THE OBSERVER'S HANDBOOK 1959

Fifty-first Year of Publication

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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THE OBSERVER'S HANDBOOK 1959

EDITOR
RUTH J. NORTHCOTT

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252 COLLEGE STREET, TORONTO 2B, ONTARIO

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ACKNOWLEDGEMENTS

The OBSERVER'S HANDBOOK for 1959 is the 51st issue. Three additions have been made: daily values of the sun's selenographic colongitude, planetary appulses and occultations, and a table of the nearest stars.

Cordial thanks are offered to those who assisted with the preparation of this volume, Gustav Bakos, Barbara Gaizauskas, William Greig, Kulli Milles, David Sher, Isabel K. Williamson and Dorothy Yane. Special thanks are due to Gordon E. Taylor and the British Astronomical Association for data on planetary appulses and occultations, to R. M. Petrie and Jean K. McDonald of the Dominion Astrophysical Observatory for the compilation of the table on the nearest stars and to Margaret W. Mayall, Director of the A.A.V.S.O., for the predictions of the times of maxima of the long-period variables.

Our deep indebtedness to the British *Nautical Almanac* and *American Ephemeris* is thankfully acknowledged.

RUTH J. NORTHCOTT

ANNIVERSARIES AND FESTIVALS, 1959

New Year's Day	Thu.	Jan.	1
Epiphany	Tue.	Jan.	6
Septuagesima Sunday		Jan.	25
Accession of Queen Elizabeth (1952)	Fri.	Feb.	6
Quinquagesima (Shrove Sunday)		Feb.	8
Ash Wednesday		Feb.	11
St. David	Sun.	Mar.	1
St. Patrick	Tue.	Mar.	17
Palm Sunday		Mar.	22
Good Friday		Mar.	27
Easter Sunday		Mar.	29
Birthday of Queen Elizabeth (1926)	Tue.	Apr.	21
St. George	Thu.	Apr.	23
Rogation Sunday		May	3
Ascension Day	Thu.	May	7
Pentecost (Whit Sunday)		May	17
Empire Day (Victoria Day)	Mon.	May	18
Trinity Sunday		May	24
Corpus Christi	Thu.	May	28
St. John Baptist (Midsummer Day)	Wed.	June	24
Dominion Day	Wed.	July	1
Birthday of Queen Mother Elizabeth (1900)	Tue.	Aug.	4
Labour Day	Mon.	Sept.	7
St. Michael (Michaelmas Day)	Tue.	Sept.	29
Hebrew New Year (Rosh Hashanah)	Sat.	Oct.	3
Thanksgiving Day	Mon.	Oct.	12
All Saints' Day	Sun.	Nov.	1
Remembrance Day	Wed.	Nov.	11
First Sunday in Advent		Nov.	29
St. Andrew	Mon.	Nov.	30
Christmas Day	Fri.	Dec.	25

SYMBOLS AND ABBREVIATIONS

SUN, MOON AND PLANETS

☉ The Sun	☾ The Moon generally	♃ Jupiter
● New Moon	☿ Mercury	♄ Saturn
○ Full Moon	♀ Venus	♅ 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 R.A., Right Ascension; δ or Dec., Declination.
h, m, s, Hours, Minutes, Seconds of Time.
° ′ ″, Degrees, Minutes, Seconds of Arc.

SIGNS OF THE ZODIAC

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

THE GREEK ALPHABET

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

THE CONFIGURATIONS OF JUPITER'S SATELLITES

In the Configurations of Jupiter's Satellites (pages 33, 35, etc.), O represents the disk of the planet, d signifies that the satellite is on the disk, * signifies that the satellite is behind the disk or in the shadow. Configurations are for an inverting telescope.

CALCULATIONS FOR ALGOL

The calculations for the minima of Algol are based on the epoch J.D. 2434576.5110 and period 2.86731 days as published in the 1954 International Supplement, Kracow Observatory.

CELESTIAL DISTANCES

Celestial distances given herein are based on the standard value of 8.80″ for the sun's parallax, not the more recent value 8.790″ determined by Sir Harold Spencer Jones.

