THE OBSERVER'S HANDBOOK FOR 1939

PUBLISHED BY

The Royal Astronomical Society of Canada

C. A. CHANT, Editor
F. S. HOGG, Assistant Editor
DAVID DUNLAP OBSERVATORY

THIRTY-FIRST YEAR OF PUBLICATION

TORONTO
198 College Street
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1939

1939 CALENDAR 1939

JANUARY

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

FEBRUARY

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

MARCH

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	..

APRIL

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	..

MAY

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	..

JUNE

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	..

JULY

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	..

AUGUST

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	..

SEPTEMBER

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

OCTOBER

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	..

NOVEMBER

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	..
Sat.	4	11	18	25	..

DECEMBER

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

Julian Day Calendar, 1939

J. D. 2,420,000 plus the following:

Jan. 1	9265	May 1	9385	Sept. 1	9508
Feb. 1	9296	June 1	9416	Oct. 1	9538
Mar. 1	9324	July 1	9446	Nov. 1	9569
Apr. 1	9355	Aug. 1	9477	Dec. 1	9599

The Julian Day commences at noon.
Thus J.D. 2,429,265.0 = Jan. 1.5 G.C.T.

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CONTENTS

PRINTED IN CANADA

PREFACE

In the HANDBOOK for 1939, which is the thirty-first issue, numerous changes have been made. By giving the times of sunrise and sunset for every second day, although additional latitudes have been included, there has been a saving of six pages of space. This has allowed the inclusion of times of beginning and ending of twilight, of ephemerides of Saturn's satellites and of the brighter asteroids, the extension of information on Meteors and Occultations, and the insertion of a table of miscellaneous Astronomical Data. The table of Satellites has also been revised. It was hoped to revise the table of The Brightest Stars, but circumstances prevented it this year.

The small star maps at the back necessarily contain only a few objects. Four similar maps 9 inches in diameter are obtainable from the Director of University Extension, University of Toronto, for one cent each. Observers desiring fuller information are recommended to obtain Norton's *Star Atlas and Reference Handbook* (Gall and Inglis, price 12*s* 6*d*; supplied also by Eastern Science Supply Co., Boston). The sixth edition contains late information.

The changes enumerated have been possible through the help of Dr. F. S. Hogg who is now Assistant Editor. Cordial thanks are tendered to all who assisted but especially to Miss Ruth J. Northcott, M.A., of the David Dunlap Observatory.

C. A. CHANT.

David Dunlap Observatory,
Richmond Hill, Ont., December 1938.

ANNIVERSARIES AND FESTIVALS 1939

New Year's Day	Sun.	Jan. 1
Epiphany	Fri.	Jan. 6
Septuagesima Sunday		Feb. 5
Quinquagesima (Shrove Sunday)		Feb. 19
Ash Wednesday		Feb. 22
Quadragesima (First Sunday in Lent)		Feb. 26
St. David	Wed.	Mar. 1
St. Patrick	Fri.	Mar. 17
Annunciation (Lady Day)	Sat.	Mar. 25
Palm Sunday		Apr. 2
Good Friday		Apr. 7
Easter Sunday		Apr. 9
St. George	Sun.	Apr. 23
Rogation Sunday		May 14
Ascension Day	Thu.	May 18
Empire Day (Victoria Day)	Wed.	May 24
Birthday of the Queen Mother, Mary (1867)	Fri.	May 26
Pentecost (Whit Sunday)		May 28
Trinity Sunday		June 4
Corpus Christi	Thu.	June 8
St. John Baptist (Midsummer Day)	Sat.	June 24
Dominion Day	Sat.	July 1
Birthday of Queen Elizabeth (1900)	Fri.	Aug. 4
Labour Day	Mon.	Sept. 4
Hebrew New Year (Rosh Hashanah)	Thu.	Sept. 14
St. Michael (Michaelmas Day)	Fri.	Sept. 29
All Saints' Day	Wed.	Nov. 1
Remembrance Day	Sat.	Nov. 11
St. Andrew	Thu.	Nov. 30
First Sunday in Advent		Dec. 3
Accession of King George VI (1936)	Mon.	Dec. 11
Birthday of King George VI (1895)	Thu.	Dec. 14
Christmas Day	Mon.	Dec. 25

Thanksgiving Day, date set by Proclamation

SYMBOLS AND ABBREVIATIONS

SIGNS OF THE ZODIAC

♈ Aries........ 0°	♌ Leo........120°	♐ Sagittarius...240°
♉ Taurus ......30°	♍ Virgo......150°	♑ Capricornus..270°
♊ Gemini ......60°	♎ Libra......180°	♒ Aquarius....300°
♋ Cancer.......90°	♏ Scorpio ....210°	♓ Pisces.......330°

SUN, MOON AND PLANETS

☉ The Sun.	☾ The Moon generally.	♃ Jupiter.
● New Moon.	☿ Mercury.	♄ Saturn.
☉ Full Moon.	♀ Venus.	♅ or ♅ Uranus.
☽ First Quarter	⊕ Earth.	♆ Neptune.
☾ Last Quarter.	♂ Mars.	♇ Pluto

ASPECTS AND ABBREVIATIONS

☌ Conjunction, or having the same Longitude or Right Ascension.
☍ Opposition, or differing 180° in Longitude or Right Ascension.
□ Quadrature, or differing 90° in Longitude or Right Ascension.
☊ Ascending Node; ☋ Descending Node.
α or A.R., Right Ascension; δ Declination.
h, m, s, Hours, Minutes, Seconds of Time.
° ′ ″, Degrees, Minutes, Seconds of Arc.

THE GREEK ALPHABET

A, α,	Alpha.	I, ι,	Iota.	P, ρ,	Rho.
B, β,	Beta.	K, κ,	Kappa.	Σ, σ, ς,	Sigma.
Γ, γ,	Gamma.	Λ, λ,	Lambda.	T, τ,	Tau.
Δ, δ,	Delta.	M, μ,	Mu.	Υ, υ,	Upsilon.
E, ϵ,	Epsilon.	N, ν,	Nu.	Φ, ϕ,	Phi.
Z, ζ,	Zeta.	Ξ, ξ,	Xi.	X, χ,	Chi.
H, η,	Eta.	O, o,	Omicron.	Ψ, ψ,	Psi.
Θ, θ, ϑ,	Theta.	Π, π,	Pi.	Ω, ω,	Omega.

THE CONFIGURATIONS OF JUPITER'S SATELLITES

In the Configurations of Jupiter's Satellites (pages 27, 29, 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.

ABBREVIATIONS FOR THE CONSTELLATIONS

Andromeda	And	Andr
Antlia	Ant	Antl
Apus	Aps	Apus
Aquarius	Aqr	Aqar
Aquila	Aql	Aqil
Ara	Ara	Arae
Aries	Ari	Arie
Auriga	Aur	Auri
Bootes	Boo	Boot
Caelum	Cae	Cael
Camelopardalis	Cam	Caml
Cancer	Cnc	Canc
Canes Venatici	CVn	CVen
Canis Major	CMa	CMaj
Canis Minor	CMi	CMin
Capricornus	Cap	Capr
Carina	Car	Cari
Cassiopeia	Cas	Cass
Centaurus	Cen	Cent
Cepheus	Cep	Ceph
Cetus	Cet	Ceti
Chamaeleon	Cha	Cham
Circinus	Cir	Circ
Columba	Col	Colm
Coma Berenices	Com	Coma
Corona Australis	CrA	CorA
Corona Borealis	CrB	CorB
Corvus	Crv	Corv
Crater	Crt	Crat
Crux	Cru	Cruc
Cygnus	Cyg	Cygn
Delphinus	Del	Dlph
Dorado	Dor	Dora
Draco	Dra	Drac
Equuleus	Equ	Equl
Eridanus	Eri	Erid
Fornax	For	Forn
Gemini	Gem	Gemi
Grus	Gru	Grus
Hercules	Her	Herc
Horologium	Hor	Horo
Hydra	Hya	Hyda
Hydrus	Hyi	Hydi
Indus	Ind	Indi
Lacerta	Lac	Lacr
Leo	Leo	Leon
Leo Minor	LMi	LMin
Lepus	Lep	Leps
Libra	Lib	Libr
Lupus	Lup	Lupi
Lynx	Lyn	Lync
Lyra	Lyr	Lyra
Mensa	Men	Mens
Microscopium	Mic	Micr
Monoceros	Mon	Mono
Musca	Mus	Musc
Norma	Nor	Norm
Octans	Oct	Octn
Ophiuchus	Oph	Ophi
Orion	Ori	Orio
Pavo	Pav	Pavo
Pegasus	Peg	Pegs
Perseus	Per	Pers
Phoenix	Phe	Phoe
Pictor	Pic	Pict
Pisces	Psc	Pisc
Piscis Australis	PsA	PscA
Puppis	Pup	Pupp
Pyxis	Pyx	Pyxi
Reticulum	Ret	Reti
Sagitta	Sge	Sgte
Sagittarius	Sgr	Sgtr
Scorpius	Scr	Scor
Sculptor	Scl	Scul
Scutum	Sct	Scut
Serpens	Ser	Serp
Sextans	Sex	Sext
Taurus	Tau	Taur
Telescopium	Tel	Tele
Triangulum	Tri	Tria
Triangulum Australe	TrA	TrAu
Tucana	Tuc	Tucn
Ursa Major	UMa	UMaj
Ursa Minor	UMi	UMin
Vela	Vel	Velr
Virgo	Vir	Virg
Volans	Vol	Voln
Vulpecula	Vul	Vulp

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

From *Transactions of the I.A.U.*, Vol. IV., 1932, page 221.

MISCELLANEOUS ASTRONOMICAL DATA

Units of Length

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

Units of Time

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

The Earth

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

Mass of earth = 6.6×10^{21} tons; velocity of escape from ⊕ = 6.94 miles/sec.

Earth's Orbital Motion

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

Solar Motion

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

The Galactic System

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

Extragalactic Nebulae

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

Radiation Constants

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

Miscellaneous

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

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

π = 3.141,592,653,6
No. of square degrees in the sky = 41,253

1939 EPHEMERIS OF THE SUN AT 0h. GREENWICH CIVIL TIME

Date	Apparent R.A.	Corr. to Sundial	Apparent Dec.
	h m s	m s	° ′ ″
Jan. 1	18 42 06	+03 06	−23 05.5
" 4	18 55 20	+04 31	−22 50.2
" 7	19 08 30	+05 52	−22 30.7
" 10	19 21 37	+07 08	−22 07.2
" 13	19 34 39	+08 21	−21 39.8
" 16	19 47 35	+09 27	−21 08.7
" 19	20 00 26	+10 28	−20 33.9
" 22	20 13 10	+11 23	−19 55.5
" 25	20 25 47	+12 10	−19 13.9
" 28	20 38 17	+12 51	−18 29.1
" 31	20 50 40	+13 23	−17 41.2
Feb. 3	21 02 55	+13 49	−16 50.6
" 6	21 15 02	+14 07	−15 57.3
" 9	21 27 03	+14 17	−15 01.5
" 12	21 38 56	+14 21	−14 03.5
" 15	21 50 43	+14 18	−13 03.3
" 18	22 02 23	+14 09	−12 01.2
" 21	22 13 57	+13 53	−10 57.4
" 24	22 25 24	+13 31	−09 52.1
" 27	22 36 47	+13 04	−08 45.4
Mar. 2	22 48 04	+12 31	−07 37.6
" 5	22 59 16	+11 54	−06 28.8
" 8	23 10 24	+11 12	−05 19.2
" 11	23 21 29	+10 27	−04 09.0
" 14	23 32 30	+09 39	−02 58.2
" 17	23 43 30	+08 49	−01 47.2
" 20	23 54 27	+07 57	−00 36.0
" 23	00 05 24	+07 03	+00 35.1
" 26	00 16 19	+06 09	+01 46.0
" 29	00 27 14	+05 14	+02 56.5
Apr. 1	00 38 09	+04 19	+04 06.6
" 4	00 49 04	+03 25	+05 15.9
" 7	01 00 01	+02 32	+06 24.4
" 10	01 11 00	+01 41	+07 31.9
" 13	01 22 01	+00 53	+08 38.3
" 16	01 33 05	+00 07	+09 43.4
" 19	01 44 12	−00 35	+10 47.0
" 22	01 55 23	−01 14	+11 49.0
" 25	02 06 38	−01 49	+12 49.3
" 28	02 17 56	−02 20	+13 47.7
May 1	02 29 20	−02 46	+14 44.1
" 4	02 40 47	−03 08	+15 38.2
" 7	02 52 20	−03 25	+16 30.0
" 10	03 03 58	−03 37	+17 19.4
" 13	03 15 41	−03 44	+18 06.2
" 16	03 27 29	−03 45	+18 50.2
" 19	03 39 23	−03 41	+19 31.4
" 22	03 51 22	−03 32	+20 09.6
" 25	04 03 25	−03 18	+20 44.7
" 28	04 15 33	−03 00	+21 16.6
" 31	04 27 45	−02 38	+21 45.2
June 3	04 40 00	−02 12	+22 10.3
" 6	04 52 20	−01 42	+22 32.0
" 9	05 04 42	−01 10	+22 50.2
" 12	05 17 01	−00 35	+23 04.7
" 15	05 29 34	+00 02	+23 15.6
" 18	05 42 02	+00 41	+23 22.8
" 21	05 54 31	+01 20	+23 26.3
" 24	06 06 59	+01 59	+23 26.1
" 27	06 19 27	+02 38	+23 22.2
" 30	06 31 54	+03 15	+23 14.5

Date	Apparent R.A.	Corr. to Sundial	Apparent Dec.
	h m s	m s	° ′ ″
July 3	06 44 18	+03 50	+23 03.3
" 6	06 56 41	+04 22	+22 48.3
" 9	07 09 00	+04 52	+22 29.8
" 12	07 21 16	+05 18	+22 07.9
" 15	07 33 28	+05 41	+21 42.4
" 18	07 45 36	+05 59	+21 13.7
" 21	07 57 39	+06 12	+20 41.7
" 24	08 09 37	+06 20	+20 06.6
" 27	08 21 30	+06 24	+19 28.4
" 30	08 33 17	+06 21	+18 47.4
Aug. 2	08 44 59	+06 13	+18 03.6
" 5	08 56 35	+06 00	+17 17.1
" 8	09 08 06	+05 41	+16 28.1
" 11	09 19 32	+05 17	+15 36.7
" 14	09 30 53	+04 48	+14 43.1
" 17	09 42 09	+04 15	+13 47.3
" 20	09 53 20	+03 36	+12 49.6
" 23	10 04 26	+02 53	+11 50.0
" 26	10 15 29	+02 06	+10 48.8
" 29	10 26 27	+01 15	+09 46.0
Sept. 1	10 37 23	+00 20	+08 41.8
" 4	10 48 15	−00 37	+07 36.4
" 7	10 59 06	−01 36	+06 29.9
" 10	11 09 54	−02 37	+05 22.4
" 13	11 20 41	−03 40	+04 14.0
" 16	11 31 28	−04 43	+03 05.0
" 19	11 42 14	−05 47	+01 55.5
" 22	11 53 00	−06 50	+00 45.6
" 25	12 03 46	−07 53	−00 24.5
" 28	12 14 34	−08 55	−01 34.6
Oct. 1	12 25 23	−09 55	−02 44.7
" 4	12 36 15	−10 53	−03 54.5
" 7	12 47 11	−11 48	−05 03.9
" 10	12 58 09	−12 38	−06 12.8
" 13	13 09 12	−13 25	−07 20.9
" 16	13 20 20	−14 08	−08 28.2
" 19	13 31 32	−14 45	−09 34.3
" 22	13 42 49	−15 17	−10 39.2
" 25	13 54 13	−15 43	−11 42.6
" 28	14 05 42	−16 03	−12 44.5
" 31	14 17 19	−16 17	−13 44.6
Nov. 3	14 29 02	−16 23	−14 42.7
" 6	14 40 53	−16 22	−15 38.6
" 9	14 52 51	−16 13	−16 32.3
" 12	15 04 57	−15 57	−17 23.5
" 15	15 17 11	−15 33	−18 11.9
" 18	15 29 32	−15 01	−18 57.5
" 21	15 42 01	−14 22	−19 40.0
" 24	15 54 36	−13 36	−20 19.4
" 27	16 07 19	−12 43	−20 55.3
" 30	16 20 08	−11 44	−21 27.7
Dec. 3	16 33 04	−10 38	−21 56.5
" 6	16 46 06	−09 26	−22 21.5
" 9	16 59 12	−08 09	−22 42.5
" 12	17 12 23	−06 48	−22 59.6
" 15	17 25 37	−05 23	−23 12.6
" 18	17 38 54	−03 56	−23 21.4
" 21	17 52 13	−02 27	−23 26.0
" 24	18 05 32	−00 58	−23 26.3
" 27	18 18 51	+00 32	−23 22.4
" 30	18 32 09	+02 00	−23 14.4

Corr. to Sundial gives that quantity which, if the sign be + must be added to, or if the sign be − subtracted from, the *apparent* or sundial time, to get the local *mean* 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.

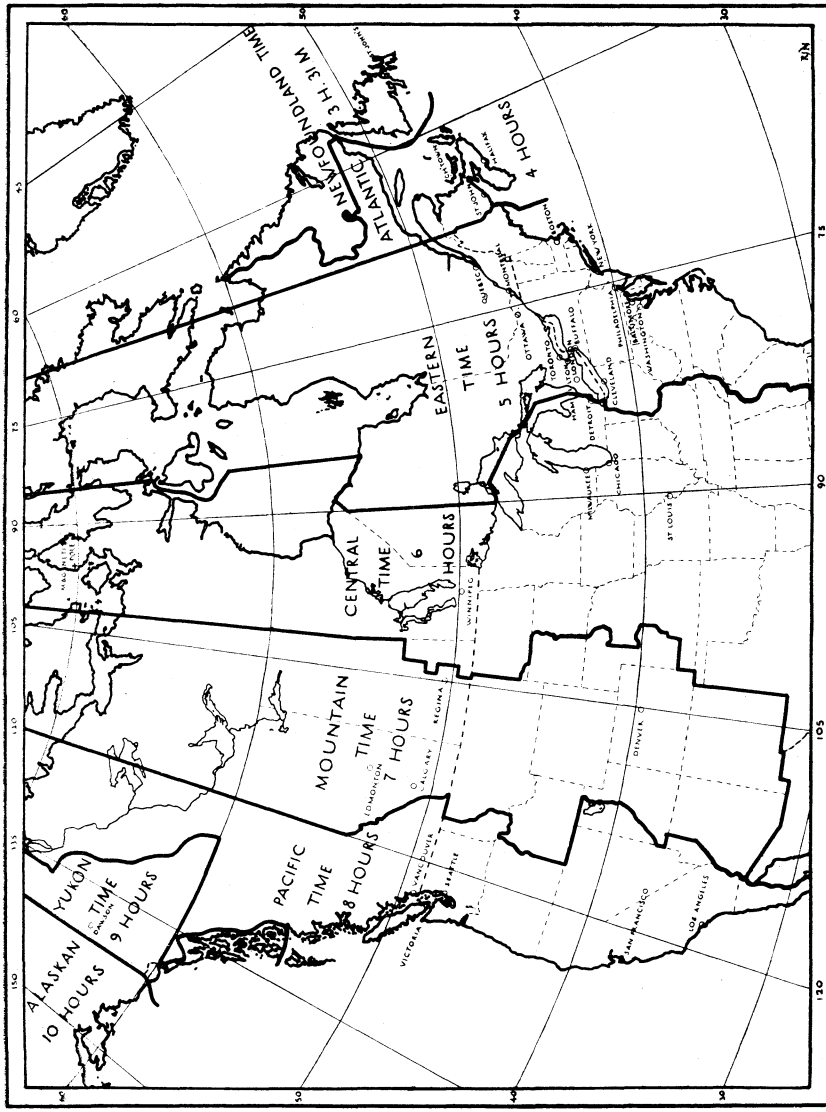
3. *Sidereal Time*—This is time as determined from the stars. It is sidereal noon when the Vernal Equinox or First of Aries is on the meridian. In accurate time-keeping the moment when a star is on the meridian is observed and the corresponding mean time is then computed with the assistance of the Nautical 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.

MAP OF STANDARD TIME ZONES



TIMES OF SUNRISE AND SUNSET

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

How the Tables are Constructed

The time of sunrise and sunset at a given place, in local mean time, varies from day to day, and depends principally upon the declination of the sun. Variations in the equation of time, the apparent diameter of the sun and atmospheric refraction at the points of sunrise and sunset also affect the final result. These quantities, as well as the solar declination, do not have precisely the same values on corresponding days from year to year, and so the table gives only approximately average values. The times are for the rising and setting of the upper limb of the sun, and are corrected for refraction. It must also be remembered that these times are computed for the sea horizon, which is only approximately realised on land surfaces, and is generally widely departed from in hilly and mountainous localities. The greater or less elevation of the point of view above the ground must also be considered, to get exact results.

The Standard Times for Any Station

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

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

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

In the above list Owen Sound is under "48°", and the correction is + 24 min. On page 11 the time of sunrise on February 12 for latitude 44° is 7.09; add 24 min. and we get 7.33 (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 01	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 05	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 01	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 57	5 54	5 47	5 54	5 46
30	5 53	5 46	5 54	5 46	5 55	5 44	5 56	5 43	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

THE SUN AND PLANETS FOR 1939

By Donald A. MacRae

THE SUN

It is a well-known fact that the variations in the number and positions of sun-spots observed on the sun are roughly periodic. The average interval between times of maximum solar activity is 11.13 years, but the observed intervals range from eight to fourteen years. The rise to maximum is usually more rapid than the fall which follows. Since 1934 solar activity has been increasing and a maximum was expected early in 1938. Minor fluctuations since August 1937 have made it difficult to decide whether the sun has already passed the maximum or is still in a state of increasing activity. In either case sun-spots will be numerous and the year 1939 will offer an abundance of magnetic storms, auroral displays and other associated phenomena.

MERCURY

Mercury, the planet closest to the sun, is also the smallest and least massive. With the exception of Pluto its orbit is the most eccentric and has the greatest inclination to the ecliptic. Mercury appears to move swiftly from one side of the sun to the other several times each year and at times of greatest elongation its angular distance from the sun is always small, varying from 18° to 28°. It is visible to the naked eye for about two weeks at these times.

When Mercury is near greatest elongation east of the sun it appears in the evening, setting very soon after the sun. When near greatest western elongation it can be seen in the morning just before sunrise. In northern and southern latitudes at sunset the ecliptic is most nearly vertical in the spring; at sunrise it is most nearly vertical in the autumn. Therefore eastern elongations in the spring and western elongations in the autumn are most favourable for observing Mercury.

Mercury reaches eastern elongation three times during 1939. The dates, angular distances from the sun, and magnitudes are: March 16 (most favourable), 18°, +0.0; July 13, 27°, +0.7; November 7, 23°, +0.0.

Mercury reaches western elongation four times as follows, January 3, 23°, +0.0; May 1, 27°, +0.7; August 28 (most favourable), 18°, +0.1; December 16, 21°, —0.2.

