THE OBSERVER'S HANDBOOK FOR 1940

PUBLISHED BY

The Royal Astronomical Society of Canada

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

THIRTY-SECOND YEAR OF PUBLICATION

TORONTO
198 COLLEGE STREET
PRINTED FOR THE SOCIETY
BY THE UNIVERSITY OF TORONTO PRESS
1940

1940 CALENDAR 1940

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

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

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

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

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

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

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

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

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

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

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

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

JULIAN DAY CALENDAR, 1940

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

Jan. 1	9630	May 1	9751	Sept. 1	9874
Feb. 1	9661	June 1	9782	Oct. 1	9904
Mar. 1	9690	July 1	9812	Nov. 1	9935
Apr. 1	9721	Aug. 1	9843	Dec. 1	9965

The Julian Day commences at noon.
Thus J.D. 2,429,630.0 = Jan. 1.5 G.C.T.

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CONTENTS

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PREFACE

The HANDBOOK for 1940, which is the thirty-second issue, is arranged similarly to that of last year. The chief changes are: (1) The table of constellations has been re-set, giving the English as well as the Latin names; (2) The table of brightest stars has been completely revised by Dr. Harper and includes the latest available information; (3) An account of the transit of Mercury in 1940 is given.

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, Mass.). The sixth edition contains late information.

For the preparation of the material in the volume Dr. F. S. Hogg, Assistant Editor, is largely responsible; but hearty thanks are due to all the staff of the David Dunlap Observatory for their assistance.

C. A. CHANT.

David Dunlap Observatory,
Richmond Hill, Ont., November 1939.

ANNIVERSARIES AND FESTIVALS 1940

New Year's Day	Mon.	Jan. 1
Epiphany	Sat.	Jan. 6
Septuagesima Sunday		Jan. 21
Quinquagesima (Shrove Sunday)		Feb. 4
Ash Wednesday		Feb. 7
Quadragesima (First Sunday in Lent)		Feb. 11
St. David	Fri.	Mar. 1
St. Patrick	Sun.	Mar. 17
Palm Sunday		Mar. 17
Good Friday		Mar. 22
Easter Sunday		Mar. 24
Annunciation (Lady Day)	Mon.	Mar. 25
St. George	Tue.	Apr. 23
Rogation Sunday		Apr. 28
Ascension Day	Thu.	May 2
Pentecost (Whit Sunday)		May 12
Trinity Sunday		May 19
Corpus Christi	Thu.	May 23
Empire Day (Victoria Day)	Fri.	May 24
Birthday of the Queen Mother, Mary (1867)	Sun.	May 26
St. John Baptist (Midsummer Day)	Mon.	June 24
Dominion Day	Mon.	July 1
Birthday of Queen Elizabeth (1900)	Sun.	Aug. 4
Labour Day	Mon.	Sept. 2
St. Michael (Michaelmas Day)	Sun.	Sept. 29
Hebrew New Year (Rosh Hashanah)	Thu.	Oct. 3
All Saints' Day	Fri.	Nov. 1
Remembrance Day	Mon.	Nov. 11
St. Andrew	Sat.	Nov. 30
First Sunday in Advent		Dec. 1
Accession of King George VI (1936)	Wed.	Dec. 11
Birthday of King George VI (1895)	Sat.	Dec. 14
Christmas Day	Wed.	Dec. 25

Thanksgiving Day, date set by Proclamation

SYMBOLS AND ABBREVIATIONS

SIGNS OF THE ZODIAC

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

SUN, MOON AND PLANETS

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

ASPECTS AND ABBREVIATIONS

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

THE GREEK ALPHABET

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

THE CONFIGURATIONS OF JUPITER'S SATELLITES

In the Configurations of Jupiter's Satellites (pages 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.

THE CONSTELLATIONS

Latin and English Names with Abbreviations

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

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

MISCELLANEOUS ASTRONOMICAL DATA

Units of Length

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

Units of Time

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

The Earth

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

Earth's Orbital Motion

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

Solar Motion

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

The Galactic System

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

Extragalactic Nebulae

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

Radiation Constants

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

Miscellaneous

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

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

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

1940 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

Date	Apparent R.A.	Corr. to Sundial	Apparent Dec.
	h m s	m s	° ′
Jan. 1	18 41 00	+02 58	−23 06.6
" 4	18 54 14	+04 23	−22 51.5
" 7	19 07 26	+05 44	−22 32.4
" 10	19 20 33	+07 02	−22 09.2
" 13	19 33 36	+08 15	−21 42.2
" 16	19 46 32	+09 22	−21 11.3
" 19	19 59 23	+10 23	−20 36.8
" 22	20 12 07	+11 18	−19 58.8
" 25	20 24 45	+12 06	−19 17.4
" 28	20 37 15	+12 46	−18 32.9
" 31	20 49 38	+13 19	−17 45.3
Feb. 3	21 01 54	+13 46	−16 54.9
" 6	21 14 02	+14 05	−16 01.7
" 9	21 26 04	+14 16	−15 06.1
" 12	21 37 58	+14 21	−14 08.2
" 15	21 49 45	+14 19	−13 08.2
" 18	22 01 26	+14 09	−12 06.3
" 21	22 13 00	+13 54	−11 02.7
" 24	22 24 28	+13 32	−09 57.6
" 27	22 35 50	+13 04	−08 51.0
Mar. 1	22 47 07	+12 32	−07 43.3
" 4	22 58 20	+11 55	−06 34.5
" 7	23 09 29	+11 15	−05 25.0
" 10	23 20 34	+10 30	−04 14.7
" 13	23 31 37	+09 43	−03 04.0
" 16	23 42 36	+08 53	−01 53.0
" 19	23 53 34	+08 00	−00 41.9
" 22	00 04 29	+07 07	+00 29.2
" 25	00 15 24	+06 12	+01 40.1
" 28	00 26 19	+05 17	+02 50.7
" 31	00 37 14	+04 22	+04 00.7
Apr. 3	00 48 10	+03 28	+05 10.2
" 6	00 59 07	+02 36	+06 18.8
" 9	01 10 06	+01 45	+07 26.4
" 12	01 21 07	+00 57	+08 32.9
" 15	01 32 11	+00 11	+09 38.1
" 18	01 43 17	−00 32	+10 41.8
" 21	01 54 28	−01 12	+11 44.0
" 24	02 05 41	−01 48	+12 44.4
" 27	02 17 00	−02 19	+13 42.9
" 30	02 28 22	−02 46	+14 39.5
May 3	02 39 50	−03 08	+15 33.8
" 6	02 51 23	−03 25	+16 25.8
" 9	03 03 01	−03 37	+17 15.4
" 12	03 14 44	−03 43	+18 02.4
" 15	03 26 32	−03 45	+18 46.7
" 18	03 38 25	−03 42	+19 28.1
" 21	03 50 22	−03 34	+20 06.5
" 24	04 02 25	−03 21	+20 41.9
" 27	04 14 32	−03 03	+21 14.0
" 30	04 26 44	−02 41	+21 42.9
June 2	04 39 00	−02 15	+22 08.3
" 5	04 51 19	−01 45	+22 30.3
" 8	05 03 41	−01 12	+22 48.8
" 11	05 16 06	−00 37	+23 03.6
" 14	05 28 33	−00 00	+23 14.8
" 17	05 41 01	+00 38	+23 22.4
" 20	05 53 29	+01 16	+23 26.2
" 23	06 05 57	+01 55	+23 26.2
" 26	06 18 25	+02 33	+23 22.6
" 29	06 30 52	+03 11	+23 15.3

Date	Apparent R.A.	Corr. to Sundial	Apparent Dec.
	h m s	m s	° ′
July 2	06 43 17	+03 46	+23 04.3
" 5	06 55 40	+04 19	+22 49.6
" 8	07 08 00	+04 50	+22 31.4
" 11	07 20 17	+05 16	+22 09.7
" 14	07 32 29	+05 39	+21 44.6
" 17	07 44 37	+05 57	+21 16.1
" 20	07 56 40	+06 11	+20 44.4
" 23	08 08 38	+06 19	+20 09.6
" 26	08 20 31	+06 22	+19 31.7
" 29	08 32 19	+06 20	+18 50.9
Aug. 1	08 44 01	+06 13	+18 07.3
" 4	08 55 39	+06 01	+17 21.0
" 7	09 07 10	+05 43	+16 32.2
" 10	09 18 37	+05 20	+15 41.0
" 13	09 29 58	+04 51	+14 47.5
" 16	09 41 14	+04 17	+13 51.9
" 19	09 52 25	+03 39	+12 54.4
" 22	10 03 31	+02 56	+11 55.0
" 25	10 14 34	+02 09	+10 53.9
" 28	10 25 33	+01 18	+09 51.2
" 31	10 36 29	+00 25	+08 47.1
Sept. 3	10 47 23	−00 32	+07 41.8
" 6	10 58 13	−01 31	+06 35.3
" 9	11 09 02	−02 32	+05 27.8
" 12	11 19 49	−03 34	+04 19.6
" 15	11 30 35	−04 38	+03 10.6
" 18	11 41 21	−05 42	+02 01.2
" 21	11 52 06	−06 46	+00 51.3
" 24	12 02 53	−07 49	−00 18.7
" 27	12 13 41	−08 51	−01 28.9
" 30	12 24 31	−09 51	−02 39.0
Oct. 3	12 35 23	−10 48	−03 48.9
" 6	12 46 18	−11 42	−04 58.4
" 9	12 57 16	−12 34	−06 07.3
" 12	13 08 19	−13 21	−07 15.5
" 15	13 19 25	−14 04	−08 22.7
" 18	13 30 37	−14 42	−09 28.9
" 21	13 41 54	−15 15	−10 33.9
" 24	13 53 17	−15 42	−11 37.5
" 27	14 04 46	−16 02	−12 39.5
" 30	14 16 22	−16 15	−13 39.8
Nov. 2	14 28 06	−16 22	−14 38.1
" 5	14 39 56	−16 21	−15 34.2
" 8	14 51 54	−16 13	−16 28.1
" 11	15 03 59	−15 57	−17 19.4
" 14	15 16 12	−15 34	−18 08.1
" 17	15 28 32	−15 04	−18 53.9
" 20	15 41 00	−14 26	−19 36.7
" 23	15 53 35	−13 40	−20 16.3
" 26	16 06 18	−12 47	−20 52.5
" 29	16 19 07	−11 47	−21 25.2
Dec. 2	16 32 03	−10 42	−21 54.3
" 5	16 45 04	−09 30	−22 19.6
" 8	16 58 10	−08 14	−22 41.0
" 11	17 11 20	−06 53	−22 58.4
" 14	17 24 34	−05 29	−23 11.7
" 17	17 37 50	−04 03	−23 20.8
" 20	17 51 08	−02 34	−23 25.7
" 23	18 04 27	−01 04	−23 26.4
" 26	18 17 47	+00 25	−23 22.9
" 29	18 31 05	+01 54	−23 15.1

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

SOLAR AND SIDEREAL TIME

In practical astronomy three different kinds of time are used, while in ordinary life we use a fourth.

1. *Apparent Time*—By apparent noon is meant the moment when the sun is on the meridian, and apparent time is measured by the distance in degrees that the sun is east or west of the meridian. Apparent time is given by the sun-dial.

2. *Mean Time*—The interval between apparent noon on two successive days is not constant, and a clock cannot be constructed to keep apparent time. For this reason *mean time* is used. The length of a mean day is the average of all the apparent days throughout the year. The *real sun* moves about the ecliptic in one year; an imaginary *mean sun* is considered as moving uniformly around the celestial equator in one year. The difference between the times that the real sun and the mean sun cross the meridian is the *equation of time*. Or, in general, *Apparent Time—Mean Time = Equation of Time.* This is the same as *Correction to Sundial* on page 7, with the sign reversed.

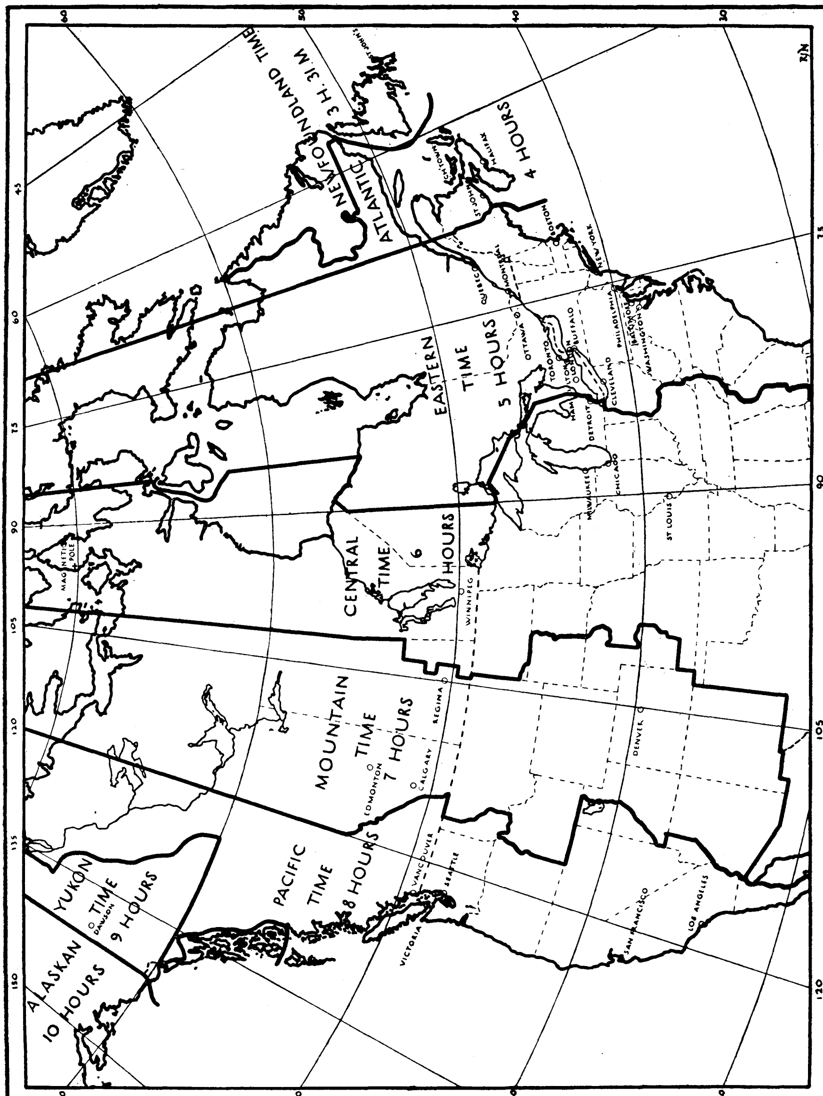
3. *Sidereal Time*—This is time as determined from the stars. It is sidereal noon when the Vernal Equinox or First of Aries is on the meridian. In accurate time-keeping the moment when a star is on the meridian is observed and the corresponding mean time is then computed with the assistance of the Nautical Almanac. When a telescope is mounted equatorially the position of a body in the sky is located by means of the sidereal time.

4. *Standard Time*—In everyday life we use still another kind of time. A moment's thought will show that in general two places will not have the same mean time; indeed, difference in longitude between two places is determined from their difference in time. But in travelling it is very inconvenient to have the time varying from station to station. For the purpose of facilitating transportation the system of *Standard Time* was introduced in 1883. Within a certain belt approximately 15° wide, all the clocks show the same time, and in passing from one belt to the next the hands of the clock are moved forward or backward one hour.

In Canada we have six standard time belts, as follows;—60th meridian or Atlantic Time, 4h. slower than Greenwich; 75th meridian or Eastern Time, 5h.; 90th meridian or Central Time, 6h.; 105th meridian or Mountain Time, 7h.; 120th meridian or Pacific Time, 8h.; and 135th meridian or Yukon Time, 9h. slower than Greenwich.

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

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

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

In the above list Owen Sound is under "44°", and the correction is + 24 min. On page 11 the time of sunrise on February 12 for latitude 44° is 7.05; add 24 min. and we get 7.29 (Eastern Standard Time). Regina is under "50°", and the correction is —2 min. From the table the time is 7.17 and subtracting 2 min. we get the time of sunrise 7.15 (Mountain Standard Time).

DATE		Latitude **36°** Sunrise	Latitude **36°** Sunset	Latitude **40°** Sunrise	Latitude **40°** Sunset	Latitude **44°** Sunrise	Latitude **44°** Sunset	Latitude **46°** Sunrise	Latitude **46°** Sunset	Latitude **48°** Sunrise	Latitude **48°** Sunset	Latitude **50°** Sunrise	Latitude **50°** Sunset	Latitude **52°** Sunrise	Latitude **52°** Sunset
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
January	**1**	7 11	4 57	7 22	4 45	7 35	4 32	7 42	4 25	7 50	4 17	7 59	4 08	8 08	3 59
	3	7 11	4 58	7 23	4 47	7 35	4 34	7 42	4 26	7 50	4 19	7 59	4 10	8 08	4 01
	5	7 12	5 00	7 23	4 49	7 35	4 36	7 42	4 29	7 50	4 22	7 58	4 13	8 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 PLANETS FOR 1940

By G. H. Tidy

MERCURY

Mercury is the nearest planet to the sun and completes one revolution in 88 days. The eccentricity of its orbit (.206) is very large compared with that of the other planets except Pluto, so that its distance from the sun varies from 28.5 million to 43.5 million miles.

It is probably the smallest and least massive of the planets. Its period of rotation is the same as its period of revolution, so that the side nearest the sun is at a temperature of 670° F. and the other side is extremely cold.