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*	Sco	Scor
Sculptor, *Sculptor*	Scl	Scul
Scutum, *Shield*	Sct	Scut
Serpens, *Serpent*	Ser	Serp
Sextans, *Sextant*	Sex	Sext
Taurus, *Bull*	Tau	Taur
Telescopium, *Telescope*	Tel	Tele
Triangulum, *Triangle*	Tri	Tria
Triangulum Australe, *Southern Triangle*	TrA	TrAu
Tucana, *Toucan*	Tuc	Tucn
Ursa Major, *Greater Bear*	UMa	UMaj
Ursa Minor, *Lesser Bear*	UMi	UMin
Vela, *Sails*	Vel	Velr
Virgo, *Virgin*	Vir	Virg
Volans, *Flying Fish*	Vol	Voln
Vulpecula, *Fox*	Vul	Vulp

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

MISCELLANEOUS ASTRONOMICAL DATA

Units of Length

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

Units of Time

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

The Earth

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

Earth's Orbital Motion

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

Solar Motion

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

The Galactic System

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

Extra-galactic Nebulae

Red shift = +180 km./sec./megaparsec = +34 miles /sec./million l.y.

Radiation Constants

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

Miscellaneous

Constant of gravitation, G = 6.670×10^{-8} c.g.s. units
Mass of the electron, m = 9.1055×10^{-28} gm.; mass of the proton = 1.6725×10^{-24} gm.
Planck's constant, h = 6.6234×10^{-27} erg. sec.
Loschmidt's number = 2.6873×10^{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