At its closest approach to the earth this year (inferior conjunction, April 3) its distance will be 54,000,000 miles. At greatest elongations its semi-diameter is between three and four seconds of arc.

VENUS

Venus is the next planet in order from the sun. In size and mass and perhaps in other respects it resembles the earth. To us it appears as the most brilliant "star" in the sky. Venus performs in the same way as Mercury but moves much more slowly and is farther removed from the sun. The time for one complete oscillation is 1.6 years and greatest elongation is about 45°. When west of the sun Venus appears as the morning star and in this position it was known to the ancients as Phosphorus, the light-bringer. When east of the sun it is the evening star, Hesperus.

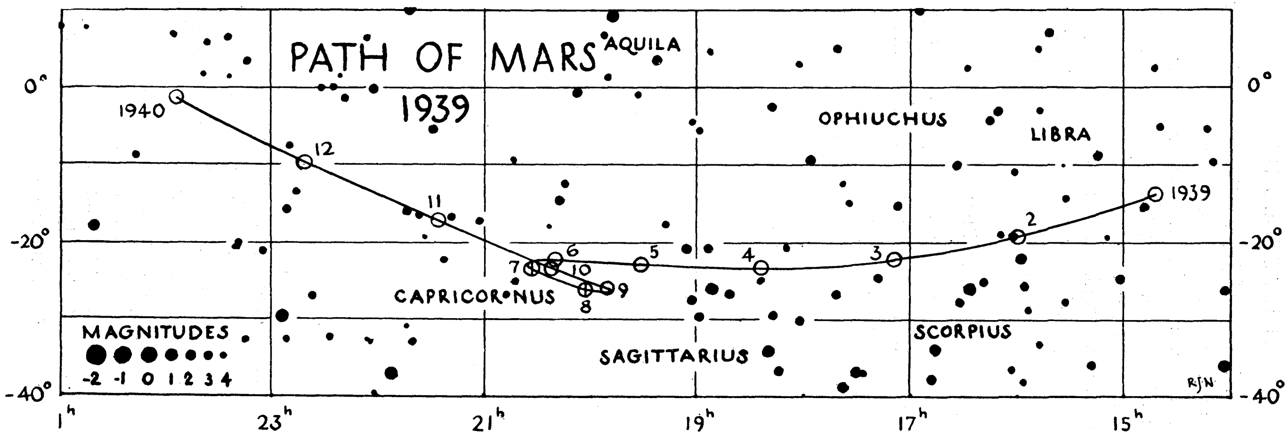
At the beginning of the year Venus is west of the sun and at its greatest brilliancy, magnitude —4.4, thirteen times as bright as Sirius. Greatest western elongation (47° and magnitude —4.1) occurs on January 30. January, in fact, is the most favourable time for observation; after this month Venus moves in toward the sun again very slowly but it rapidly becomes more poorly situated for observation because of the position of the ecliptic at sunrise. Superior conjunction occurs on September 5, and from then until the end of the year it will be moving eastward away from the sun, and will set soon after sunset.

After April its magnitude will remain close to —3.4. Since Venus is on the far side of the sun most of the year it is never very close to the earth and its semidiameter decreases quickly from 18 to about 5 seconds of arc.

MARS

Mars is the fourth planet from the sun and the first superior planet. Its path in the sky is similar to all planets beyond the earth, a slow motion in the region of the zodiac from west to east with occasional periods when its motion is retrograde. Mars is best observed at favourable oppositions, when the planet is near its perihelion at the time of opposition. These occur every 15 or 17 years, always in the latter part of August, and the next one will be in 1941. Nevertheless Mars is very well placed for observation during 1939 and at the time of opposition will be within 36,000,000 miles of the earth, as compared with 34,600,000 at the most favourable oppositions.

On January 1 it is of magnitude +1.7, four hours west of the sun in the constellation Libra, and 180 million miles from the earth. It increases in brightness and remains in the morning sky for the first half of the year. From June 24 to August 24 its motion is retrograde in the constellation Capricornus, and opposition comes on July 23, when it is of magnitude —2.6, 2.5 times as bright as Sirius. Its diameter is then about 24 seconds of arc. During the latter part of the year it is an evening star of magnitude about +0.0 in the constellations Capricornus and Aquarius. Eastern quadrature occurs on November 29. The accompanying chart gives its path among the stars during the year.



Path of Mars among the Stars during 1939

In this and the following maps, the position of the planet is indicated for the first of each month. Mars is visible all year.

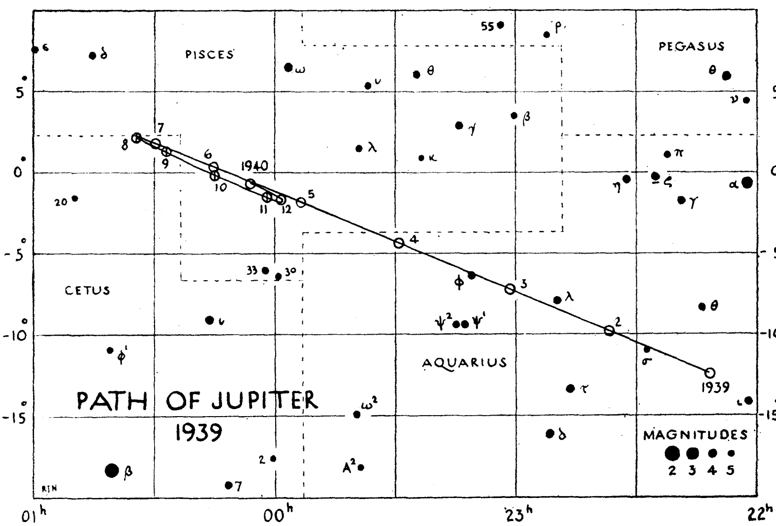
THE ASTEROIDS

Between the orbits of Mars and Jupiter there are a large number of small bodies revolving about the sun. The first of these minor planets was discovered in 1801, and the number with orbits determined is now about 1400. The majority are less than 50 miles in diameter. They all revolve from west to east, and some approach very close to the earth.

In most telescopes these asteroids show no discs but because of their swift motions among the stars they make very interesting subjects for observation. Ephemerides of the brighter asteroids are found on page 24.

JUPITER

Jupiter is the largest and the most massive planet of the solar system. Because of its distance from the sun and the earth, its motion among the stars is quite slow. An evening star of magnitude —1.6 at the beginning of the year,

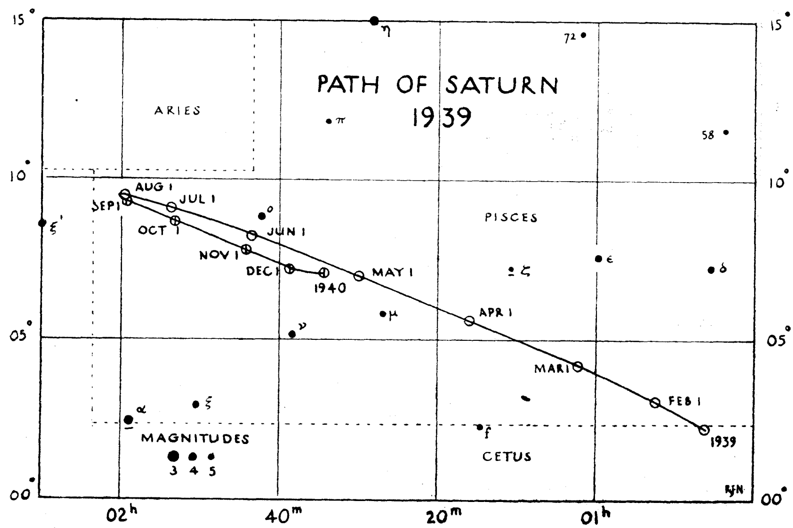


conjunction with the sun occurs on March 6. After this it will be visible in the early morning sky, western quadrature coming on June 29. From July 30 to November 25 its motion is retrograde. Opposition occurs on September 27, when it is of maximum brightness for the year, magnitude —2.5. It is in eastern quadrature on December 22 still a brilliant object at magnitude —2.0. For its path among the stars, see the accompanying chart.

Jupiter's period of rotation is the shortest of all the planets, about ten hours; as a result there is a marked flattening at the poles. Four of its moons can be seen with a good pair of binoculars. Their configurations are given elsewhere. Seven other moons (two discovered in 1938) are so faint they are visible in only the largest telescopes. The moons, the surface detail, its large disc and its position in the sky make Jupiter a very interesting object for observation. In September its apparent semidiameter is about 23″ and its distance from the earth is 367 million miles.

SATURN

Saturn is the next planet in order from the sun. It is also next to Jupiter in size and mass. Its motion in the heavens is very slow. It remains about two hours east of Jupiter all year and as a result its configurations except that they occur about a month later are similar to Jupiter's. Saturn begins the year in eastern quadrature (January 2) with magnitude +0.9. Conjunction with the sun occurs on April 11. In the summer it will be visible in the morning sky, western quadrature being on July 24, when it is of magnitude +0.6. After

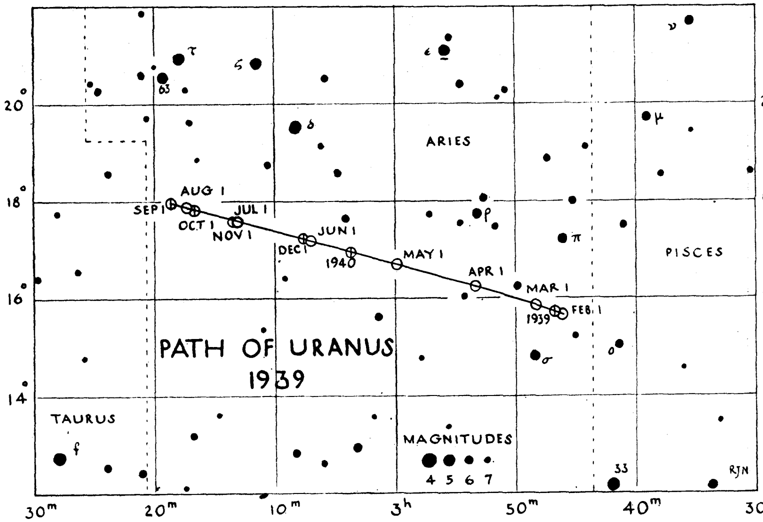


August 14 its motion is retrograde. At opposition on October 21 its magnitude is +0.2 and it will be visible all night as a yellowish star. Toward the end of the year it will be an object in the evening sky, at magnitude about +0.5. In October 1939 its distance from the earth is 770 million miles and its semi-diameter is almost 9″.

Saturn's unique ring system makes it one of the most interesting objects in our skies. These rings, the outer ring, the bright ring, and the crape ring, are composed of a large number of very small satellites which revolve about Saturn in a plane inclined to the planet's orbit at an angle of 27°. In 1936 the rings were presented edge on and so were invisible. They will appear opened out to their maximum extent in 1943, when the planet will be in an excellent position for observation in the northern hemisphere.

URANUS

The ancient astronomers were well familiar with the first six planets. The seventh, Uranus, was not discovered until telescopic observation was firmly established. To Sir William Herschel goes the credit for finding this body, which he at first thought was a comet. Later observations proved it to be the next planet beyond Saturn. Herschel suggested calling it *Georgium Sidus* after George III. During 1939 it will appear as a blue-green sixth magnitude star about one and a half hours east of Saturn in the constellation Aries. Its semi-diameter is 1.8 seconds of arc.



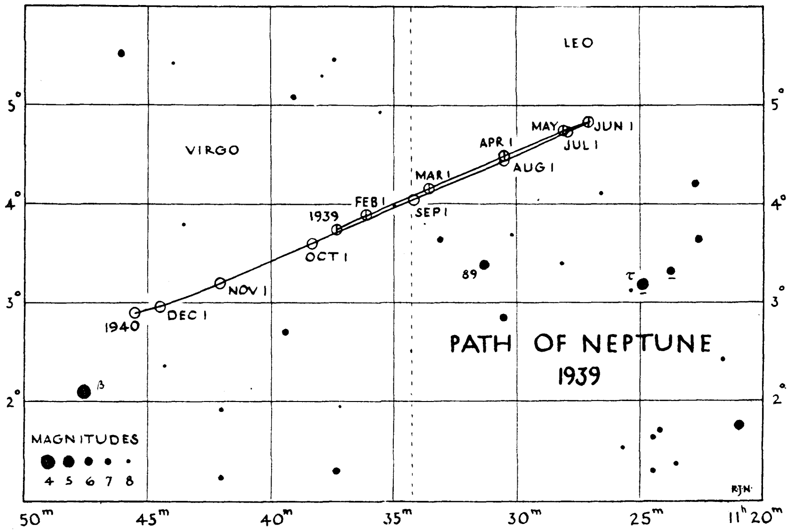
Eastern quadrature is on February 3 so that for the first three months it can be observed in the evening. From March to June it is too near the sun for good observation. Conjunction occurs on May 9. Western quadrature is on August 15 and opposition on November 13, when it is above the horizon all night. The path of Uranus among the stars is given in the chart. Its motion is direct from January 22 to August 28.

NEPTUNE

Although Uranus was discovered by accident, the next planet was found by means of the so-called "astronomy of the invisible". The story of its almost simultaneous discovery in 1846 by Leverrier and Adams is one of the most interesting in Astronomy. The observed deviations of Uranus from its calculated orbit led them both to predict correctly the position in the sky of the perturbing planet Neptune.

In 1939 Neptune appears as a blue-green eighth magnitude star in the constellations Leo and Virgo. It is conveniently situated for observation in the first half of the year, reaching opposition on March 13 at magnitude 7.7, and eastern quadrature on June 12. From August to October it is rather close to the sun, passing conjunction on September 16. It is in western quadrature on December 18, and can be seen in the morning. The accompanying chart will identify Neptune among the stars; until June 2 the planet is retrograding.

Neptune's rotation period is quite short. It has been determined spectrographically as 15¾ hours. At opposition it is about 2,700 million miles from the earth and has an apparent semidiameter of 1.25 seconds of arc.



PLUTO

The success of the theory of perturbations in this field led Lowell to investigate the existence of a trans-Neptunian planet. The observatory which he founded announced the discovery of Pluto reasonably near its predicted position on March 13, 1930, the anniversary of Lowell's birth and of Herschel's discovery of Uranus.

During 1939 Pluto is a yellowish star in the constellation Cancer, just south of λ Cancri. It is about magnitude 15 and so is invisible in all but the largest telescopes. The position, which changes only slightly during the year, on August 1 is

$$\alpha : 8^h\ 17^m.9 \qquad \delta : +23^\circ\ 10'$$

OPPOSITION EPHEMERIDES OF THE BRIGHTEST ASTEROIDS, 1939.

PREPARED BY PROFESSOR G. STRACKE

3 JUNO

July 28	$22^h\ 05.2^m$	$-\ 1°\ 02'$
Aug. 5	22 00.6	− 1 48
13	21 54.9	− 2 48
21	21 48.5	− 3 59
29	21 42.0	− 5 19
Sept. 6	21 36.1	− 6 42

Opp. Aug. 19 Mag. 8.3

4 VESTA

Oct. 8	$2^h\ 27.2^m$	$+\ 2°\ 42'$
16	2 20.3	+ 2 00
24	2 12.6	+ 1 22
Nov. 1	2 04.8	+ 0 52
9	1 57.3	+ 0 31
17	1 50.8	+ 0 22

Opp. Oct. 28 Mag. 6.9

7 IRIS

June 18	$19^h\ 24.8^m$	$-\ 18°\ 52'$
26	19 17.7	− 18 45
July 4	19 09.6	− 18 41
12	19 00.9	− 18 37
20	18 52.4	− 18 35
28	18 44.6	− 18 33

Opp. July 7 Mag. 8.7

11 PARTHENOPE

Aug. 13	$22^h\ 46.9^m$	$-\ 11°\ 31'$
21	22 41.1	− 12 31
29	22 34.5	− 13 32
Sept. 6	22 27.9	− 14 28
14	22 21.9	− 15 16
22	22 16.8	− 15 53

Opp. Aug. 30 Mag. 8.6

12 VICTORIA

July 20	$21^h\ 09.6^m$	$+\ 1°\ 22'$
28	21 04.2	+ 1 44
Aug. 5	20 57.9	+ 1 44
13	20 51.6	+ 1 24
21	20 46.1	+ 0 47
29	20 42.1	− 0 02

Opp. Aug. 5 Mag. 8.1

29 AMPHITRITE

Dec. 24	$7^h\ 55.0^m$	$+\ 30°\ 20'$
Jan. 1	7 47.3	+ 30 43
9	7 38.5	+ 30 59
17	7 29.4	+ 31 07
25	7 20.8	+ 31 05
Feb. 2	7 13.4	+ 30 54

Opp. Jan. 13 Mag. 8.8

40 HARMONIA

Sept. 6	$00^h\ 18.8^m$	$-\ 6°\ 15'$
14	00 12.3	− 7 10
22	00 05.0	− 8 03
30	23 57.5	− 8 50
Oct. 8	23 50.7	− 9 24
16	23 45.0	− 9 44

Opp. Sept. 24 Mag. 8.9

41 DAPHNE

Mar. 22	$13^h\ 35.8^m$	$-\ 2°\ 26'$
30	13 33.1	− 0 19
Apr. 7	13 29.2	+ 1 53
15	13 24.8	+ 4 00
23	13 20.5	+ 5 54
May 1	13 16.9	+ 7 29

Opp. Apr. 13 Mag. 8.6

43 ARIADNE

May 25	$17^h\ 47.6^m$	$-\ 24°\ 46'$
June 2	17 41.9	− 24 20
10	17 34.8	− 23 51
18	17 27.0	− 23 18
26	17 19.6	− 22 45
July 4	17 13.5	− 22 12

Opp. June 14 Mag. 8.8

511 DAVIDA

Oct. 24	$3^h\ 26.9^m$	$-\ 4°\ 23'$
Nov. 1	3 21.3	− 4 47
9	3 14.9	− 5 00
17	3 08.1	− 4 59
25	3 01.7	− 4 44
Dec. 3	2 56.0	− 4 14

Opp. Nov. 13 Mag. 8.7

These ephemerides have been made available through the kindness of Professor Stracke and of Professor A. Kopff, the Director of the Astronomisches Rechen-Institut, of Berlin. Positions are for equinox of 1950.

ECLIPSES, 1939

In 1939 there will be four eclipses, two of the sun and two of the moon.

I. *An Annular Eclipse of the Sun,* 1939 April 19, visible in Canada. The path of annular eclipse begins in the Aleutian Islands, passes through Alaska, over the mouth of the Mackenzie River, and ends after passing over the North Pole. The eclipse will be visible in its partial phases throughout the whole of North America and the North Atlantic. In western Canada, the eclipse will begin about 10^h and end about 12^h 30^m. In eastern Canada it will begin about 11^h and end about 13^h (75th Meridian Civil Time).

II. *A Total Eclipse of the Moon,* 1939 May 3, invisible in Canada. Visible only in Asia, Africa, and part of Europe.

III. *A Total Eclipse of the Sun,* 1939 October 12, invisible in Canada. The path of totality is short and passes close to the South Pole. The duration of the total phase is about one and one-half minutes. The eclipse is visible in its partial phase in the southern Pacific Ocean.

IV. *A Partial Eclipse of the Moon,* 1939 October 27, visible in Canada. The beginning is visible generally in Europe except the extreme eastern part, the western part of Africa, the Atlantic Ocean, North and South America, the eastern part of the Pacific Ocean, and the north-eastern extremity of Asia. The ending is visible generally in the North Atlantic Ocean, the Arctic Ocean, North and South America, the Pacific Ocean, Polynesia, the eastern part of Australia, and north-eastern Asia.

Circumstances of the Eclipse (75th Meridian Civil Time)

		d	h	m
Moon enters penumbra	October	27	22	42
Moon enters umbra	"	27	23	54
Middle of eclipse	"	28	01	36
Moon leaves umbra	"	28	03	18
Moon leaves penumbra	"	28	04	31

The Magnitude of the eclipse is 0.992 (moon's diameter=1.0). First contact of the umbra with the moon's limb occurs 48° east of the north point and last contact 77° west of the north point.

THE SKY MONTH BY MONTH

By P. M. Millman

THE SKY FOR JANUARY, 1939

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

The Sun—During January the sun's R.A. increases from 18h 42m to 20h 55m, and its Decl. changes from 23° 6′S. to 17° 25′ S. The equation of time (see p. 7) decreases from −3m 6s to −13m 33s. Owing to this rapid drop in value the time of mean noon appears, for the first ten days of the month, to remain at the same distance from sunrise, that is, the forenoons as indicated by our clocks are of the same length. On the 20th of the month the sun moves into the sign Aquarius, the second winter zodiacal sign. The signs of the zodiac are all exactly 30° in length, commencing at the first point of Aries. Though the sign of Aquarius once corresponded to the constellation of the same name, it now is situated among the stars of Capricornus, owing to the westward motion of the first point of Aries. The earth is nearest the sun, that is in perihelion, on January 3.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. The moon occults the planet Uranus on the 29th of the month.

Mercury on the 15th is in R.A. 18h 16m, Decl. 23° 14′ S. and transits at 10.43. Mercury reaches its greatest elongation west of the sun in the morning sky on the 3rd and for a few days before and after this date will be well placed for observation rising nearly 2 hours before the sun in the S.E. and being about 19° above the horizon at sunrise. It is a reddish star of magnitude 0.

Venus on the 15th is in R.A. 16h 28m, Decl. 17° 33′ S. and transits at 8.54. It is a brilliant object in the morning sky rising over 3 hours before the sun, Greatest elongation west is on the 30th.

Mars on the 15th is in R.A. 15h 16m, Decl. 17° 14′ S. and transits at 7.41. It is slowly moving into the morning sky, being in view most of the last half of the night. It is in close conjunction with the moon on the 14th.

Jupiter on the 15th is in R.A. 22h 22m, Decl. 11° 14′ S. and transits at 14.46. It is a bright star in the evening sky setting over 3 hours after the sun. For the configurations of its satellites see next page and for their eclipses, etc. see p. 50.

Saturn on the 15th is in R.A. 0h 48m, Decl. 2° 32′ N. and transits at 17.11. It is in quadrature with the sun on the 2nd and appears just east of the meridian at sunset, remaining in view for the first half of the night. For the elongations, etc., of its satellites see p. 52.

Uranus on the 15th is in R.A. 2h 46m, Decl. 15° 40′ N. and transits at 19.08.

Neptune on the 15th is in R.A. 11h 37m, Decl. 3° 46′ N. and transits at 4.01.

Pluto—For information regarding this planet, see p. 23.