Since its orbit lies within that of the earth, the planet appears to move in the sky from one side of the sun to the other several times each year, greatest elongations (maximum separation from the sun) ranging from 18° to 28°. Since it is always fairly close to the ecliptic, the best time for observing it is at greatest eastern elongation in the spring and at greatest western elongation in the autumn, at which times the ecliptic is most nearly vertical. The dates of greatest elongation this year, together with the planet's separation from the sun and magnitude, are as follows: East—Feb. 28, 18° 09′, -0.6^m (most favourable); June 24, 25° 18′ $+0.7^m$; Oct. 20, 24° 30′, $+0.2^m$; and West—Apr. 12, 27° 40′, $+0.6^m$; Aug. 10, 18° 57′ $+0.4^m$; Nov. 28, 20° 11′, -0.3^m (most favourable).

At these times the planet appears between 3″ and 4″ in diameter.

VENUS

Venus, the second nearest planet to the sun, moves in a nearly circular orbit at a mean distance of 67 million miles from the sun, making one revolution in 225 days. The planet is almost the twin of the earth in size and mass, its diameter approximating 7,600 miles, and its average density being slightly less than that of the earth. A dense atmosphere surrounds the planet and prevents observation of its surface, so that its period of rotation is in doubt, though it seems likely to be about two weeks.

Of all the major planets, Venus approaches the earth most closely and is the brightest object in the sky except the sun and moon. Like Mercury, it appears to oscillate from one side of the sun to the other in a period of 584 days, reaching a distance of about 47° from the latter at greatest elongations.

On Jan. 1 it will be 2 hours east of the sun, and will move out to greatest eastern elongation on Apr. 17, when it will appear as an evening star of magnitude —3.9, 46° from the sun. It will then move back toward the sun, reaching inferior conjunction on June 26. Greatest western elongation will occur on Sept. 5, when it will be visible in the morning sky, again 46° from the sun, and magnitude —4.0.

The semidiameter of the planet will be about 12″ at greatest elongations and about 29″ at inferior conjunction, the distances from the earth at these times being respectively 66 and 26.9 million miles. It will attain maximum brightness of —4.2 magnitudes in May and August.

MARS

Mars is the farthest from the sun of the four inner planets. Its orbit is outside that of the earth, with a mean distance of 142 million miles. Due to the orbit's eccentricity, the planet's distance from the sun ranges between 128 and 154 million miles. It takes 687 days to complete one revolution, and the synodic period is 780 days, the longest in the solar system. One of the smallest of the major planets, it has a diameter of 4,200 miles.

Since its thin atmosphere does not prevent observation of the surface detail, the period of rotation has been well determined, about $24^h\ 37^m$. The surface temperature of the planet ranges from —90°F. to +60°F. Two faint moons, Phobos and Deimos, revolve in orbits close to the planet.

When in opposition, the planet can approach the earth as close as 34,600,000 miles, but during 1940 it passes around the side of the sun farthest from the earth and is not in a favourable position for observation. In January it is about 5 hours east of the sun, which gradually overtakes it, and for several weeks before and after conjunction on Aug. 30, Mars is hidden by the sun's light. It then appears as a morning star for the remainder of the year.

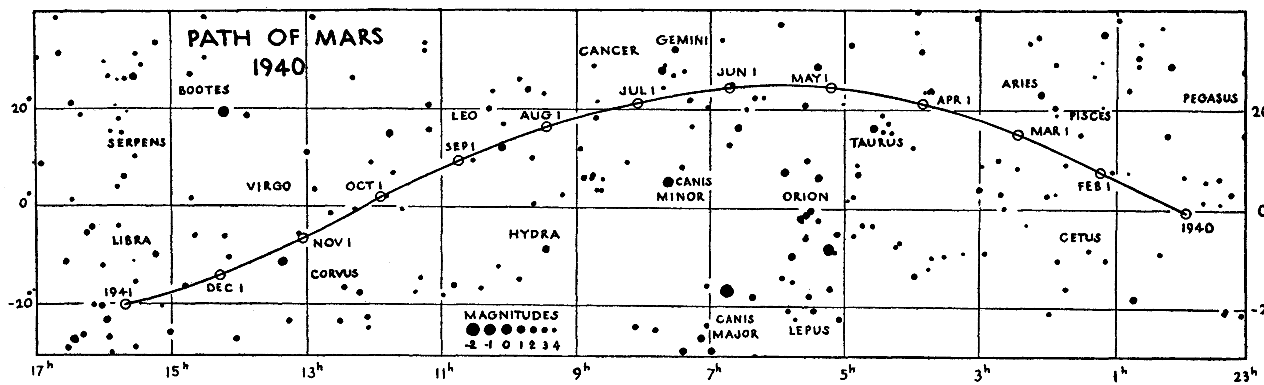
Its semidiameter decreases from 3.7″ in January to 1.8″ in July.

THE ASTEROIDS

The gap between the orbits of Mars and Jupiter is filled by very many small bodies, orbits of over 1,400 of which have been determined. Most of them are under 50 miles in diameter. Their orbits cover a fairly wide range in eccentricity and inclination to the ecliptic, and some of them pass very close to the earth.

Several of the brightest asteroids approach magnitude 7 at opposition, and because of their changing brightness and rapid motion with respect to the stars, they are very interesting objects for observation.

Ephemerides for some of the brightest of the asteroids are given on page 24 of this Handbook.



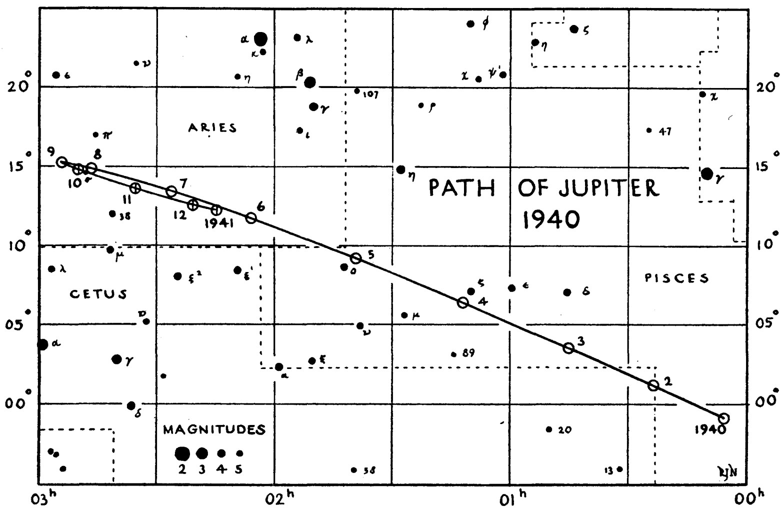
Path of Mars among the Stars during 1940

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

JUPITER

Jupiter, the largest and most massive of the planets, is except for the moon and Venus, the most conspicuous object in the night sky. At a mean distance of 483 million miles from the sun, it completes one revolution in 11.9 years. It has a very short period of rotation, about 10 hours. The spectroscope shows that the planet's atmosphere contains ammonia and methane. The surface temperature is about —200°F., showing that the planet radiates little heat of its own, contrary to former belief.

Jupiter is an excellent object for observation, even with a small telescope. Much surface detail is visible, the flattening at the poles due to rotation



is quite evident, and four of the eleven moons discovered up to the present are easily observed.

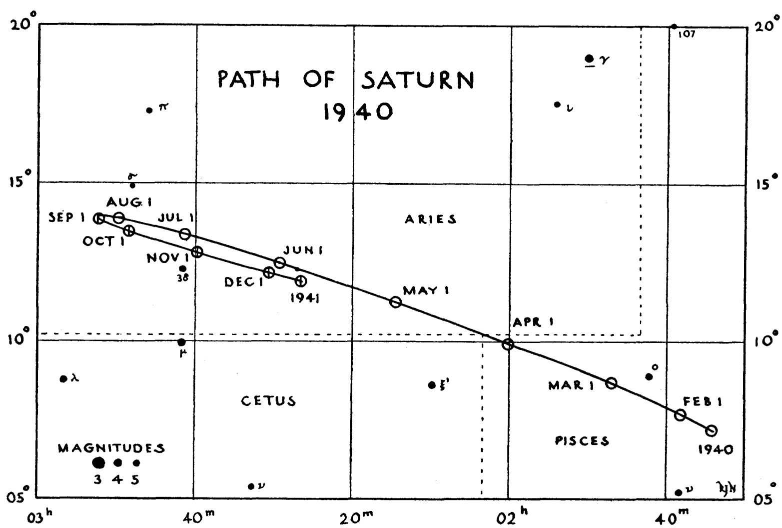
In January, Jupiter is five hours east of the sun in the constellation Pisces. The sun slowly overtakes it, conjunction occurring on Apr. 11. In June it is visible as a morning star 2 hours west of the sun, and western quadrature takes place on Aug. 6. That is, the planet is 90° from the sun on that date. The planet retrogrades from Sept. 4 to the end of the year. It is in opposition Nov. 2, when it appears as a bright star magnitude —2.4, on the meridian at midnight.

Its distance from the earth and its semidiameter at opposition are respectively 370 million miles and 23″.

SATURN

Second only to Jupiter in size and mass, Saturn is the most remote of the six planets known to ancient astronomers.

Saturn's ring system makes the planet an unusually interesting object for telescopic observation. Since the rings are inclined at an angle of 27° to the plane of the planet's orbit, they appear to open out twice in the 29½ years taken by the planet to complete one revolution. They were invisible in 1936 and will be opened out to a maximum in 1943, so that 1940 will be a good year for their observation. There are three important rings: the bright main ring, an outer one, and the inner crêpe ring.



The planet has nine satellites of which the brightest is easily visible in a small telescope.

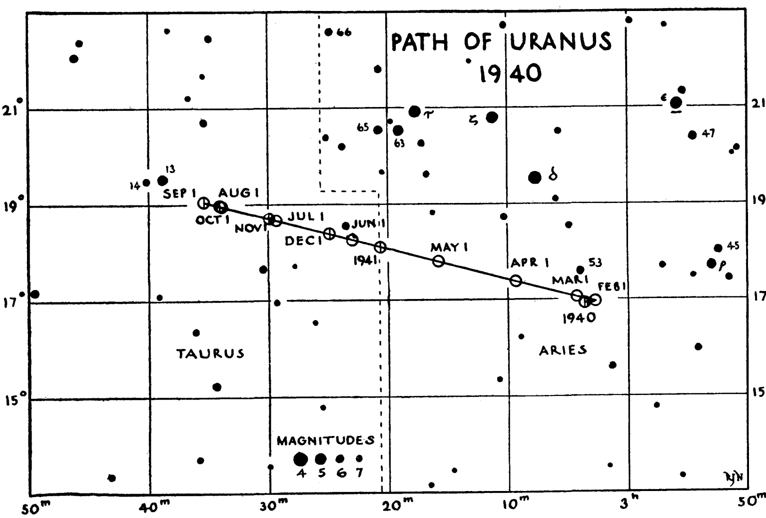
At eastern quadrature Jan. 16, the planet will appear as a yellowish star of magnitude 0.6 in the constellation Pisces. After conjunction with the sun on April 24, Saturn will appear in the morning sky and will reach western quadrature on Aug. 6. Opposition occurs on Nov. 3, when the planet will be of magnitude 0.0. Its distance at that time will be 760 million miles, and its semidiameter will approximate 9″.

It is of interest to note that Saturn is occulted by the moon several times during 1940. These occultations are not visible in Canada.

URANUS

Uranus was discovered accidentally by Herschel in 1781. He at first mistook it for a comet, but later its true character was realized. The planet lies about 19 times as far from the sun as does the earth. A disk is perceptable only in large telescopes.

Little has been learned about its surface markings due to its great distance which reduces the apparent semidiameter to about 1″.8. However, the spectroscope has proven the existence of methane gas in the very cold atmosphere.



The period of revolution of this planet about the sun is 84 years, and its period of rotation is about 11 hours. Four satellites are known.

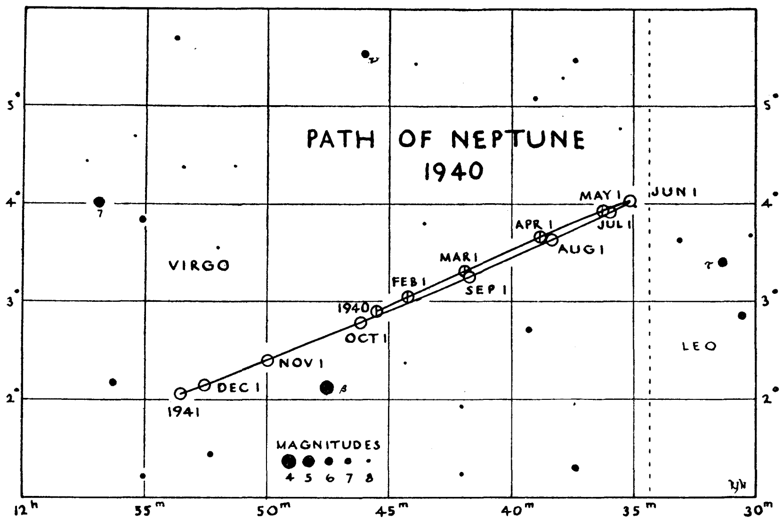
Uranus may be seen during 1940 as a 6ᵐ star in Aries and Taurus. Eastern quadrature occurs on Feb. 7, and the planet is in a good position for observation. From March to June it is hidden by the sun. (Conjunction takes place on May 12.) After June it can be seen in the morning sky and it reaches western quadrature on Aug. 19. Opposition occurs on Nov. 16. Its distance is then about 1,720 million miles.

NEPTUNE

The discovery of Neptune ranks as one of the greatest triumphs of mathematical astronomy. It had long been noted that Uranus was not following exactly its predicted orbit, and from the irregularities Leverrier and Adams predicted independently the orbit and position of the hypothetical planet assumed to produce them. Neptune was discovered within one degree of the predicted position.

Its distance from the sun is about 2,800 million miles and it requires 165 years to complete one revolution. It has one satellite. It is magnitude 8 and shows a disk 1″.2 in diameter.

During 1940 Neptune will be in the constellation Virgo. The planet will be in a favourable position for observation in the spring, since opposition will take place on Mar. 14, and it will pass eastern quadrature on June 13. Conjunction will occur on Sept. 18, and the sun will interfere with observations a few months before and after that date. Western quadrature takes place on Dec. 19. The planet's motion is direct from June 3 to Dec. 30.



PLUTO

In March, 1930, Neptune lost its distinction as the outermost known planet of the solar system when Pluto was discovered at the Lowell Observatory as a result of a long systematic search initiated by Percival Lowell.

Pluto's distance from the sun is about 3,700 million miles and its period of revolution 248 years. Due to its great distance and lack of satellites we know little about its size and mass, other than that it seems similar to the terrestrial planets. It is about fifteenth magnitude, visible only in large telescopes.

Its position for dates near opposition (Jan. 23) is given below:

Date	R.A.			Dec.		Date	R.A.			Dec.	
Jan. 4	8h	22m	09s	+23°	22′.2	Apr. 5	8h	15m	33s	+23	24 .7
Feb. 5	8	19	11	+23	34 .3	Nov. 27	8	31	04	+23	13 .0
Mar. 4	8	16	55	+23	42 .2	Dec. 29	8	29	07	+23°	45′.9

OPPOSITION EPHEMERIDES OF THE BRIGHTEST ASTEROIDS, 1940.

