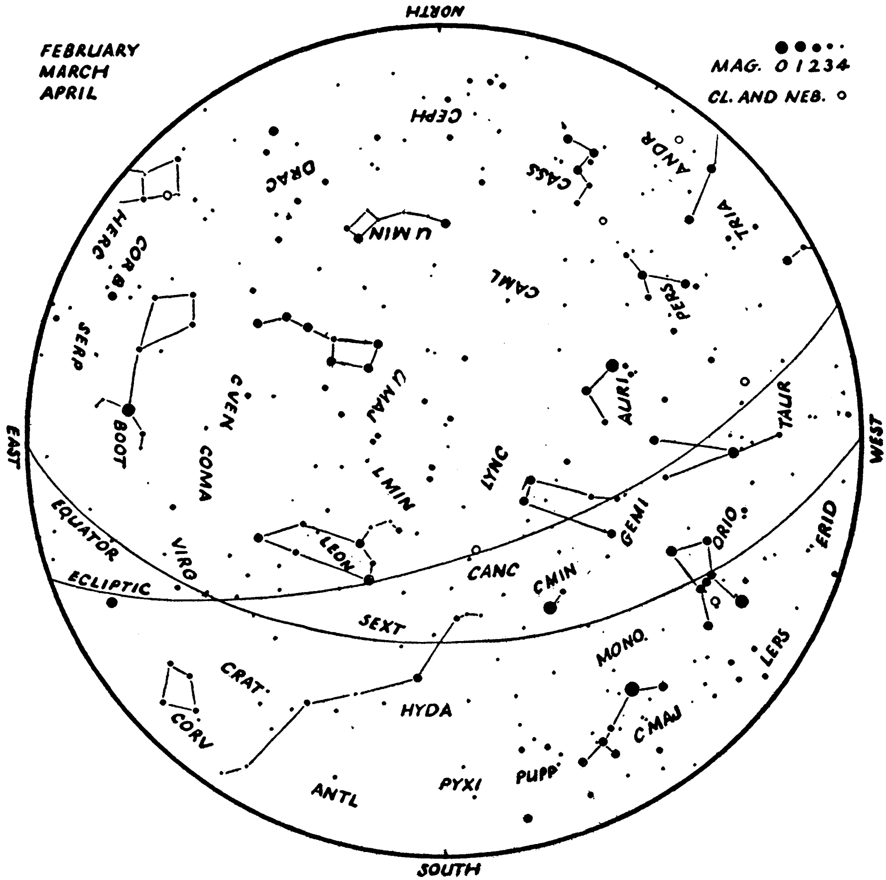
N.G.C.	M	Con	α 1900 h m	δ ° ′	Cl	Size ′	m n	m *	Dist. l.y.	Name
650	76	Per	01 36.0	+51 04	Pl	1.5	11	17	15,000	
1952	1	Tau	05 28.5	+21 57	Pl	6	11	16	10,000	Crab
1976	42	Ori	05 30.4	−05 27	Dif	30			1,800	Orion
B33		Ori	05 35.9	−02 31	Drk	4			300	Horsehead
2261		Mon	06 33.7	+08 49	Dif	2				Hubble's var
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