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. 18h 45m
Sun.	1	13	09	☌ ♅ ☾ ♅ 0° 35′ S.		32104
Mon.	2	15		□ ♄ ☉ Quadrantid Meteors. p. 54	12 31	30124
Tue.	3	5		☿ Greatest elongation W., 22° 49′		31024
		17		⊕ in Perihelion. Dist. from ☉, 91,340,000 mi.		
Wed.	4	10		♀ in Perihelion		d2013
Thu.	5	16	30	○ Full Moon	9 21	42103
Fri.	6	6		Moon in Perigee. Dist. from ⊕, 221,900 mi.		d4023
Sat.	7					42031
Sun.	8				6 10	43210
Mon.	9					43021
Tue.	10	10	22	☌ ♆ ☾ ♆ 5° 31′ N.		43102
Wed.	11				2 59	42031
Thu.	12	8	10	☾ Last Quarter		24103
Fri.	13				23 48	01423
Sat.	14	16	00	☌ ♂ ☾ ♂ 0° 21′ N.		d034*
Sun.	15					23104
Mon.	16	1		☿ in ☋	20 38	30214
		4	12	☌ ♀ ☾ ♀ 2° 05′ N.		
Tue.	17					31024
Wed.	18	15	25	☌ ☿ ☾ ☿ 4° 25′ S.		20314
Thu.	19				17 27	21034
Fri.	20	8	27	● New Moon		01243
		18		Moon in Apogee. Dist. from ⊕, 252,700 mi.		
Sat.	21					d023*
Sun.	22	10		♅ Stationary in R.A.	14 16	42310
Mon.	23	12	44	☌ ♃ ☾ ♃ 6° 00′ S.		4301*
Tue.	24					43102
Wed.	25				11 06	4201*
Thu.	26	7		♀ Greatest Hel. Lat. N.		42103
		8		☿ in Aphelion.		
		14	44	☌ ♄ ☾ ♄ 5° 13′ S.		
Fri.	27					40123
Sat.	28	10	00	☽ First Quarter	7 55	41023
		21	15	☌ ♅ ☾ ♅ 0° 20′ S.		
Sun.	29					d2340
Mon.	30	8		♀ Greatest elongation W., 46° 56′		32014
Tue.	31				4 44	31024

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

THE SKY FOR FEBRUARY, 1939

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

The Sun—During February the sun's R.A. increases from 20h 55m to 22h 44m, and its Decl. changes from 17° 25′ S. to 8° 0′ S. The equation of time decreases from —13m 33s to a minimum of —14m 21s. on Feb. 12, and then rises to —12m 42s at the end of the month (see p. 7). For changes in the length of the day see p. 11. The sun enters the sign Pisces, the third winter sign, on the 19th.

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

Mercury on the 15th is in RA. 21h 41m, Decl. 16° 5′ S. and transits at 12.07. It is in superior conjunction with the sun on the 18th and too near the sun for observation during February.

Venus on the 15th is in R.A. 18h 39m, Decl. 20° 30′ S. and transits at 9.03. It is a brilliant yellow star of magnitude —4, rising in the south-east almost three hours before the sun.

Mars on the 15th is in R.A. 16h 34m, Decl. 21° 26′ S. and transits at 6.57. It is a red star of the first magnitude in the morning sky, rising about an hour after midnight.

Jupiter on the 15th is in R.A. 22h 49m, Decl. 8° 36′ S. and transits at 13.10. It is fast approaching the sun in the evening sky, setting a little over an hour after sunset. For the configurations of its satellites see next page and for their eclipses, etc., see p. 50.

Saturn on the 15th is in R.A. 0h 57m, Decl. 3° 34′ N. and transits at 15.18. It is a pale yellow star slightly brighter than first magnitude and sets about four hours after the sun in the evening sky. For the elongations, etc., of its satellites see p. 52.

Uranus on the 15th is in R.A. 2h 47m, Decl. 15° 44′ N. and transits at 17.07.

Neptune on the 15th is in R.A. 11h 35m, Decl. 4° 0′ N. and transits at 1.57.

Pluto—For information regarding this planet, see p. 23.

				FEBRUARY 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 18h 30m
	d	h	m		h m	
Wed.	1			....		32O14
Thu.	2			....		21O34
Fri.	3	10		□♅☉..	1 33	O1234
		19		Moon in Perigee. Dist. from ⊕, 221,600 mi.		
Sat.	4	2	55	🌕 Full Moon............................		1O234
Sun.	5			....	22 23	23O14
Mon.	6	19	09	☌♆☾ ♆ 5° 19′ N................		32O4*
Tue.	7			....		314O2
Wed.	8			....	19 12	d43O1
Thu.	9			....		421O3
Fri.	10	23	12	☾ Last Quarter..........................		4O213
Sat.	11			....	16 01	41O23
Sun.	12	7	31	☌♂☾ ♂ 1° 40′ S..................		d42O1
Mon.	13			....		4321O
Tue.	14	21	47	☌♀☾ ♀ 1° 36′ S..................	12 51	d34O2
Wed.	15	16		☿ Greatest Hel. Lat. S....................		34O21
Thu.	16	21		Moon in Apogee. Dist. from ⊕, 252,600 mi.....		21O34
Fri.	17			....	9 40	O2134
Sat.	18	21		☌☿☉ Superior..........................		1O234
Sun.	19	3	28	🌑 New Moon.		
		9	54	☌☿☾ ☿ 7° 02′ S.		
Mon.	20	7	25	☌♃☾ ♃ 5° 38′ S..................	6 29	
Tue.	21			....		
Wed.	22			....		
Thu.	23	0	43	☌♄☾ ♄ 4° 41′ S..................	3 19	
Fri.	24			....		
Sat.	25	4	11	☌♅☾ ♅ 0° 00′.		
Sun.	26	0		☌☿♃ ☿ 0° 25′ S..................	0 08	
		22	26	☽ First Quarter.		
Mon.	27			....		
Tue.	28			....	20 57	

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 February 19 to May 1.

THE SKY FOR MARCH, 1939

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

The Sun—During March the sun's R.A. increases from 22h 44m to 0h 38m amd its Decl. changes from 8° 0′ S. to 4° 7′ N. The equation of time increases from —12m 42s to —4m 19s (see p. 7). For changes in the length of the day, see p. 12. The sun is at the vernal equinox and crosses the equator on its trip north at 12h 29m G.C.T. on the 21st. This date marks the beginning of spring and day and night are approximately equal all over the world.

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

Mercury on the 15th is in R.A. 0h 40m, Decl. 6° 13′ N. and transits at 13.13. It is at greatest elongation east of the sun on the 16th. At this time it appears in the evening sky being about 18° above the horizon at sunset and setting approximately 1h 40m after the sun. This is the most favourable elongation of the year for observing Mercury in the evening sky.

Venus on the 15th is in R.A. 20h 53m, Decl. 16° 57′ S. and transits at 9.26. It is slowly growing fainter as it recedes from the earth but is still very prominent in the morning sky, rising just under 2 hours before the sun.

Mars on the 15th is in R.A. 17h 44m, Decl. 23° 18′ S. and transits at 6.17. It is in quadrature on the 21st but owing to its southern declination it does not rise till some time after midnight.

Jupiter on the 15th is in R.A. 23h 14m, Decl. 6° 1′ S. and transits at 11.45. It is in conjunction with the sun on March. 6 and too near that body to be observed this month.

Saturn on the 15th is in R.A. 1h 8m, Decl. 4° 48′ N. and transits at 13.39. It is in the S.W. at sunset and sets about 2 hours after the sun. It is rapidly approaching the sun in the evening sky and by the end of the month will be unfavourably placed for observation. For the elongations, etc., of its satellites, see p. 52.

Uranus on the 15th is in R.A. 2h 50m, Decl. 16° 0′ N. and transits at 15.20.

Neptune on the 15th is in R.A. 11h 32m, Decl. 4° 18′ N. and transits at 0.05. Opposition to the sun is on the 13th.

Pluto—For information regarding this planet, see p. 23.

MARCH

75th Meridian Civil Time

	d	h	m		Min. of Algol h	m
Wed.	1			....		
Thu.	2			....		
Fri.	3			....	17	47
Sat.	4	6		Moon in Perigee. Dist. from ⊕, 223,300 mi.		
Sun.	5	13	00	○ Full Moon.		
Mon.	6	5	04	☌ ♆ ☾ ♆ 5° 16′ N.	14	36
		7		☌ ♃ ☉		
		16		☿ in ☊		
Tue.	7			....		
Wed.	8			....		
Thu.	9			....	11	25
Fri.	10			....		
Sat.	11	7		☿ in Perihelion.		
Sun.	12	16	37	☾ Last Quarter	8	14
Mon.	13	0	16	☌ ♂ ☾ ♂ 3° 33′ S.		
		6		☍ ♆ ☉ Dist. from ⊕, 2,715,000,000 mi.		
Tue.	14			....		
Wed.	15			....	5	04
Thu.	16	10		Moon in Apogee. Dist. from ⊕, 252,100 mi.		
		20		☿ Greatest elongation E., 18° 27′.		
Fri.	17	4	29	☌ ♀ ☾ ♀ 4° 54′ S.		
Sat.	18			....	1	53
Sun.	19	10		♂ in ♉		
Mon.	20	3	01	☌ ♃ ☾ ♃ 5° 17′ S.	22	42
		20	49	● New Moon.		
Tue.	21	7	29	☉ enters ♈, Spring commences. Long. of ☉, 0°.		
		14		☿ Greatest Hel. Lat. N.		
		14		□ ♂ ☉		
Wed.	22	6	02	☌ ☿ ☾ ☿ 1° 14′ N.		
		12	17	☌ ♄ ☾ ♄ 4° 14′ S.		
Thu.	23	8		♀ in ♉	19	31
Fri.	24	2		☿ Stationary in R.A.		
		11	24	☌ ♅ ☾ ♅ 0° 16′ N.		
Sat.	25			....		
Sun.	26			....	16	21
Mon.	27			....		
Tue.	28	7	16	☽ First Quarter.		
Wed.	29			....	13	10
Thu.	30			....		
Fri.	31			....		

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 February 19 to May 1.

THE SKY FOR APRIL, 1939

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

The Sun—During April the sun's R.A. increases from 0h 38m to 2h 29m and its Decl. changes from 4° 7′ N. to 14° 44′ N. The equation of time rises from −4m 19s to +2m 46s (see p. 7). For changes in the length of the day, see p. 12. On the 20th the sun enters the sign Taurus, the second spring sign of the zodiac. There is an annular eclipse of the sun on the 19th, visible in Canada and the United States as a partial eclipse. For details see p. 29.

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

Mercury on the 15th is in R.A. 0h 22m, Decl. 2° 7′ N. and transits at 10.50. It is in inferior conjunction with the sun on the 3rd and too near that body for observation during most of the month. During the last few days of the month it is approaching western elongation and will be visible in the morning sky.

Venus on the 15th is in R.A. 23h 15m, Decl. 6° 5′ S. and transits at 9.47. It is a bright star in the morning sky, rising about an hour and a half before the sun. On April 21st it is in close conjunction with Jupiter, the two planets being less than half a degree apart. For a few days Venus and Jupiter will form a fine double star in the morning sky.

Mars on the 15th is in R.A. 18h 58m, Decl. 23° 28′ S. and transits at 5.28. It is steadily growing brighter as opposition is approached, being now a red star of 0 magnitude. It is in view during the last half of the night.

Jupiter on the 15th is in R.A. 23h 41m, Decl. 3° 12′ S. and transits at 10.10. It is near the sun in the morning sky and not well placed for observation. On the 21st it is in close conjunction with Venus.

Saturn on the 15th is in R.A. 1h 23m, Decl. 6° 16′ N. and transits at 11.51. It is in conjunction with the sun on the 11th and too near that body to be observed during this month.

Uranus on the 15th is in R.A. 2h 56m, Decl. 16° 27′ N. and transits at 13.24.

Neptune on the 15th is in R.A. 11h 29m, Decl. 4° 37′ N. and transits at 21.56.

Pluto—For information regarding this planet, see p. 23.

APRIL

75th Meridian Civil Time

	d	h	m		Min. of Algol h	m
Sat.	1	8		Moon in Perigee. Dist. from ⊕, 226,500 mi.....		59
Sun.	2	14	08	☌ ♆ ☾ ♆ 5° 20′ N.		
Mon.	3	3		☌ ☿ ☉ Inferior.		
		23	18	● Full Moon.		
Tue.	4			....	6	48
Wed.	5			....		
Thu.	6			....		
Fri.	7			....	3	37
Sat.	8			....		
Sun.	9			....		
Mon.	10	16	33	☌ ♂ ☾ ♂ 5° 16′ S..................	0	27
Tue.	11	11	11	☾ Last Quarter.		
		15		☌ ♄ ☉		
Wed.	12			....	21	16
Thu.	13	4		Moon in Apogee. Dist from ⊕, 251,400 mi.		
Fri.	14	1		☿ in ♉		
Sat.	15	13		☿ Stationary in R.A......................	18	05
Sun.	16	12	54	☌ ♀ ☾ ♀ 5° 32′ S.		
		23	04	☌ ♃ ☾ ♃ 4° 57′ S.		
Mon.	17	19	09	☌ ☿ ☾ ☿ 3° 59′ S.		
Tue.	18			....	14	54
Wed.	19			Annular Eclipse of ☉, see p. 25.		
		1	41	☌ ♄ ☾ ♄ 3° 53′ S.		
		11	35	● New Moon.		
Thu.	20	20	22	☌ ♅ ☾ ♅ 0° 27′ N.		
Fri.	21	21		☌ ♀ ♃ ♀ 0° 24′ S................	11	43
				Lyrid Meteors, p. 54		
Sat.	22			....		
Sun.	23			....		
Mon.	24	7		☿ in Aphelion............................	8	32
Tue.	25			....		
Wed.	26	13	25	☽ First Quarter.		
		17		♀ in Aphelion.		
Thu.	27			....	5	21
Fri.	28	5		Moon in Perigee. Dist. from ⊕, 229,400 mi.		
Sat.	29	21	06	☌ ♆ ☾ ♆ 5° 24′ N.		
Sun.	30			....	2	10

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 February 19 to May 1.

THE SKY FOR MAY, 1939

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

The Sun—During May the sun's R.A. increases from 2h 29m to 4h 32m and its Decl. changes from 14° 44′ N. to 21° 54′ N. The equation of time increases from +2m 46s to a maximum of +3m 45s on the 15th and then drops to +2m 30s. at the end of the month (see p. 7). For changes in the length of the day see p. 13. On May 21 the sun enters Gemini, the third spring sign of the zodiac.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. There is a total eclipse of the moon on May 3, invisible in Canada and the United States. For details see p. 29.

Mercury on the 15th is in R.A. 1h 58m, Decl. 9° 9′ N. and transits at 10.32. On May 1 it reaches greatest elongation west of the sun but is not particularly well placed for observation, rising barely an hour before the sun and being about 9° above the horizon at sunrise. It is of magnitude 0.7. On May 10 it is in close conjunction with Saturn.

Venus on the 15th is in R.A. 1h 29m, Decl. 7° 25′ N. and transits at 10.02. Its magnitude has now dropped to −3.4 and it rises just over an hour before the sun.

Mars on the 15th is in R.A. 19h 56m, Decl. 22° 42′ S. and transits at 4.28. It is gradually coming into the evening sky, rising about midnight in the S.E. It has brightened to magnitude −0.6.

Jupiter on the 15th is in R.A. 0h 4m, Decl. 0° 46′ S. and transits at 8.35. It is a bright star, rising almost due east about 2 hours before the sun. For the configurations of its satellites see next page, and for their eclipses, etc., see p. 50.

Saturn on the 15th is in R.A. 1h 36m, Decl. 7° 36′ N. and transits at 10.07. It is in the morning sky but not well placed for observation, rising barely an hour before the sun. It is in close conjunction with Mercury on the 10th and with Venus on the 16th.

Uranus on the 15th is in R.A. 3h 3m, Decl. 16° 56′ N. and transits at 11.33.

Neptune on the 15th is in R.A. 11h 27m, Decl. 4° 48′ N. and transits at 19.56.

Pluto—For information regarding this planet, see p. 23.

MAY

75th Meridian Civil Time

	d	h	m			Min. of Algol h	m	Config. of Jupiter's Sat. 4h 45m
Mon.	1	4		☿	Greatest elongation W., 26° 55′.			
Tue.	2					22	59	21O43
Wed.	3			Total Eclipse of ☾, see p. 00				324O1
		10	15	🌕	Full Moon.			
Thu.	4			Eta Aquarid Meteors, p. 54				341O2
Fri.	5					19	48	d43O1
Sat.	6							4231O
Sun.	7							d4O23
Mon.	8					16	37	4O123
Tue.	9	4		☌ ♅ ☉				421O3
		5	00	☌ ♂ ☾	♂ 6° 53′ S.			
Wed.	10	10		☌ ☿ ♄	☿ 0° 45′ S.			423O1
Thu.	11	0		Moon in Apogee. Dist. from ⊕, 251,200 mi.		13	26	314O2
		5	40	☾	Last Quarter.			
Fri.	12							3O214
Sat.	13							231O4
Sun.	14	15		☿	Greatest Hel. Lat. S.	10	15	O1234
		18	03	☌ ♃ ☾	♃ 4° 36′ S.			
Mon.	15							O234*
Tue.	16	16		☌ ♀ ♄	♀ 0° 34′ N.			21O34
		16	15	☌ ♄ ☾	♄ 3° 36′ S.			
		16	16	☌ ♀ ☾	♀ 3° 02′ S.			
Wed.	17	8	53	☌ ☿ ☾	☿ 2° 54′ S.	7	04	d2O14
Thu.	18	7	20	☌ ♅ ☾	♅ 0° 36′ N.			31O24
		23	25	🌑	New Moon.			
Fri.	19	4		♀	Greatest Hel. Lat. S.			3O241
Sat.	20					3	53	2314O
Sun.	21							4O13*
Mon.	22							41O23
Tue.	23	7		Moon in Perigee. Dist. from ⊕, 228,800 mi.		0	42	421O3
Wed.	24							42O31
Thu.	25	3		☌ ☿ ♅	☿ 1° 12′ S.	21	31	431O2
		18	20	☽	First Quarter.			
Fri.	26							43O21
Sat.	27	2	27	☌ ♆ ☾	♆ 5° 21′ N.			4321O
Sun.	28					18	20	O31**
Mon.	29							1O243
Tue.	30							d2O34
Wed.	31					15	09	2O134

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

THE SKY FOR JUNE, 1939

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

The Sun—During June the sun's R.A. increases from 4h 32m to 6h 36m and its Decl. changes from 21° 54′ N. to a maximum value of 23° 26′ 40″ N. on the 22nd and then drops back to 23° 11′ N. at the end of the month. The equation of time drops from +2m 30s to −3m 27s (see p 7). .The sun is at the summer solstice, the point in its path farthest north of the equator, at 7h 40m G.C.T., June 22. At this time it enters the sign Cancer and summer commences. The duration of daylight is now greatest and does not change appreciably for some days, see p. 13. During the last part of June and first part of July the local mean time of sunset appears almost constant owing to the decrease in the equation of time.

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

Mercury on the 15th is in R.A. 6h 10m, Decl. 25° 8′ N. and transits at 12.44. It is in superior conjunction with the sun on the 7th and not well placed for observation during June.

Venus on the 15th is in R.A. 3h 55m, Decl. 19° 9′ N. and transits at 10.26. It is a bright yellow star in the morning sky but is becoming less favourably placed for observation as it approaches superior conjunction and rises barely an hour before sunrise.

Mars on the 15th is in R.A. 20h 31m, Decl. 22° 54′ S. and transits at 3.00. It is a red star, becoming noticeably brighter as it moves into the evening sky. It is now of magnitude −1.5, being of the same brightness as Sirius. On June 24th it reaches a stationary point in its path among the stars and starts to retrograde, or move westward.

Jupiter on the 15th is in R.A. 0h 23m, Decl. 1° 8′ N. and transits at 6.52. It is in quadrature on June 29 and is visible in the morning sky during the last half of the night. Its magnitude is now −2. For the configurations of its satellites, see opposite page, and for their eclipses, etc., see p. 50.

Saturn on the 15th is in R.A. 1h 49m, Decl. 8° 42′ N. and transits at 8.17. It is slowly separating from the sun in the morning sky, rising just under 3 hours before the sun. It is a pale yellow star of magnitude 0.7. For the elongations, etc., of its satellites, see p. 52.

Uranus on the 15th is in R.A. 3h 10m, Decl. 17° 24′ N. and transits at 9.38.

Neptune on the 15th is in R.A. 11h 27m, Decl. 4° 48′ N. and transits at 17.54.

Pluto—For information regarding this planet, see p. 23.

JUNE

75th Meridian Civil Time

	d	h	m		Min. of Algol h	m	Config. of Jupiter's Sat. 3h 30m
Thu.	1	22	11	🌕 Full Moon			31O24
Fri.	2	5		♆ Stationary in R.A.			3O124
		16		☿ in ☊			
Sat.	3				11	58	321O4
Sun.	4						2O14*
Mon.	5	4		☌ ♀ ♅ ♀ 1° 11′ S.			1O423
Tue.	6	7	58	☌ ♂ ☾ ♂ 8° 39′ S.	8	46	d4O13
Wed.	7	4		☌ ☿ ☉ Superior			42O3*
		7		☿ in Perihelion			
		18		Moon in Apogee. Dist. from ⊕, 251,400 mi.			
Thu.	8						431O2
Fri.	9	23	07	☾ Last Quarter	5	35	43O12
Sat.	10	19		♄ Greatest Hel. Lat. S.			4321O
Sun.	11	11	45	☌ ♃ ☾ ♃ 4° 12′ S.			42O1*
Mon.	12	6		□ ♆ ☉	2	24	41O23
Tue.	13	6	34	☌ ♄ ☾ ♄ 3° 18′ S.			4O213
Wed.	14	19	24	☌ ♅ ☾ ♅ 0° 47′ N.	23	13	21O43
Thu.	15	16	16	☌ ♀ ☾ ♀ 0° 58′ N.			d3O24
Fri.	16						3O124
Sat.	17	8	37	🌑 New Moon	20	02	321O4
		13		☿ Greatest Hel. Lat. N.			
Sun.	18	8	16	☌ ☿ ☾ ☿ 6° 28′ N.			23O14
Mon.	19	15		Moon in Perigee. Dist. from ⊕, 225,800 mi.			1O234
Tue.	20				16	50	O2134
Wed.	21						21O34
Thu.	22	2	40	☉ enters ♋, Summer commences. Long. of ☉, 90°			dO14*
Fri.	23	8	01	☌ ♆ ☾ ♆ 5° 10′ N.	13	39	34O2*
		23	35	☽ First Quarter.			
Sat.	24	3		♂ Stationary in R.A.			4321O
Sun.	25						423O1
Mon.	26				10	28	41O32
Tue.	27						4O213
Wed.	28						421O3
Thu.	29	20		□ ♃ ☉	7	16	4O31*
Fri.	30						3O2**

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

THE SKY FOR JULY, 1939

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

The Sun—During July the sun's R.A. increases from 6h 36m to 8h 41m and its Decl. changes from 23° 11′ N. to 18° 19′ N. The equation of time drops from −3m 27s to a minimum of −6m 24s on the 27th and then rises to −6m 16s at the end of the month (see p. 7). For changes in the length of the day, see p. 14. The sun enters Leo, the second summer sign of the zodiac, on July 23rd. The earth is in aphelion, the point in its orbit farthest from the sun, on the 5th of the month. For distance from the sun, see opposite page.