PREPARED BY PROFESSOR G. STRACKE

1 CERES

Feb. 21	$11^{h}\ 35.6^{m}$	$+20°\ 52'$
29	11 29.5	+ 21 50
Mar. 8	11 22.6	+ 22 39
16	11 15.7	+ 23 14
24	11 9.2	+ 23 34
Apr. 1	11 3.8	+ 23 37

Opp. Mar. 10 Mag. 7.0

2 PALLAS

Dec. 19	$7^{h}\ 34.8^{m}$	$-31°\ 3'$
27	7 30.0	− 31 24
Jan. 4	7 23.9	− 31 15
12	7 17.2	− 30 29
20	7 10.7	− 29 5
28	7 4.9	− 27 5

Opp. Jan. 10 Mag. 6.9

6 HEBE

Jan. 20	$9^{h}\ 27.2^{m}$	$+12°\ 4'$
28	9 20.2	+ 13 22
Feb. 5	9 12.5	+ 14 43
13	9 4.9	+ 16 3
21	8 57.9	+ 17 19
29	8 52.0	+ 18 26

Opp. Feb. 5 Mag. 8.9

9 METIS

Apr. 1	$14^{h}\ 1.8^{m}$	$-5°\ 24'$
9	13 54.7	− 4 51
17	13 47.0	− 4 19
25	13 39.2	− 3 51
May 3	13 31.9	− 3 29
11	13 25.8	− 3 15

Opp. Apr. 18 Mag. 9.3

16 PSYCHE

Nov. 11	$4^{h}\ 53.0^{m}$	$+17°\ 47'$
19	4 46.9	+ 17 31
27	4 39.8	+ 17 16
Dec. 5	4 32.4	+ 17 3
13	4 25.4	+ 16 52
21	4 19.2	+ 16 46

Opp. Dec. 2 Mag. 9.1

19 FORTUNA

Sept. 16	$1^{h}\ 15.0^{m}$	$+9°\ 9'$
24	1 10.2	+ 8 34
Oct. 2	1 4.2	+ 7 50
10	0 57.4	+ 6 59
18	0 50.9	+ 6 8
26	0 45.1	+ 5 22

Opp. Oct. 9 Mag. 8.8

20 MASSALIA

Feb. 29	$12^{h}\ 12.8^{m}$	$-4°\ 16'$
Mar. 8	12 6.5	− 3 43
16	11 59.3	− 2 59
24	11 52.0	− 2 9
Apr. 1	11 45.1	− 1 17
9	11 39.3	− 0 28

Opp. Mar. 19 Mag. 8.9

132 AETHRA

Dec. 27	$8^{h}\ 4.0^{m}$	$-6°\ 13'$
Jan. 4	7 57.0	− 10 15
12	7 48.0	− 13 58
20	7 38.0	− 17 9
28	7 28.1	− 19 39
Feb. 5	7 19.5	− 21 24

Opp. Jan. 15 Mag. 9.2

192 NAUSICAA

June 28	$19^{h}\ 56.5^{m}$	$-31°\ 19'$
July 6	19 48.7	− 31 38
14	19 39.7	− 31 48
22	19 30.2	− 31 47
30	19 21.1	− 31 35
Aug. 7	19 13.3	− 31 11

Opp. July 15 Mag. 8.7

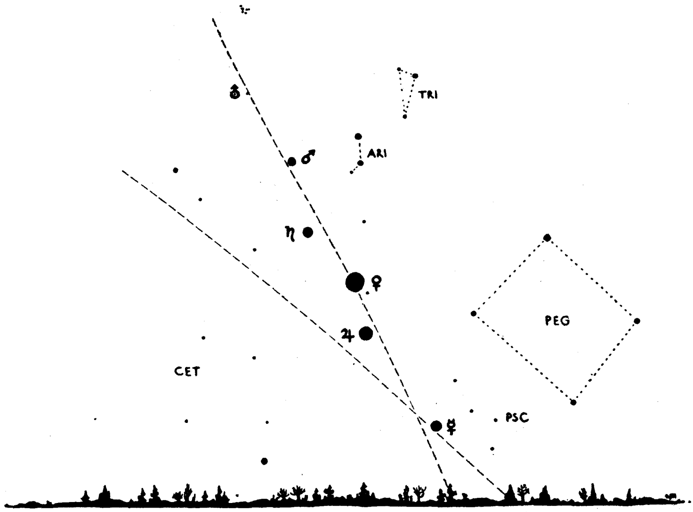
354 Eleonora

Jan. 28	$10^{h}\ 11.5^{m}$	$+11°\ 35'$
Feb. 5	10 6.6	+ 13 14
13	10 0.8	+ 14 58
21	9 54.7	+ 16 42
29	9 48.8	+ 18 20
Mar. 8	9 43.7	+ 19 47

Opp. Feb. 16 Mag. 9.3

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.

A REMARKABLE GROUPING OF SIX BRIGHT PLANETS



The western horizon, one-half hour after sunset, Feb. 28, 1940.

ECLIPSES FOR 1940

During 1940 there will be 2 eclipses, both of the sun.

I. *An annular eclipse of the sun,* April 7, visible in North America. The path of annular eclipse begins in the Pacific Ocean, crosses Southern California, and passes north of the Gulf of Mexico, entering the Atlantic off Florida. The partial phases will be visible throughout the continent except Alaska and the northern islands.

On the Pacific Coast of Canada, the partial phase will begin about 20^h and will end about 22^h. In the Great Lakes region it will begin about 20^h 30^m and end about 23^h. (Universal Time.)

II. *A total eclipse of the sun, October 1,* invisible in Canada. The path of totality crosses the northern part of South America, the South Atlantic, and the southern tip of Africa. Length of totality on the east coast of South America and in South Africa is about 4^m.

Circumstances of the Eclipse

	U. T. d	h	m	Longitude from Green.		Latitude	
Eclipse begins	1	10	8	+64°	10′	+ 7°	58′
Central eclipse begins	1	11	4	+78	30	+ 2	41
Central eclipse ends	1	14	23	—53	47	—32	36
Eclipse ends	1	15	19	—39	21	—27	20

THE SKY MONTH BY MONTH

By P. M. Millman

THE SKY FOR JANUARY, 1940

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 41m to 20h 54m and its Decl. changes from 23° 07′ S. to 17° 29′ S. The equation of time (see p. 7) decreases from −2m 58s to −13m 29s. 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. For changes in the length of the day, see p. 11. The sun moves into the second winter sign of the zodiac, Aquarius, on the 20th of the month. The signs of the zodiac are all exactly 30° in length and now no longer correspond to the constellations of the same name. For example, the sign Aquarius is now situated among the stars of the constellation Capricornus. The earth is in perihelion, the point on its orbit nearest the sun, on January 2.

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. 18h 58m, Decl. 24° 04′ S. and transits at 11.27. It is in superior conjunction with the sun on the 31st and not well placed for observation during January.

Venus on the 15th is in R.A. 21h 54m, Decl. 14° 33′ S. and transits at 14.21. It is a brilliant star in the western evening sky, being a little over 20° above the horizon at sunset and setting approximately 3 hours after the sun.

Mars on the 15th is in R.A. 0h 28m, Decl. 2° 55′ N. and transits at 16.53. It is a red first magnitude star on the meridian at sunset and setting approximately 6 hours after the sun. It is in conjunction with Jupiter on the 7th (see opposite page).

Jupiter on the 15th is in R.A. 0h 13m, Decl. 0° 05′ N. and transits at 16.37. It is on the meridian at sunset and sets about 6 hours after the sun. Conjunction with Mars takes place on the 7th. 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. 1h 35m, Decl. 7° 16′ N. and transits at 17.58. It is a pale yellow star in the evening sky, slightly brighter than the first magnitude. Saturn is in quadrature with the sun on the 15th and is in view for the first half of the night. For the elongations of Saturn's satellites, etc., see p. 52.

Uranus on the 15th is in R.A. 3h 03m, Decl. 16° 55′ N. and transits at 19.26.

Neptune on the 15th is in R.A. 11h 45m, Decl. 2° 56′ N. and transits at 4.10.

Pluto—For information in regard to 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. 20h 15m
Mon.	1	0	49	☌♆☾	♆ 4° 00′ N.	16	06	321O4
		23	56	☾	Last Quarter			
Tue.	2	1		⊕	in Perihelion. Dist. from ☉, 91,343,000 mi.			d32O4
		22		☿	in ☋			
Wed.	3							3O124
Thu.	4					12	56	1O324
Fri.	5							2O134
Sat.	6							12O34
Sun.	7	10		☌♂♃	♂ 1° 10′ N.	9	45	O1432
Mon.	8	4	33	☌☿☾	☿ 5° 15′ S.			d341O
Tue.	9	8	53	●	New Moon			342O1
Wed.	10					6	34	43O2*
Thu.	11							413O2
Fri.	12	8	23	☌♀☾	♀ 6° 24′ S.			42O13
Sat.	13	5		☿	in Aphelion	3	23	412O3
Sun.	14	7		Moon	in Apogee. Dist. from ⊕, 251,900 mi.			4O132
Mon.	15	17	02	☌♃☾	♃ 3° 13′ S.			431O2
		20		□♄☉				
Tue.	16	2	07	☌♂☾	♂ 1° 30′ S.	0	13	32O1*
Wed.	17	11	48	☌♄☾	♄ 2° 32′ S.			3O24*
		13	21	☽	First Quarter			
		16		♂	in ☊			
Thu.	18					21	02	31O24
Fri.	19	6	11	☌♅☾	♅ 1° 45′ N.			2O134
Sat.	20							21O34
Sun.	21					17	51	O1234
Mon.	22							13O24
Tue.	23	5		♃	in Perihelion			32O14
Wed.	24	18	22	○	Full Moon	14	41	31O4*
Thu.	25							d43O2
Fri.	26	6		Moon	in Perigee. Dist. from ⊕, 223,900 mi.			42O13
		18		♅	Stationary in R.A.			
Sat.	27					11	30	421O3
Sun.	28	7	24	☌♆☾	♆ 3° 47′ N.			4O123
Mon.	29							d41O2
Tue.	30					8	19	432O1
Wed.	31	9	47	☾	Last Quarter			4312O
		14		☌☿☉	Superior			

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

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 54m to 22h 47m and its Decl. changes from 17° 29′ S. to 7° 43′ S. The equation of time decreases from −13m 29s to a minimum of −14m 21s on the 12th and then increases to −12m 32s 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 of the zodiac, 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 R.A. 22h 34m, Decl. 10° 20′ S. and transits at 13.00. It reaches greatest elongation east of the sun in the evening sky on the 28th. At this time Mercury is 16° above the horizon at sunset and appears as a red star slightly brighter than zero magnitude. This is one of the most favourable times of the year for observing the planet in the evening sky. It sets about 1h 40m after the sun.

Venus on the 15th is in R.A. 0h 13m, Decl. 0° 49′ N. and transits at 14.38. It is slowly increasing its apparent distance from the sun in the western evening sky. On the evening of the 20th there is an interesting conjunction with Jupiter, the two planets being just over a degree apart at sunset (see opposite page).

Mars on the 15th is in R.A. 1h 46m, Decl. 11° 23′ N. and transits at 16.09. It is in the evening sky and visible in the south-west during the first part of the night. Mars is in conjunction with Saturn on the morning of the 13th and with the moon on the evening of the same date. At this time the moon, Mars and Saturn will be an interesting trio in the sky with Jupiter and Venus not far away.

Jupiter on the 15th is in R.A. 0h 34m, Decl. 2° 24′ N. and transits at 14.56. It is a bright star of magnitude −1.7, high in the south-west at sunset and setting nearly 4 hours after the sun. Conjunction with Venus takes place on the 20th. 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. 1h 42m, Decl. 8° 03′ N. and transits at 16.03. It is high in the south at sunset and sets over 5 hours after the sun. Conjunction with Mars takes place on the 13th. For the elongations of Saturn's satellites, etc., see p. 52.

Uranus on the 15th is in R.A. 3h 03m, Decl. 16° 57′ N. and transits at 17.24.

Neptune on the 15th is in R.A. 11h 43m, Decl. 3° 10′ N. and transits at 2.07.

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

NOTE.—During the last week in February and the first in March there will be a most unusual distribution of planets in the evening sky. The six brightest major planets will all be well placed for observation in the western evening sky and will lie along the ecliptic in a zone roughly 50° in length. Mercury will be near the western horizon followed in order by Jupiter, Venus, Saturn, Mars, and Uranus. The five naked-eye planets will be within 40° of each other. For diagram see page 25.

FEBRUARY

75th Meridian Civil Time

	d	h	m			Min. of Algol h m	Config. of Jupiter's Sat. 19h 45m
Thu.	1						43O12
Fri.	2	13		☿	Greatest Hel. Lat. S.	5 08	2O43*
Sat.	3						21O43
Sun.	4						O1234
Mon.	5					1 58	1O324
Tue.	6						32O14
Wed.	7	18		□ ♅ ☉		22 47	312O4
Thu.	8	2	45	●	New Moon		3O124
		21	08	☌ ☿ ☾	☿ 6° 16′ S.		
Fri.	9						d1O4*
Sat.	10	21			Moon in Apogee. Dist. from ⊕, 252,400 mi.	19 36	21O43
Sun.	11	16	11	☌ ♀ ☾	♀ 2° 46′ S.		4O123
Mon.	12	9	32	☌ ♃ ☾	♃ 2° 27′ S.		41O32
Tue.	13	3		☌ ♂ ♄	♂ 2° 59′ N.	16 26	432O1
		21	55	☌ ♄ ☾	♄ 1° 59′ S.		
		22	53	☌ ♂ ☾	♂ 1° 03′ N.		
Wed.	14						4312O
Thu.	15	14	20	☌ ♅ ☾	♅ 2° 02′ N.		43O12
Fri.	16	7	55	☽	First Quarter	13 15	41O2*
Sat.	17						d42O3
Sun.	18						4O3**
Mon.	19					10 04	1O432
Tue.	20	17		☌ ♀ ♃	♀ 1° 00′ N.		23O14
Wed.	21	13		☿	in ☊		321O4
Thu.	22					6 54	3O124
Fri.	23	4	55	○	Full Moon		13O24
		17			Moon in Perigee. Dist. from ⊕, 221,900 mi.		
Sat.	24	4		♀	in ☊		2O134
		16	21	☌ ♆ ☾	♆ 3° 42′ N.		
Sun.	25					3 43	O34**
Mon.	26	4		☿	in Perihelion		1O234
Tue.	27						23O41
Wed.	28	6		☿	Greatest elongation E., 18° 09′	0 32	3421O
Thu.	29	21	35	☾	Last Quarter		43O12

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

THE SKY FOR MARCH, 1940

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 47m to 0h 41m and its Decl. changes from 7° 43′ S. to 4° 24′ N. The equation of time increases from −12m 32s to −4m 04s (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 way north at 18h 24m G.C.T. March 20. 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 its conjunctions with the planets, see opposite page.

Mercury on the 15th is in R.A. 23h 37m, Decl. 1° 24′ N. and transits at 12.03. Mercury may be glimpsed for the first few days of the month near the western horizon just after sunset. It rapidly fades into the twilight glow, however, and reaches inferior conjunction with the sun on the 15th.

Venus on the 15th is in R.A. 2h 18m, Decl. 15° 11′ N. and transits at 14.48. The planet is noticeably increasing in brightness in the evening sky, being now of magnitude −3.7. It sets nearly 4 hours after the sun. It is in conjunction with the planet Saturn on the 8th.

Mars on the 15th is in R.A. 3h 02m, Decl. 17° 58′ N. and transits at 15.31. It is a red star, appearing high in the southwest at sunset and setting about five hours after the sun. Mars is slowly growing fainter as its distance from the earth increases. It is now of magnitude +1.5.

Jupiter on the 15th is in R.A. 0h 58m, Decl. 4° 58′ N. and transits at 13.25. It is steadily approaching the sun in the evening sky and now sets under two hours after that body. The magnitude is now −1.6. 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. 1h 53m, Decl. 9° 09′ N. and transits at 14.20. It is approaching the sun in the western evening sky and now sets about 3 hours after the sun. It is in conjunction with Venus on the 8th.

Uranus on the 15th is in R.A. 3h 06m, Decl. 17° 11′ N. and transits at 15.33.

Neptune on the 15th is in R.A. 11h 40m, Decl. 3° 29′ N. and transits at 0.10. Opposition to the sun is on the 14th.

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

NOTE.—During the last week in February and the first in March there will be the most unusual distribution of planets in the evening sky. The six brightest major planets will all be well placed for observation in the western evening sky and will lie along the ecliptic in a zone roughly 50° in length. Mercury will be near the western horizon, followed in order by Jupiter, Venus, Saturn, Mars, and Uranus. The five naked-eye planets will be within 40° of each other. For diagram, see page 25.

	d	h	m	MARCH 75th Meridian Civil Time	Min. of Algol h	m	Config. of Jupiter's Sat. 19h 30m
Fri.	1			....	21	22	41302
Sat.	2			....			42013
Sun.	3			....			42103
Mon.	4			....	18	11	d4023
Tue.	5	12		☿ Stationary in R.A.			d4201
Wed.	6			....			32410
Thu.	7	11		☿ Greatest Hel. Lat. N.	15	00	30421
Fri.	8	9		☌ ♀ ♄ ♀ 3° 22′ N.			31024
		21	23	● New Moon			
Sat.	9	0		Moon in Apogee. Dist. from ⊕, 252,600 mi....			20134
		18	03	☌ ☿ ☾ ☿ 1° 45′ N.			
Sun.	10			....	11	49	21034
Mon.	11	3	25	☌ ♃ ☾ ♃ 1° 42′ S.			01234
Tue.	12	9	01	☌ ♄ ☾ ♄ 1° 29′ S.			d034*
		17	47	☌ ♀ ☾ ♀ 2° 36′ N.			
Wed.	13	18	41	☌ ♂ ☾ ♂ 3° 13′ N.	8	39	32104
		22	06	☌ ♅ ☾ ♅ 2° 17′ N.			
Thu.	14	16		☍ ♆ ☉ Dist. from ⊕, 2,716,000,000 mi....			30214
Fri.	15	10		☌ ☿ ☉ Inferior			31042
Sat.	16	13		☌ ♂ ♅ ♂ 1° 06′ N.	5	28	42031
		22	25	☽ First Quarter			
Sun.	17			....			42103
Mon.	18			....			40123
Tue.	19			....	2	17	4023*
Wed.	20	13	24	☉ enters ♈, Spring commences. Long. of ☉, 0°			42310
Thu.	21			....	23	07	4301*
Fri.	22			....			43102
Sat.	23	2	33	☌ ♆ ☾ ♆ 3° 46′ N.			2401*
		5		Moon in Perigee. Dist. from ⊕, 221,900 mi....			
		14	33	○ Full Moon			
Sun.	24			....	19	56	21043
Mon.	25			....			01234
Tue.	26	9		☌ ♀ ♅ ♀ 2° 31′ N.			
Wed.	27	19		☿ Stationary in R.A.	16	45	
Thu.	28	20		♀ in Perihelion			
Fri.	29			....			
Sat.	30	11	20	☾ Last Quarter	13	34	
		22		☿ in ☋			
Sun.	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 March 27 to May 26.

THE SKY FOR APRIL, 1940

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

The Sun—During April the sun's R.A. increases from 0h 41m to 2h 32m and its Decl. changes from 4° 24′ N. to 14° 58′ N. The equation of time increases from −4m 04s to +2m 54s (see p. 7). For changes in the length of the day, see p. 12. On the 21st the sun enters Taurus, the second spring sign of the zodiac. There is an annular eclipse of the sun on the 7th, visible in most of Canada and the United States as a partial eclipse. The central path lies across the extreme southern part of the United States. 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.

Mercury on the 15th is in R.A. 23h 54m, Decl. 3° 12′ S. and transits at 10.23. It is at western elongation in the morning sky on the 12th but not particularly well placed for observation since at best it rises under an hour before the sun and is only 8° above the horizon at sunrise.