1959 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

Date 1959	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.	Date 1959	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
	h m s	m s	° ′		h m s	m s	° ′
Jan. 1	18 42 44	+ 3 08	−23 04.7	July 3	6 44 59	+ 3 53	+23 02.3
4	18 55 58	+ 4 32	−22 49.1	6	6 57 21	+ 4 26	+22 47.2
7	19 09 09	+ 5 53	−22 29.4	9	7 09 41	+ 4 56	+22 28.5
10	19 22 16	+ 7 11	−22 05.8	12	7 21 57	+ 5 22	+22 06.4
13	19 35 17	+ 8 23	−21 38.2	15	7 34 08	+ 5 44	+21 40.8
16	19 48 14	+ 9 29	−21 06.9	18	7 46 16	+ 6 02	+21 11.9
19	20 01 04	+10 30	−20 31.9	21	7 58 18	+ 6 15	+20 39.7
22	20 13 47	+11 23	−19 53.5	24	8 10 15	+ 6 22	+20 04.5
25	20 26 23	+12 10	−19 11.7	27	8 22 08	+ 6 25	+19 26.2
28	20 38 52	+12 49	−18 26.7	30	8 33 55	+ 6 22	+18 45.0
31	20 51 15	+13 22	−17 38.8				
				Aug. 2	8 45 36	+ 6 14	+18 01.0
Feb. 3	21 03 29	+13 47	−16 48.0	5	8 57 13	+ 6 01	+17 14.4
6	21 15 37	+14 05	−15 54.5	8	9 08 44	+ 5 42	+16 25.2
9	21 27 38	+14 16	−14 58.6	11	9 20 09	+ 5 18	+15 33.7
12	21 39 31	+14 20	−14 00.4	14	9 31 30	+ 4 49	+14 40.0
15	21 51 17	+14 16	−13 00.2	17	9 42 45	+ 4 14	+13 44.1
18	22 02 57	+14 06	−11 58.0	20	9 53 55	+ 3 35	+12 46.4
21	22 14 30	+13 50	−10 54.2	23	10 05 01	+ 2 52	+11 46.7
24	22 25 57	+13 27	− 9 48.8	26	10 16 03	+ 2 04	+10 45.4
27	22 37 19	+12 59	− 8 42.1	29	10 27 02	+ 1 13	+ 9 42.6
Mar. 2	22 48 36	+12 26	− 7 34.3	Sept. 1	10 37 58	+ 0 19	+ 8 38.3
5	22 59 48	+11 49	− 6 25.4	4	10 48 50	− 0 38	+ 7 32.8
8	23 10 57	+11 08	− 5 15.7	7	10 59 41	− 1 37	+ 6 26.2
11	23 22 02	+10 23	− 4 05.4	10	11 10 29	− 2 39	+ 5 18.7
14	23 33 03	+ 9 36	− 2 54.7	13	11 21 16	− 3 42	+ 4 10.3
17	23 44 03	+ 8 45	− 1 43.7	16	11 32 02	− 4 45	+ 3 01.3
20	23 55 00	+ 7 53	− 0 32.5	19	11 42 47	− 5 50	+ 1 51.8
23	0 05 56	+ 6 59	+ 0 38.6	22	11 53 33	− 6 54	+ 0 42.0
26	0 16 51	+ 6 04	+ 1 49.4	25	12 04 19	− 7 57	− 0 28.1
29	0 27 45	+ 5 09	+ 2 59.9	28	12 15 07	− 8 58	− 1 38.3
Apr. 1	0 38 40	+ 4 15	+ 4 09.9	Oct. 1	12 25 57	− 9 58	− 2 48.3
4	0 49 36	+ 3 21	+ 5 19.2	4	12 36 50	−10 55	− 3 58.1
7	1 00 34	+ 2 29	+ 6 27.7	7	12 47 45	−11 49	− 5 07.5
10	1 11 33	+ 1 39	+ 7 35.2	10	12 58 44	−12 40	− 6 16.3
13	1 22 35	+ 0 50	+ 8 41.5	13	13 09 47	−13 27	− 7 24.4
16	1 33 39	+ 0 05	+ 9 46.6	16	13 20 54	−14 10	− 8 31.5
19	1 44 46	− 0 37	+10 50.1	19	13 32 06	−14 47	− 9 37.5
22	1 55 57	− 1 16	+11 52.0	22	13 43 23	−15 19	−10 42.3
25	2 07 12	− 1 52	+12 52.2	25	13 54 47	−15 45	−11 45.7
28	2 18 30	− 2 22	+13 50.5	28	14 06 17	−16 05	−12 47.4
				31	14 17 54	−16 17	−13 47.4
May 1	2 29 54	− 2 48	+14 46.7				
4	2 41 22	− 3 10	+15 40.8	Nov. 3	14 29 38	−16 23	−14 45.5
7	2 52 56	− 3 26	+16 32.5	6	14 41 30	−16 21	−15 41.3
10	3 04 35	− 3 37	+17 21.8	9	14 53 28	−16 13	−16 34.8
13	3 16 18	− 3 43	+18 08.4	12	15 05 34	−15 56	−17 25.8
16	3 28 07	− 3 44	+18 52.3	15	15 17 48	−15 32	−18 14.1
19	3 40 01	− 3 40	+19 33.3	18	15 30 09	−15 01	−18 59.5
22	3 51 59	− 3 31	+20 11.3	21	15 42 38	−14 22	−19 41.9
25	4 04 03	− 3 17	+20 46.3	24	15 55 14	−13 35	−20 21.1
28	4 16 11	− 2 59	+21 18.0	27	16 07 57	−12 42	−20 56.8
31	4 28 23	− 2 36	+21 46.4	30	16 20 47	−11 41	−21 29.1
June 3	4 40 39	− 2 09	+22 11.4	Dec. 3	16 33 44	−10 34	−21 57.7
6	4 52 59	− 1 39	+22 32.9	6	16 46 46	− 9 22	−22 22.5
9	5 05 22	− 1 06	+22 50.9	9	16 59 52	− 8 05	−22 43.3
12	5 17 47	− 0 30	+23 05.2	12	17 13 03	− 6 44	−23 00.2
15	5 30 14	+ 0 07	+23 15.9	15	17 26 17	− 5 20	−23 12.9
18	5 42 42	+ 0 45	+23 22.9	18	17 39 33	− 3 53	−23 21.5
21	5 55 11	+ 1 24	+23 26.2	21	17 52 52	− 2 24	−23 25.9
24	6 07 39	+ 2 03	+23 25.8	24	18 06 11	− 0 55	−23 26.0
27	6 20 07	+ 2 41	+23 21.7	27	18 19 30	+ 0 35	−23 22.0
30	6 32 34	+ 3 18	+23 13.8	30	18 32 49	+ 2 04	−23 13.6

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

ORBITAL ELEMENTS (1954, Dec. 31, 12^h G.C.T.)