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

Mercury on the 15th is in R.A. 9h 21m, Decl. 14° 42′ N. and transits at 13.53. It reaches greatest elongation east of the sun on the 13th and is fairly well placed for observation in the evening sky, setting over an hour after the sun. It is a star of magnitude 0.7, 13° above the horizon at sunset.

Venus on the 15th is in R.A. 6h 31m, Decl. 23° 16′ N. and transits at 11.05. It is in the morning sky, rising shortly before the sun and not particularly well placed for observation. It is of stellar magnitude −3.3.

Mars on the 15th is in R.A. 20h 22m, Decl. 25° 33′ S. and transits at 0.53. It is in opposition to the sun on July 23 and is in view all night at this time. It has now reached a stellar magnitude −2.6, which is as bright as Jupiter ever appears. This opposition and the equally favourable one in 1941 will be the two best oppositions for Martian observation in the next 15 years. At such times the brightness of the planet is rather surprising to the layman. Mars is closest to the earth a few days after opposition, on July 27. It is 36,000,000 miles distant at this time and has an apparent angular diameter of 24 seconds of arc.

Jupiter on the 15th is in R.A. 0h 33m, Decl. 2° 5′ N. and transits at 5.04. It rises in the east shortly before midnight and is a brilliant star visible for the last half of the night. On July 30 it is at a stationary point in its path among the stars and starts to move westward or retrograde. For the configurations of its satellites, see opposite page, and for their eclipses, etc., see p. 50.

Saturn on the 15th is in R.A. 1h 57m, Decl. 9° 21′ N. and transits at 6.27. It is in the morning sky, rising about 5 hours before the sun. Quadrature is reached on the 24th. For the elongations, etc., of its satellite, see p. 52.

Uranus on the 15th is in R.A. 3h 15m, Decl. 17° 45′ N. and transits at 7.46.

Neptune on the 15th is in R.A. 11h 29m, Decl. 4° 37′ N. and transits at 15.58.

Pluto—For information regarding this planet, see p. 23.

JULY

75th Meridian Civil Time

	d	h	m		Min. of Algol h	m	Config. of Jupiter's Sat. 2h 45h
Sat.	1	11	16	🌕 Full Moon			dd3O4
Sun.	2				4	05	23O14
Mon.	3	17	56	☌ ♂ ☾ ♂ 10° 36′ S.			1O324
Tue.	4						O1234
Wed.	5	9		Moon in Apogee. Dist. from ⊕, 252,000 mi.	0	54	21O34
		15		⊕ in Aphelion. Dist from ☉, 94,452,000 mi.			
Thu.	6						2O134
Fri.	7				21	42	31O24
Sat.	8						3O214
Sun.	9	0	58	☌ ♃ ☾ ♃ 3° 52′ S.			32O41
		14	49	☾ Last Quarter.			
Mon.	10	18	58	☌ ♄ ☾ ♄ 3° 00′ S.	18	31	41O32
Tue.	11	0		☿ in ☋			4O123
Wed.	12	6	57	☌ ♅ ☾ ♅ 1° 03′ N.			412O3
Thu.	13	14		☿ Greatest elongation E. 26° 31′	15	20	42O13
Fri.	14	11		♀ in ☊			431O2
Sat.	15	16	14	☌ ♀ ☾ ♀ 4° 33′ N.			43O12
Sun.	16	16	03	🌑 New Moon	12	08	432O*
Mon.	17	18		Moon in Perigee. Dist. from ⊕, 223,200 mi.			413O*
Tue.	18	13	35	☌ ☿ ☾ ☿ 3° 25′ N.			O1423
Wed.	19				8	57	12O34
Thu.	20	15	40	☌ ♆ ☾ ♆ 4° 53′ N.			2O134
Fri.	21	6		☿ in Aphelion			13O24
Sat.	22				5	45	3O124
Sun.	23	3		☍ ♂ ☉ Dist. from ⊕, 36,170,000 mi.			32O4*
		6	34	☽ First Quarter.			
Mon.	24	13		□ ♄ ☉			dO4**
Tue.	25				2	34	O1423
Wed.	26	17		☿ Stationary in R.A.			124O3
Thu.	27	16		♂ Nearest ⊕. Dist. from ⊕, 36,030,000 mi.	23	23	42O13
Fri.	28			Delta Aquarid Meteors, p. 54			413O2
Sat.	29						43O12
Sun.	30	7		♃ Stationary in R.A.	20	11	4321O
		11	13	☌ ♂ ☾ ♂ 11° 41′ S.			
Mon.	31	1	37	🌕 Full Moon			432O1

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

THE SKY FOR AUGUST, 1939

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

The Sun—During August the sun's R.A. increases from 8h 41m to 10h 37m and its Decl. changes from 18° 19′ N. to 8° 42′ N. The equation of time increases from −6m 16s to −0m 20s (see p. 7). For changes in the length of the day, see p. 14. The sun enters Virgo, the third summer zodiacal sign, on the 23rd.

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

Mercury on the 15th is in R.A. 9h 1m, Decl. 12° 43′ N. and transits at 11.27. It is in inferior conjunction with the sun on the 10th. August 28, Mercury reaches greatest elongation west of the sun in the morning sky, at which time it rises in the east about an hour and a half before the sun. It will be visible for some days before and after the 28th as a reddish star of 0 magnitude.

Venus on the 15th is in R.A. 9h 12m, Decl. 17° 18′ N. and transits at 11.43. It is approaching the sun in the morning sky and not well placed for observation.

Mars on the 15th is in R.A. 19h 51m, Decl. 27° 23′ S. and transits at 22.15. It is a very prominent red star in the evening sky, appearing in the south-east directly after sunset. On August 24 it reaches a stationary point in its path as it ceases to retrograde, commencing to move eastward once more among the stars.

Jupiter on the 15th is in R.A. 0h 33m, Decl. 1° 56′ N. and transits at 3.02. The planet rises in the east just under two hours after sunset and during the last month has materially increased in brightness, being now of magnitude −2.4. At this time both Jupiter and Mars are brilliant objects in the evening and add considerably to the beauty of the summer sky, making it this year the rival of the brilliant winter groups of stars. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 50.

Saturn on the 15th is in R.A. 2h 0m, Decl. 9° 29′ N. and transits at 4.29. It is moving into the evening sky, rising shortly before midnight. It has increased in brightness to magnitude 0.4 as opposition is approached. A stationary point in its path among the stars is reached on August 14, on which date it commences to retrograde. For the elongations of its satellites, etc., see p. 52.

Uranus on the 15th is in R.A. 3h 18m, Decl. 17° 56′ N. and transits at 5.46.

Neptune on the 15th is in R.A. 11h 32m, Decl. 4° 16′ N. and transits at 13.59.

Pluto—For information in regard to this planet, see p. 23.

AUGUST

75th Meridian Civil Time

	d	h	m	Phenomenon			Min. of Algol h	Min. of Algol m	Config. of Jupiter's Sat. 2h 00m
Tue.	1	19		Moon in Apogee. Dist. from ⊕, 252,400 mi.					4O32*
Wed.	2						17	00	d41O3
Thu.	3								24O13
Fri.	4								d1O24
Sat.	5	8	46	☌ ♃ ☾	♃	3° 42′ S.	13	48	3O124
Sun.	6								321O4
Mon.	7	4	01	☌ ♄ ☾	♄	2° 46′ S.			32O14
Tue.	8	4	18	☾ Last Quarter			10	37	O324*
		16	28	☌ ♅ ☾	♅	1° 21′ N.			
Wed.	9								1O234
Thu.	10	11		☌ ☿ ☉ Inferior					2O134
		14		☿ Greatest Hel. Lat. S.					
Fri.	11			Perseid Meteors, p. 54			7	25	1O324
Sat.	12								34O12
Sun.	13	6		☌ ☿ ♀	☿	5° 40′ S.			4321O
Mon.	14	11	52	☌ ☿ ☾	☿	0° 49′ N.	4	14	432O1
		15	54	☌ ♀ ☾	♀	6° 14′ N.			
		18		♄ Stationary in R.A.					
		22	53	● New Moon.					
Tue.	15	3		Moon in Perigee. Dist. from ⊕, 222,000 mi.					41O32
		10		□ ♅ ☉					
Wed.	16								d4O23
Thu.	17	2	03	☌ ♆ ☾	♆	4° 38′ N.	1	03	42O13
		3		♀ in Perihelion.					
Fri.	18								41O23
Sat.	19	20		☿ Stationary in R.A.			21	51	34O12
Sun.	20								312O4
Mon.	21	16	21	☽ First Quarter					32O14
Tue.	22						18	40	1O324
Wed.	23	10		♂ Greatest Hel. Lat. S.					O1234
Thu.	24	10		♂ Stationary in R.A.					2O34*
Fri.	25						15	28	1O34*
Sat.	26	9	02	☌ ♂ ☾	♂	11° 00′ S.			3O124
Sun.	27								312O4
Mon.	28	2		☿ Greatest elongation W., 18° 16′			12	17	32O41
		11		♅ Stationary in R.A.					
		22		Moon in Apogee. Dist. from ⊕, 252,500 mi.					
Tue.	29	16		☿ in ☊					41O2*
		17	09	○ Full Moon.					
Wed.	30								4O123
Thu.	31						9	05	42O3*

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

THE SKY FOR SEPTEMBER, 1939

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

The Sun—During September the sun's R.A. increases from 10h 37m to 12h 25m and its Decl. changes from 8° 42′ N. to 2° 45′ S. The equation of time increases from −0m 20s to +9m 55s (see p. 7). On the 23rd, at 22h 50m G.C.T., the sun is at the autumnal equinox and crosses the equator on its way south, entering the sign Libra. Autumn commences at this time and days and nights are approximately equal all over the world.

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

Mercury on the 15th is in R.A. 11h 6m, Decl. 7° 46′ N. and transits at 11.36. It is visible in the morning sky just before sunrise for a few days at the beginning of the month. It then slips back into the twilight and is in superior conjunction with the sun on the 22nd.

Venus on the 15th is in R.A. 11h 39m, Decl. 3° 46′ N. and transits at 12.07. It is in superior conjunction with the sun on the 5th, at which time it passes into the evening sky. It is too near the sun for observation in September.

Mars on the 15th is in R.A. 20h 01m, Decl. 25° 21′ S. and transits at 20.25. It is slowly fading as the distance between it and the earth increases. It is still very prominent in the evening sky, however, being a red star of magnitude −1.5.

Jupiter on the 15th is in R.A. 0h 23m, Decl. 0° 41′ N. and transits at 0.49. It reaches opposition on the 27th and is in view all night throughout the month. This is the most favourable opposition of Jupiter for the next 12 years since the planet is nearest its perihelion point at this opposition. Because of this fact it is considerably nearer the earth than at the usual opposition, being 367,000,000 miles distant. This is 47,000,000 miles closer than it was at the opposition of 1934, for example. Jupiter reaches its maximum brightness this month at magnitude −2.5. For the configurations of its satellites, see opposite page, and for their eclipses, etc., see p. 50.

Saturn on the 15th is in R.A. 1h 57m, Decl. 9° 4′ N. and transits at 2.24. It is approaching opposition to the sun and is in view most of the night. For the elongations, etc., of its satellites, see p. 52.

Uranus on the 15th is in R.A. 3h 18m, Decl. 17° 55′ N. and transits at 3.44.

Neptune on the 15th is in R.A. 11h 36m, Decl. 3° 50′ N. and transits at 12.01.

Pluto—For information regarding this planet, see p. 23.

SEPTEMBER

75th Meridian Civil Time

	d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 1h 15m
Fri.	1	11	14	☌ ♃ ☾ ♃ 3° 48′ S.		42103
Sat.	2					43012
Sun.	3	6		☿ in Perihelion	5 54	43120
		9	23	☌ ♄ ☾ ♄ 2° 42′ S.		
Mon.	4	23	11	☌ ♅ ☾ ♅ 1° 36′ N.		43201
Tue.	5	15		☌ ♀ ☉ Superior		14302
Wed.	6	15	24	☾ Last Quarter	2 43	01423
Thu.	7	23		♀ Greatest Hel. Lat. N.		21043
Fri.	8				23 31	d2034
Sat.	9					30124
Sun.	10					d3104
Mon.	11				20 20	32014
Tue.	12	13		Moon in Perigree. Dist. from ⊕, 222,500 mi.		13024
		19	47	☌ ☿ ☾ ☿ 6° 02′ N.		
Wed.	13	6	22	● New Moon		01423
		13		☿ Greatest Hel. Lat. N.		
		13	13	☌ ♀ ☾ ♀ 4° 49′ N.		
		14	15	☌ ♆ ☾ ♆ 4° 30′ N.		
Thu.	14	2		☌ ♀ ♆ ♀ 0° 16′ N.	17 08	21403
Fri.	15					42013
Sat.	16	16		☌ ♆ ☉		4302*
Sun.	17	13		♂ in Perihelion	13 57	43102
Mon.	18					43201
Tue.	19	7		☌ ☿ ♆ ☿ 0° 34′ N.		41302
Wed.	20	5	34	☽ First Quarter	10 46	40132
Thu.	21					42103
Fri.	22	9		☌ ☿ ☉ Superior		20413
Sat.	23	3	05	☌ ♂ ☾ ♂ 9° 42′ S.	7 34	d024*
		17	50	☉ enters ♎, Autumn comm. Long. of ☉ 180°.		
Sun.	24					31024
Mon.	25	4		Moon in Apogee. Dist from ⊕, 252,200 mi.		32014
Tue.	26				4 23	3104*
Wed.	27	14		☍ ♃ ☉ Dist. from ⊕, 367,100,000 mi.		03124
Thu.	28	9	27	○ Full Moon		12034
		10	53	☌ ♃ ☾ ♃ 4° 06′ S.		
Fri.	29				1 11	20143
Sat.	30	12	19	☌ ♄ ☾ ♄ 2° 50′ S.		10342

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

THE SKY FOR OCTOBER, 1939

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

The Sun—During October the sun's R.A. increases from 12h 25m to 14h 21m and its Decl. changes from 2° 45′ S. to 14° 4′ S. The equation of time rises from +9m 55s to +16m 20s (see p. 7). For changes in the length of the day see p. 15. The sun enters Scorpio, the second autumnal sign of the zodaic, on the 24th of the month. There is a total eclipse of the sun on October 12, invisible in North America. For details, see p. 25.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. There is a partial eclipse of the moon on October 28, visible in Canada and the United States. For details see p. 25.

Mercury on the 15th is in R.A. 14h 13m, Decl. 14° 19′ S. and transits at 12.43. It is too near the sun for observation during October.

Venus on the 15th is in R.A. 13h 57m, Decl. 11° 10′ S. and transits at 12.27. It is in the evening sky but sets only a few minutes after the sun and so is not well placed for observation.

Mars on the 15th is in R.A. 20h 50m, Decl. 20° 54′ S. and transits at 19.18. It is a red star of magnitude −0.7 in the evening sky, setting over six hours after the sun.

Jupiter on the 15th is in R.A. 0h 8m, Decl. 0° 52′ S. and transits at 22.33. It is a brilliant star of magnitude −2.4, appearing in the east at sunset and remaining in view all night. For the configurations of its satellites, see next page, and for their eclipses, etc., see p. 50.

Saturn on the 15th is in R.A. 1h 49m, Decl. 8° 18′ N. and transits at 0.18. It is in opposition to the sun on the 22nd and is in view all night throughout the month. It reaches a maximum brightness at this time of magnitude 0.1. The rings of Saturn at this opposition are opened a little more than half the maximum possible value. They appear inclined to the line of sight by about 15 degrees. For some years now the brightness of the planet has increased at each opposition owing to the opening out of the rings as seen from the earth. These will appear at their maximum inclination to the line of sight at the end of 1943. For the elongations, etc., of the satellites of Saturn, see p. 52.

Uranus on the 15th is in R.A. 3h 15m, Decl. 17° 43′ N. and transits at 1.43.

Neptune on the 15th is in R.A. 11h 40m, Decl. 3° 25′ N. and transits at 10.07.

Pluto—For information regarding this planet, see p. 23.

OCTOBER

75th Meridian Civil Time

	d	h	m				Min. of Algol h	m	Config. of Jupiter's Sat. 23h 30m
Sun.	1	20		☌ ☿ ♀	☿	0° 36′ S.	22	00	432O*
Mon.	2	3	49	☌ ♅ ☾	♅	1° 41′ N.			4312O
Tue.	3								4O312
Wed.	4						18	49	412O3
Thu.	5								42O13
Fri.	6	0	27	☾ Last Quarter					41O32
		23		☿ in ☋					
Sat.	7						15	38	34O12
Sun.	8								32O4*
Mon.	9								321O4
Tue.	10	20		Moon in Perigee.	Dist. from ⊕, 224,700 mi.		12	26	O124*
Wed.	11	2	21	☌ ♆ ☾	♆	4° 27′ N.			d1O34
Thu.	12			Total Eclipse of ☉, see p. 25					2O134
		15	30	● New Moon.					
Fri.	13	9	45	☌ ♀ ☾	♀	0° 48′ N.	9	15	1O234
		16	27	☌ ☿ ☾	☿	1° 17′ S.			
Sat.	14								3O124
Sun.	15								321O4
Mon.	16						6	04	d324O
Tue.	17	5		☿ in Aphelion					43O12
Wed.	18								41O23
Thu.	19	22	24	☽ First Quarter.	Orionid Meteors, p. 54		2	52	42O13
Fri.	20								41O23
Sat.	21	13	09	☌ ♂ ☾	♂	8° 11′ S.	23	41	43O12
		22		☍ ♄ ☉	Dist. from ⊕, 771,900,000 mi.				
Sun.	22	18		Moon in Apogee.	Dist. from ⊕, 251,600 mi.				4321O
Mon.	23								342O1
Tue.	24						20	30	34O2*
Wed.	25	11	42	☌ ♃ ☾	♃	4° 22′ S.			1O243
Thu.	26								2O134
Fri.	27	15	09	☌ ♄ ☾	♄	3° 03′ S.	17	19	1O34*
Sat.	28			Partial Eclipse of ☾, see p. 25					3O124
		1	42	○ Full Moon.					
Sun.	29	8	13	☌ ♅ ☾	♅	1° 37′ N.			312O4
Mon.	30						14	07	32O14
Tue.	31								3O24*

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

THE SKY FOR NOVEMBER, 1939

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

The Sun—During November the sun's R.A. increases from 14h 21m to 16h 24m and its Decl. changes from 14° 4′ S. to 21° 38′ S. The equation of time increases from +16m 20s to a maximum of +16m 23s on November 4 and then decreases to +11m 22s at the end of the month (see p. 7). For changes in the length of the day, see p. 16. On the 23rd the sun enters Sagittarius, the third autumn sign of the zodiac.

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

Mercury on the 15th is in R.A. 16h 45m, Decl. 24° 49′ S. and transits at 13.11. On November 7 it is at greatest elongation east of the sun in the evening sky but is not well placed for observation, setting barely 30 minutes after the sun. It is in inferior conjunction on the 28th.

Venus on the 15th is in R.A. 16h 32m, Decl. 22° 25′ S. and transits at 13.01. It sets about an hour after the sun in the evening sky.

Mars on the 15th is in R.A. 22h 0m, Decl. 14° 7′ S. and transits at 18.25. It is in quadrature on November 29 and appears in the western evening sky for the first half of the night. It is now of zero magnitude.

Jupiter on the 15th is in R.A. 23h 59m, Decl. 1° 46′ S. and transits at 20.22. It has faded slightly as it recedes from the earth after opposition but is still a very brilliant object in view for most of the night. It is at a stationary point on the 25th and commences to move eastward among the stars again on this date. For the configurations of its satellites, see opposite page, and for their eclipses, etc., see p. 50.

Saturn on the 15th is in R.A. 1h 40m, Decl. 7° 29′ N. and transits at 22.03. It is well placed for observation, rising in the east shortly before sunset and being visible most of the night. For the elongations, etc., of its satellites, see p. 52.

Uranus on the 15th is in R.A. 3h 10m, Decl. 17° 24′ N. and transits at 23.32. Opposition to the sun occurs on the 13th.

Neptune on the 15th is in R.A. 11h 43m, Decl. 3° 4′ N. and transits at 8.09.

Pluro—For information regarding this planet, see p. 23.

NOVEMBER

75th Meridian Civil Time

	d	h	m		Min. of Algol h	m	Config. of Jupiter's Sat. 22h 00m
Wed.	1						d0243
Thu.	2				10	56	24013
Fri.	3	1		♀ in ♉			41203
Sat.	4	8	12	☾ Last Quarter			d4012
Sun.	5				7	45	43120
Mon.	6	13		☿ Greatest Hel. Lat. S.			43201
Tue.	7	12	18	☌ ♆ ☾ ♆ 4° 23′ N.			43102
		16		Moon in Perigee. Dist. from ⊕, 228,100 mi.			
		22		☿ Greatest elongation E., 23° 10′.			
Wed.	8				4	34	d4032
Thu.	9						4203*
Fri.	10						21043
Sat.	11	2	54	● New Moon	1	23	03124
Sun.	12	10	42	☌ ♀ ☾ ♀ 3° 37′ S.			d3104
		19	24	☌ ☿ ☾ ☿ 6° 12′ S.			
Mon.	13	1		☍ ♅ ☉ Dist. from ⊕, 1,731,000,000 mi.	22	12	32014
Tue.	14						31024
Wed.	15			Leonid Meteors, p. 54			01324
Thu.	16				19	01	2034*
Fri.	17						21043
Sat.	18	1		☌ ☿ ♀ ☿ 1° 24′ S.			04312
		9		☿ Stationary in R.A.			
		18	21	☽ First Quarter.			
Sun.	19	7	22	☌ ♂ ☾ ♂ 6° 23′ S.	15	50	34102
		14		Moon in Apogee. Dist. from ⊕, 251,200 mi.			
Mon.	20						43201
Tue.	21	16	49	☌ ♃ ☾ ♃ 4° 20′ S.			4310*
Wed.	22				12	39	4012*
Thu.	23	19	49	☌ ♄ ☾ ♄ 3° 09′ S.			42103
Fri.	24						d4203
Sat.	25	6		♃ Stationary in R.A.	9	28	40132
		14		☿ in ♌			
		14	07	☌ ♅ ☾ ♅ 1° 31′ N.			
Sun.	26	16	54	○ Full Moon			34102
Mon.	27						32041
Tue.	28	12		☌ ☿ ☉ Inferior	6	17	3104*
Wed.	29	3		□ ♂ ☉			0124*
Thu.	30	5		☿ in Perihelion			21034

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

THE SKY FOR DECEMBER, 1939

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

The Sun—During December the sun's R.A. increases from 16h 24m to 18h 41m and its Decl. changes from 21° 38′ S. to a minimum value of 23° 26′ 40″ S. on the 22nd, rising to 23° 7′ S. at the end of the month. The equation of time drops from +11m 22s to −2m 58s (see p. 7). At 18h 6m G.C.T., December 22, the sun enters Capricornus, the first winter sign of the zodiac, and winter commences. It is at its position farthest south of the equator and the length of daylight in the northern hemisphere is at a minimum, changing very slightly for several days, see p. 16.