Venus on the 15th is in R.A. 4h 33m, Decl. 25° 18′ N. and transits at 15.02. It reaches its greatest elongation east of the sun on the 17th and is a brilliant yellow-white star of magnitude −4, setting 4 hours after the sun. It appears high in the west almost directly the sun has dropped below the horizon.

Mars on the 15th is in R.A. 4h 27m, Decl. 22° 44′ N. and transits at 14.54. It is visible in the western evening sky just to the north of Aldebaran, the two objects appearing as a pair of red stars.

Jupiter on the 15th is in R.A. 1h 25m, Decl. 7° 48′ N. and transits at 11.51. It is in conjunction with the sun on the 11th and too near that body for observation during April.

Saturn on the 15th is in R.A. 2h 07m, Decl. 10° 29′ N. and transits at 12.32. It is too near the sun to be well observed during April. Conjunction with the sun is on the 24th, at which time the planet enters the morning sky.

Uranus on the 15th is in R.A. 3h 12m, Decl. 17° 35′ N. and transits at 13.37.

Neptune on the 15th is in R.A. 11h 38m, Decl. 3° 48′ N. and transits at 22.01.

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

APRIL

75th Meridian Civil Time

	d	h	m		Min. of Algol h	m
Mon.	1					
Tue.	2				10	23
Wed.	3					
Thu.	4					
Fri.	5	4		Moon in Apogee. Dist. from ⊕, 252,400 mi.	7	13
		8	27	☌☿☾ ☿ 4° 03′ S.		
Sat.	6					
Sun.	7			Annular eclipse of ☉, see p. 25		
		15	18	● New Moon		
		22	15	☌♃☾ ♃ 1° 01′ S.		
Mon.	8	21	09	☌♄☾ ♄ 1° 06′ S.	4	02
Tue.	9					
Wed.	10	4		☿ in Aphelion		
		6	12	☌♅☾ ♅ 2° 26′ N.		
		19		☌♀♂ ♀ 2° 11′ N.		
Thu.	11	13	38	☌♂☾ ♂ 4° 50′ N.	0	51
		14	14	☌♀☾ ♀ 7° 04′ N.		
		17		☌♃☉		
Fri.	12	4		☿ Greatest elongation W., 27° 40′		
Sat.	13				21	40
Sun.	14					
Mon.	15	8	46	☽ First Quarter		
Tue.	16				18	29
Wed.	17	7		♀ Greatest elongation E., 45° 44′		
Thu.	18					
Fri.	19	11	56	☌♆☾ ♆ 3° 51′ N.	15	18
		16		♀ Greatest Hel. Lat. N.		
Sat.	20	14		Moon in Perigee. Dist. from ⊕, 223,700 mi.		
Sun.	21	23	37	○ Full Moon		
Mon.	22				12	08
Tue.	23					
Wed.	24	13		☌♄☉		
Thu.	25				8	57
Fri.	26					
Sat.	27					
Sun.	28				5	46
Mon.	29	2	49	☾ Last Quarter		
Tue.	30	12		☿ Greatest Hel. Lat. S.		

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 March 27 to May 26.

THE SKY FOR MAY, 1940

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

The Sun—During May the sun's R.A. increases from 2h 32m to 4h 35m and its Decl. changes from 14° 58′ N. to 22° 0′ N. The equation of time increases from +2m 54s at the beginning of the month to a maximum of +3m 45s on the 14th and then drops to +2m 24s 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.

Mercury on the 15th is in R.A. 2h 55m, Decl. 15° 49′ N. and transits at 11.27. It is in superior conjunction with the sun on the 21st and too near the sun to be observed during May.

Venus on the 15th is in R.A. 6h 26m, Decl. 27° 04′ N. and transits at 14.55. It is slowly approaching the sun in the evening sky and at the same time increasing in brilliance. Maximum brightness of Venus is on May 20, at which time it is a star of magnitude −4.2 and may just be seen with the naked eye in broad daylight if one knows the exact spot in which to look. One way to see Venus in the daytime is to locate the direction due south, which will mark the meridian. Venus will transit this line at the given time and at an altitude $h = 90 - \varphi + \delta$ where φ is observer's latitude and δ is Decl. of Venus.

Mars on the 15th is in R.A. 5h 53m, Decl. 24° 32′ N. and transits at 14.21. It is about 28° above the horizon at sunset and just north of the west point. Mars sets about 3 hours after the sun.

Jupiter on the 15th is in R.A. 1h 52m, Decl. 10° 22′ N. and transits at 10.20. It is close to the sun in the morning sky and not well placed for observation this month. 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 21m, Decl. 11° 45′ N. and transits at 10.49. It is too near the sun in the morning sky for observation.

Uranus on the 15th is in R.A. 3h 19m, Decl. 18° 02′ N. and transits at 11.46.

Neptune on the 15th is in R.A. 11h 36m, Decl. 3° 59′ N. and transits at 20.01.

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

							Min. of Algol	Config. of Jupiter's Sat. 4h 30m
	MAY							
	75th Meridian Civil Time							
	d	h	m				h m	
Wed.	1					....	2 35	
Thu.	2	18		Moon in Apogee. Dist. from ⊕, 251,900 mi.....				
Fri.	3					....	23 24	
Sat.	4					....		
Sun.	5	0		☌☿♃	☿	1° 11′ S..................		
		17	41	☌♃☾	♃	0° 23′ S..................		
		20	07	☌☿☾	☿	1° 20′ S..................		
Mon.	6	10	22	☌♄☾	♄	0° 47′ S..................	20 13	
Tue.	7	7	07	●	New Moon..........................			
		15	23	☌♅☾	♅	2° 31′ N..................		
Wed.	8					....		
Thu.	9					....	17 02	
Fri.	10	4		☌☿♄	☿	0° 42′ N..................		
		7	46	☌♂☾	♂	5° 50′ N..................		
		22	52	☌♀☾	♀	8° 52′ N..................		
Sat.	11					....		
Sun.	12	17		☌♅☉		....	13 51	
Mon.	13					....		
Tue.	14	15	51	☽	First Quarter........................			
Wed.	15					....	10 40	
Thu.	16	19	12	☌♆☾	♆	3° 46′ N..................		
Fri.	17	20		☌☿♅	☿	0° 02′ S..................		
Sat.	18	14		Moon in Perigee. Dist. from ⊕, 226,700 mi.....			7 29	
Sun.	19	13		☿	in ☊................................			
Mon.	20	11		♀	Greatest Brilliancy....................			
Tue.	21	8	33	○	Full Moon..........................		4 18	
		15		☌☿☉		Superior......................		
Wed.	22					....		
Thu.	23					....		
Fri.	24	4		☿	in Perihelion..........................		1 06	
Sat.	25					....		
Sun.	26					....	21 55	
Mon.	27					....		4231O
Tue.	28	19	40	☾	Last Quarter..........................			42O13
Wed.	29					....	18 44	41O23
Thu.	30	12		Moon in Apogee. Dist. from ⊕, 251,300 mi.....				d4O13
Fri.	31					....		213O4

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 March 27 to May 26.

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 35m to 6h 39m and its Decl. changes from 22° 0′ N. to a maximum of 23° 26′.6 N. on June 21 and then decreases to 23° 08′ N. The equation of time decreases from +2m 24s to −3m 34s (see p. 7). The sun is at the summer solstice at 13h 37m G.C.T. June 21, at which time it is furthest north of the equator, and days are longest in the northern hemisphere. For changes in the length of the day, see p. 13. It will be noticed that the duration of daylight changes little during the last half of June. The local mean time of sunset is 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. 7h 13m, Decl. 24° 11′ N. and transits at 13.42. During the month the planet is slowly separating from the sun in the evening sky and reaches eastern elongation on the 24th. At this time Mercury sets about an hour and a half after the sun and is 16° above the horizon at sunset. It may be seen for about a week before and after elongation, a red star of magnitude +0.7. There is a close conjunction with Mars on the 16th (see opposite page).

Venus on the 15th is in R.A. 6h 50m, Decl. 22° 56′ N. and transits at 13.13. It is rapidly approaching the sun in the evening sky. The planet reaches a stationary point on June 4 and commences to retrograde, or move west, at this time. There is a close conjunction between Mars and Venus on the 7th, visible best on the evening of the 6th. Venus is in inferior conjunction with the sun on the 26th and passes into the morning sky at this time.

Mars on the 15th is in R.A. 7h 20m, Decl. 23° 21′ N. and transits at 13.46. It is gradually fading into the evening twilight and is not particularly well placed for observation, setting under two hours after the sun. Conjunction with Venus takes place on the 7th.

Jupiter on the 15th is in R.A. 2h 18m, Decl. 12° 37′ N. and transits at 8.43. Its distance from the sun in the morning sky is now rapidly increasing. It rises two and a half hours before the sun and is due east and 25° above the horizon at sunrise. The moon will be observed near Jupiter on the morning of the 30th from the western part of the continent. 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 35m, Decl. 12° 51′ N. and transits at 9.01. It rises just over two hours before the sun in the morning sky.

Uranus on the 15th is in R.A. 3h 26m, Decl. 18° 29′ N. and transits at 9.51.

Neptune on the 15th is in R.A. 11h 35m, Decl. 4° 00′ N. and transits at 17.59.

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

				JUNE 75th Meridian Civil Time	Min. of Algol		Config. of Jupiter's Sat. 4h 00m
	d	h	m		h	m	
Sat.	1				15	33	3O124
Sun.	2	13	12	☌ ♃ ☾ ♃ 0° 15′ N.			3O24*
Mon.	3	0	12	☌ ♄ ☾ ♄ 0° 27′ S.			d23O4
		10		☿ Greatest Hel. Lat. N.			
		17		♆ Stationary in R.A.			
Tue.	4	1	46	☌ ♅ ☾ ♅ 2° 40′ N.	12	22	2O134
		19		♀ Stationary in R.A.			
Wed.	5	20	05	● New Moon			1O234
Thu.	6						O2134
Fri.	7	1		☌ ♀ ♂ ♀ 0° 22′ N.	9	11	21O34
		7	58	☌ ☿ ☾ ☿ 7° 02′ N.			
		23	37	☌ ♀ ☾ ♀ 6° 27′ N.			
Sat.	8	1	00	☌ ♂ ☾ ♂ 6° 15′ N.			3O421
Sun.	9						341O2
Mon.	10				5	59	432O1
Tue.	11	21		☌ ☿ ♀ ☿ 1° 24′ N.			42O13
Wed.	12	20	59	☽ First Quarter			41O23
Thu.	13	0	49	☌ ♆ ☾ ♆ 3° 34′ N.	2	48	4O213
		18		□ ♆ ☉			
Fri.	14	10		Moon in Perigee. Dist. from ⊕, 229,400 mi.			421O3
		17		♀ in ☊			
Sat.	15				23	37	43O1*
Sun.	16	20		☌ ☿ ♂ ☿ 0° 26′ N.			341O2
Mon.	17						32O14
Tue.	18				20	26	2O34*
Wed.	19	18	02	○ Full Moon			1O234
Thu.	20						O1234
Fri.	21	8	37	☉ enters ♋, Summer commences. Long. of ☉, 90°	17	15	21O34
Sat.	22						3O14*
Sun.	23						31O24
Mon.	24	9		☿ Greatest elongation E., 25° 18′	14	03	32O14
Tue.	25						24O**
Wed.	26	16		☌ ♀ ☉ Inferior			d4O23
		21		☿ in ☊			
Thu.	27	6		Moon in Apogee. Dist. from ⊕, 251,100 mi.	10	52	4O123
		13	13	☾ Last Quarter			
Fri.	28						421O3
Sat.	29						432O1
Sun.	30	7	46	☌ ♃ ☾ ♃ 0° 51′ N.	7	41	431O2
		13	47	☌ ♄ ☾ ♄ 0° 06′ S.			

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

THE SKY FOR JULY, 1940

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

The Sun—During July the sun's R.A. increases from 6h 39m to 8h 44m and its Decl. changes from 23° 08′ N. to 18° 07′ N. The equation of time drops from −3m 34s to a minimum of −6m 22s on the 26th and then rises to −6m 13s 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 the 22nd. The earth is in aphelion, the point on its orbit furthest from the sun, on the 4th.

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. 8h 20m, Decl. 15° 15′ N. and transits at 12.45. It is in inferior conjunction on the 22nd and is too near the sun to be observed during July.

Venus on the 15th is in R.A. 5h 48m, Decl. 17° 59′ N. and transits at 10.14. It is gradually separating from the sun in the morning sky and by the 15th is rising an hour and a half before the sun and appears 16° above the eastern horizon at sunrise. There is an occultation of Venus by the moon on July 31. This is visible in Western Canada (see p. 53). Towards the end of the month Venus is once more approaching its greatest brilliance, and, if located before sunrise, may be followed on into the daylight sky. It will be particularly easy to locate late on the 31st since at this time it will be between the moon and the sun, and quite near the former.

Mars on the 15th is in R.A. 8h 40m, Decl. 19° 34′ N. and transits at 13.08. During July Mars is too near the sun in the western evening sky to be well observed.

Jupiter on the 15th is in R.A. 2h 38m, Decl. 14° 13′ N. and transits at 7.06. It is slowly brightening in the morning sky, being now of magnitude −2. It is in view for most of the last half of the night. 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 46m, Decl. 13° 35′ N. and transits at 7.13. It is steadily separating from the sun in the morning sky and appears as a pale yellow star of magnitude +0.5. On the morning of the 28th it will be observed close to the moon. For the elongations of Saturn's satellites, etc., see p. 52.

Uranus on the 15th is in R.A. 3h 32m, Decl. 18° 49′ N. and transits at 7.59.

Neptune on the 15th is in R.A. 11h 37m, Decl. 3° 49′ N. and transits at 16.03.

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

JULY

75th Meridian Civil Time

Day	d	h	m	Phenomenon			Min. of Algol h	m	Config. of Jupiter's Sat. 3h 15m
Mon.	1	12	46	☌♅☾	♅	2° 54′ N.			d43O1
Tue.	2								421O*
Wed.	3						4	29	4O123
Thu.	4	5		⊕	in Aphelion.	Dist. from ☉, 94,239,000 mi.			O423*
		8	11	☌♀☾	♀	0° 34′ N.			
Fri.	5	6	28	●	New Moon				21O34
Sat.	6	17	20	☌♂☾	♂	6° 06′ N.	1	18	23O14
		21	02	☌☿☾	☿	2° 25′ N.			
Sun.	7	3		☿	in Aphelion				31O24
		14		☿	Stationary in R.A.				
Mon.	8						22	07	3O214
Tue.	9	14		Moon in Perigee.		Dist. from ⊕, 228,800 mi.			231O4
		19		☌☿♂	☿	4° 24′ S.			
Wed.	10	6	39	☌♆☾	♆	3° 16′ N.			O2134
Thu.	11						18	55	O423*
Fri.	12	1	35	☽	First Quarter				241O3
Sat.	13								d42O1
Sun.	14						15	44	431O2
Mon.	15								43O21
Tue.	16								4231O
Wed.	17						12	32	4O13*
Thu.	18	8		♀	Stationary in R.A.				41O23
Fri.	19	4	55	○	Full Moon				d42O3
		8		♀	in Aphelion				
Sat.	20	16		♂	Greatest Hel. Lat. N.		9	21	24O13
Sun.	21								31O24
Mon.	22	0		☌☿☉		Inferior			3O124
Tue.	23						6	10	321O4
Wed.	24								O314*
Thu.	25	0		Moon in Apogee.		Dist. from ⊕, 251,400 mi.			1O234
Fri.	26						2	58	2O134
Sat.	27	6	29	☾	Last Quarter				2O34*
		11		☿	Greatest Hel. Lat. S.				
		23	50	☌♃☾	♃	1° 21′ N.			
Sun.	28	1	47	☌♄☾	♄	0° 12′ N.	23	47	31O42
		23	16	☌♅☾	♅	3° 11′ N.			
Mon.	29								34O12
Tue.	30								4321O
Wed.	31	16	22	☌♀☾	♀	0° 30′ S.	20	35	42O31

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

THE SKY FOR AUGUST, 1940

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 44m to 10h 40m and its Decl. changes from 18° 07′ N. to 8° 25′ N. The equation of time increases from −6m 13s to −0m 06s (see p. 7). For changes in the length of the day, see p. 14. The sun enters Virgo, the third summer sign of the zodiac, 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. 8h 25m, Decl. 19° 05′ N. and transits at 10.54. It is in the morning sky and reaches greatest elongation west of the sun on the 10th. It rises barely an hour before the sun, however, and is only about 9° above the horizon at sunrise, so is not particularly well placed for observation.

Venus on the 15th is in R.A. 6h 35m, Decl. 18° 39′ N. and transits at 9.02. It is a very bright star in the morning sky, rising several hours before the sun. Greatest brilliance occurs on the 2nd, at which time Venus is of magnitude −4.2. It may be followed on into the daylight sky during the first part of the month.

Mars on the 15th is in R.A. 9h 59m, Decl. 13° 34′ N. and transits at 12.24. It is rapidly approaching the sun in the evening sky. Conjunction takes place on the 30th at which time Mars enters the morning sky.

Jupiter on the 15th is in R.A. 2h 52m, Decl. 15° 08′ N. and transits at 5.17. It is in quadrature on the 6th and rises 7 hours before the sun, being on the meridian at sunrise. Conjunction with Saturn takes place on the 15th (see opposite page). 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 52m, Decl. 13° 54′ N. and transits at 5.17. It rises over 4 hours before the sun and is high in the south-east at sunrise. It is in quadrature with the sun on the 6th. On the 27th Saturn reaches a stationary point on its orbit and starts to retrograde, or move westward, among the stars. In a telescope the rings appear fairly well open and are seen from the south side. For the elongations of Saturn's satellites, etc., see p. 52.