Planet	Mean Distance from Sun (a)		Period of Revolution		Eccentricity (e)	Inclination (i)	Long. of Node (☊)	Long. of Perihelion (π)	Mean Long. of Planet
	⊕ = 1	millions of miles	Sidereal (P)	Mean Synodic					
				days		°	°	°	°
Mercury	0.387	36.0	88.0d.	116	.206	7.0	47.8	76.8	305.8
Venus	0.723	67.2	224.7	584	.007	3.4	76.3	130.9	127.1
Earth	1.000	92.9	365.3	...	.017	....	....	102.2	99.4
Mars	1.524	141.5	687.0	780	.093	1.8	49.2	335.2	21.3
Jupiter	5.203	483.3	11.86y.	399	.048	1.3	100.0	13.6	108.0
Saturn	9.539	886.	29.46	378	.056	2.5	113.3	92.2	219.5
Uranus	19.18	1783.	84.01	370	.047	0.8	73.8	169.9	119.8
Neptune	30.06	2791.	164.8	367	.009	1.8	131.3	44.2	205.9
Pluto	39.52	3671.	248.4	367	.249	17.1	109.6	223.2	137.6

PHYSICAL ELEMENTS

Object	Symbol	Mean Diameter* miles	Mass* ⊕ = 1	Mean Density* water = 1	Axial Rotation	Mean Surface Gravity* ⊕ = 1	Albedo*	Magnitude at Greatest Brilliancy
Sun	☉	864,000	332,000	1.41	$24^d.7$ (equatorial)	27.9		−26.8
Moon	☾	2,160	0.0123	3.33	$27^d\ 7.7^h$	0.16	0.072	−12.6
Mercury	☿	3,010	0.0543	5.46	88^d	0.38	0.058	− 1.9
Venus	♀	7,610	0.8136	5.06	30^d?	0.88	0.76	− 4.4
Earth	⊕	7,918	1.0000	5.52	$23^h\ 56^m.1$	1.00	0.39	
Mars	♂	4,140	0.1069	4.12	$24^h\ 37^m.4$	0.39	0.148	− 2.8
Jupiter	♃	86,900	318.35	1.35	$9^h\ 50^m\pm$	2.65	0.51	− 2.5
Saturn	♄	71,500	95.3	0.71	$10^h\ 02^m\pm$	1.17	0.50	− 0.4
Uranus	♅	29,500	14.54	1.56	$10^h.8\pm$	1.05	0.66	+ 5.7
Neptune	♆	26,800	17.2	2.47	$15^h.8\pm$	1.23	0.62	+ 7.6
Pluto	♇	3,600	0.033?	2?	$6^d.390$	0.16?	0.16	+14

*Kuiper, "The Atmospheres of the Earth and Planets," 1952.