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

Mercury on the 15th is in R.A. 15h 57m, Decl. 17° 59′ S. and transits at 10.26. It reaches greatest elongation west of the sun in the morning sky on December 16, rising an hour and three-quarters before the sun at this time. It will be in the S.E. and 16° above the horizon at sunrise.

Venus on the 15th is in R.A. 19h 15m, Decl. 23° 51′ S. and transits at 13.46. It is a bright yellow star in the evening sky, setting in the south-west almost two hours after the sun.

Mars on the 15th is in R.A. 23h 12m, Decl. 6° 2′ S. and transits at 17.39. It is moving north among the stars of the evening sky and sets about seven hours after the sun, being in view for the first half of the night. It is growing fainter as the distance between Mars and the earth increases.

Jupiter on the 15th is in R.A. 0h 1m, Decl. 1° 26′ S. and transits at 18.26. It is in the south-east at sunset and sets shortly after midnight. Quadrature with the sun is reached on the 22nd. For the configurations of its satellites, see opposite page, and for their eclipses, etc., see p. 50.

Saturn on the 15th is in R.A. 1h 35m, Decl. 7° 4′ N. and transits at 20.00. It is in view most of the night, appearing in the south-east after sunset. Its magnitude has now dropped to 0.5 as it recedes from the earth after opposition. A stationary point in its path among the stars is reached on the 28th, at which time it resumes its eastward motion.

Uranus on the 15th is in R.A. 3h 5m, Decl. 17° 5′ N. and transits at 21.30.

Neptune on the 15th is in R.A. 11h 45m, Decl. 2° 54′ N. and transits at 6.12.

Pluto—For information regarding this planet, see p. 23.

DECEMBER

75th Meridian Civil Time

	d	h	m		Min. of Algol h	m	Config. of Jupiter's Sat. 20h 45m
Fri.	1				3	06	2O134
Sat.	2						O234*
Sun.	3	0		♃ Greatest Hel. Lat. S.	23	55	31O24
		2		Moon in Perigee. Dist. from ⊕, 230,100 mi.			
		15	20	☾ Last Quarter.			
Mon.	4	19	40	☌ ♆ ☾ ♆ 4° 14′ N.			32O14
Tue.	5						312O4
Wed.	6				20	44	43O12
Thu.	7	10		♀ in Alphelion			412O3
Fri.	8	1		☿ Stationary in R.A.			42O13
Sat.	9	4	47	☌ ☿ ☾ ☿ 0° 13′ N.	17	33	41O23
Sun.	10	12		☿ Greatest Hel. Lat. N.			431O2
		16	45	● New Moon.			
Mon.	11						432O1
Tue.	12	19	48	☌ ♀ ☾ ♀ 6° 29′ S.	14	22	4312O
				Geminid Meteors, p. 54			
Wed.	13						34O12
Thu.	14						d1O43
Fri.	15				11	11	2O143
Sat.	16	19		☿ Greatest elongation W., 21° 25′			1O234
Sun.	17	11		Moon in Apogee. Dist. from ⊕, 251,300 mi.			ddO24
Mon.	18	3		□ ♆ ☉	8	00	32O4*
		4	35	☌ ♂ ☾ ♂ 4° 05′ S.			
		16	04	☽ First Quarter.			
Tue.	19	2	58	☌ ♃ ☾ ♃ 3° 55′ S.			321O4
Wed.	20						3O124
Thu.	21	2	53	☌ ♄ ☾ ♄ 2° 59′ S.	4	49	1O234
Fri.	22	13	06	☉ enters ♑, Winter comm. Long. of ☉, 270°			24O13
		18		□ ♃ ☉			
		21	46	☌ ♅ ☾ ♅ 1° 32′ N.			
Sat.	23						41O3*
Sun.	24				1	38	4O312
Mon.	25						432O*
Tue.	26	6	28	○ Full Moon	22	28	4321O
Wed.	27						43O12
Thu.	28	21		♄ Stationary in R.A.			41O2*
Fri.	29	0		♆ Stationary in R.A.	19	17	42O13
		6		Moon in Perigee. Dist. from ⊕, 227,300 mi.			
		21		♀ Greatest Hel. Lat. S.			
Sat.	30						14O3*
Sun.	31						O3142

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

PHENOMENA OF JUPITER'S SATELLITES, 1939

E—eclipse, O—occultation, T—transit, S—shadow, D—disappearance, R—reappearance, I—ingress, e—egress. The Roman numerals denote the satellites. 75th Meridian Civil Time. (For other times see p. 00).

JANUARY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
4	18	45	IV	TI		19	44	I	ER
5	20	05	I	OD	16	18	05	II	ER
6	18	20	I	SI	21	18	38	I	OD
	19	39	I	Te	22	18	13	I	Te
7	17	47	II	SI		18	57	I	Se
	17	48	I	ER	25	18	07	III	OD
	18	43	II	Te	29	17	58	I	TI
	18	52	III	TI		18	36	I	SI
13	19	24	I	TI	30	18	02	I	ER
14	18	42	II	TI					

FEBRUARY

d	h	m	Sat.	Phen.
5	18	13	III	Se

Jupiter being near the Sun, phenomena of the Satellites are not given from February 19 to May 1.

MAY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
7	03	54	I	TI	28	02	55	IV	OD
17	03	50	III	TI		03	35	II	ED
22	03	50	I	ED	30	03	05	I	SI
23	03	24	I	Se		03	08	II	Te
24	03	15	III	SI	31	03	45	I	OR

JUNE

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
4	02	40	III	OD	16	02	07	I	OR
5	04	06	IV	Se	22	01	03	III	TI
6	03	11	II	TI		03	14	I	SI
	03	14	II	Se		03	44	III	Te
7	02	07	I	ED	23	04	03	I	OR
8	02	57	I	Te	24	01	16	I	Te
13	03	08	II	SI	29	02	18	III	Se
14	04	02	I	ED		03	10	II	ED
15	02	41	I	TI	30	02	19	I	ED
	03	23	II	OR		03	20	IV	ED
	03	34	I	Se					

JULY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	00	33	II	TI	16	00	36	I	ED
	00	59	I	TI		04	12	I	OR
	01	49	I	Se	17	00	00	IV	ER
	03	10	I	Te		00	05	I	Se
	03	11	II	Te		00	24	III	ER
2	00	26	I	OR		01	22	I	Te
6	03	20	III	SI		02	53	II	OR
7	04	13	I	ED		03	05	III	OD
8	00	19	II	SI	23	02	30	I	ED
	01	30	I	SI		23	46	I	SI
	02	52	I	TI	24	00	10	II	ED
	03	01	II	Se		01	02	I	TI
	03	10	II	TI		01	27	III	ED
	03	43	I	Se		01	58	I	Se
9	02	19	I	OR		03	13	I	Te
10	00	24	II	OR		04	24	III	ER
	01	48	III	OR	25	00	30	I	OR
15	02	56	II	SI	26	00	07	II	Te
	03	24	I	SI	27	23	08	III	Te

JULY—*Con.*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
30	04	25	I	ED		02	52	I	TI
31	01	39	I	SI		03	52	I	Se
	02	45	II	ED		22	53	I	ED

AUGUST

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	02	20	I	OR	17	00	23	I	OR
	23	30	I	Te		21	32	I	Te
	23	59	II	TI	18	01	42	II	OR
2	00	12	II	Se		03	24	III	SI
	02	35	II	Te	21	21	22	III	OD
4	00	22	III	TI		23	46	III	OR
	02	47	III	Te	22	04	37	I	ED
7	03	33	I	SI	23	01	49	I	SI
	04	40	I	TI		02	40	I	TI
8	00	48	I	ED		04	02	I	Se
	04	09	I	OR		04	51	I	Te
	22	01	I	SI		23	05	I	ED
	23	07	I	TI	24	02	09	I	OR
9	00	07	II	SI		21	07	I	TI
	00	14	I	Se		22	30	I	Se
	01	18	I	Te		23	18	I	Te
	02	24	II	TI		23	46	II	ED
	02	49	II	Se	25	04	01	II	OR
	22	36	I	OR	26	21	22	II	Se
10	23	22	II	OR		22	54	II	Te
	23	24	III	SI	27	21	08	IV	SI
11	02	16	III	Se		22	28	IV	Se
	02	41	IV	SI	28	21	34	III	ED
	03	58	III	TI	29	00	26	III	ER
	04	26	IV	Se		00	47	III	OD
15	02	42	I	ED		03	10	III	OR
	23	55	I	SI	30	03	42	I	SI
16	00	54	I	TI		04	26	I	TI
	02	08	I	Se	31	01	00	I	ED
	02	45	II	SI		03	55	I	OR
	03	05	I	Te		22	11	I	SI
	04	48	II	TI		22	52	I	TI

SEPTEMBER

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	00	24	I	Se		03	28	II	Te
	01	03	I	Te	11	21	40	II	OR
	02	21	II	ED	14	04	50	I	ED
	22	21	I	OR	15	01	59	I	SI
2	21	18	II	SI		02	20	I	TI
	22	37	II	TI		04	13	I	Se
	23	59	II	Se		04	31	I	Te
3	01	12	II	Te		19	30	III	SI
5	01	35	III	ED		20	57	III	TI
	04	45	IV	ED		22	17	III	Se
7	02	55	I	ED		23	18	I	ED
8	00	05	I	SI		23	19	III	Te
	00	36	I	TI	16	01	50	I	OR
	02	18	I	Se		20	28	I	SI
	02	47	I	Te		20	45	I	TI
	04	56	II	ED		22	41	I	Se
	20	01	III	Te		22	57	I	Te
	21	23	I	ED	17	02	33	II	SI
9	00	06	I	OR		03	09	II	TI
	20	47	I	Se		05	14	II	Se
	21	13	I	Te		20	16	I	OR
	23	55	II	SI	18	20	49	II	ED
10	00	54	II	TI		23	54	II	OR
	02	36	II	Se					

SEPTEMBER—*Con.*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
22	03	54	I	SI		05	24	II	TI
	04	03	I	TI		19	42	I	ED
	23	31	III	SI		22	00	I	OR
23	00	11	III	TI	25	19	04	I	Se
	01	13	I	ED		19	06	I	Te
	02	18	III	Se		23	25	II	ED
	02	35	III	Te	26	02	07	II	OR
	03	33	I	OR	27	18	31	II	TI
	22	22	I	SI		21	06	II	Te
	22	29	I	TI		21	10	II	Se
24	00	36	I	Se	30	03	05	I	OD
	00	40	I	Te		03	25	III	TI
	05	10	II	SI		03	33	III	SI

OCTOBER

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	00	12	I	TI		22	06	I	TI
	00	17	I	SI		22	36	I	SI
	02	24	I	Te	17	00	18	I	Te
	02	30	I	Se		00	49	I	Se
	21	31	I	OD		19	25	I	OD
	23	51	I	ER		22	10	I	ER
2	18	38	I	TI		23	44	III	OD
	18	46	I	SI	18	18	45	I	Te
	20	50	I	Te		19	17	I	Se
	20	59	I	Se	19	01	16	II	TI
3	01	45	II	OD		02	22	II	SI
	04	41	II	ER		03	53	II	Te
	18	20	I	ER	20	19	22	II	OD
	20	29	III	ER		23	11	II	ER
4	20	45	II	TI	21	18	20	III	Se
	21	07	II	SI	22	18	19	II	Se
	23	21	II	Te	23	02	44	I	OD
	23	47	II	Se		23	51	I	TI
8	01	56	I	TI	24	00	31	I	SI
	02	12	I	SI		02	04	I	Te
	04	08	I	Te		02	44	I	Se
	04	25	I	Se		21	11	I	OD
	23	15	I	OD	25	00	05	I	ER
9	01	46	I	ER		03	04	III	OD
	20	22	I	TI		18	18	I	TI
	20	41	I	SI		19	00	I	SI
	22	34	I	Te		20	30	I	Te
	22	54	I	Se		21	12	I	Se
10	03	59	II	OD	26	03	34	II	TI
	20	15	I	ER		18	34	I	ER
	20	27	III	OD	27	21	39	II	OD
11	00	30	III	ER	28	01	48	II	ER
	23	00	II	TI		19	13	III	Te
	23	44	II	SI		19	42	III	SI
12	01	37	II	Te		22	22	III	Se
	02	24	II	Se	29	18	17	II	SI
13	20	35	II	ER		19	21	II	Te
15	03	40	I	TI		20	56	II	Se
	04	07	I	SI	31	01	38	I	TI
16	00	59	I	OD		02	26	I	SI
	03	41	I	ER		22	57	I	OD

NOVEMBER

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	02	00	I	ER		19	04	II	TI
	20	04	I	TI		20	55	II	SI
	20	55	I	SI		21	41	II	Te
	22	17	I	Te		23	33	II	Se
	23	08	I	Se	7	17	44	II	ER
2	20	29	I	ER	8	00	45	I	OD
3	23	59	II	OD		21	52	I	TI
4	20	03	III	TI		22	51	I	SI
	22	41	III	Te	9	00	04	I	Te
	23	44	III	SI		01	03	I	Se
5	02	23	III	Se		19	12	I	OD

NOVEMBER—*Con.*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
	22	25	I	ER	19	23	52	II	TI
10	18	31	I	Te	21	22	59	II	ER
	19	32	I	Se	22	19	55	III	OR
11	23	34	III	TI		22	01	III	ED
12	21	27	II	TI	23	00	38	III	ER
	23	33	II	SI		18	05	II	Se
13	00	05	II	Te		22	51	I	OD
14	20	22	II	ER	24	19	59	I	TI
15	17	58	III	ED		21	11	I	SI
	20	36	III	ER		22	11	I	Te
	23	41	I	TI		23	23	I	Se
16	00	46	I	SI	25	20	44	I	ER
	21	00	I	OD	26	17	52	I	Se
17	00	20	I	ER	28	20	26	II	OD
	18	08	I	TI	29	20	53	III	OD
	19	15	I	SI		23	40	III	OR
	20	21	I	Te	30	18	06	II	SI
	21	27	I	Se		18	13	II	Te
18	18	49	I	ER		20	42	II	Se

DECEMBER

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	00	42	I	OD		23	18	II	Te
	21	51	I	TI		23	20	II	SI
	23	07	I	SI	16	22	57	I	OD
2	00	03	I	Te	17	18	26	III	TI
	19	10	I	OD		20	07	I	TI
	22	40	I	ER		21	14	III	Te
3	17	36	I	SI		21	27	I	SI
	18	28	III	Se		22	20	I	Te
	18	31	I	Te		23	39	I	Se
	19	47	I	Se	18	17	26	I	OD
5	22	38	IV	TI	19	18	08	I	Se
	22	58	II	OD	21	23	15	II	TI
	23	21	IV	Te	22	17	24	IV	Te
7	18	06	II	TI	23	17	26	II	OD
	20	43	II	SI		22	51	II	ER
	20	44	II	Te	24	22	03	I	TI
	23	19	II	Se		22	28	III	TI
8	23	44	I	TI		23	24	I	SI
9	17	34	II	ER	25	17	50	II	Se
	21	03	I	OD		19	22	I	OD
10	18	12	I	TI		22	55	I	ER
	19	32	I	SI	26	17	52	I	SI
	19	58	III	SI		18	44	I	Te
	20	25	I	Te		20	04	I	Se
	21	43	I	Se	27	17	24	I	ER
	22	30	III	Se	28	18	14	III	ED
11	19	04	I	ER		20	46	III	ER
14	20	39	II	TI	30	20	06	II	OD

From May to September Jupiter's satellites I, II, III, IV, are eclipsed on the west side of the planet, and in January and November and December on the east side. The disappearance of satellites I and II is visible May to September, and the reappearance in January and February and October to December. Both disappearance and reappearance of satellite III are visible in January, May to August; and November and December; satellite IV in January and May to August. Satellite IV is eclipsed during 1939.

GREATEST EASTERN AND WESTERN ELONGATIONS OF SATURN'S SATELLITES TITAN AND IAPETUS

TITAN

Eastern	d	h	Western	d	h
Jan.	3	21.7	Jan.	11	23.9
"	19	21.2	"	27	23.5
Feb.	4	21.2			
June	29	02.1	July	7	02.6
July	15	01.9	"	23	02.0
"	31	01.2	Aug.	8	01.1
Aug.	16	00.1	"	23	23.7
"	31	22.5	Sept.	8	21.9
Sept.	16	20.4	"	24	19.8
Oct.	2	18.0	Oct.	10	17.4
"	18	15.4	"	26	14.9
Nov.	3	12.7	Nov.	11	12.4
"	19	10.2	"	27	10.1
Dec.	5	08.0	Dec.	13	08.2
"	21	06.2	"	29	06.7

IAPETUS

Eastern	d	h	Western	d	h
Feb.	12	00.3	Jan.	4	04.2
July	24	11.2	Sept.	3	09.3
Oct.	11	06.7	Nov.	20	13.4
Dec.	28	15.2			

CONJUNCTION WITH PLANET

IAPETUS

Inferior	d	h	Superior	d	h
			Jan.	23	09.8
Aug.	14	08.8	July	4	17.3
Oct.	31	16.8	Sept.	22	01.6
			Dec.	9	06.6

TITAN

Inferior	d	h	Superior	d	h
Jan.	8	02.1	Jan.	15	19.3
"	24	01.7	"	31	19.0
			June	24	23.0
July	3	05.9	July	10	22.8
"	19	05.5	"	26	22.2
Aug.	4	04.7	Aug.	11	21.1
"	20	03.4	"	27	19.6
Sept.	5	01.7	Sept.	12	17.7
"	20	23.6	"	28	15.4
Oct.	6	21.1	Oct.	14	12.9
"	22	18.5	"	30	10.3
Nov.	7	16.0	Nov.	15	07.8
"	23	13.6	Dec.	1	05.6
Dec.	9	11.5	"	17	03.8
"	25	09.9	Jan.	2	02.4

LUNAR OCCULATIONS

Prepared by J. F. HEARD

When the moon passes between the observer and a star that star is said to be occulted by the moon and the phenomenon is known as a lunar occultation. The passage of the star behind the east limb of the moon is called the immersion and its appearance from behind the west limb the emersion. As in the case of eclipses, the times of immersion and emersion and the duration of the occultation are different for different places on the earth's surface. The tables given below, adapted from the 1939 Nautical Almanac, give the times of immersion or emersion or both for occultations of stars brighter than magnitude 5.0 visible at Toronto and at Montreal and also at Vancouver and Calgary, at night. Occultations of stars fainter than magnitude 4.5 are excluded for 24 hours before and after Full Moon. Emersions at the bright limb of the moon are given only in the case of stars brighter than magnitude 3.5, and immersions at the bright limb only in the case of stars brighter than magnitude 4.5; so that most of the phenomena listed take place at the dark limb. The terms *a* and *b* are for determining corrections to the times of the phenomena for stations within 300 miles of Toronto or Montreal in the first table, and within 300 miles of Vancouver or Calgary, in the second table. 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. The moon occults Uranus Jan. 29th.

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL 1939

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	m	m	°	h m	m	m	°
Feb. 12	ψ Oph		4.6	E	22.8	Low	—	—	—	5 35.4	−0.4	−0.3	324
" 22	δ Psc		4.6	I	3.6	18 28.4	—	—	4	Graze	—	—	—
Mar. 11	β¹ Scr		2.9	I	20.0	2 31.6	—	—	167	2 31.1	−0.7	−0.8	150
" 11	β¹ Scr		2.9	E	20.0	3 07.2	—	—	221	3 26.0	−2.3	+1.7	236
May 1-2	α Vir		1.2	I	12.5	23 47.5	−2.3	+0.2	71	0 01.0	−2.2	+0.3	59
" 2	α Vir		1.2	E	12.5	0 45.7	−1.1	−2.2	334	0 47.3	−0.9	−2.6	344
" 5	ν Scr	m.	4.3	I	15.6	0 02.3	−2.2	+1.8	57	0 19.3	−2.4	+2.0	45
" 5	ν Scr	m.	4.3	E	15.6	1 01.3	−1.4	−1.2	325	1 06.7	−1.4	−1.8	335
June 28	ψ Oph		4.6	I	11.5	Sun	—	—	—	20 08.0	−1.1	−0.4	139
July 22	α Vir		1.2	I	6.1	Graze	—	—	—	19 08.0	−0.7	−2.6	170
" 22	α Vir		1.2	E	6.1	Graze	—	—	—	19 50.4	−2.3	+0.4	235
" 25	ν Scr	m.	4.3	I	9.2	20 44.4	−2.0	−0.4	97	20 54.9	−1.8	−0.6	93
Aug. 27	β Cap		3.2	I	12.0	0 14.7	−0.8	+1.1	29	0 20.3	−0.6	+0.7	32
" 27	β Cap		3.2	E	12.0	1 15.7	−1.7	−2.0	288	1 20.6	−1.3	−2.0	286
Sept. 6	68 Tau		4.2	I	22.2	2 03.1	−1.1	+0.9	102	2 11.6	−1.3	+0.8	103
" 6	68 Tau		4.2	E	22.2	2 09.2	−1.0	+2.3	234	2 19.7	−1.2	+2.2	234
" 9	λ Gem		3.6	E	25.2	2 26.1	0.0	+1.3	264	2 29.0	−0.1	+1.4	265
Nov. 15	ρ Sgr		4.0	I	4.6	17 01.0	−2.4	−1.5	119	17 11.6	−2.3	−1.9	122
" 28	119 Tau		4.7	E	17.0	3 20.8	−1.7	−0.2	252	3 28.7	−1.4	−0.8	262
" 29	λ Gem		3.6	E	18.8	21 09.3	−0.1	+1.2	271	21 12.4	−0.2	+1.3	272
Dec. 28	α Cnc		4.3	I	18.3	21 25.2	−0.1	+2.4	59	21 30.9	−0.2	+2.8	54
" 28	α Cnc		4.3	E	18.3	22 08.3	−0.7	−0.7	325	22 11.2	−0.8	−1.1	332

*Immersion or Emersion.