Uranus on the 15th is in R.A. 3h 35m, Decl. 19° 00′ N. and transits at 6.00.

Neptune on the 15th is in R.A. 11h 40m, Decl. 3° 28′ N. and transits at 14.04.

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

				AUGUST 75th Meridian Civil Time	Min. of Algol		Config. of Jupiter's Sat. 2h 45m
	d	h	m		h	m	
Thu.	1	4		☿ Stationary in R.A.			41O23
Fri.	2	11		♀ Greatest Brilliancy			d4O13
		11	51	☌☿☾ ☿ 1° 36′ N.			
Sat.	3	15	09	● New Moon	17	24	42O3*
Sun.	4	8	58	☌♂☾ ♂ 5° 22′ N.			d43O2
Mon.	5	22		Moon in Perigee. Dist. from ⊕, 225,800 mi.			34O12
Tue.	6	14	34	☌♆☾ ♆ 3° 00′ N.	14	13	321O4
		20		□♃☉			
		21		□♄☉			
Wed.	7						23O14
Thu.	8						1O234
Fri.	9				11	01	O2134
Sat.	10	5		☿ Greatest elongation W., 18° 57′			21O34
		7	00	☽ First Quarter			
		14		♀ Greatest Hel. Lat. S.			
Sun.	11						3O214
Mon.	12				7	50	3O124
Tue.	13						321O4
Wed.	14						23O41
Thu.	15	8		☌♃♄ ♃ 1° 15′ N.	4	38	41O23
		12		☿ in ☊			
Fri.	16						4O213
Sat.	17	18	02	○ Full Moon			421O3
Sun.	18				1	27	43O1*
Mon.	19	1		□♅☉			43O2*
Tue.	20	3		☿ in Perihelion	22	15	4321O
Wed.	21	17		Moon in Apogee. Dist. from ⊕, 252,000 mi.			423O1
Thu.	22						41O23
Fri.	23				19	04	O4123
Sat.	24	10	53	☌♄☾ ♄ 0° 22′ N.			21O34
		11	33	☌♃☾ ♃ 1° 39′ N.			
Sun.	25	8	03	☌♅☾ ♅ 3° 25′ N.			O314*
		20		♂ in Aphelion			
		22	33	☾ Last Quarter			
Mon.	26				15	53	3O24*
Tue.	27	18		♄ Stationary in R.A.			d32O4
Wed.	28						23O14
Thu.	29	14	56	☌♀☾ ♀ 1° 54′ N.	12	41	1O234
Fri.	30	4		☌♂☉			O1243
		9		☿ Greatest Hel. Lat. N.			
Sat.	31						214O3

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

THE SKY FOR SEPTEMBER, 1940

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 40m to 12h 28m and its Decl. changes from 8° 25′ N. to 3° 02′ S. The equation of time increases from −0m 06s to +10m 10s (see p. 7). For changes in the length of the day, see p. 15. The sun enters Libra and is at the autumnal equinox at 4h 46m G.C.T. on Sept. 23. This is the beginning of autumn and day and night 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. 12h 05m, Decl. 0° 28′ N. and transits at 12.31. It is in superior conjunction with the sun on the 4th and too near that body to be observed during September.

Venus on the 15th is in R.A. 8h 33m, Decl. 16° 59′ N. and transits at 8.58. The planet is very prominent in the morning sky and reaches greatest apparent elongation west of the sun on the 5th. At this time Venus rises 4 hours before the sun and is 40° above the horizon at sunrise. It is a very brilliant yellow star.

Mars on the 15th is in R.A. 11h 13m, Decl. 6° 11′ N. and transits at 11.37. It is in the morning sky and too near the sun for observation.

Jupiter on the 15th is in R.A. 2h 54m, Decl. 15° 11′ N. and transits at 3.17. It is fast moving into the evening sky and now rises well before midnight. Jupiter reaches a stationary point in its orbit and starts to retrograde, or move west among the stars, on the 4th. 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 51m, Decl. 13° 44′ N. and transits at 3.15. It is in view for the greater part of the night, rising about 2 hours after sunset. The stellar magnitude has now increased to +0.3. For the elongations of Saturn's satellites, etc., see p. 52.

Uranus on the 15th is in R.A. 3h 35m, Decl. 19° 00′ N. and transits at 3.59.

Neptune on the 15th is in R.A. 11h 44m, Decl. 3° 02′ N. and transits at 12.06.

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

				SEPTEMBER 75th Meridian Civil Time			Min. of Algol		Config. of Jupiter's Sat. 2h 00m
	d	h	m				h	m	
Sun.	1	0		⛢	Stationary in R.A.		9	30	42O31
		22	30	☌☿☾	☿	4° 54′ N.			
		23	15	●	New Moon				
Mon.	2	0	15	☌♂☾	♂	4° 05′ N.			431O2
		18		☌☿♂	☿	0° 43′ N.			
Tue.	3	1		Moon in Perigee. Dist. from ⊕, 223,200 mi.					43O21
		1	14	☌♆☾	♆	2° 49′ N.			
Wed.	4	7		☌☿☉	Superior		6	18	432O*
		15		♃	Stationary in R.A.				
Thu.	5	8		♀	Greatest elongation W., 45° 57′				41O23
Fri.	6								4O123
Sat.	7						3	07	421O3
Sun.	8	14	32	☽	First Quarter				24O31
Mon.	9						23	55	31O42
Tue.	10								3O124
Wed.	11	10		☌☿♆	☿	0° 02′ N.			32O4*
Thu.	12						20	44	1O234
Fri.	13								O1234
Sat.	14								12O34
Sun.	15						17	33	2O134
Mon.	16	9	41	○	Full Moon				31O42
Tue.	17								34O21
Wed.	18	3		☌♆☉			14	21	4321O
		3		Moon in Apogee. Dist. from ⊕, 252,400 mi.					
Thu.	19								d43O*
Fri.	20	16	26	☌♄☾	♄	0° 20′ N.			4O123
		17	38	☌♃☾	♃	1° 39′ N.			
Sat.	21	14	26	☌⛢☾	⛢	3° 31′ N.	11	10	412O3
Sun.	22	20		☿	in ☋				42O13
		23	46	☉ enters ≏, Autumn commences. Long. of ☉, 180°					
Mon.	23								413O2
Tue.	24	12	47	☾	Last Quarter		7	59	34O12
Wed.	25								3214O
Thu.	26								32O14
Fri.	27						4	47	O324*
Sat.	28	5	07	☌♀☾	♀	3° 37′ N.			12O34
		18		☌♂♆	♂	0° 13′ S.			
Sun.	29								2O134
Mon.	30	13	42	☌♆☾	♆	2° 44′ N.	1	36	13O24
		15	27	☌♂☾	♂	2° 24′ N.			

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

THE SKY FOR OCTOBER, 1940

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 28m to 14h 24m and its Decl. changes from 3° 02′ S. to 14° 19′ S. The equation of time increases from +10m 10s to +16m 20s (see p. 7). For changes in the length of the day, see p. 15. On October 23rd the sun enters Scorpio, the second autumnal sign of the zodiac. There is a total eclipse of the sun on October 1st, 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.

Mercury on the 15th is in R.A. 14h 48m, Decl. 18° 47′ S. and transits at 13.15. It is in the evening sky and is at greatest eastern elongation on the 20th. This is not a favourable elongation for observing the planet since at best it is only 6° above the south-western horizon at sunset and sets about forty minutes after the sun.

Venus on the 15th is in R.A. 10h 44m, Decl. 8° 40′ N. and transits at 9.11. It is slowly approaching the sun in the morning sky and its brightness is decreasing. The magnitude is now −3.7, a drop of half a magnitude from its greatest brilliancy, which occurred in August.

Mars on the 15th is in R.A. 12h 24m, Decl. 1° 33′ S. and transits at 10.49. It is near the sun in the morning sky, rising an hour and a half before the sun and being 15° above the horizon at sunrise.

Jupiter on the 15th is in R.A. 2h 44m, Decl. 14° 26′ N. and transits at 1.10. It is now in view for almost all the night, having increased in brightness to magnitude −2.4 and rising about an hour after sunset. Conjunction with Saturn takes place on the 11th. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 51.

Saturn on the 15th is in R.A. 2h 45m, Decl. 13° 11′ N. and transits at 1.10. It is in view most of the night as a pale yellow star of magnitude +0.1. Early on the evening of the 17th it will be observed very near the moon. Saturn is actually occulted 8 times during the last 7 months of the year, but none of these occultations is visible in Canada. For the elongations of Saturn's satellites, etc., see p. 52.

Uranus on the 15th is in R.A. 3h 32m, Decl. 18° 51′ N. and transits at 1.58.

Neptune on the 15th is in R.A. 11h 48 m, Decl. 2° 37′ N. and transits at 10.12.

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

OCTOBER

75th Meridian Civil Time

Day	d	h	m	Phenomenon		Min. of Algol h	m	Config. of Jupiter's Sat. 1h 15m
Tue.	1			Total eclipse of ⊙. See p. 25				3O124
		7	41	●	New Moon			
		11		Moon in Perigee. Dist. from ⊕, 221,900 mi.				
Wed.	2	15	00	☌☿☾	☿ 2° 56′ S.	22	24	321O4
Thu.	3	2		☿	in Aphelion			32O41
Fri.	4							4O32*
Sat.	5	21		♀	in ☊	19	13	d41O3
Sun.	6							42O13
Mon.	7							d41O2
Tue.	8	1	18	☽	First Quarter	16	02	43O12
Wed.	9							4321O
Thu.	10							432O1
Fri.	11	18		☌♃♄	♃ 1° 17′ N.	12	51	41O32
Sat.	12							dO243
Sun.	13							2O134
Mon.	14					9	39	1O324
Tue.	15	5		Moon in Apogee. Dist. from ⊕, 252,400 mi.				3O124
Wed.	16	3	15	○	Full Moon			312O4
Thu.	17	18	41	☌♃☾	♃ 1° 24′ N.	6	28	32O14
		19	14	☌♄☾	♄ 0° 08′ N.			
Fri.	18	18	55	☌♅☾	♅ 3° 27′ N.			1O324
Sat.	19							O1243
Sun.	20	11		☿	Greatest elongation E., 24° 30′	3	17	24O3*
Mon.	21							41O3*
Tue.	22							43O12
Wed.	23	10		☿	Greatest Hel. Lat. S.	0	06	4312O
Thu.	24	1	04	☾	Last Quarter			432O1
Fri.	25					20	54	41O32
Sat.	26							4O123
Sun.	27	22	43	☌♀☾	♀ 2° 56′ N.			421O3
Mon.	28	1	53	☌♆☾	♆ 2° 38′ N.	17	43	421O3
Tue.	29	6	38	☌♂☾	♂ 0° 28′ N.			3O142
		16		☌♀♆	♀ 0° 11′ N.			
		23		Moon in Perigee. Dist. from ⊕, 222,500 mi.				
Wed.	30	17	03	●	New Moon			312O4
Thu.	31	23	53	☌☿☾	☿ 6° 35′ S.	14	32	32O14
		23	45	Config. of Jupiter's Sat.				1O24*

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

THE SKY FOR NOVEMBER, 1940

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 24m to 16h 28m and its Decl. changes from 14° 19′ S. to 21° 45′ S. The equation of time increases from +16m 20s to a maximum of +16m 22s on the 3rd and then drops to +11m 04s at the end of the month (see p. 7). For changes in the length of the day, see p. 16. On the 22nd the sun enters Sagittarius, the third autumnal 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. 14h 54m, Decl. 15° 29′ S. and transits at 11.13. The planet is in inferior conjunction and transits the sun on November 11th (see p. 80). At this time it moves into the morning sky and gradually separates from the sun, reaching its greatest apparent distance west of that body on the 28th. The two weeks centred on this date provide a good opportunity for observing Mercury. It will appear as a red star of magnitude −0.2, 17° above the horizon at sunrise on the 28th. On this date it rises about 2 hours before the sun.

Venus on the 15th is in R.A. 13h 02m, Decl. 4° 35′ S. and transits at 9.26. It is a brilliant star of magnitude −3.5 rising about 3 hours before the sun in the morning sky.

Mars on the 15th is in R.A. 13h 38m, Decl. 9° 25′ S. and transits at 10.02. It is a red star of 2nd magnitude, rising a little over 2 hours before the sun in the morning sky.

Jupiter on the 15th is in R.A. 2h 28m, Decl. 13° 12′ N. and transits at 22.48. It is in opposition to the sun on the 2nd, being in view all night at this time. It will be fairly near the moon early on the evening of November 13. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 51.

Saturn on the 15th is in R.A. 2h 35m, Decl. 12° 27′ N. and transits at 22.55. It is in opposition to the sun on the 3rd and at this time is in view all night, rising at sunset. The stellar magnitude is just 0.0. A very close conjunction with the moon will be visible in Canada and the United States on the evening of the 13th. For the elongations of Saturn's satellites, etc., see p. 52.

Uranus on the 15th is in R.A. 3h 28m, Decl. 18° 34′ N. and transits at 23.47. Opposition to the sun is on the 16th.

Neptune on the 15th is in R.A. 11h 51m, Decl. 2° 16′ N. and transits at 8.14.

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

NOVEMBER

75th Meridian Civil Time

	d	h	m			Min. of Algol h	m	Config. of Jupiter's Sat. 23h 45m
Fri.	1	1		☿	Stationary in R.A.			O1234
Sat.	2	23		☍♃☉	Dist. from ⊕, 369,900,000 mi.			21O34
Sun.	3	16		☍♄☉	Dist. from ⊕, 763,400,000 mi.	11	21	2O134
Mon.	4							3O42*
Tue.	5							d341O
Wed.	6	16	08	☽	First Quarter	8	10	432O1
Thu.	7							413O2
Fri.	8	17		♀	in Perihelion			4O123
Sat.	9					4	59	421O3
Sun.	10							42O13
Mon.	11	11			Moon in Apogee. Dist. from ⊕, 252,300 mi.			43O2*
		11		☿	in ☊			
					Transit of ☿. See p. 80			
		18		☌☿☉	Inferior			
Tue.	12					1	47	341O2
Wed.	13	17	56	☌♃☾	♃ 1° 08′ N.			32O41
		21	20	☌♄☾	♄ 0° 03′ S.			
Thu.	14	21	23	🌕	Full Moon	22	36	13O24
		22	57	☌♅☾	♅ 3° 21′ N.			
Fri.	15							O1234
Sat.	16	2		☿	in Perihelion			21O34
		10		☍♅☉	Dist. from ⊕, 1,725,000,000 mi.			
Sun.	17					19	25	2O134
Mon.	18							13O24
Tue.	19							d3O24
Wed.	20	19		☿	Stationary in R.A.	16	14	32O14
Thu.	21							31O4*
Fri.	22	11	36	☾	Last Quarter			4O132
Sat.	23					13	03	412O3
Sun.	24	11	36	☌♆☾	♆ 2° 27′ N.			42O13
Mon.	25							d41O2
Tue.	26	9		☿	Greatest Hel. Lat. N.	9	52	43O12
		16	32	☌♀☾	♀ 0° 05′ N.			
		21	45	☌♂☾	♂ 1° 30′ S.			
Wed.	27	7			Moon in Perigee. Dist. from ⊕, 224,900 mi.			432O*
		16	35	☌☿☾	☿ 0° 35′ S.			
Thu.	28	17		☿	Greatest elongation W., 20° 11′			4312O
Fri.	29	3	42	●	New Moon	6	41	4O132
Sat.	30	9		♀	Greatest Hel. Lat. N.			12O43

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

THE SKY FOR DECEMBER, 1940

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 28m to 18h 44m and its Decl. changes from 21° 45′ S. to a minimum of 23° 26′.7 S. on December 21st and then rises at the end of the month to 23° 03′ S. The equation of time decreases from 11m 04s to −3m 21s (see p. 7). At 23h 55m G.C.T. December 21th the sun is at the winter solstice and enters Capricornus, the first winter sign of the zodiac. 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. 16h 25m, Decl. 21° 02′ S. and transits at 10.53. For the first few days of the month the planet will still be visible in the morning sky (see p. 46). It then approaches the sun too closely to be observed during the remainder of December.

Venus on the 15th is in R.S. 15h 23m, Decl. 16° 54′ S. and transits at 9.50. It is approaching the sun in the morning sky and rises two and a half hours before sunrise. The magnitude is now −3.4 and it is just over 20° above the horizon at sunrise.

Mars on the 15th is in R.A. 14h 55m, Decl. 16° 08′ S. and transits at 9.20. It is slowly separating from the sun in the morning sky. It now rises over 3 hours before the sun and is 25° above the horizon at sunrise. Conjunction with Venus takes place on the 2nd (see opposite page).

Jupiter on the 15th is in R.A. 2h 17m, Decl. 12° 22′ N. and transits at 20.38. It reaches a stationary point on its orbit on the 31st and at this time commences to move eastward again among the stars. It is still a brilliant object in the night sky, setting just before sunrise. A close conjunction with the moon will take place early on the evening of the 10th (see opposite page). For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 51.

Saturn on the 15th is in R.A. 2h 28m, Decl. 11° 55′ N. and transits at 20.49. It is well placed for observation, rising shortly before sunset and remaining in view most of the night. A very close conjunction with the moon will be visible on the night of December 10-11. For the elongations of Saturn's satellites, etc., see p. 52.

Uranus on the 15th is in R.A. 3h 23m, Decl. 18° 16′ N. and transits at 21.44.