SATELLITES OF THE SOLAR SYSTEM

Name	Stellar Mag.	Mean Dist. from Planet			Revolution Period			Diameter Miles	Discoverer
		"	*	Miles	d	h	m		
SATELLITE OF THE EARTH									
Moon	−12.6	530		238,857	27	07	43	2160	
SATELLITES OF MARS									
Phobos	12	8		5,800	0	07	39	10?	Hall, 1877
Deimos	13	21		14,600	1	06	18	5?	Hall, 1877
SATELLITES OF JUPITER									
V	13	48		112,600	0	11	57	100?	Barnard, 1892
Io	5	112		261,800	1	18	28	2300	Galileo, 1610
Europa	6	178		416,600	3	13	14	2000	Galileo, 1610
Ganymede	5	284		664,200	7	03	43	3200	Galileo, 1610
Callisto	6	499		1,169,000	16	16	32	3200	Galileo, 1610
VI	14	3037		7,114,000	250	16		100?	Perrine, 1904
VII	16	3113		7,292,000	260	01		40?	Perrine, 1905
X	18	3116		7,300,000	260			15?	Nicholson, 1938
XI	18	5990		14,000,000	692			15?	Nicholson, 1938
VIII	16	6240		14,600,000	739			40?	Melotte, 1908
IX	17	6360		14,900,000	758			20?	Nicholson, 1914
XII	18	—		—	631			15?	Nicholson, 1951
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									
Miranda	17	9		81,000	1	09	56		Kuiper, 1948
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
SATELLITES OF NEPTUNE									
Triton	13	16		220,000	5	21	03	3000?	Lassell, 1846
Nereid	19	260		3,460,000	359			200?	Kuiper, 1949

*As seen from the sun.

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

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 Sun-dial* 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. At 0h. G.C.T. the Greenwich Sidereal Time = R.A. apparent sun + 12h. − correction to sun-dial (p. 7). Sidereal time gains with respect to mean time at the rate of 3m. 56s. a day or about 2 hours a month.

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 seven standard time belts, as follows;—Newfoundland Time, 3h. 30m. slower than Greenwich; 60th meridian or Atlantic Time, 4h.; 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 11.

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

MAP OF STANDARD TIME ZONES

Revisions: Newfoundland Time is 3h. 30m. slower than Greenwich Time.
The "panhandle" region of Alaska, containing such towns as Juneau and Skagway, is on 120th meridian (Pacific) Time, instead of Yukon Time.

JULIAN DAY CALENDAR, 1959

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

Jan. 1.....6,570	May 1.....6,690	Sept. 1.....6,813
Feb. 1.....6,601	June 1.....6,721	Oct. 1.....6,843
Mar. 1.....6,629	July 1.....6,751	Nov. 1.....6,874
Apr. 1.....6,660	Aug. 1.....6,782	Dec. 1.....6,904

The Julian Day commences at noon. Thus J.D. 2,436,570.0 = Jan. 1.5 G.C.T.

TIMES OF RISING AND SETTING OF THE SUN AND MOON

The times of sunrise and sunset for places in latitudes ranging from 32° to 54° are given on pages 13 to 18, and of twilight on page 19. The times of moonrise and moonset are given on pages 20 to 25. The times are given in Local Mean Time, and in the table below are given corrections to change from Local Mean Time to Standard Time for the cities and towns named.

The tabulated values are computed for the sea horizon for the rising and setting of the upper limb of the sun and moon, and are corrected for refraction. Because variations from the sea horizon usually exist on land, the tabulated times can rarely be observed.

The sun's declination, apparent diameter and the equation of time do not have precisely the same values on corresponding days from year to year. As the times of sunrise and sunset depend upon these factors, these tables for the solar phenomena can give only average values which may be in error by one or two minutes.

The Standard Times for Any Station

To derive the Standard Time of rising and setting phenomena for any place, 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 Mean Time of the phenomenon for the proper latitude on the desired day. Finally apply the correction to get the Standard Time.