LUNAR OCCULTATIONS VISIBLE AT VANCOUVER AND CALGARY 1939

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	m	m	°	h m	m	m	°
Feb. 26	ε Tau	3.6	I	7.8	19 40.1	—	—	25	Graze	—	—	—
Mar. 8	α Vir	1.2	I	17.0	0 24.7	−1.5	+1.3	82	1 42.3	−2.0	+1.5	65
" 8	α Vir	1.2	E	17.0	1 25.2	−0.9	−0.8	327	2 30.4	−0.6	−1.6	343
" 28-29	λ Gem	3.6	I	8.2	23 23.6	−0.4	−1.7	109	0 24.2	−0.3	−1.6	99
Apr. 11	ρ Sgr	4.0	I	21.4	Low	—	—	—	3 37.1	−1.3	+2.1	48
" 11	ρ Sgr	4.0	E	21.4	3 30.3	−1.2	+0.9	292	4 43.1	−1.5	+0.6	295
May 1	χ Vir	4.8	I	11.7	1 03.3	−0.9	−2.0	145	2 07.9	−0.7	−2.0	138
" 1	α Vir	1.2	I	12.5	19 40.6	−0.8	+0.8	109	20 50.5	−1.1	+0.9	96
" 1	α Vir	1.2	E	12.5	20 48.6	−1.0	+0.2	298	21 57.8	−1.0	−0.3	311
June 12	ε Psc	4.4	I	24.3	2 34.0	−0.1	+2.0	55	Sun	—	—	—
Sept. 5	δ Tau	3.9	E	22.1	Low	—	—	—	23 38.2	+0.4	+2.2	219
" 5-6	68 Tau	4.2	I	22.2	Low	—	—	—	0 03.0	+0.2	+1.9	56
" 5-6	68 Tau	4.2	E	22.2	23 52.3	−0.2	+1.1	287	0 56.7	−0.4	+1.2	282
" 21	ρ Sgr	4.0	I	8.8	22 14.7	−1.7	−2.3	120	Low	—	—	—
Nov. 16	β Cap	3.2	I	5.8	18 46.1	−1.1	−0.2	56	19 54.8	−0.9	−0.6	63
" 16	β Cap	3.2	E	5.8	19 59.8	−1.0	−1.2	263	Low	—	—	—
" 27-28	119 Tau	4.7	E	17.0	23 10.8	−1.3	+0.9	272	0 24.5	−1.5	+0.5	272
Dec. 24	δ Tau	3.9	I	13.6	4 24.8	+0.3	−2.2	125	Low	—	—	—

*Immersion or Emersion.

METEORS OR SHOOTING STARS

By Peter M. Millman

Meteors are small fragmentary particles of iron or stone, the debris of space, which, on entering the earth's atmosphere at high velocity, ignite and are in general completely vaporized. On a clear moonless night a single observer should see on the average about 7 meteors per hour during the first six months of the year and approximately twice this number during the second half of the year. The above figures are averages over the whole night, however, and it should be noted that meteors are considerably more numerous during the second half of the night at which time the observer is on the preceding hemisphere of the earth in its journey around the sun.

In addition to the so-called sporadic meteors there are well-marked groups of meteors which travel in elliptical orbits about the sun and appear at certain seasons of the year. The meteors of any one group, or shower, move along parallel paths and hence, owing to the laws of perspective, seem to radiate from a point in the sky known as the radiant. The shower is usually named after the constellation in which the radiant is located. The following table lists the chief meteoric showers of the year. The material was collected from different sources, including the publications of Denning and Olivier.

The Chief Annual Meteor Showers for the Northern Hemisphere.

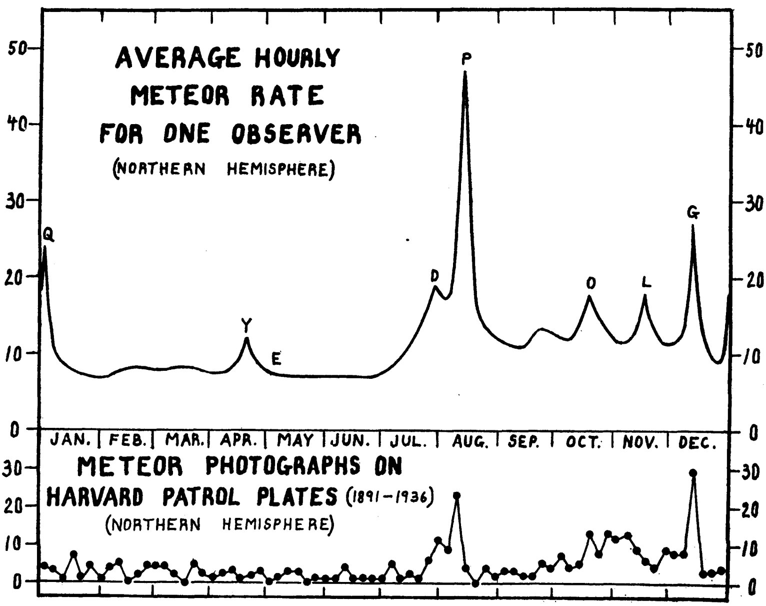
Shower	Approx. Radiant		Maximum Date	Hourly No. (all meteors)	Duration (in days)	Abbre-viation
	α	δ				
Quadrantids	232°	+52°	Jan. 3	20	4	Q
Lyrids	280	+37	Apr. 21	10	4	Y
Eta Aquarids	336	− 1	May 4	10	8	E
Delta Aquarids	340	−17	July 28	20	3	D
Perseids	47	+57	Aug. 12	50	25	P
Orionids	96	+15	Oct. 22	20	14	O
Leonids	152	+22	Nov. 16	20	14	L
Geminids	110	+33	Dec. 12	30	14	G

The date of maximum given above applies to either morning or evening and is approximate only, as local irregularities in the showers in addition to the effect of leap year may shift it by a day or more. With the exception of the Geminids, all the showers listed are most active well after midnight. It should be noted that large numbers of meteors appeared on June 28, 1916, and on Oct. 9, 1933, and there is the possibility of a return of these showers.

A meteor observer should make as complete a record as he can with efficiency. The most important information to note includes the number of meteors per hour, their magnitudes and positions in the sky, evidences of enduring trains and, where several stations are co-operating, the exact time of the appearance of each meteor. Magnitudes of meteors are generally determined by comparison with stars and the positions of meteor trails may most conveniently be recorded by plotting them as straight lines on gnomonic star maps. The observer should also make sure that the record sheet contains his name, the exact place of observation, the night when the observations were made given as a double date (e.g. the evening of May 4 or the morning of May 5 would be recorded as May 4-5), and finally, a note on the weather conditions.

The first curve shown in the figure below gives the expected hourly rate of meteors for a single observer at different times of the year. It has been drawn from data published by Denning, Olivier, and Hoffmeister. This curve varies somewhat from year to year. The corresponding curve for the southern hemisphere, which is not plotted, lacks the high maximum at P, has its highest maxima at E and D, and best general rates from April through July.

The second curve gives the number of meteor photographs found on all Harvard patrol plates up to Oct. 15, 1936, for each five-day interval throughout the year, taken from a catalogue of meteor photographs published by Miss Hoffleit. Since these plates were exposed on a uniform system the curve gives some indication of the favourable periods for meteor photography. The high photographic efficiency of the Geminid shower is a marked feature.



Of recent years the study of meteors has become increasingly important both because of its cosmic significance and because of its close association with studies of the upper atmosphere. The amateur who does not possess a telescope can render more real assistance in this field than in any other. In particular, all observations of very bright meteors or fireballs should be reported immediately in full. Maps and instructions for meteor observations may be secured from the writer at the Dunlap Observatory, Richmond Hill, Ont., the Canadian headquarters for the collection of meteor data.

For more complete instructions concerning the visual observation of meteors see the JOURNAL of the Royal Astronomical Society of Canada, vol. 31, p. 255, 1937; and for meteor photography volume 31, p. 295, 1937.

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

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

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

PHYSICAL ELEMENTS

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

Satellites of the Solar System

Name	Stellar Mag.	Mean Dist. from Planet ″ *	Mean Dist. from Planet Miles	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.

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 numbers 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 STAR

Star	α 1900	δ	Mag. and Spect.	d	D	Remarks
	h m	° ′		″	L.Y.	
η And	00 31.5	+33 10	4.4B3; 8.5	36	410	†
π Cas	00 43.0	+57 17	3.6F8; 7.2M0	8	18	479y; 66AU
α UMi	01 22.6	+88 46	var. F8; 8.8	19	270	Polaris
γ Ari	01 48.1	+18 48	4.8A0; 4.8A0	8.3	200	
α Pis	01 56.9	+02 17	5.2A2; 4.3A2	2.4	162	††
γ And	01 57.8	+41 51	2.3K0; 5.4A0; 6.6	10, 0.7	220	5.5y; 23AU
6 Tri	02 06.6	+29 50	5.4G4; 7.0F3	3.6	270	††
η Per	02 43.4	+55 29	3.9K0; 8.5	28	360	
32 Eri	03 49.3	−03 15	5.0A; 6.3G5	6.7	330	
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	1100	Trapezium
β Mon	06 24.0	−06 58	4.7B2; 5.2; 5.6	7, 25	330	†
12 Lyn	06 37.4	+59 33	5.3A2; 6.2; 7.4	1.7, 8	190	
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	44	340y; 79AU
ζ Cnc	08 06.5	+17 57	5.6G0; 6.0; 6.2	1, 5	71	60y; 21AU
γ Leo	10 14.5	+20 21	2.6K0; 3.8G5	4	140	
ξ UMa	11 12.9	+32 06	4.4G0; 4.9G0	2	23	††60y; 20AU
ι Leo	11 18.7	+11 05	4.1F3; 6.8F3	2	57	
γ Vir	12 36.6	−00 54	3.6F0; 3.7F0	6	38	178y; 42AU
α CVn	12 51.4	+38 51	2.9A0; 5.4A0	20	130	††
ζ UMa	13 19.9	+55 27	2.4A2; 4.0A2	14	76	††
π Boo	14 36.0	+16 51	4.9A0; 5.1A0	6	200	†
ε Boo	14 40.6	+27 30	2.7K0; 5.1A0	3	180	
ξ Boo	14 46.8	+19 31	4.8G5; 6.7	3	21	151y; 31AU
δ Ser	15 30.0	+10 52	4.2F0; 5.2F0	4	130	
ξ Sco	15 58.9	−11 06	5.1F3; 4.8; 7G7	1, 7	86	44.7y; 19AU
α Her	17 10.1	+14 30	var.M5; 5.4G	5	470	†
δ Her	17 10.9	+24 57	3.2A0; 8.1G2	11	91	† Optical
ε Lyr	18 41.0	+39 32	5.1, 6.0A3; 5.1, 5.4A5	3, 2	230	Pairs 207″
β Cyg	19 26.7	+27 45	3.2K0; 5.4B9	34	220	†
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	96	
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	410	†
ζ Agr	22 23.7	−00 32	4.4F2; 4.6F1	3	120	
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		†
σ Cas	23 53.9	+55 12	5.1B2; 7.2B3	3	650	

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

VARIABLE STARS

By FRANK S. HOGG

Of the naked eyes stars visible to a northern observer, nearly a hundred are known to undergo variations in their light. With field glasses or a small telescope the number of variables is enormously increased. Thus there is no dearth of material with which an inquisitive amateur may satisfy himself as to the reality and nature of the fluctuations of the light of stars. Further this curiosity may be turned to real scientific value, in that the study of variable stars is one of the best organized and most fruitful fields of research for amateur observers. For years the professional astronomer has entrusted the visual observation of many of the most important variable stars entirely to amateurs, as organized into societies in England in 1890, America in 1911, and France in 1921. The American Association of Variable Star Observers has charts of the fields of 350 of these stars, and in general supervises the work of amateur observers. The Recorder is Mr. Leon Campbell, at the Harvard Observatory, Cambridge, Massachusetts. New observers are welcomed, and supplied with charts.

In our galaxy there are already known about 5,000 variables, while in globular clusters and outside systems there are some 3,000 more. Almost all those which have been sufficiently studied may be conveniently classified, according to their light variation into ten groups, by Ludendorff's classification. His classes, with their typical stars, are listed as follows:

I. New or temporary stars: Nova Aquilae 3, 1918.
II. Nova-like variables: T Pyxidis, RS Ophiuchi.
III. R Coronae stars: R. Coronae Borealis. Usually at constant maximum, with occasional sharp minima.
IV. U Geminorum stars: U Geminorum. Usually at constant minimum, with occasional sharp maxima.
V. Mira stars: *o*Ceti. Range of several magnitudes, fairly regular period of from 100 to 600 days.
VI. μCephei stars: μCephei. Red stars with irregular variations of a few tenths of a magnitude.
VII. RV Tauri stars: RV Tauri. Usually a secondary minimum occurs between successive primary minima.
VIII. Long period Cepheids: δCephei. Regular periods of one to forty-five days. Range about 1.5 magnitudes.
IX. Short period Cepheids: RR Lyrae. Regular periods less than one day. Range about a magnitude.
X. Eclipsing stars: βPersei. Very regular periods. Variations due to covering of one star by companion.

1939 maxima of bright variable stars (E.S.T.)

o Ceti Aug. 31
δ Cep Jan. 1.9, 7.5, etc.
χ Cyg Aug. 14
β Lyr Jan. 5.3, Jan. 18.2, etc.
R Sct Jan. 9, May 31, Oct. 18

REPRESENTATIVE BRIGHT VARIABLE STARS

Name	Design.	Max.	Min.	Sp.	Period	Type	Date	Discoverer
η Aql	194700	3.7	4.4	G4	7.17652	VIII	1784	Pigott
N Aql	184300	-0.2	10.9	Q	Irr.	I	1918	Bower
ε Aur	045443	3.3	4.1	F5p	9833.	X	1821	Fritsch
δ Cep	222557	3.6	4.3	G0	5.36640	VIII	1784	Goodricke
U Cep	005381	6.8	9.2	A0	2.49293	X	1880	W. Ceraski
o Cet[1]	0214*03*	2.0	10.1	M5e	331.8	V	1596	Fabricius
RR Cet	012700	8.4	9.0	F0	0.55304	IX	1906	Oppolzer
R CrB	154428	5.8	13.8	cG0e	Irr.	III	1795	Pigott
χ Cyg	194632	4.2	14.0	M7e	412.9	V	1686	Kirch
P Cyg	201437a	3.5	6.0	B1qk	Irr.	II	1600	Blaeu
SS Cyg	213843	8.1	12.0	Pec.	Irr.	IV	1896	Wells
XX Cyg	200158	11.4	12.1	A	0.13486	IX	1904	L. Ceraski
ζ Gem	065820	3.7	4.1	cG1	10.15353	VII	1847	Schmidt
η Gem	060822	3.3	4.2	M2	235.58	V	1865	Schmidt
R Gem	070122a	6.5	14.3	Se	370.1	V	1848	Hind
U Gem	074922	8.8	13.8	Pec.	Irr.	IV	1855	Hind
α Her	171014	3.1	3.9	M5	Irr.	VI	1795	W. Herschel
R Hya	1324*22*	3.5	10.1	M7e	414.7	V	1670	Montanari
R Leo	094211	5.0	10.5	M7e	310.3	V	1782	Koch
β Lyr	184633	3.4	4.3	B5e	12.92504	X	1784	Goodricke
RR Lyr	192242	7.2	8.0	A5	0.56685	IX	1901	Fleming
α Ori[2]	054907	0.2	1.2	M2	2070. Irr.	VI	1840	J. Herschel
U Ori	054920	5.4	12.2	M7e	376.9	V	1885	Gore
β Per[3]	030140	2.3	3.5	B8	2.86731	X	1669	Montanari
ρ Per	025838	3.3	4.1	M4	Irr.	VI	1854	Schmidt
R Sge	200916	8.6	10.4	cG7	70.84	VII	1859	Baxendell
R Sct	1842*05*	4.5	9.0	K5e	141.5	VII	1795	Pigott
λ Tau	035512	3.8	4.1	B3	3.95294	X	1848	Baxendell
RV Tau	044126	9.4	12.5	K0	78.60	VII	1905	L. Ceraski
SU Tau	054319	9.5	15.4	G0e	Irr.	III	1908	Cannon
α UMi[4]	012288	2.3	2.4	cF7	3.96858	VIII	1911	Hertzsprung
N Her	180445	1.5	14.0	Q	Irr.	I	1934	Prentice
N Lac	221255	2.2	—	Q	Irr.	I	1936	Peltier

[1] o Cet (Mira); [2] α Ori (Betelgeuse); [3] β Per (Algol); [4] α UMi (Polaris).

Most of the data in this Table are from Prager's 1936 *Katalog und Ephemeriden Veranderlicher Sterne.* The stars are arranged alphabetically in order of constellations. The second column, the Harvard designation, gives the 1900 position of the star. The first four figures of the designation give the hour and minute of right ascension, the last two the declination in degrees, italicised for stars south of the equator. Thus the position of the fourth star of the list, δ Cephei, is R.A. 22h 25m, Dec. +57 , (222557). The remaining columns give the maximum and minimum magnitudes, spectral class, the period in days and decimals of a day, the classification on Ludendorff's system, and the discoverer and date. In the case of eclipsing stars, the spectrum is that of the brighter component.

THE DISTANCES OF THE STARS

The measurement of the distances of the stars is one of the most important problems in astronomy. Without such information it is impossible to form any idea as to the magnitude of our universe or the distribution of the various bodies in it.

The parallax of a star is the apparent change of position in the sky which the star would exhibit as one would pass from the sun to the earth at a time when the line joining earth to sun is at right angles to the line drawn to the star; or, more accurately, it is the angle subtended by the semi-major axis of the earth's orbit when viewed perpendicularly from the star. Knowing the parallax, the distance can be deduced at once.

For many years attempts were made to measure stellar parallaxes, but without success. The angle to be measured is so exceedingly small that it was lost in the unavoidable instrumental and other errors of observation. The first satisfactory results were obtained by Bessel, who in 1838, by means of a heliometer, succeeded in determining the parallax of 61 Cygni, a 6th magnitude star with a proper motion of 5″ a year. On account of this large motion the star was thought to be comparatively near to us, and such proved to be the case. At about the same time Henderson, at the Cape of Good Hope, from meridian-circle observations, deduced the parallax of Alpha Centauri to be 0″.75. For a long time this was considered to be the nearest of all the stars in the sky, but in 1913 Innes, director of the Union Observatory, Johannesburg, South Africa, discovered a small 11th mag. star, 2° 13′ from Alpha Centauri, with a large proper motion and to which, from his measurements, he assigned a parallax of 0″.78. Its brightness is only 1/20,000 that of Alpha Centauri. In 1916 Barnard discovered an 11th mag. star in Ophiuchus with a proper motion of 10″ per year, the greatest on record, and its parallax is about 0″.53. It is believed to be next to Alpha Centauri in distance from us.

The distances of the stars are so enormous that a very large unit has to be chosen to express them. The one generally used is the light-year, that is, the distance travelled by light in a year, or 186,000x60x60x24x365¼ miles. A star whose parallax is 1″ is distant 3.26 light years; if the parallax is 0″.1, the distance is 32.6 l.-y.; if the parallax is 0″.27 the distance is 3.26÷.27=12 l.-y. In other words, the distance is inversely proportional to the parallax. In recent years the word *parsec* has been introduced to express the distances of the stars. A star whose distance is 1 parsec is such that its *par*-allax is 1 *sec*-ond. Thus 1 parsec is equivalent to 3.26 l.-y., 10 parsecs=32.6 l.-y., etc.

In later times much attention has been given to the determination of parallaxes, chiefly by means of photography, and now several hundred are known with tolerable accuracy.

THE SUN'S NEIGHBOURS

By J. A. Pearce

Through the kindness of Dr. Adriaan van Maanen, who has supplied the fundamental data, this table has been revised to contain all stars known to be nearer than five parsecs or 16.3 light-years. One star of the former table, has been discarded, and five new members have been added, making a total of forty stars in a space of 524 cubic parsecs. With the exceptions of Sirius, Procyon and Altair, all the stars are dwarfs; the list including the three white dwarfs, Sirius B, 40 Eridani B, and van Maanen's star. Forty-five per cent. of the stars are members of binary systems.

Star	α(1900) h m	δ ° ′	Sp	μ ″	π ″	L.y.	m	M	L
Sun	.....	....	G0				−26.7	4.8	1.0
Groom 34A	0 13	+43 27	M2	2.89	0.274	11.9	8.1	10.3	.0063
Groom 34B	.....	....	M5	2.85	.271	12.1	10.7	12.9	.0006
van Maanen	0 44	+ 4 55	F3	3.01	.242	13.5	12.3	14.2	.0002
τCeti	1 39	−16 28	G7	1.92	.292	11.2	3.6	5.9	.36
εEri	3 28	− 9 48	K1	0.96	.304	10.7	3.8	6.2	.28
40 Eri A	4 11	− 7 49	K0	4.08	.213	15.3	4.5	6.1	.30
40 Eri B	.....	....	A0	4.03	.213	15.3	9.7	11.3	.0025
40 Eri C	.....	....	M6	4.03	.213	15.3	10.8	12.4	.0009
Gould 5h 243	5 08	−44 59	M0	8.70	.264	12.3	9.2	11.3	.0025
αCMa A	6 41	−16 35	A2	1.32	.373	8.7	− 1.6	1.3	25.1
αCMa B	.....	....	F0	1.32	.373	8.7	8.4	11.3	.0025
αCMi A	7 34	+ 5 29	F4	1.24	.303	10.8	0.5	2.9	5.8
αCMi B	.....	....	.....	1.24	.303	10.8	12.5	14.9	.00009
Groom 1618	10 05	+49 58	M0	1.45	.230	14.2	6.8	8.6	.030
WB 10h 234	10 14	+20 22	M4e	0.49	.217	15.0	9.0	10.7	.0044
Wolf 359	10 52	+ 7 36	M6e	4.84	.413	7.9	13.5	16.6	.00002
Lal 21185	10 58	+36 38	M2	4.78	.381	8.6	7.6	10.5	.0052
Innes	11 12	−57 02	.....	2.69	.339	9.6	(12.5)	13.2	.0004
αCen A	14 33	−60 25	G5	3.68	.758	4.3	0.3	4.7	1.10
αCen B	.....	....	K1	3.68	.758	4.3	1.7	6.1	.30
Prox. Cen	14 23	−62 15	M	3.85	.758	4.3	11.0	15.4	.00006
DM−12.4523	16 25	−12 24	M5	1.24	.270	12.1	9.5	11.7	.0017
DM−46.11540	17 21	−46	.....	1.06	.239	13.6	9.4	11.3	.0025
CD−44.11909	17 30	−44	.....	1.14	.215	15.2	(12.9)	12.6	.0008
AO 17415	17 37	+68 26	M4	1.33	.214	15.2	9.1	10.7	.0044
Barnard	17 53	+ 4 25	M5	10.30	.541	6.0	9.7	13.4	.0004
Bu 8798A	18 42	+59 29	M4	2.31	290	11.2	9.2	11.5	.0021
Bu 8798B	.....	....	M5	2.31	290	11.2	9.7	12.0	.0013
αAqu	19 46	+ 8 36	A2	0.66	.207	15.7	0.9	2.5	8.3
61 Cyg A	21 02	+38 15	K8	5.27	.301	10.8	5.6	8.0	.052
61 Cyg B	.....	....	M0	5.15	.301	10.8	6.3	8.7	.028
Lac 8760	21 11	−39 15	M1	3.53	.255	12.8	6.6	8.6	.030
εIndi	21 56	−57 12	K8	4.70	.288	11.3	4.7	7.0	.13
Kruger 60A	22 24	+57 12	M3	0.87	.247	13.2	9.2	11.2	.0028
Kruger 60B	.....	....	M4	0.92	.247	13.2	10.8	12.8	.0006
BD+43.4305	22 42	+43 49	M5e	0.86	.217	15.0	9.5	11.2	.0028
Lac 9352	22 59	−36 26	M2	6.90	.274	11.9	7.4	9.6	.012
Ross 248	23 36	+43	M6	1.82	.319	10.2	(13.8)	14.3	.0002
DM−37.15492	23 59	−37 51	M3	6.11	.217	15.0	8.3	10.0	.0083

Note.—Magnitudes in brackets are photographic, all others are visual. A colour index of +2.0 has been taken to compute the visual absolute magnitudes of these stars. *Symbols*: Sp, spectrum; μ, proper motion; π, parallax; L.-y., light-year; m, apparent magnitude; M, absolute magnitude; L, luminosity compared to the sun.