Neptune on the 15th is in R.A. 11h 53m, Decl. 2° 05′ N. and transits at 6.17.

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

DECEMBER

75th Meridian Civil Time

	d	h	m				Min. of Algol h m	Config. of Jupiter's Sat. 22h 30m
Sun.	1			....				2O134
Mon.	2	7		☌♀♂	♀	1° 17′ N.................	3 30	1O324
Tue.	3			....				3O124
Wed.	4			....				321O4
Thu.	5			....			0 19	321O4
Fri.	6	11	01	☽	First Quarter......................			O3124
Sat.	7			....			21 08	d1O43
Sun.	8			....				24O13
Mon.	9	3		Moon in Apogee. Dist. from ⊕, 251,700 mi.....				41O23
Tue.	10	19	33	☌♃☾	♃	1° 07′ N.................	17 57	43O12
Wed.	11	0	56	☌♄☾	♄	0° 01′ S.................		4321O
Thu.	12	3	58	☌♅☾	♅	3° 20′ N.................		d432O
Fri.	13			....			14 47	4O32*
Sat.	14	14	38	☺	Full Moon..........................			41O23
Sun.	15			....				42O13
Mon.	16			....			11 36	14O3*
Tue.	17			....				3O142
Wed.	18			....				321O4
Thu.	19	12		□♆☉	....		8 25	32O14
		19		☿	in ☋............................			
Fri.	20			....				3O24*
Sat.	21	18	07	☌♆☾	♆	2° 11′ N.................		1O234
		18	55	☉ enters ♑, Winter commences. Long. of ☉, 270°				
		20	45	☾	Last Quarter.......................			
Sun.	22			....			5 14	2O134
Mon.	23			....				1O34*
Tue.	24			....				3O412
Wed.	25	1		Moon in Perigee. Dist. from ⊕, 228,400 mi.....			2 03	3142O
		12	59	☌♂☾	♂	3° 16′ S.................		
Thu.	26	13	04	☌♀☾	♀	3° 08′ S.................		432O1
Fri.	27			....			22 52	431O2
Sat.	28	0	46	☌☿☾	☿	5° 52′ S.................		41O23
		15	56	●	New Moon..........................			
Sun.	29			....				42O13
Mon.	30	2		☿	in Aphelion........................		19 42	412O3
		10		♆	Stationary in R.A..................			
Tue.	31	9		♃	Stationary in R.A..................			43O12

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

JANUARY

d	h	m	Sat.	Phen	d	h	m	Sat.	Phen.
1	17	51	II	SI		20	58	III	OD
	17	51	II	Te	15	18	40	III	Se
	20	26	II	Se		20	34	II	TI
	21	18	I	OD	16	19	02	IV	OD
2	18	29	I	TI		20	29	IV	OR
	19	48	I	SI	17	19	44	I	OD
	20	42	I	Te		20	07	II	ER
	22	00	I	Se	18	18	10	I	SI
3	19	20	I	ER		19	08	I	Te
4	19	37	III	OR		20	21	I	Se
	22	17	III	ED	22	18	02	III	Te
8	17	52	II	TI		20	17	III	SI
	20	27	II	SI	24	21	43	I	OD
	20	31	II	Te	25	18	55	I	TI
9	20	27	I	TI		20	06	I	SI
	21	45	I	SI		21	08	I	Te
10	17	45	I	OD	26	19	34	I	ER
	21	15	I	ER	29	19	34	III	TI
11	18	25	I	Se	31	20	29	II	OD

FEBRUARY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	20	55	I	TI	10	18	27	I	SI
2	18	03	II	Te		19	40	I	Te
	18	13	I	OD		20	38	I	Se
	20	09	II	Se	16	18	41	III	OD
3	18	42	I	Se	17	19	28	I	TI
9	18	10	II	TI		20	22	I	SI
	18	29	III	ED	18	19	49	I	ER
	20	10	II	SI		20	02	II	ER
	20	13	I	OD	25	18	46	I	OD
	20	49	II	Te	26	18	59	I	Se
	20	54	III	ER	27	18	52	III	Se

MARCH

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
4	18	43	I	SI	12	18	48	II	TI
5	18	37	II	Te	20	18	52	I	Te

Jupiter being near the Sun, phenomena of the Satellites are not given from March 27 to May 26.

JUNE

d	h	m	Sat.	Phen	d	h	m	Sat.	Phen.
2	03	48	I	ED	22	03	21	II	ED
3	04	12	I	Te	24	02	20	II	Te
10	03	04	I	SI	25	03	43	III	OD
	04	02		TI		04	00	I	ED
11	03	21	I	OR	26	02	30	I	TI
19	02	40	I	Te		03	31	I	Se

JULY

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	02	33	II	TI	17	02	58	II	ER
	02	40	II	Se		03	04	II	OD
2	03	02	III	ED	18	04	11	I	ED
3	03	16	I	SI	19	01	32	I	SI
4	03	47	I	OR		02	51	I	TI
8	02	44	II	SI		03	41	I	Se
10	02	55	II	OR	20	01	07	III	SI
11	02	16	I	ED		02	11	I	OR
12	01	47	I	Se		03	08	III	Se
	03	03	I	Te	24	02	59	II	ED
13	02	29	III	TI	26	02	34	II	Te
	04	18	III	Te		03	26	I	SI

JULY—*Cont.*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
27	00	34	I	ED	31	00	54	III	OD
	04	07	I	OR		02	36	III	OR
28	01	23	I	Te					

AUGUST

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	23	53	II	SI		02	33	II	ER
2	02	25	II	Se		02	44	II	OD
	02	43	II	TI		03	35	I	SI
3	02	28	I	ED	19	00	45	I	ED
4	00	08	II	OR		04	17	I	OR
	01	10	I	TI		23	24	I	TI
	01	57	I	Se		23	41	II	Te
	03	18	I	Te	20	00	12	I	Se
5	00	31	I	OR		01	31	I	Te
7	01	09	III	ER		22	45	I	OR
9	02	30	II	SI	24	23	08	III	Se
10	04	22	I	ED	25	02	35	II	ED
	23	59	II	ER		02	48	III	TI
11	00	12	II	OD		04	15	III	Te
	01	42	I	SI	26	02	39	I	ED
	02	42	II	OR		23	35	II	Se
	03	04	I	TI		23	44	II	TI
	03	50	I	Se		23	57	I	SI
12	02	24	I	OR	27	01	15	I	TI
	23	39	I	Te		02	06	I	Se
14	03	08	III	ED		02	13	II	Te
17	22	54	III	TI		03	22	I	Te
18	00	00	II	ED	28	00	37	I	OR
	00	25	III	Te					

SEPTEMBER

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	01	10	III	SI		23	35	II	ED
	03	08	III	Se	19	00	06	I	SI
	05	09	II	ED		01	08	I	TI
2	04	33	I	ED		01	12	III	ER
	23	39	II	SI		02	15	I	Se
3	01	51	I	SI		03	15	I	Te
	02	12	II	Se		03	44	III	OD
	02	14	II	TI		04	08	II	OR
	03	05	I	TI		05	04	III	OR
	03	59	I	Se		21	19	I	ED
	04	42	II	Te	20	00	31	I	OR
	23	02	I	ED		20	44	I	Se
4	02	27	I	OR		20	47	II	Se
	21	53	III	OR		21	42	I	Te
	22	28	I	Se		22	46	II	Te
	23	23	II	OR	25	04	45	I	ED
	23	39	I	Te	26	02	00	I	SI
8	05	10	III	SI		02	10	II	ED
10	02	16	II	SI		02	55	I	TI
	03	44	I	SI		03	14	III	ED
	04	42	II	TI		04	09	I	Se
	04	50	II	Se		05	02	I	Te
	04	54	I	TI		05	12	III	ER
11	00	56	I	ED		23	14	I	ED
	04	16	I	OR	27	02	18	I	OR
	22	13	I	SI		20	29	I	SI
	23	21	I	TI		20	50	II	SI
12	00	08	III	OD		21	21	I	TI
	00	22	I	Se		22	38	I	Se
	01	28	I	Te		22	40	II	TI
	01	31	III	OR		23	24	II	Se
	01	47	II	OR		23	28	I	Te
	22	43	I	OR	28	01	08	II	Te
17	04	54	II	SI		20	44	I	OR
18	02	51	I	ED	29	20	56	III	TI
	23	13	III	ED		22	10	III	Te

OCTOBER

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
3	03	54	I	SI	18	04	58	I	ED
	04	40	I	TI	19	02	10	I	SI
	04	44	II	ED		02	34	I	TI
4	01	08	I	ED		04	20	I	Se
	04	03	I	OR		04	42	I	Te
	22	22	I	SI		04	43	II	SI
	23	06	I	TI		05	34	II	TI
	23	28	II	SI		23	27	I	ED
5	00	32	I	Se	20	04	58	I	OR
	01	00	II	TI		20	39	I	SI
	01	13	I	Te		21	00	I	TI
	02	02	II	Se		22	48	I	Se
	03	27	II	Te		23	08	I	Te
	22	30	I	OR		23	11	II	ED
6	19	40	I	Te	21	02	22	II	OR
	21	12	III	SI		05	14	III	SI
	21	53	II	OR		20	24	I	OR
	23	08	III	Se	22	20	36	II	Se
7	00	19	III	TI		21	09	II	Te
	01	33	III	Te	24	19	18	III	ED
11	03	03	I	ED		21	55	III	OR
12	00	16	I	SI	26	04	05	I	SI
	00	51	I	TI		04	18	I	TI
	02	05	II	SI	27	01	22	I	ED
	02	26	I	Se		03	42	I	OR
	02	58	I	Te		22	33	I	SI
	03	17	II	TI		22	43	I	TI
	04	39	II	Se	28	00	43	I	Se
	05	45	II	Te		00	51	I	Te
	21	32	I	ED		01	46	II	ED
13	00	14	I	OR		04	35	II	OR
	19	17	I	TI		19	50	I	ED
	20	36	II	ED		22	08	I	OR
	20	54	I	Se	29	19	11	I	Se
	21	24	I	Te		19	17	I	Te
14	00	08	II	OR		20	40	II	SI
	01	13	III	SI		20	56	II	TI
	03	09	III	Se		23	14	II	Se
	03	39	III	TI		23	24	II	Te
	04	53	III	Te	31	23	20	III	ED

NOVEMBER

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
1	01	16	III	ER		05	18	III	ER
2	05	59	I	SI	10	05	01	I	OD
	06	01	I	TI	11	02	10	I	TI
4	00	27	I	TI		02	22	I	SI
	00	28	I	SI		04	18	I	Te
	02	34	I	Te		04	32	I	Se
	02	37	I	Se		18	00	III	Te
	04	20	II	OD		19	12	III	Se
	21	43	I	OD		23	27	I	OD
	23	56	I	ER	12	01	51	I	ER
5	18	52	I	TI		20	36	I	TI
	18	56	I	SI		20	51	I	SI
	21	00	I	Te		22	44	I	Te
	21	06	I	Se		23	00	I	Se
	23	10	II	TI	13	01	25	II	TI
	23	18	II	SI		01	56	II	SI
6	01	39	II	Te		03	54	II	Te
	01	52	II	Se		04	29	II	Se
	18	25	I	ER		17	53	I	OD
7	20	12	II	ER		20	20	I	ER
8	03	03	III	OD	14	17	29	I	Se

NOVEMBER—*Cont.*

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen.
	19	39	II	OD		20	27	II	Se
	22	48	II	ER	25	23	06	III	TI
16	17	49	II	Se	26	00	41	III	Te
18	03	54	I	TI		01	20	III	SI
	04	17	I	SI		02	56	I	OD
	19	49	III	TI		03	15	III	Se
	21	18	III	SI	27	00	05	I	TI
	21	19	III	Te		00	41	I	SI
	23	13	III	Se		02	13	I	Te
19	01	11	I	OD		02	50	I	Se
	03	46	I	ER		21	22	I	OD
	22	20	I	TI	28	00	10	I	ER
	22	46	I	SI		18	31	I	TI
20	00	28	I	Te		19	09	I	SI
	00	55	I	Se		20	39	I	Te
	03	41	II	TI		21	19	I	Se
	04	34	II	SI	29	00	09	II	OD
	19	37	I	OD		04	00	II	ER
	22	15	I	ER		17	22	III	ER
21	18	54	I	Te		18	39	I	ER
	19	24	I	Se	30	19	07	II	TI
	21	54	II	OD		20	31	II	SI
22	01	24	II	ER		21	38	II	Te
23	17	53	II	SI		23	04	II	Se
	19	19	II	Te					

DECEMBER

d	h	m	Sat.	Phen.	d	h	m	Sat.	Phen
3	02	26	III	TI	15	01	46	II	SI
4	01	50	I	TI		02	20	II	Te
	02	36	I	SI	16	17	58	II	OD
	23	08	I	OD		22	31	II	ER
5	02	06	I	ER	18	17	38	II	Se
	20	17	I	TI	19	23	52	I	TI
	21	04	I	SI	20	00	55	I	SI
	22	25	I	Te		02	01	I	Te
	23	14	I	Se		21	11	I	OD
6	02	27	II	OD		23	22	III	OD
	17	35	I	OD	21	00	26	I	ER
	17	57	III	OR		01	05	III	OR
	19	27	III	ED		18	20	I	TI
	20	35	I	ER		19	24	I	SI
	21	23	III	ER		20	28	I	Te
7	17	42	I	Se		21	33	I	Se
	21	27	II	TI	22	02	13	II	TI
	23	09	II	SI		18	55	I	ER
	23	58	II	Te	23	20	21	II	OD
8	01	42	II	Se	24	01	08	II	ER
9	19	54	II	ER		17	27	III	SI
12	00	55	I	OD		19	21	III	Se
	22	04	I	TI	25	17	43	II	SI
	23	00	I	SI		17	58	II	Te
13	00	13	I	Te		20	16	II	Se
	01	09	I	Se	27	01	42	I	TI
	19	22	I	OD		23	01	I	OD
	19	40	III	OD	28	20	10	I	TI
	21	29	III	OR		21	19	I	SI
	22	30	I	ER		22	19	I	Te
	23	29	III	ED		23	28	I	Se
14	01	26	III	ER	29	17	29	I	OD
	17	29	I	SI		20	50	I	ER
	18	40	I	Te	30	17	57	I	Se
	19	38	I	Se		22	47	II	OD
	23	49	II	TI	31	18	30	III	Te

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. 8).

SATURN'S SATELLITES TITAN AND IAPETUS

ELONGATION				CONJUNCTION			
TITAN				TITAN			
Eastern		Western		Inferior		Superior	
d	h	d	h	d	h	d	h
Jan. 6	05.0	Jan. 14	05.7	Jan. 10	08.8	Jan. 2	02.4
22	04.2	30	05.1	26	08.1	18	01.5
Feb. 7	03.9	Feb. 15	04.9	Feb. 11	07.9	Feb. 3	01.0
		Jul. 8	09.1			19	00.9
Jul. 16	10.0	24	08.8	Jul. 4	13.0	Jul. 12	06.1
Aug. 1	09.7	Aug. 9	08.3	20	12.9	28	05.8
17	09.0	25	07.2	Aug. 5	12.5	Aug. 13	05.2
Sep. 2	07:7	Sept. 10	05.7	21	11.5	29	04.0
18	05.9	26	03.8	Sep. 6	10.1	Sep. 14	02.4
Oct. 4	03.7	Oct. 12	01.5	22	08.3	30	00.3
20	01.1	27	22.9	Oct. 8	06.0	Oct. 15	21.8
Nov. 4	22.5	Nov. 12	20.3	24	03.5	31	19.2
20	19.7	28	17.8	Nov. 9	00.8	Nov. 16	16.5
Dec. 6	17.2	Dec. 14	15.6	24	22.2	Dec. 2	14.0
22	15.0	30	13.8	Dec. 10	19.9	18	11.8
				26	17.9		
IAPETUS				IAPETUS			
Eastern		Western		Inferior		Superior	
d	h	d	h	d	h	d	h
		Feb. 7	23.3	Jan. 18	12.1		
		Jul. 19	11.4			Aug. 7	12.5
Aug. 27	08.9	Oct. 6	18.7	Sep. 17	03.2	Oct. 25	07.9
Nov. 13	16.5	Dec. 23	23.0	Dec. 4	04.6		

LUNAR OCCULTATIONS

Prepared by J. F. Heard

When the moon passes between the observer and a star that star is said to be occulted by the moon and the phenomenon is known as a lunar occultation. The passage of the star behind the east limb of the moon is called the immersion and its appearance from behind the west limb the emersion. As in the case of eclipses, the times of immersion and emersion and the duration of the occultation are different for different places on the earth's surface. The tables given below, adapted from the 1940 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.

Attention is called to a day-time occultation of Venus visible in Western Canada on July 31.