CANADIAN CITIES AND TOWNS						AMERICAN CITIES		
	Lat.	Cor.		Lat.	Cor.		Lat.	Cor.
Belleville	44	+ 09	Peterborough	44	+ 13	Atlanta	34	+ 37
Brandon	50	+ 40	Port Arthur	48	+ 57	Baltimore	39	+ 06
Brantford	43	+ 21	Prince Albert	53	+ 03	Birmingham	34	− 13
Calgary	51	+ 36	Prince Rupert	54	+ 41	Boston	42	− 16
Charlottetown	46	+ 13	Quebec	47	− 15	Buffalo	43	+ 15
Chatham	42	+ 29	Regina	50	− 02	Chicago	42	− 10
Cornwall	45	− 01	St. Catharines	43	+ 17	Cincinnati	39	+ 38
Dawson	64	+ 18	St. Hyacinthe	46	− 09	Cleveland	42	+ 26
Edmonton	54	+ 34	Saint John, N.B.	45	+ 24	Dallas	33	+ 27
Fort William	48	+ 57	St. John's, Nfld.	48	+ 01	Denver	40	00
Fredericton	46	+ 26	St. Thomas	43	+ 25	Detroit	42	+ 32
Galt	43	+ 21	Sarnia	43	+ 30	Fairbanks	65	− 10
Glace Bay	46	00	Saskatoon	52	+ 07	Indianapolis	40	− 15
Granby	45	− 09	Sault Ste. Marie	47	+ 37	Juneau	58	+ 58
Guelph	44	+ 21	Shawinigan Falls	47	− 09	Kansas City	39	+ 18
Halifax	45	+ 15	Sherbrooke	45	− 13	Los Angeles	34	− 07
Hamilton	43	+ 19	Stratford	43	+ 24	Louisville	38	− 17
Hull	45	+ 03	Sudbury	47	+ 24	Memphis	35	00
Kingston	44	+ 06	Sydney	46	+ 01	Milwaukee	43	− 09
Kitchener	43	+ 22	Timmins	48	+ 26	Minneapolis	45	+ 13
London	43	+ 25	Toronto	44	+ 18	New Orleans	30	00
Medicine Hat	50	+ 23	Three Rivers	46	− 10	New York	41	− 04
Moncton	46	+ 19	Trail	49	− 09	Omaha	41	+ 24
Montreal	45	− 06	Truro	45	+ 13	Philadelphia	40	+ 01
Moose Jaw	50	+ 02	Vancouver	49	+ 12	Pittsburgh	40	+ 20
Niagara Falls	43	+ 16	Victoria	48	+ 14	Portland	46	+ 11
North Bay	46	+ 18	Windsor	42	+ 32	St. Louis	39	+ 01
Oshawa	44	+ 15	Winnipeg	50	+ 29	San Francisco	38	+ 10
Ottawa	45	+ 03	Woodstock	43	+ 23	Seattle	48	+ 09
Owen Sound	45	+ 24	Yellowknife	63	+ 37	Washington	39	+ 08

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

In the above list Owen Sound is under "45°", and the correction is + 24 min. On page 13 the time of sunrise on February 12 for latitude 45° is 7.07; add 24 min. and we get 7.31 (Eastern Standard Time).

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

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

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

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

	DATE	Latitude 32° Sunrise	Latitude 32° Sunset	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 54° Sunrise	Latitude 54° 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	h m	h m
September	2	5 35	6 23	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 08	6 50
	4	5 36	6 22	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 12	6 46
	6	5 38	6 19	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 15	6 41
	8	5 39	6 17	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 19	6 36
	10	5 41	6 13	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 22	6 31
	12	5 42	6 10	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 26	6 26
	14	5 43	6 09	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 30	6 21
	16	5 44	6 05	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 33	6 16
	18	5 46	6 02	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 37	6 11
	20	5 46	6 01	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 40	6.06
	22	5 48	5 57	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 01
	24	5 49	5 56	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 52	5 51	5 51	5 51	5 51	5 51	5 51
	28	5 52	5 49	5 52	5 49	5 52	5 49	5 53	5 48	5 53	5 48	5 54	5 47	5 54	5 47	5 55	5 46
	30	5 54	5 46	5 53	5 46	5 54	5 46	5 55	5 44	5 56	5 44	5 57	5 43	5 57	5 43	5 58	5 41
October	2	5 54	5 44	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 02	5 36
	4	5 56	5 41	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 06	5 31
	6	5 57	5 39	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 09	5 26
	8	5 58	5 36	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 13	5 21
	10	6 00	5 34	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 17	5 17
	12	6 00	5 33	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 20	5 12
	14	6 03	5 29	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 24	5 07
	16	6 04	5 27	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 28	5 02
	18	6 05	5 25	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 32	4 58
	20	6 07	5 22	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 36	4 53
	22	6 09	5 20	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 39	4 49
	24	6 10	5 18	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 43	4 44
	26	6 12	5 16	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 47	4 40
	28	6 13	5 14	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 51	4 36
	30	6 15	5 12	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 55	4 32

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

BEGINNING OF MORNING AND ENDING OF EVENING TWILIGHT

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

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 12. 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).