THE BRIGHTEST STARS

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

By W. E. Harper

The accompanying table contains the principal facts regarding 257 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 44 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 13 stars variable in light this fourth column shows their maximum and minimum magnitudes. The 20 first magnitudes 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 these may not necessarily be correct to the third decimal place.

The parallaxes are taken from Schlesinger's Catalogue of Bright Stars, 1930. The distance is given also in light years in the eighth column as to the lay mind that seems a fitting unit. In only one case (α Cygni) was the parallax negative and it was entered as formerly as ″.005. 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 257 stars or star systems here listed 144 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, 72; 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 of 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 92 velocities are starred, indicating that 36 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.

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
α Andromedae	0 3	+28 32	2.2	A1	.217	.040	81	0.2	−13.0*
β Cassiopeiae	4	+58 36	2.4	F2	.561	.071	46	1.7	+11.4
γ Pegasi	8	+14 38	2.9	B2	.010	.010	326	−2.1	+ 5.0*
β Hydri	20	−77 49	2.9	G0	2.243	.141	23	3.6	+22.8
α Phoenicis	21	−42 51	2.4	G5	.446	.045	72	0.7	+74.6*
δ Andromedae	34	+30 19	3.5	K3	.167	.028	116	0.7	− 7.1*
α Cassiopeiae	35	+55 59	2.2–2.8	G8	.062	.017	192	−1.6	− 3.8
β Ceti	39	−18 32	2.2	G7	.230	.040	81	0.3	+13.1
‖γ Cassiopeiae	51	+60 11	2.2	B0e	.031	.036	91	0.0	− 6.8
‖β Phoenicis	1 2	−47 15	3.4	G4	.042	.021	155	0.0	− 1.2
β Andromedae	4	+35 5	2.4	M0	.219	.044	74	0.6	+ 0.1
δ Cassiopeiae	19	+59 43	2.8	A3	.306	.030	109	0.2	+ 6.8
‖α Ursae Minoris	23	+88 46	2.1	F7	.043	.012	272	−2.3	−17.4*
γ Phoenicis	24	−43 50	3.4	M1	.222	.024	136	0.3	+25.7*
α **Eridani**	34	−57 44	0.6	B9	.093	.045	72	−1.1	+19
ε Cassiopeiae	47	+63 11	3.4	B5	.043	.013	251	−1.0	− 8.1
β Arietis	49	+20 19	2.7	A3	.150	.066	49	1.8	− 0.6*
ǀα **Hydri**	56	−62 3	3.0	A7	.256	.067	49	2.2	+ 7.0*
ǀγ Andromedæ	1 58	+41 51	2.3	K0	.073	.015	217	−1.0	−11.7
α Arietis	2 2	+22 59	2.2	K2	.242	.040	81	0.2	−14.3
β Trianguli	4	+34 31	3.1	A6	.161	.027	121	0.2	+10.4*
ǀo **Ceti**	14	− 3 26	1.7–9.6	M6e	.239	.013	251	−2.7	+59.8*
‖ǀθ Eridani	54	−40 42	3.4	A2	.071	.022	148	0.1	+11.9*
α Ceti	57	+ 3 42	2.8	M1	.080	.017	192	−0.1	−25.7
γ Persei	58	+53 7	3.1	F9	.012	.017	192	−0.8	+ 1.0*
ρ Persei	59	+38 27	3.4–4.2	M6	.176	.018	181	−0.3	+28.2
β Persei	3 2	+40 34	2.1–3.2	B8	.011	.025	130	−0.9	+ 5.7*
α Persei	17	+49 30	1.9	F4	.041	.020	163	−1.6	− 2.4
δ Persei	36	+47 28	3.1	B5	.047	.015	217	−1.0	−10.0*
‖η Tauri	41	+23 48	3.0	B5p	.053	.013	251	−1.5	+10.3
ζ Persei	48	+31 35	2.9	B1	.023	.006	543	−3.2	+20.9
γ Hydri	49	−74 33	3.2	M3	.128	.012	272	−1.4	+16.0
‖ε Persei	51	+39 43	3.0	B2	.041	.006	543	−3.2	− 6. *
γ Eridani	53	−13 47	3.2	M0	.133	.021	155	−0.2	+61.7
λ Tauri	55	+12 12	3.3–4.2	B3	.015	.006	543	−2.8	+13.0*
α Reticuli	4 13	−62 43	3.4	G5	.069	.022	148	0.1	+35.6

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
α **Tauri**	4 30	+16 18	1.1	K8	.205	.057	57	−0.1	+54.1
α Doradus	32	−55 15	3.5	A0p	.003	....	....	.....	+25.6
π^3 Orionis	44	+ 6 47	3.3	F5	.474	.124	26	3.0	+24.6
ι Aurigae	50	+33 0	2.9	K4	.030	.021	155	−0.5	+17.6
ε Aurigae	55	+43 41	3.4–4.1	F2	.015	.006	543	−2.8	− 4.1*
η Aurigae	5 0	+41 6	3.3	B3	.082	.012	272	−1.3	+ 7.8
ε Leporis	1	−22 30	3.3	K5	.074	.026	125	0.4	+ 1.0
β Eridani	3	− 5 13	2.9	A1	.117	.052	63	1.5	− 7.
μ Leporis	8	−16 19	3.3	A0p	.053	.030	109	0.7	+27.7
‖α **Aurigae**	9	+45 54	0.2	G1	.439	.068	48	−0.6	+30.2*
‖β **Orionis**	10	− 8 19	0.3	B8p	.005	.006	543	−5.8	+23.6*
‖η Orionis	19	− 2 29	3.4	B0	.009	.007	466	−2.3	+19.5*
γ Orionis	20	+ 6 16	1.7	B2	.019	.017	192	−2.2	+18.0
β Tauri	20	+28 31	1.8	B8	.180	.035	93	−0.5	+ 8.0
β Leporis	24	−20 50	3.0	G2	.095	.021	155	−0.4	−13.5
‖δ Orionis	27	− 0 22	2.4	B0	.006	.009	362	−2.8	+19.9*
α Leporis	28	−17 54	2.7	F6	.006	.017	192	−1.2	+24.7
ι Orionis	31	− 5 59	2.9	O8	.007	.007	466	−2.9	+21.5*
ε Orionis	31	− 1 16	1.8	B0	.004	.008	407	−.73	+25.8
ζ Tauri	32	+21 5	3.0	B3e	.028	.014	233	−1.3	+16.4*
‖ζ Orionis	36	− 2 0	1.8	B0	.012	.008	407	−3.4	+18.0
α Columbae	36	−34 8	2.8	B8	.040	.022	148	−0.5	+34.6
κ Orionis	43	− 9 42	2.2	B0	.009	.013	251	−2.2	+20.1
β Columbae	47	−35 48	3.2	K0	.397	.019	172	−0.4	+89.4
α **Orionis**	50	+ 7 23	0.5–1.1	M2	.032	.012	272	−4.1	+21.0*
β Aurigae	52	+44 56	2.1	A0p	.046	.029	112	−0.4	−18.1*
θ Aurigae	53	+37 12	2.7	A1	.106	.032	102	0.2	+28.6
η Geminorum	6 9	+22 32	3.2–4.2	M2	.062	.013	251	−1.2	+21.4*
μ Geminorum	17	+22 34	3.2	M3	.129	.016	204	−0.8	+54.8
β Canis Majoris	18	−17 54	2.0	B1	.003	.012	272	−2.6	+34.4*
α **Carinae**	22	−52 38	−0.9	F0	.022	.016	204	−4.8	+20.5
γ Geminorum	32	+16 29	1.9	A2	.066	.047	69	0.3	−11.3*
ν Puppis	35	−43 6	3.2	B8	.020	.025	130	0.2	+28.2*
ε Geminorum	38	+25 14	3.2	G9	.020	.010	326	−1.8	+ 9.9
ξ Geminorum	40	+13 0	3.4	F5	.230	.048	68	1.8	+25.1
‖α **Canis Majoris**	41	−16 35	−1.6	A2	1.315	.375	9	1.3	− 7.5*
α Pictoris	47	−61 50	3.3	A5	.271	....	....	.....	+20.9

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 Puppis	6 47	−50 30	2.8	G8	.094	.031	105	0.3	+36.4*
||ε Canis Majoris	55	−28 50	1.6	B1	.005	.012	272	−3.0	+27.4
ζ Geminorum	58	+20 43	3.7–4.3	G0p	.007	.004	815	−3.3	+ 6.7*
o^2 Can. Majoris	59	−23 41	3.1	B5p	.000	.007	466	−2.7	+48.6
δ Can. Majoris	7 4	−26 14	2.0	G4p	.005	.010	326	−2.9	+34.3*
L^2 Puppis	10	−44 29	3.4–6.2	M5e	.334	....	....	.....	+53.0
π Puppis	14	−36 55	2.7	K5	.012	.023	142	−0.4	+15.8
β Can. Minoris	22	+ 8 29	3.1	B8	.063	.024	136	0.0	+23.
σ Puppis	26	−43 6	3.3	M0	.192	.027	121	0.4	+88.1
α_2 Geminorum	28	+32 6	2.0	A2	.201	.074	44	1.4	+ 6.0*
α_1 Geminorum	28	+32 6	2.8	A0	.209	.074	44	2.2	− 1.2*
||α **Can. Minoris**	34	+ 5 29	0.5	F5	1.242	.310	10	2.9	− 3.0*
β **Geminorum**	39	+28 16	1.2	G9	.623	.110	30	1.4	+ 3.3
ξ Puppis	45	−24 37	3.5	K1	.007	.004	815	−3.5	+ 3.7*
ζ Puppis	8 0	−39 43	2.3	O8	.036	....	....	.....	−24.
ρ Puppis	3	−24 1	2.9	F6	.097	.016	204	−1.1	+46.6
||γ Velorum	6	−47 3	2.2	OW9	.002	....	....	.....	+35.
||ε Carinae	20	−59 11	1.7	K0	.032	.014	233	−2.5	+11.5
o Urs. Majoris	22	−61 3	3.5	G2	.166	.011	296	−1.3	+19.8
||ε Hydrae	41	+ 6 47	3.5	F9	.193	.024	136	0.4	+36.8*
δ Velorum	42	−54 20	2.0	A0	.093	.030	109	−0.6	+ 2.2
ζ Hydrae	50	+ 6 20	3.3	G7	.101	.016	204	−0.7	+22.6
ι Urs. Majoris	52	−48 26	3.1	A4	.500	.070	47	2.3	+12.6
λ Velorum	9 4	−43 2	2.2	K4	.022	.018	181	−1.5	+18.4
β Carinae	12	−69 18	1.8	A0	.192	....	....	.....	− 5.
ι Carinae	14	−58 51	2.2	F0	.023	....	....	.....	+13.3
α Lyncis	15	+34 49	3.3	K8	.214	.023	142	0.1	+37.4
κ Velorum	19	−54 35	2.6	B3	.017	.015	217	−1.5	+21.7*
α Hydrae	23	− 8 14	2.2	K4	.036	.016	204	−1.8	− 4.4
θ Urs. Majoris	26	−52 8	3.3	F7	1.096	.060	54	2.2	+15.8
N Velorum	28	−56 36	3.0	K5	.041	.039	84	1.4	−13.9
ε Leonis	40	+24 14	3.1	G0	.045	.012	272	−1.4	+ 5.1
||υ Carinae	45	−64 36	3.1	F0	.019	....	....	.....	+13.6
α **Leonis**	10 3	+12 27	1.3	B6	.244	.055	59	0.0	+ 2.6
q Carinae	14	−60 50	3.4	K5	.045	.012	272	−1.2	+ 8.6
||γ Leonis	14	+20 21	2.3	G8	.347	.024	136	−0.7	−36.8

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
μ Urs. Majoris	10 16	+42 0	3.2	K4	.082	.033	99	0.8	−20.3
θ Carinae	39	−63 52	3.0	B0	.023	.008	407	−2.4	+24. *
η Carinae	41	−59 10	1.0–7.4	Pec.	.007	....	....	.....	−25.0
μ Velorum	42	−48 54	2.8	G5	.084	.028	116	0.1	+ 6.9
ν Hydrae	45	−15 40	3.3	K3	.214	.033	99	0.9	−1..0
β Urs. Majoris	56	+56 55	2.4	A3	.089	.043	76	0.6	−12.1*
α Urs. Majoris	58	+62 17	2.0	G5	.137	.030	109	−0.7	− 8.6
ψ Urs. Majoris	11 4	+45 2	3.2	K0	.067	.044	74	1.4	− 3.6
δ Leonis	9	+21 4	2.6	A2	.208	.072	45	1.9	−23.2
θ Leonis	9	+15 59	3.4	A2	.103	.025	130	0.4	+ 7.8
λ Centauri	31	−62 28	3.3	B9	.046	.022	148	0.0	+ 7.9
β Leonis	44	+15 8	2.2	A2	.507	.095	34	2.1	− 2.3
γ Urs. Majoris	49	+54 15	2.5	A0	.095	.041	79	0.6	−11.1
δ Centauri	12 3	−50 10	2.9	B3e	.044	.018	181	−0.8	+ 9.
ε Corvi	5	−22 4	3.2	K2	.063	.027	121	−0.4	+ 4.9
δ Crucis	10	−58 12	3.1	B3	.051	....	....	.....	+26.4
δ Urs. Majoris	10	+57 35	3.4	A0	.113	.044	74	1.7	−12.
γ Corvi	11	−16 59	2.8	B8	.159	.021	155	−0.6	− 4.2*
α^1 Crucis	21	−62 33	1.6	B1	.048	.015	217	−2.5	−12.2*
α^2 Crucis	21	−62 32	2.1	B3	.048	.015	217	−2.0	+ 0.3*
γ Corvi	25	−15 58	3.1	A0	.249	.030	109	0.5	+ 8.7
‖δ Crucis	26	−56 33	1.5	M4	.270	....	....	.....	+21.3
β Corvi	29	−22 51	2.8	G5	.061	.020	163	−0.6	− 7.7
α Muscae	31	−68 35	2.9	B5	.038	.012	272	−1.7	+18.
γ Centauri	36	−48 24	2.4	A0	.200	.032	102	−0.1	− 7.5
‖γ Virginis	36	− 0 54	2.9	F0	.561	.085	38	2.6	−19.6
‖β Muscae	40	−67 34	3.3	B3	.041	.014	233	−1.0	+42. *
β Crucis	42	−59 9	1.5	B1	.054	.011	296	−3.3	+20.0
ε Urs. Majoris	50	+56 30	1.7	A2	.117	.045	72	0.0	−11.9*
|α Can. Venat.	51	+38 51	2.8	A1	.233	.025	130	−0.1	− 3.6*
ε Virginis	57	+11 30	3.0	G6	.270	.034	96	0.6	−14.0
γ Hydrae	13 13	−22 39	3.3	G7	.085	.017	192	−0.5	− 5.4
ι Centauri	15	−36 11	2.9	A2	.351	....	....	.....	+ 0.1
‖ζ^1 Urs. Majoris	20	+55 27	2.4	A2p	.131	.043	76	0.6	− 9.9*
α **Virginis**	20	−10 38	1.2	B2	.051	.017	192	−2.6	+ 1.6*
ζ Virginis	30	− 0 5	3.4	A2	.285	.036	91	1.2	−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 Centauri	13 34	−52 57	2.6	B2	.040	.013	251	−1.9	+ 5.6
η Urs. Majoris	44	+49 49	1.9	B3	.116	.013	251	−2.5	−10.9
μ Centauri	44	−41 59	3.3	B3e	.030	....	....	.....	+12.6
ζ Centauri	49	−46 48	3.1	B3	.079	.010	326	−1.9	*
η Boötis	50	+18 54	2.8	G1	.370	.100	33	2.8	− 0.2*
β **Centauri**	57	−59 53	0.9	B3	.039	.020	163	−2.6	+12.0*
π Hydrae	14 1	−26 12	3.5	K3	.165	.036	91	−1.3	+27.2
θ Centauri	1	−35 53	2.3	G8	.748	.067	49	−1.4	+ 1.3
α **Boötis**	11	+19 42	0.2	K0	2.287	.085	38	−0.1	− 5.1
γ Boötis	28	+38 45	3.0	A3	.182	.058	56	1.8	−35.5
η Centauri	29	−41 43	2.6	B3e	.052	.016	204	−1.3	− 0.2
‖α **Centauri**	33	−60 25	0.1	G0	3.682	.760	4	4.7	−22.2
α Circini	34	−64 32	3.4	F0	.312	.070	47	2.6	+ 7.4
α Lupi	35	−46 58	2.9	B2	.036	.009	362	−2.3	+ 7.3*
‖ε Boötis	41	+27 30	2.7	G8	.045	.018	181	−1.0	+16.4
‖α^2 Librae	45	−15 38	2.9	F1	.129	.073	45	2.2	−10. *
β Urs. Minoris	51	+74 34	2.2	K4	.028	.035	93	0.0	+16.9
β Lupi	52	−42 44	2.8	B3	.066	.012	272	−1.8	− 0.3*
κ Centauri	53	−41 42	3.4	B2	.037	.009	362	−1.9	+ 9.1*
σ Librae	58	−24 53	3.4	M4	.094	.024	136	0.3	− 4.3
ζ Lupi	15 5	−51 43	3.5	G5	.132	.017	192	−0.4	− 9.7
γT Australis	10	−68 19	3.1	A0	.064	....	....	.....	0.
β Librae	12	− 9 1	2.7	B8	.108	.024	136	−0.4	−37. *
δ Lupi	15	−40 17	3.4	B3	.032	.010	326	−1.6	+ 1.6
γ Urs. Minoris	21	+72 11	3.1	A2	.017	.042	78	1.3	− 3.9*
ι Draconis	23	+59 19	3.5	K3	.010	.031	105	0.9	−11.1
‖γ Lupi	28	−40 50	3.0	B3	.042	.016	204	−1.0	+ 6.
α Cor. Borealis	30	+27 3	2.3	A0	.160	.044	74	0.5	+ 1.0*
α Serpentis	39	+ 6 44	2.8	K3	.142	.045	72	1.0	+ 3.0
βT Australis	46	−63 7	3.0	F0	.440	.090	36	2.8	− 0.3
π Scorpii	53	−25 50	3.0	B3	.042	.012	272	−1.6	− 3.0*
δ Scorpii	54	−22 20	2.5	B1	.042	.011	296	−2.3	−16. *
‖β Scorpii	16 0	−19 32	2.8	B3	.041	.005	652	−1.4	− 9.3*
δ Ophiuchi	9	− 3 26	3.3	K8	.159	.029	112	0.4	−19.8
ε Ophiuchi	13	− 4 27	3.3	G9	.088	.030	109	0.7	−10.3
‖σ Scorpii	15	−25 21	3.1	B1	.033	.007	466	−2.7	− 0.4*
‖η Draconis	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 **Scorpii**	16 23	−26 12	1.2	M1	.032	.020	163	−2.3	− 3.2*
β Herculis	26	+21 42	2.8	G4	.104	.021	155	−0.6	−25.8*
τ Scorpii	30	−28 1	2.9	B1	.042	.007	466	−2.9	+ 0.6
ζ Ophiuchi	32	−10 22	2.7	B0	.024	.009	362	−2.5	−19. *
||ζ Herculis	38	+31 47	3.0	G0	.601	.106	31	3.1	−70.8*
αT Australis	38	−68 51	1.9	K5	.034	.030	109	−0.7	− 3.7
ε Scorpii	44	−34 7	2.4	G9	.668	.040	81	0.4	− 2.5
μ[1] Scorpii	45	−37 53	3.1	B3	.032	.012	272	−1.5	*
ζ Arae	50	−55 50	3.1	K5	.047	.021	155	−0.3	− 6.0
κ Ophiuchi	53	+ 9 32	3.4	K3	.296	.037	88	1.3	−55.6
||η Ophiuchi	17 5	−15 36	2.6	A2	.094	.036	91	0.4	− 1.0
η Scorpii	5	−43 6	3.4	A7	.294	.069	47	2.6	−28.4
ζ Draconis	8	+65 50	3.2	B8	.023	.026	125	0.3	−14.1
||α Herculis	10	+14 30	3.1-3.9	M7	.030	.007	466	−2.7	−32.5
δ Herculis	11	+24 57	3.2	A2	.164	.036	91	0.9	−39. *
π Herculis	12	+36 55	3.4	K3	.021	.022	148	0.1	−25.7
θ Ophiuchi	16	−24 54	3.4	B2	.030	.009	362	−1.9	− 3.6
β Arae	17	−55 26	2.8	K1	.035	.017	192	−1.0	− 0.4
υ Scorpii	24	−37 13	2.8	B3	.040	.010	326	−2.2	+18. *
α Arae	24	−49 48	3.0	B3e	.085	.017	192	−0.9	− 2.2
λ Scorpii	27	−37 2	1.7	B2	.040	.016	204	−2.3	0. *
β Draconis	28	+52 23	3.0	G0	.012	.008	407	−2.5	−20.1
θ Scorpii	30	−42 56	2.0	F0	.010	....	....	.....	+ 1.4
α Ophiuchi	30	+12 38	2.1	A0	.264	.052	63	0.7	+15. *
κ Scorpii	36	−38 58	2.5	B3	.032	.011	296	−2.3	−10. *
β Ophiuchi	38	+ 4 37	2.9	K2	.157	.036	91	0.7	−11.9
ι[1] Scorpii	41	−40 5	3.1	F8	.004	.007	466	−2.6	−27.6
||μ Herculis	43	+27 47	3.5	G5	.817	.112	29	3.7	−16.1
G Scorpii	43	−37 1	3.2	K2	.068	.028	116	0.5	+24.7
ν Ophiuchi	54	− 9 46	3.5	G7	.118	.023	142	0.3	+12.4
γ Draconis	54	+51 30	2.4	K5	.026	.028	116	−0.3	−27.8
γ Sagittarii	59	−30 26	3.1	K0	.206	.041	79	−1.1	+22.3*
η Sagittarii	18 11	−36 48	3.2	M4	.223	.032	102	0.7	+ 0.5
δ Sagittarii	15	−29 52	2.8	K4	.042	.035	93	0.6	−20.0
η Serpentis	16	− 2 55	3.4	G9	.898	.060	54	2.3	+ 8.9
ε Sagittarii	18	−34 26	2.0	A0	.139	....	....	.....	−10.8
λ Sagittarii	22	25 29	2.9	K1	.197	.048	68	−1.4	−43.3
α **Lyrae**	34	+38 41	0.1	A1	.348	.123	26	0.6	−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 Sagittarii	18 39	−27 6	3.3	B8	.053	.018	181	−0.4	+21.5*
‖β Lyrae	46	+33 15	3.4–4.1	B2p	.011	.003	1086	−4.2	−19.0*
σ Sagittarii	49	−26 25	2.1	B3	.081	.018	181	−1.6	−10.7
γ Lyrae	55	+32 33	3.3	B9p	.010	.016	204	−0.7	−21.5*
‖ζ Sagittarii	56	−30 1	2.7	A2	.026	.036	91	0.5	+22.1
τ Sagittarii	19 1	−27 49	3.4	K0	.265	.043	76	1.6	+45.4*
ζ Aquilae	1	+13 43	3.0	A0	.103	.037	88	0.9	−25. *
π Sagittarii	4	−21 11	3.0	F2	.041	.022	148	−0.3	− 9.8
δ Draconis	13	+67 29	3.2	G8	.135	.032	102	0.8	+24.8
δ Aquilae	21	+ 2 55	3.4	A3	.267	.057	57	2.2	−32.3*
‖β Cygni	27	+27 45	3.2	K0	.010	.020	163	0.3	−23.9*
γ Aquilae	42	+10 22	2.8	K3	.018	.023	142	−0.4	− 2.0
‖δ Cygni	42	+44 53	3.0	A1	.067	.034	96	0.6	−20.
α **Aquilae**	46	+ 8 36	0.9	A2	.659	.200	16	2.4	−26.1
θ Aquilae	20 6	− 1 7	3.4	A0	.035	.017	192	−0.5	−28.6*
‖β Capricorni	15	−15 6	3.2	F8	.042	.017	192	−0.6	−19.0*
α Pavonis	18	−57 3	2.1	B3	.090	.013	251	−2.3	+ 1.8*
γ Cygni	19	+39 56	2.3	F8	.006	.007	466	−3.4	− 7.6
α Indi	31	−47 38	3.2	G2	.072	.036	91	1.0	− 1.1
α **Cygni**	38	+44 55	1.3	A2p	.004	.005	652	−5.2	− 6.3*
ε Cygni	42	+33 36	2.6	G7	.485	.045	72	0.9	−10.5*
ζ Cygni	21 9	+29 49	3.4	G6	.061	.018	181	−0.3	+16.9*
α Cephei	16	+62 10	2.6	A2	.163	.078	42	2.1	− 8.
β Aquarii	26	− 6 1	3.1	G1	.020	.006	543	−3.0	+ 6.7
β Cephei	27	+70 7	3.3	B1	.013	.008	407	−2.2	− 7.2*
ε Pegasi	39	+ 9 25	2.5	K2	.028	.020	163	−1.0	+ 5.2
δ Capricorni	42	−16 35	3.0	A3	.395	.095	34	2.9	− 6.4*
γ Gruis	48	−37 50	3.2	B8	.108	.018	181	−0.6	− 2.1
α Aquarii	22 1	− 0 48	3.2	G0	.018	.007	466	−2.6	+ 7.6
α Gruis	2	−47 27	2.2	B5	.200	.028	116	−0.6	+11.8
α Tucanae	12	−60 45	2.9	K5	.085	.023	142	−0.3	+42.2*
β Gruis	37	−47 24	2.2	M6	.132	.015	217	−1.9	+ 1.6
η Pegasi	38	+29 42	3.1	G1	.039	.013	251	−1.3	+ 4.4*
α **P Australis**	52	−30 9	1.3	A3	.367	.122	26	1.7	+ 6.5
β Pegasi	59	+27 32	2.6	M3	.235	.020	163	−0.9	+ 8.6
α Pegasi	59	+14 40	2.6	A0	.077	.034	96	0.2	− 4. *
γ Cephei	23 35	+77 4	3.4	K1	.167	.069	47	2.6	−42.0