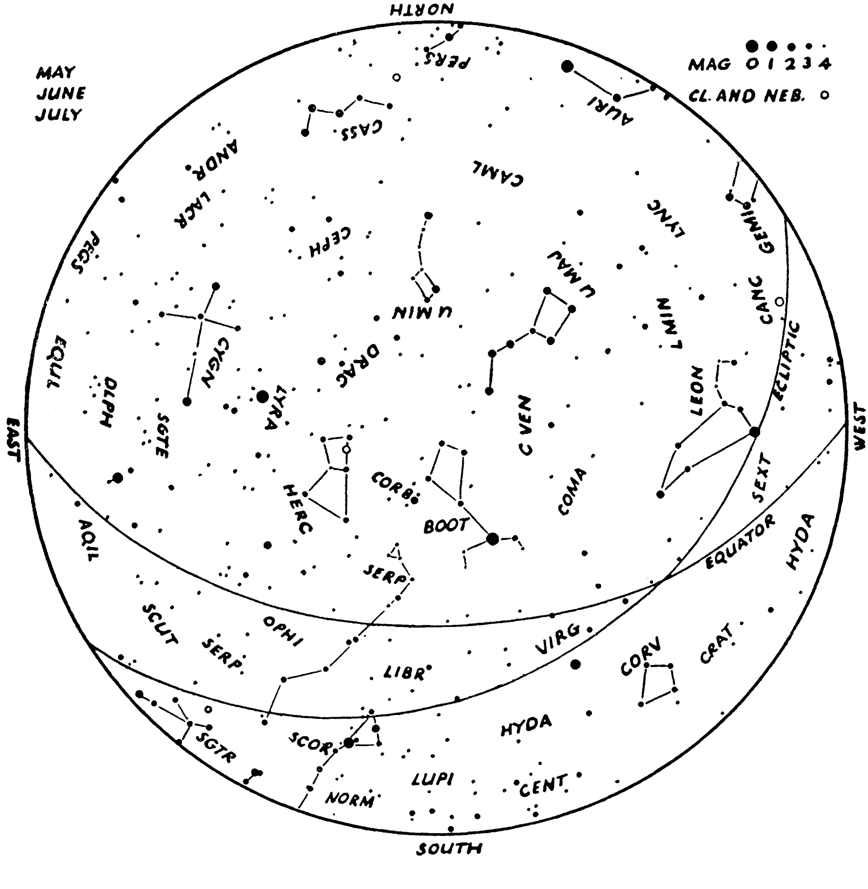


The above map represents the evening sky at

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

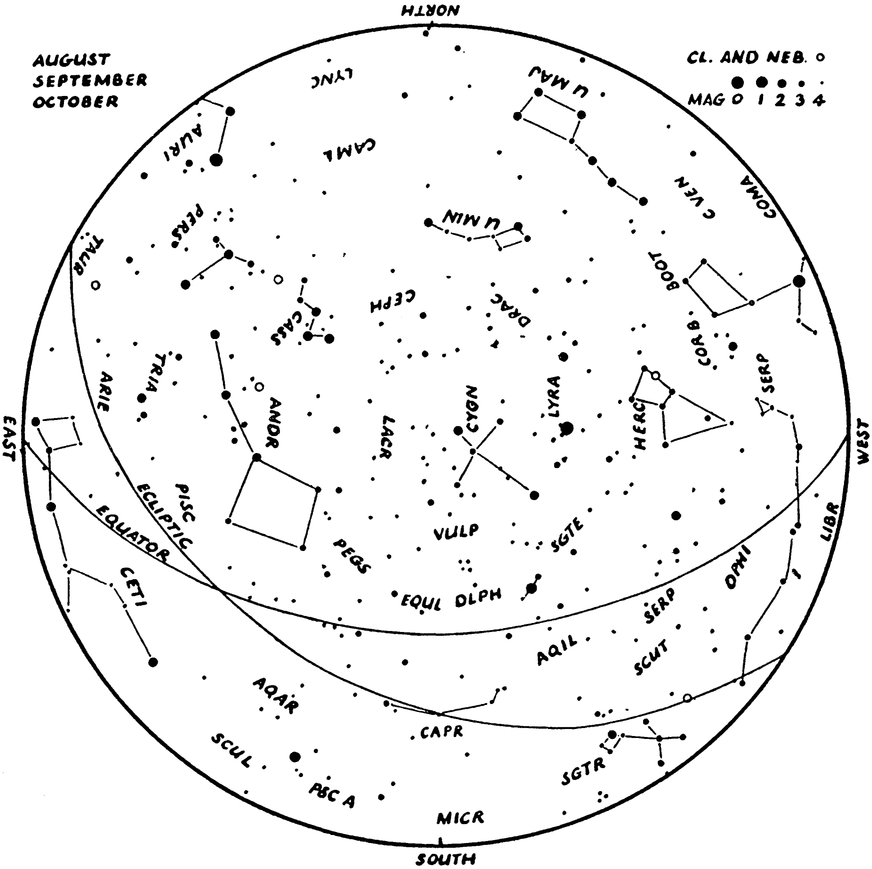


The above map represents the evening sky at

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

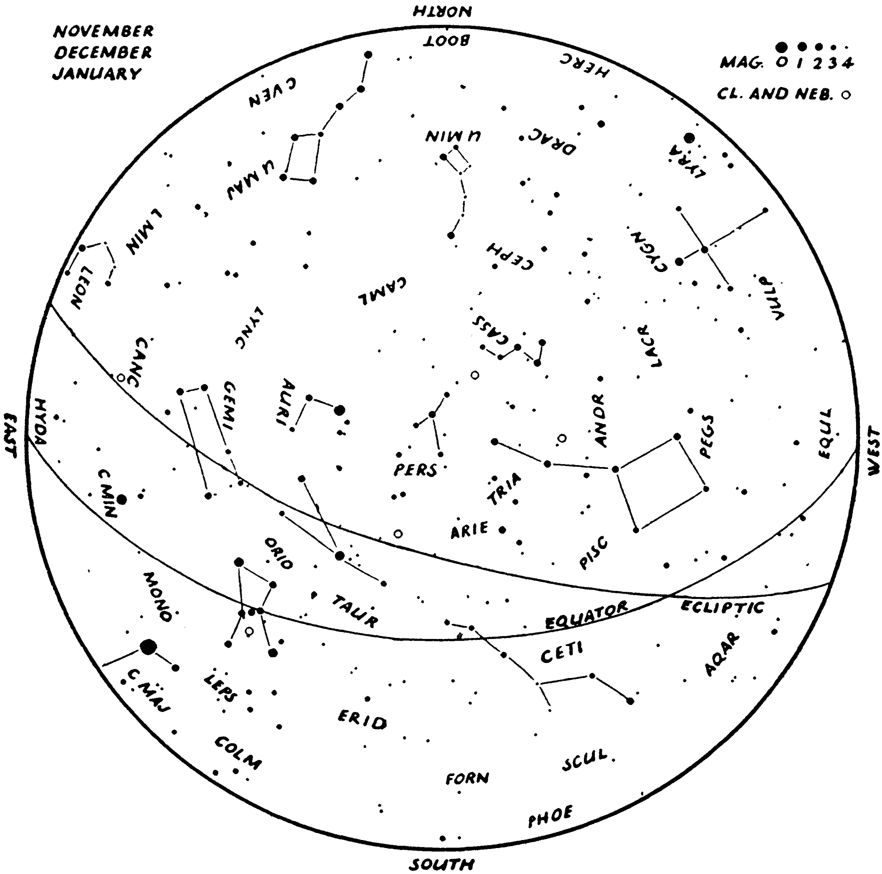


The above map represents the evening sky at

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′ä-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-ël-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

No. 47. Polaris: 1945 position given on page 65.

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

Pronunciation Key

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

TABLE OF PRECESSION FOR 50 YEARS

R.A.	Prec. in Dec.	Precession in Right Ascension $\delta = +85°$	+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.

Station.	Mean Temperature, Fahrenheit.												Average Annual.		
	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.

Station	Mean Precipitation. (Unit = one tenth of an inch)												Year.		
	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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1890-1945

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