TIME OF MOONRISE AND MOONSET, 1959. (Local Mean Time)

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

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

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

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

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

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

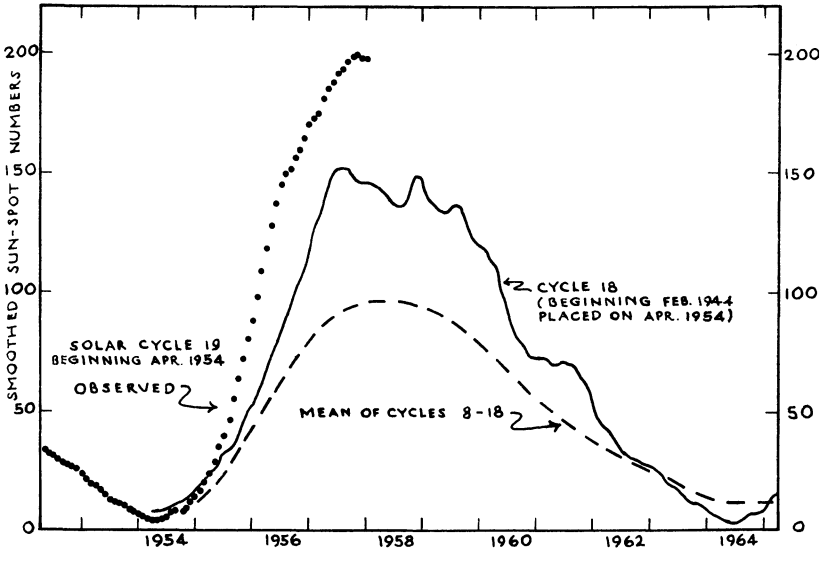
THE PLANETS FOR 1959

THE SUN

The diagram represents the sun-spot activity of the current 19th cycle, as far as the final numbers are available. The present cycle began at the minimum in April 1954. For comparison, cycle 18 which began February 1944 (solid curve), and the mean of cycles 8 to 18 (dashed curve), are placed with their minima on April 1954.

The present cycle reached its maximum in January 1958 and since then has been declining slowly. It is expected that by the conclusion of the International Geophysical Year at the end of 1958, the solar activity will have dropped considerably.

The observations for sun-spot numbers may be performed by devoted amateur astronomers with small-sized telescopes (suitably protected). Here is a field for amateurs who wish to make a valuable contribution to solar astronomy.



MERCURY

Mercury is exceptional in many ways. It is the planet nearest the sun and travels fastest in its orbit, its speed varying from 23 mi. per sec. at aphelion to 35 mi. per sec. at perihelion. The amount of heat and light from the sun received by it per square mile is, on the average, 6.7 times the amount received by the earth. Its period of rotation on its axis is believed to be the same as its period of revolution about the sun, which is 88 days.

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

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

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

MAXIMUM ELONGATIONS OF MERCURY DURING 1959

Elong. East – Evening Star			Elong. West – Morning Star		
Date	Distance	Mag.	Date	Distance	Mag.
Mar. 12	18°	−0.1	Apr. 26	27°	+0.7
July 8	26°	+0.7	Aug. 23	18°	+0.1
Nov. 3	24°	+0.0	Dec. 12	21°	−0.2

The most favourable elongations to observe are: in the evening, Mar. 12, and in the morning, Aug. 23. At these times Mercury is over 80 million miles from the earth, and in a telescope looks like a half-moon about 7″ in diameter.