STAR CLUSTERS AND NEBULAE

Prepared by J. F. HEARD

The amateur who possesses a telescope will find great interest in the observation and identification of star clusters and nebulae. Such objects, of course, have been extensively catalogued and classified. The most frequently quoted catalogue is Dreyer's New General Catalogue (N.G.C.) containing 7,840 objects, extended by the Index Catalogue (I.C.) containing 5,386 more. The most interesting catalogue historically, however, and one which is still quoted for reference to the more conspicuous objects is Messier's Catalogue (M) which contains 103 objects. It was drawn up in 1781 by Charles Messier for his own convenience in identifying comets.

Messier's Catalogue as given below is adapted from a publication by Shapley and Davis (Pub. A.S.P., XXIX, 178, 1917). It includes the Messier number, the N.G.C. number, the 1900 position, the classification of the object and, under remarks, the name of the object (if any).

The classification is not that of Messier; it is the new classification based on modern knowledge of these objects. The clusters are classified as open clusters, which are loose irregular aggregates usually of a few scores of stars, or as globular clusters which are compact aggregates of upwards to hundreds of thousands of stars in spherical formation. The nebulae are classified as diffuse, planetary or spiral. The diffuse nebulae are great clouds of gas and "star-dust" rendered luminous by nearby stars and the planetaries are compact atmospheres of the same materials surrounding a single star. The spirals, on the other hand, are self-luminous and quite outside our stellar system and must be thought of as island universes or other galaxies like our own.

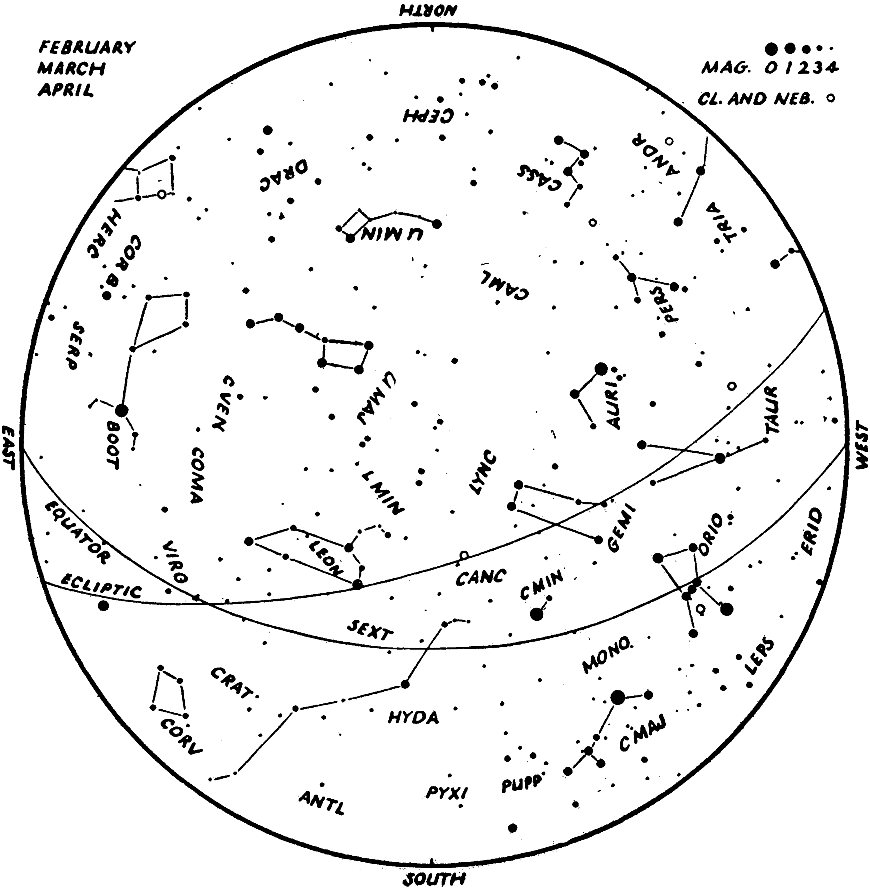
MESSIER'S CATALOGUE OF CLUSTERS AND NEBULAE

Messier	N.G.C.	R.A. (1900)	Dec. (1900)	Type of Object	Remarks
		h m	° ′		
1	1952	5 28.5	+21 57	Diffuse nebula	The Crab nebula in Taurus
2	7089	21 28.3	− 1 16	Globular cluster	
3	5272	13 37.6	+28 53	Globular cluster	
4	6121	16 17.5	−26 17	Globular cluster	
5	5904	15 13.5	+ 2 27	Globular cluster	
6	6405	17 33.5	−32 9	Open cluster	
7	6475	17 47.3	−34 47	Open cluster	
8	6523	17 57.6	−24 23	Diffuse nebula	The Lagoon nebula —very large
9	6333	17 13.3	−18 25	Globular cluster	
10	6254	16 51.9	− 3 57	Globular cluster	
11	6705	18 45.7	− 6 23	Open cluster	
12	6218	16 42.0	− 1 46	Globular cluster	
13	6205	16 38.1	+36 39	Globular cluster	The Hercules cluster —best example

Messier	N.G.C.	R.A. (1900)	Dec. (1900)	Type of Object	Remarks
		h m	° ′		
14	6402	17 32.4	− 3 11	Globular cluster	
15	7078	21 25.2	+11 44	Globular cluster	
16	6611	18 13.2	−13 49	Open cluster	
17	6618	18 15.0	−16 13	Diffuse nebula	The Horseshoe or Omega nebula—bright
18	6613	18 14.1	−17 10	Open cluster	
19	6273	16 56.4	−26 7	Globular cluster	
20	6514	17 56.3	−23 2	Diffuse nebula	The Trifid nebula—bright
21	6531	17 58.6	−22 30	Open cluster	
22	6656	18 30.3	−23 59	Globular cluster	
23	6494	17 51.0	−19 0	Open cluster	
24	6603	18 12.6	−18 27	Open cluster	
25	I.C. 4725	18 25.8	−19 19	Open cluster	
26	6694	18 39.8	− 9 30	Open cluster	
27	6853	19 55.3	+22 27	Planetary nebula	The Dumb-bell nebula
28	6626	18 18.4	−24 55	Globular cluster	
29	6913	20 20.3	+38 12	Open cluster	
30	7099	21 34.7	−23 38	Globular cluster	
31	224	0 37.3	+40 43	Spiral nebula	The Andromeda nebula—largest spiral
32	221	0 37.2	+40 19	Spiral nebula	Very close to M31 much smaller
33	598	1 28.2	+30 9	Spiral nebula	
34	1039	2 35.6	+42 21	Open cluster	
35	2168	6 2.7	+24 21	Open cluster	
36	1960	5 29.5	+34 4	Open cluster	
37	2099	5 45.8	+32 31	Open cluster	
38	1912	5 22.0	+35 45	Open cluster	
39	7092	21 28.6	+48 0	Open cluster	
40	....	12 17.4	+58 40	....	Two faint stars mistaken for a nebula by Messier
41	2287	6 42.7	−20 38	Open cluster	
42	1976	5 30.4	− 5 27	Diffuse nebula	The Orion nebula—very bright
43	1982	5 30.6	− 5 20	Diffuse nebula	
44	2632	8 34.3	+20 20	Open cluster	Praesepe or the Beehive cluster
45	....	3 41.5	+23 48	Open cluster	The Pleiades
46	2437	7 37.2	−14 35	Open cluster	
47	2478	7 50.2	−15 9	Open cluster	
48	....	8 9.0	− 1 39	Open cluster	
49	4472	12 24.7	+ 8 33	Spiral nebula	
50	2323	6 58.2	− 8 12	Open cluster	
51	5194	13 25.7	+47 43	Spiral nebula	The Whirlpool nebula
52	7654	23 19.8	+61 3	Open cluster	
53	5024	13 8.0	+18 42	Globular cluster	
54	6715	18 48.7	−30 36	Globular cluster	

Messier	N.G.C.	R.A. (1900)	Dec. (1900)	Type of Object	Remarks
		h m	° ′		
55	6809	19 33.7	−31 10	Globular cluster	
56	6779	19 12.7	+30 0	Globular cluster	
57	6720	18 49.9	+32 54	Planetary nebula	The Ring nebula in Lyra
58	4579	12 32.7	+12 22	Spiral nebula	
59	4621	12 37.0	+12 12	Spiral nebula	
60	4649	12 38.6	+12 6	Spiral nebula	
61	4303	12 16.8	+ 5 2	Spiral nebula	
62	6266	16 54.8	−29 58	Globular cluster	
63	5055	13 11.3	+42 34	Spiral nebula	
64	4826	12 51.8	+22 13	Spiral nebula	
65	3623	11 13.7	+13 38	Spiral nebula	
66	3627	11 15.0	+13 32	Spiral nebula	
67	2682	8 45.8	+12 11	Open cluster	
68	4590	12 34.2	−26 12	Globular cluster	
69	6637	18 24.8	−32 25	Globular cluster	
70	6681	18 36.7	−32 23	Globular cluster	
71	6838	19 49.3	+18 31	Open cluster	
72	6981	20 48.0	−12 55	Globular cluster	
73	6994	20 53.5	−13 1	Open cluster	
74	628	1 31.3	+15 16	Spiral nebula	
75	6864	20 0.2	−22 12	Globular cluster	
76	650	1 36.0	+51 4	Planetary nebula	
77	1068	2 37.6	− 0 26	Spiral nebula	
78	2068	5 41.6	+ 0 1	Diffuse nebula	
79	1904	5 20.1	−24 37	Globular cluster	
80	6093	16 11.1	−22 44	Globular cluster	
81	3031	9 47.3	+69 32	Spiral nebula	
82	3034	9 47.5	+70 10	Spiral nebula	
83	5236	13 31.4	−29 21	Spiral nebula	
84	4374	12 20.0	+13 26	Spiral nebula	
85	4382	12 20.4	+18 45	Spiral nebula	
86	4406	12 21.1	+13 30	Spiral nebula	
87	4486	12 25.8	+12 57	Spiral nebula	
88	4501	12 26.9	+14 58	Spiral nebula	
89	4552	12 30.6	+13 6	Spiral nebula	
90	4569	12 31.8	+13 43	Spiral nebula	
91	....	12 36.0	+13 50	....	Not confirmed—probably comet
92	6341	17 14.1	+43 15	Globular cluster	
93	2447	7 40.5	−23 38	Open cluster	
94	4736	12 46.2	+41 40	Spiral nebula	
95	3351	10 38.7	+12 14	Spiral nebula	
96	3368	10 41.5	+12 21	Spiral nebula	
97	3587	11 9.0	+55 34	Planetary nebula	The Owl nebula
98	4192	12 8.7	+15 27	Spiral nebula	
99	4254	12 13.8	+14 58	Spiral nebula	
100	4321	12 17.9	+16 23	Spiral nebula	
101	5457	13 59.6	+54 50	Spiral nebula	
102	5866?	15 3.8	+56 9	Spiral nebula	
103	581	1 26.6	+60 11	Open cluster	

STAR MAP I

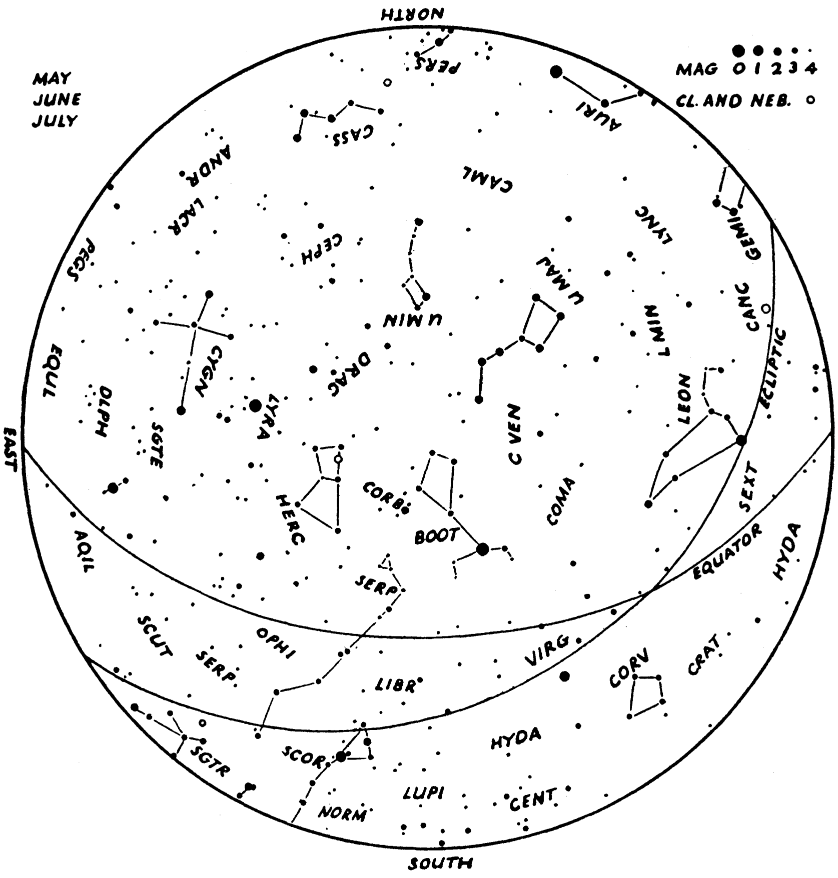


The above map represents the evening sky at

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

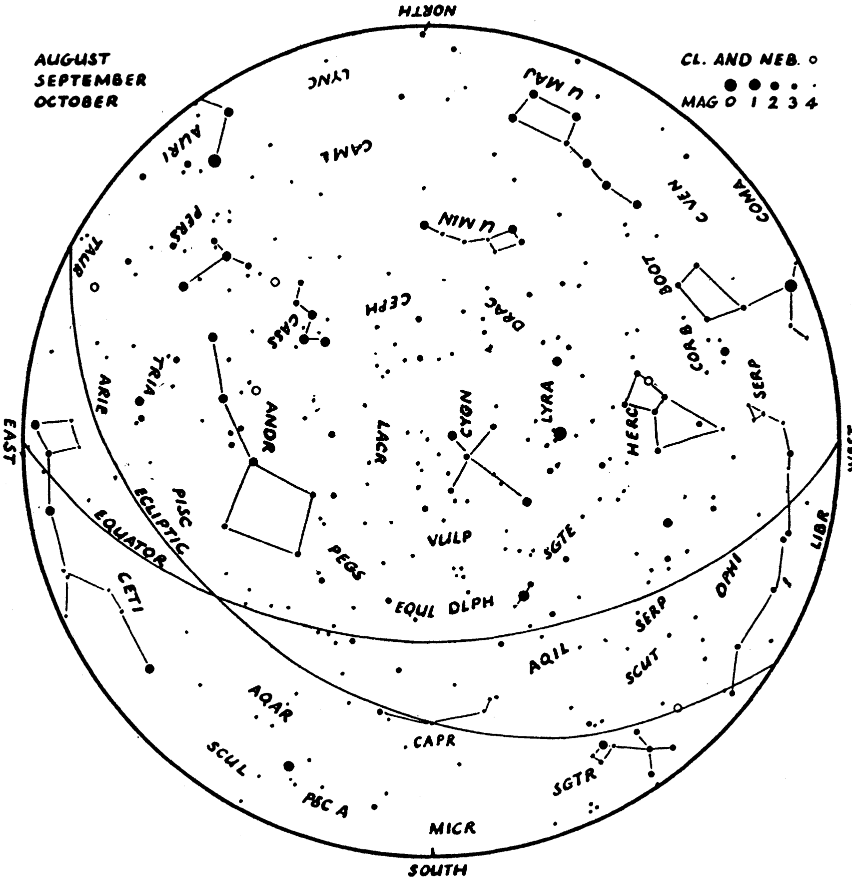


The above map represents the evening sky at

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

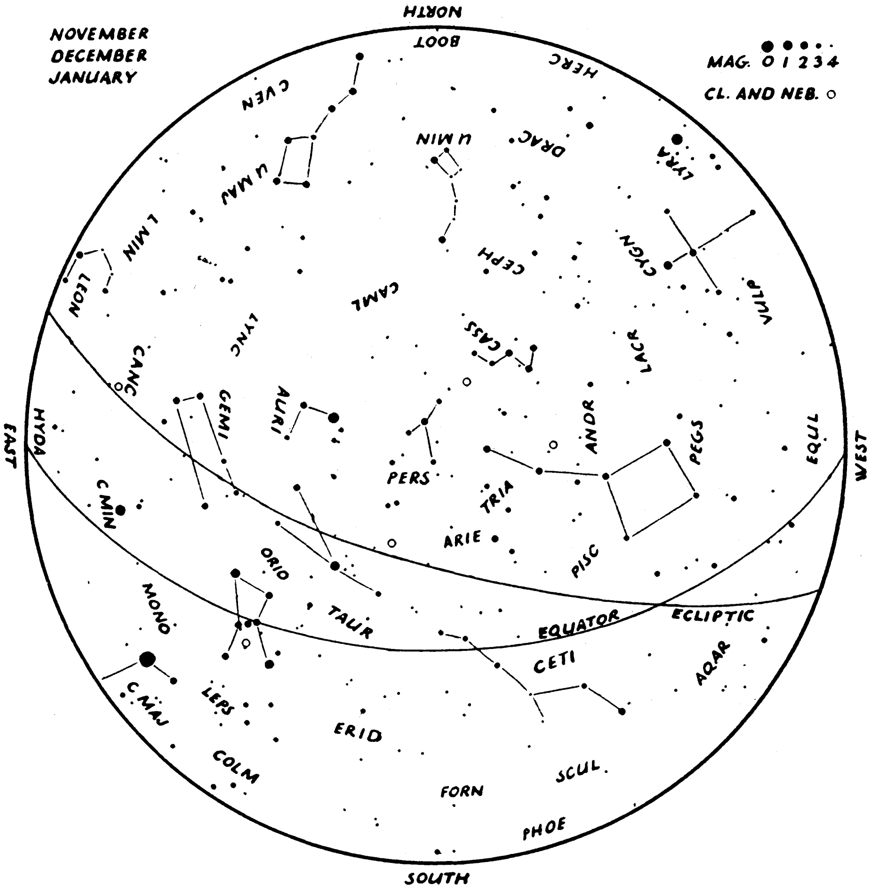


The above map represents the evening sky at

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.

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	62 9	5 45	6 22	5 52	6 15	6 00	6 07	6 04	6 04
11	5 39	63 7	5 45	6 31	5 52	6 24	5 59	6 17	6 02	6 14
21	5 38	64 5	5 43	6 40	5 48	6 35	5 54	6 30	5 56	6 28
31	5 34	65 4	5 38	6 50	5 41	6 47	5 45	6 44	5 46	6 42
Feb. 10	5 27	70 3	5 29	7 01	5 31	7 00	5 32	6 59	5 32	6 58
20	5 17	71 2	5 17	7 12	5 18	7 12	5 15	7 14	5 14	7 15
Mar. 2	5 06	72 0	5 04	7 22	5 02	7 26	4 56	7 30	4 54	7 33
12	4 52	72 9	4 48	7 33	4 43	7 39	4 35	7 47	4 31	7 51
22	4 38	73 8	4 31	7 45	4 23	7 54	4 11	8 06	4 05	8 11
Apr. 1	4 23	74 7	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	85 1	2 36	9 20	1 56	10 01	0 23	11 42	——	——
June 10	2 59	85 9	2 29	9 30	1 43	10 16	——	——	——	——
20	3 02	90 4	2 27	9 35	1 39	10 23	——	——	——	——
30	3 02	90 4	2 31	9 35	1 44	10 22	——	——	——	——
July 10	3 09	90 1	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).

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.	30	40	44	49	53	57	60	56	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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