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1940

Date	Star	Mag.	I or E*	Age of Moon	Toronto E.S.T.	a	b	P	Montreal E.S.T.	a	b	P
				d	h m			°	h m			°
Jan. 21	119 Tau	4.7	I	12.5	21 13.2	−1.9	+0.3	89	21 24.4	−1.8	+0.2	84
Feb. 21	α Cnc	4.3	I	13.7	18 12.9	−0.3	+1.7	77	18 18.6	−0.5	+1.9	73
Mar. 31	ρ Sgr	4.0	I	22.3	No occ.	—	—	—	3 12.1	—	—	158
" "	" "	"	E	22.3	" "	—	—	—	3 34.7	—	—	192
Apr. 14	λ Gem	3.6	I	7.2	19 28.7	−2.0	+0.3	68	19 41.6	−2.1	+0.8	54
June 16	λ Vir	4.6	I	10.1	0 00.3	−1.1	−2.8	159	0 01.4	−1.0	−2.6	154
July 22	θ Aqr	4.3	I	16.8	1 28.5	−1.5	+1.6	48	1 40.1	−1.5	+1.3	51
" "	" "	"	E	16.8	2 51.3	−2.1	+0.1	262	3 02.6	−1.9	−0.1	259
Aug. 14	ρ Sgr	4.0	I	11.2	19 40.6	−1.5	+1.0	90	19 51.6	−1.6	+0.9	86
Oct. 11	θ Aqr	4.3	I	10.6	21 12.3	−1.7	+1.0	55	21 23.4	−1.6	+0.6	58
" 23	λ Gem	3.6	I	21.8	0.05.7	−0.1	+1.7	76	0 10.3	−0.3	+1.8	75
" "	" "	"	E	21.8	1 07.4	−0.8	+0.8	288	1 13.9	−1.0	+0.7	290

*Immersion or Emersion.

LUNAR OCCULTATIONS VISIBLE AT VANCOUVER AND CALGARY 1940

Date	Star	Mag.	I or E*	Age of Moon	Vancouver P.S.T.	a	b	P	Calgary M.S.T.	a	b	P
				d	h m			°	h m			°
Jan. 21	119 Tau	4.7	I	12.5	17 34.6	−0.2	+2.7	42	18 41.5	−0.5	+2.6	47
Feb. 16-17	δ Tau	3.9	I	9.0	23 22.3	−0.9	+0.2	41	0 31.4	−1.0	+1.3	24
" 16-17	64 Tau	4.8	I	9..	23 47.8	−0.5	−0.9	69	0 50.3	−0.3	−0.7	58
" 20	λ Gem	3.6	I	12.0	0 42.6	−1.2	−0.7	70	1 51.5	−1.0	−0.4	56
July 21	θ Aqr	4.3	I	16.8	Low	—	—	—	23 10.5	—	—	9
" "	" "	"	E	16.8	22 33.7	−0.9	+0.3	313	23 44.4	—	—	313
" 31	Venus	−4.2	I	26.4	13 59.5	−0.8	−0.8	64	15 05.0	−0.7	−0.5	51
" "	"	"	E	26.4	14 52.3	+0.1	−2.3	310	15 46.9	+0.4	−2.5	322
Sept. 7	χ Oph	4.8	I	6.0	20 12.8	−1.6	−2.9	155	Low	—	—	—
Oct. 11	θ Aqr	4.3	I	10.6	17 37.4	—	—	2	18 48.0	—	—	5
Nov. 19	λ Gem	3.6	I	19.6	4 04.1	−1.6	−0.8	106	5 16.8	−1.5	−0.9	97
" "	" "	"	E	19.6	5 23.0	−1.4	−1.1	277	6 32.1	−1.0	−1.6	287
" 21	α Cnc	4.3	I	21.5	Graze	—	—	—	1 22.4	—	—	175
" "	" "	"	E	21.5	"	—	—	—	1 41.5	—	—	209
" 22	π Leo	4.9	E	22.6	5 26.3	−1.4	−0.7	300	6 36.7	−1.2	−1.3	312
Dec. 19	o Leo	3.8	I	20.0	0 36.3	−1.0	+3.9	48	Graze	—	—	—
" "	" "	"	E	20.0	1 12.5	−0.9	−2.6	346	"	—	—	—

*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.

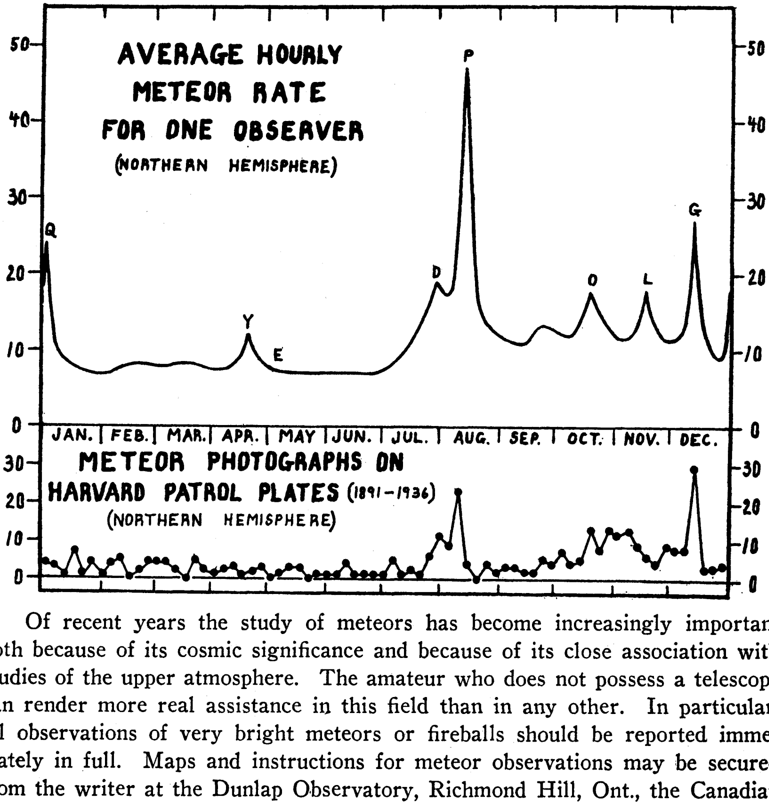
Shower	Approx. Radiant		Maximum Date	Hourly No. (all meteors)	Duration (in days)	Abbre-viation
	α	δ				
Quadrantids	232°	+52°	Jan. 3	20	4	Q
Lyrids	280	+37	Apr. 21	10	4	Y
Eta Aquarids	336	− 1	May 4	10	8	E
Delta Aquarids	340	−17	July 28	20	3	D
Perseids	47	+57	Aug. 12	50	25	P
Orionids	96	+15	Oct. 22	20	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) ⊕ = 1	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 ⊕ = 1	Density water = 1	Axial Rotation	Mean Surface Gravity ⊕ = 1	Albedo Bond's	Magnitude at Opposition or Elongation
Sun	☉	864,000	332,000	1.4	$24^d.7$ (equatorial)	27.9		− 26.7
Moon	☾	2,160	.0123	3.3	$27^d\ 7.7^h$	.16	.07	− 12.6
Mercury	☿	3,010	.056	3.8	88^d	.27	.07	0±
Venus	♀	7,580	.82	4.9	30^d ?	.85	.59	− 4±
Earth	⊕	7,918	1.00	5.5	$23^h\ 56^m$	1.00	.29	
Mars	♂	4,220	.108	4.0	$24^h\ 37^m$	.38	.15	− 2±
Jupiter	♃	87,000	318.	1.3	$9^h\ 50^m$±	2.6	.56?	− 2±
Saturn	♄	72,000	95.	.7	$10^h 15^m$±	1.2	.63?	0±
Uranus	♅	31,000	14.6	1.3	$10^h.8$±	.9	.63?	+ 5.7
Neptune	♆	33,000	17.2	1.3	16^h ?	1.0	.73?	+ 7.6
Pluto	♇	4,000?	$<.1$					+ 14

SATELLITES OF THE SOLAR SYSTEM

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

*As seen from the sun.

DOUBLE AND MULTIPLE STARS

By Frank S. Hogg

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

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

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

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

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

The accompanying table provides a list of double stars, selected on account of their brightness, suitability for small telescopes, or particular astrophysical interest. The data are taken chiefly from Aitken's *New General Catalogue of Double Stars*, and from the Yale *Catalogue of Bright Stars.* Successive columns give the star, its 1900 equatorial coordinates, the magnitudes and spectral classes of its components, their separation, in seconds of arc, and the approximate distance of the double star in light years. The last column gives, for binary stars of well determined orbits, the period in years, and the mean separation of the components in astronomical units. For stars sufficiently bright to show colour differences in the telescope used, the spectral classes furnish an indication of the colour. Thus O and B stars are bluish white, A and F white, G yellow, K orange and M stars reddish.

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

REPRESENTATIVE DOUBLE STARS

Star		α 1900	δ	Mag. and Spect.	d	D	Remarks
		h m	° ′		″	L.Y.	
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	Aqr	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. μ Cephei stars: μ Cephei. 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: δ Cephei. 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.

1940 maxima of bright variable stars (E.S.T.)

o Ceti *Jul. 28*	β Lyr *Jan. 2.2, 15.1, etc.*
δ Cep *Jan. 1.8, 7.2, ecc.*	R Sct *Mar. 8, Jul. 28, Dec. 16*
χ Cyg *Sept. 30*	β Per (*See pp. 27-41*)

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
ο 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]ο 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 Veränderlicher 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 subfended 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 $3.26 \div .27 = 12$ 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)δ		Sp	μ	π	L.y.	m	M	L
	h m	° '		"	"				
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 259 stars brighter than apparent magnitude 3.51 which it is thought may be of interest to our amateur members. The various columns should be self-explanatory but some comments may be in order.

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

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

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

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

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

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

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

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

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
α Andr........	0 3	+28 32	2.2	A1	.217	.034	96	−0.1	−13.0*
β Cass........	4	+58 36	2.4	F2	.561	.080	41	1.9	+11.4
γ Pegs........	8	+14 38	2.9	B2	.015	.005	652	−3.6	+ 5.0*
β Hydi........	20	−77 49	2.9	G0	2.243	.162	21	4.0	+22.8
α Phoe........	21	−42 51	2.4	G5	.448	.040	81	0.4	+74.6*
δ Andr........	34	+30 19	3.5	K3	.167	.026	125	0.6	− 7.1*
α Cass........	35	+55 50	2.2–2.8	G8	.062	.018	181	−1.5	− 3.8
β Ceti........	39	−18 32	2.2	G7	.233	.052	63	0.8	+13.1
‖γ Cass........	51	+60 11	2.2	B0e	.031	.035	93	−0.1	− 6.8
‖β Phoe........	1 2	−47 15	3.4	G4	.043	.020	163	−0.1	− 1.2
β Andr........	4	+35 5	2.4	M0	.219	.041	79	0.5	+ 0.1
δ Cass........	19	+59 43	2.8–2.9	A3	.308	.050	65	1.3	+ 6.8
‖α U. Min......	23	+88 46	2.3–2.4	F7	.043	.008	407	−3.4	−17.4*
γ Phoe........	24	−43 50	3.4	M1	.223	.008	407	−2.1	+25.7*
α **Erid**........	34	−57 44	0.6	B9	.093	.046	71	−1.1	+19.
ε Cass........	47	+63 11	3.4	B5	.043	.011	296	−1.4	− 8.1
β Arie........	49	+20 19	2.7	A3	.150	.066	49	1.8	− 0.6*
α Hydi........	56	−62 3	3.0	A7	.255	.080	41	2.5	+ 7.0*
‖γ Andr........	58	+41 51	2.3	K0	.073	.020	163	−1.2	−11.7
α Arie........	2 2	+22 59	2.2	K2	.242	.045	72	0.5	−14.3
β Tria........	4	+34 31	3.1	A6	.161	.029	112	0.4	+10.4*
‖o Ceti........	14	− 3 26	1.7–9.6	M6e	.239	.013	251	−2.7	+57.8*
‖θ Erid........	54	−40 42	3.4	A2	.068	.032	102	0.9	+11.9*
α Ceti........	57	+ 3 42	2.8	M1	.080	.018	181	−0.9	−25.7
γ Pers........	58	+53 7	3.1	F9	.012	.017	192	−0.7	+ 1.0*
ρ Pers........	59	+38 27	3.3–4.1	M6	.176	.024	136	0.3	+28.2
β Pers........	3 2	+40 34	2.1–3.2	B8	.011	.033	99	−0.3	+ 5.7*
α Pers........	17	+49 30	1.9	F4	.041	.017	192	−2.0	− 2.4
δ Pers........	36	+47 28	3.1	B5	.047	.012	272	−1.5	−10. *
‖η Taur........	41	+23 48	3.0	B5p	.053	.014	233	−1.3	+10.3
ζ Pers........	48	+31 35	2.9	B1	.023	.008	407	−2.6	+20.9
γ Hydi........	49	−74 33	3.2	M3	.124	.008	407	−2.3	+16.0
‖ε Pers........	51	+39 43	3.0	B2	.041	.006	543	−3.1	− 6 *
γ Erid........	53	−13 47	3.2	M0	.133	.012	272	−1.6	+61.7
λ Taur........	55	+12 12	3.8–4.2	B3	.015	.008	407	−2.2	+13.0*
α Reti........	4 13	−62 43	3.4	G5	.070	.016	204	−0.6	+35.6

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

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

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′				″	″		km./sec.
‖γ Leo	10 14	+20 21	2.3	G8	.347	.024	136	−0.8	−36.8
μ U Maj	16	+42 0	3.2	K4	.082	.031	105	0.7	−20.3*
θ Cari	39	−63 52	3.0	B0	.022	.007	466	−2.8	+24. *
η Cari	41	−59 10	1.0–7.4	Pec	.007	.....	.....	......	−25.0
‖μ Velr	42	−48 54	2.8	G5	.079	.033	99	0.4	+ 6.9
ν Hyda	45	−15 40	3.3	K3	.218	.020	163	−0.2	− 1.0
β U Maj	56	+56 55	2.4	A3	.089	.045	72	0.7	−12.1*
α U Maj	58	+62 17	2.0	G5	.137	.036	91	−0.2	− 8.6*
ψ U Maj	11 4	+45 2	3.2	K0	.067	.035	93	0.9	− 3.6
δ Leon	9	+21 4	2.6	A2	.208	.058	56	1.4	−23.2
θ Leon	9	+15 59	3.4	A2	.103	.025	130	0.4	+ 7.8
λ Cent	31	−62 28	3.3	B9	.045	.031	105	0.8	+ 7.9
β Leon	44	+15 8	2.2	A2	.507	.084	39	1.8	− 2.3
γ U Maj	49	+54 15	2.5	A0	.095	.035	93	0.2	−11.1
δ Cent	12 3	−50 10	2.9	B3e	.040	.015	217	−1.2	+ 9.
ε Corv	5	−22 4	3.2	K2	.063	.024	136	0.1	+ 4.9
δ Cruc	10	−58 12	3.1	B3	.045	.017	192	−0.7	+26.4
δ U Maj	10	+57 35	3.4	A0	.113	.050	65	1.9	−12.
γ Corv	11	−16 59	2.8	B8	.159	.024	136	−0.3	− 4.2*
α^1 Cruc	21	−62 33	1.6	B1	.048	.022	148	−1.7	−12.2*
α^2 Cruc	21	−62 32	2.1	B3	.048	.022	148	−1.2	+ 0.3*
‖δ Corv	25	−15 58	3.1	A0	.249	.026	125	0.2	+ 8.7
γ Cruc	26	−56 33	1.5	M4	.270	.....	.....	......	+21.3
β Corv	29	−22 51	2.8	G5	.059	.027	121	0.0	− 7.7
α Musc	31	−68 35	2.9	B5	.040	.015	217	−1.2	+18.
‖γ Cent	36	−48 24	2.4	A0	.200	.032	102	−0.1	− 7.5
‖γ Virg	36	− 0 54	2.9	F0	.561	.080	41	2.4	−19.6
‖β Musc	40	−67 34	3.3	B3	.039	.011	296	−1.5	+42. *
β Cruc	42	−59 9	1.5	B1	.054	.007	466	−4.3	−20. *
ε U Maj	50	+56 30	1.7	A2	.117	.067	49	0.8	−11.9*
‖α^2 C. Ven	51	+38 51	2.8	A1	.233	.030	109	0.2	− 3.5
ε Virg	57	+11 30	3.0	G6	.270	.037	88	0.8	−14.0
γ Hyda	13 13	−22 39	3.3	G7	.085	.028	116	0.5	− 5.4
ι Cent	15	−36 11	2.9	A2	.351	.049	67	1.4	+ 0.1
‖ζ^1 U. Maj	20	+55 27	2.4	A2p	.131	.042	78	0.5	− 9.9*
α **Virg**	20	−10 38	1.2	B2	.051	.018	181	−2.5	+ 1.6*
ζ Virg	30	− 0 5	3.4	A2	.285	.038	86	1.3	−13.1

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

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

Star	R.A. 1900	Decl. 1900	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Red. Vel.
	h m	° ′			″	″			km./sec.
φ Sgtr........	18 39	−27 6	3.3	B8	.150	.015	217	−0.8	+21.5*
‖β Lyra........	46	+33 15	3.4–4.1	B2p	.011	.006	543	−2.7	−19.0*
σ Sgtr........	49	−26 25	2.1	B3	.067	.021	155	−1.3	−10.7
γ Lyra........	55	+32 33	3.3	B9p	.008	.016	204	−0.7	−21.5*
‖ζ Sgtr........	56	−30 1	2.7	A2	.019	.035	93	0.4	+22.1
τ Sgtr........	19 1	−27 49	3.4	K0	.268	.036	91	1.2	+45.4*
ζ Aqil........	1	+13 43	3.0	A0	.103	.038	86	0.9	−25. *
π Sgtr........	4	−21 11	3.0	F2	.041	.017	192	−0.8	− 9.8
δ Drac........	13	+67 29	3.2	G8	.135	.028	116	0.4	+24.8
δ Aqil........	21	+ 2 55	3.4	A3	.267	.052	63	2.0	−32.3*
‖β¹ Cygn.......	27	+27 45	3.2	K0	.010	.010	326	−1.8	−23.9*
γ Agil........	42	+10 22	2.8	K3	.018	.018	181	−0.9	− 2.0
‖δ Cygn.......	42	+44 53	3.0	A1	.067	.023	116	0.2	−20.
α **Aqil**........	46	+ 8 36	0.9	A2	.659	.184	18	2.2	−26.1
θ Aqil........	20 6	− 1 7	3.4	A0	.035	.018	181	−0.3	−28.6*
‖β Capr.......	15	−15 6	3.2	F8	.042	.022	148	−0.1	−19.0*
α Pavo.......	18	−57 3	2.1	B3	.087	.014	233	−2.2	+ 1.8*
γ Cygn.......	19	+39 56	2.3	F8	.006	.008	407	−3.2	− 7.6
α Indi........	31	−47 38	3.2	G2	.072	.034	96	0.9	− 1.1
α **Cygn**.......	38	+44 55	1.3	A2p	.004	.002	1630	−7.2	− 6.3*
ε Cygn.......	42	+33 36	2.6	G7	.485	.040	81	0.6	−10.5*
ζ Cygn.......	21 9	+29 49	3.4	G6	.061	.018	181	−0.3	+16.9*
α Ceph.......	16	+62 10	2.6	A2	.163	.076	43	2.0	− 8.
β Aqar.......	26	− 6 1	3.1	G1	.020	.008	407	−2.4	+ 6.7
β Ceph.......	27	+70 7	3.3–3.4	B1	.013	.006	543	−2.8	− 7.2
ε Pegs........	39	+ 9 25	2.5	K2	.028	.014	233	−1.8	+ 5.2
δ Capr.......	42	−16 35	3.0	A3	.395	.062	53	2.0	− 6.4*
γ Grus........	48	−37 50	3.2	B8	.114	.020	163	−0.3	− 2.1
α Aqar........	22 1	− 0 48	3.2	G0	.019	.006	543	−2.9	+ 7.6
α Grus........	2	−47 27	2.2	B5	.202	.036	91	0.0	+11.8
α Tucn.......	12	−60 45	2.9	K5	.088	.019	172	−0.7	+42.2*
γ Ceph.......	23 35	+77 4	3.4	K1	.167	.062	53	2.4	−42.0
β Grus........	37	−47 24	2.2	M6	.131	.010	326	−2.8	+ 1.6
η Pegs........	38	+29 42	3.1	G1	.039	.016	204	−0.9	+ 4.4*
α **Psc. A**......	52	−30 9	1.3	A3	.367	.118	28	1.7	+ 6.5
β Pegs........	59	+27 32	2.6	M3	.235	.020	163	−0.9	+ 8.6
α Pegs........	59	+14 40	2.6	A0	.077	.033	99	0.2	− 4. *

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 probably 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

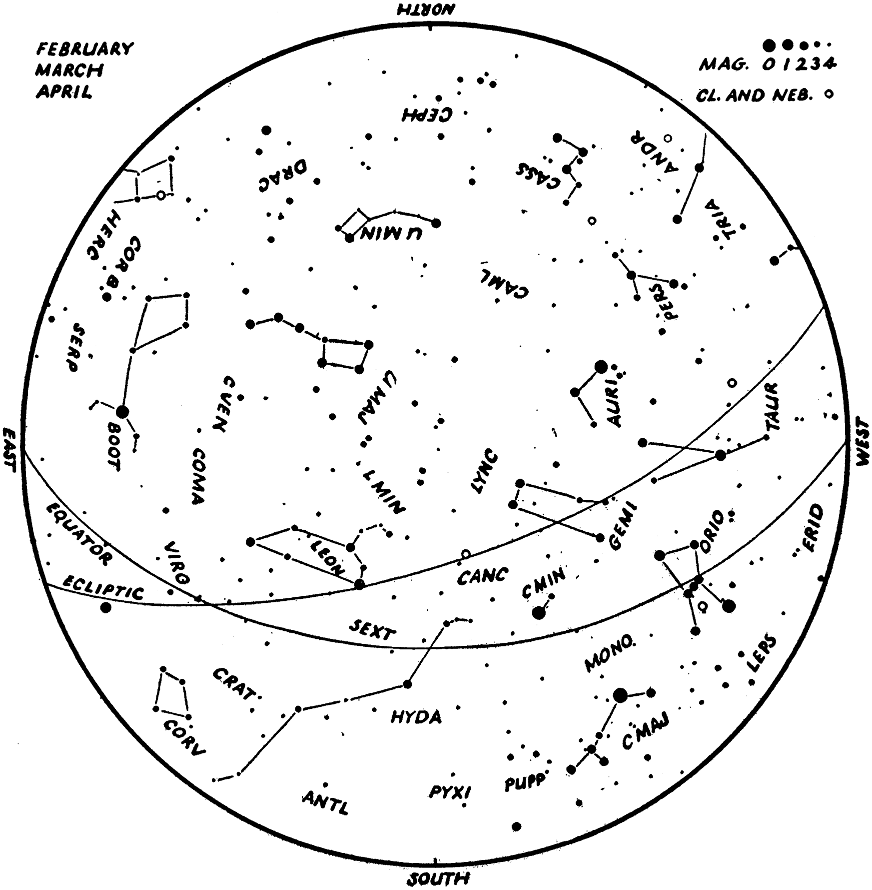
Messier	N.G.C.	R.A. (1900)	Dec. (1900)	Type of Object	Remarks
		h m	° ′		
1	1952	5 28.5	+21 57	Diffuse nebula	The Crab nebula in Taurus
2	7089	21 28.3	− 1 16	Globular cluster	
3	5272	13 37.6	+28 53	Globular cluster	
4	6121	16 17.5	−26 17	Globular cluster	
5	5904	15 13.5	+ 2 27	Globular cluster	
6	6405	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'S CATALOGUE OF CLUSTERS AND NEBULAE—*continued*

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

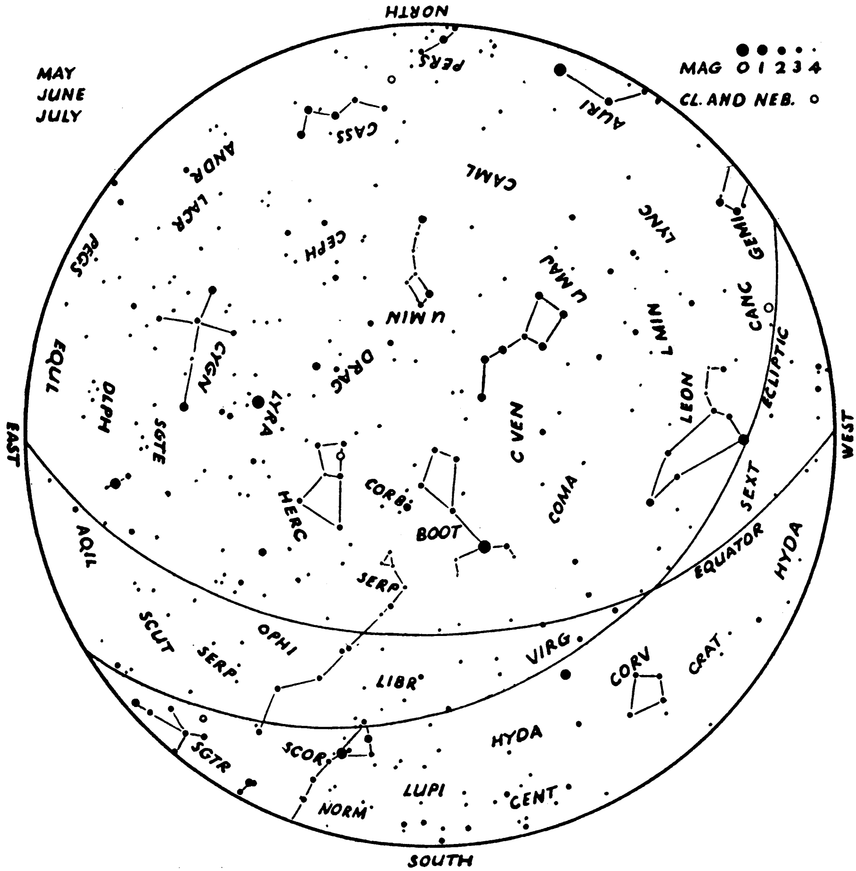


The above map represents the evening sky at

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

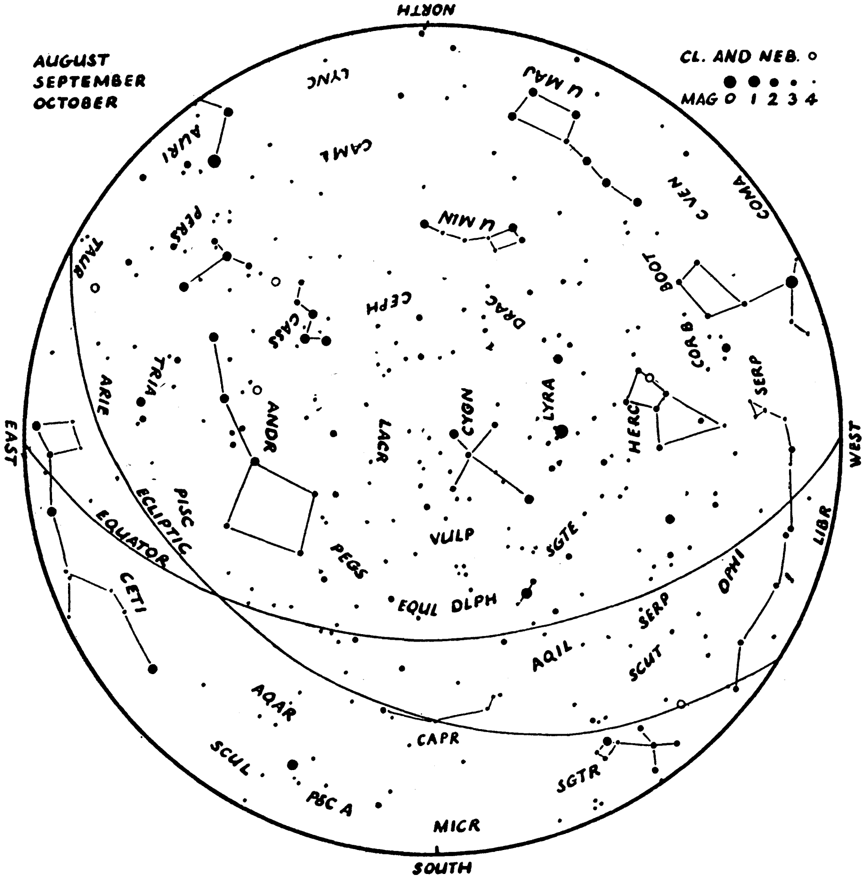


The above map represents the evening sky at

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

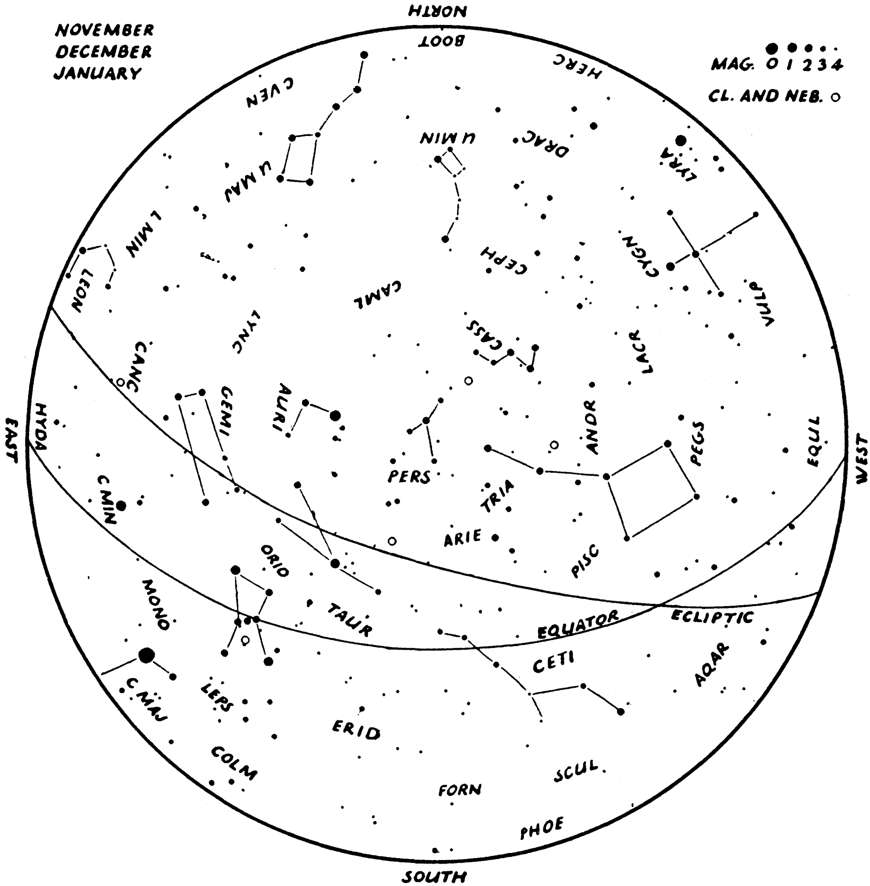


The above map represents the evening sky at

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

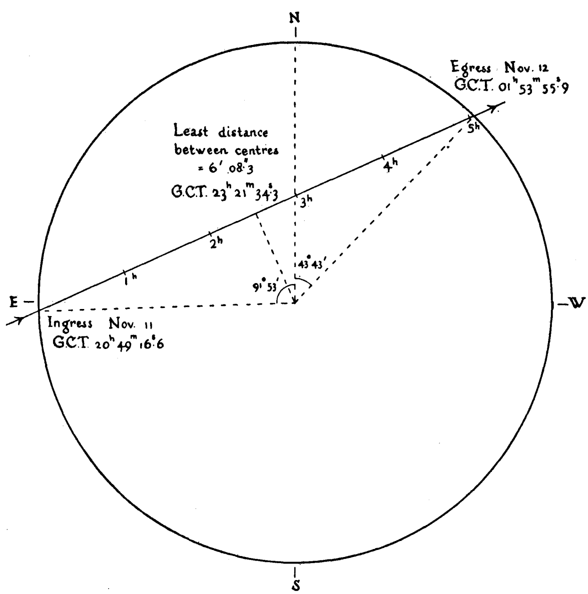
The above table gives the local mean time of the beginning of morning twilight, and of the ending of evening twilight, for various latitudes. To obtain the corresponding standard time, the method used is the same as for correcting the sunrise and sunset tables, as described on page 10. The entry —— in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

TRANSIT OF MERCURY, 1940 NOVEMBER 11-12

A transit of Mercury over the sun's disk, 1940 November 11–12, is partly visible in Canada. The ingress is visible generally in North America except the northeastern part, South America except the extreme eastern part, the Pacific Ocean, the Antarctic Ocean, Australia, and the extreme northeastern part of Asia. The egress is visible generally in the extreme northwestern part of North America, the Pacific Ocean except the extreme eastern part, Australia, Polynesia, the Antarctic Ocean, the Indian Ocean, and Asia except the extreme western part.

The accompanying table gives, for each Time Zone, the Standard Time of ingress for an observer on the standard meridian. In order to find the position of Mercury on the sun's disk at sunset, using the diagram below, the table gives the times between ingress and sunset for various latitudes. The times for stations not on the standard meridian may be obtained by applying the corrections tabulated on page 10.

Standard Time Zone	Standard Time of Ingress	Time between ingress and sunset, for standard meridian				
		36°	40°	44°	48°	52°
Eastern....	3 49 P.M.	$1^h\ 07^m$	$0^h\ 58^m$	$0^h\ 50^m$	$0^h\ 40^m$	$0^h\ 27^m$
Central....	2 49 P.M.	2 07	1 58	1 50	1 40	1 27
Mountain..	1 49 P.M.	3 07	2 58	2 50	2 40	3 27
Pacific.....	12 49 P.M.	4 07	3 58	3 50	3 40	4 27



The Geocentric Phases of the Transit of Mercury, 1940 November 11–12. The positions of Mercury on the sun's disk are shown at one-hour intervals from the time of ingress, external contact.

Temperature and Precipitation at Canadian and United States Stations

Prepared by Andrew Thomson.

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

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA
1890-1940

This year marks the completion of the first fifty years of the corporate existence of our Society. The Society was incorporated in 1890 under the name of The Astronomical and Physical Society of Toronto, and assumed its present name in 1903.

For many years the Toronto organization existed alone, but now the Society is national in extent, having active Centres in Montreal, P.Q.; Ottawa, Toronto, Hamilton and London, Ont.; Winnipeg, Man.; Edmonton, Alta.; Vancouver and Victoria, B.C. As well as about 700 members of these Canadian Centres, there are over 200 members not attached to any Centre, mostly resident in other nations, while some 300 additional institutions or persons are on the regular mailing list for our publications.

The Society publishes a monthly JOURNAL containing about 500 pages and a yearly OBSERVER'S HANDBOOK of 80 pages. Single copies of the JOURNAL or HANDBOOK are 25 cents, postpaid. In quantities of 10 or more copies, the price is 20 cents a copy.

Membership is open to anyone interested in astronomy. Annual dues, $2.00; life membership, $25.00. Publications are sent free to all members or may be subscribed for separately. Applications for membership or publications may be made to the General Secretary, 198 College St., Toronto.

The year 1940 also marks the hundredth anniversary of the founding in Toronto of the first Observatory (magnetic) in Canada. This was one of the first magnetic observatories in the world and became the nucleus of observatory development in Canada.

To mark the semi-centennial of the founding of our Society and the centenary of the founding of the first observatory, our Society plans to hold a special meeting in Toronto in the late summer. It is also planned to publish as a feature of the JOURNAL, articles and early documents dealing with the histories of the observatory and of the society.