VENUS

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

On Jan. 1, 1959, Venus is in the evening sky and crosses the meridian an hour after the sun. Its declination is −23° and it appears very low in the south-western sky at sunset. It is quite brilliant, its stellar magnitude being −3.4. It reaches greatest elongation east, 45° 25′, on June 23, with stellar magnitude −4.0. Its declination is +18° and it transits the meridian over 3 hours after the sun. On July 7 Venus occults Regulus, *see* p. 59. Greatest brilliancy, mag. −4.2, is attained on July 26. By Sept. 1 it is in inferior conjunction with the sun. It now becomes a morning star and attains greatest brilliancy, mag. −4.3, on Oct. 8. It reaches greatest elongation west, 46° 37′, on Nov. 11. Its declination is 0°, and it transits about 3 hours before the sun. It remains in the morning sky, about the same angular distance from the sun, for the rest of the year, and by Dec. 31 it is in declination −17°.

With the exception of the sun and moon, Venus is the brightest object in the sky. Its brilliance is largely due to the dense clouds which cover the surface of the planet. They reflect well the sun's light; but they also prevent the astronomer from detecting any solid object on the surface of the body. If such could be observed it would enable him to determine the planet's rotation period. It is probably around 30 days.

MARS

The orbit of Mars is outside that of the earth and consequently its planetary phenomena are quite different from those of the two inferior planets discussed

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

The sidereal, or true mechanical, period of revolution of Mars is 687 days; and the synodic period (for example, the interval from one opposition to the next one) is 780 days. This is the average value; it may vary from 764 to 810 days. At the opposition on Sept. 10, 1956, the planet was closer to the earth than it will be for some years. The planet was in opposition on Nov. 16, 1958; then on Dec. 30, 1960. There will not be an opposition in 1959.

On Jan. 1, 1959, Mars is in Aries, and is well up in the east at sunset; its stellar magnitude is −0.6. It remains in the evening sky until it comes into conjunction with the sun on Oct. 29. On Dec. 31 it is in Ophiuchus. For its position throughout the year see the map.

JUPITER

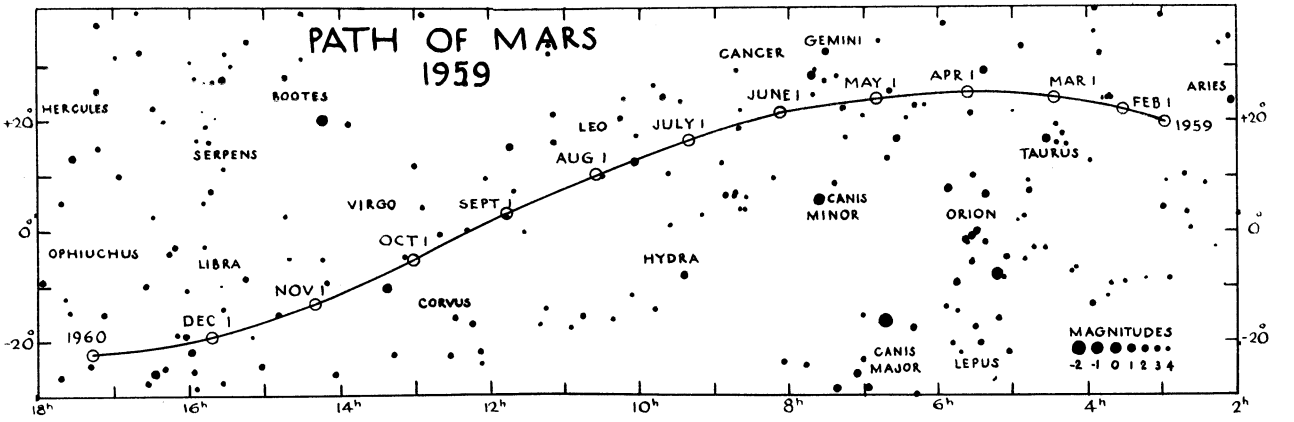
Jupiter is the giant of the family of the sun. Its mean diameter is 87,000 miles and its mass is $2\frac{1}{2}$ times that of all the rest of the planets combined! Its mean distance is 483 million miles and the revolution period is 11.9 years. This planet is known to possess 12 satellites, the last discovered in 1951 (see p. 9). Not so long ago it was generally believed that the planet was still cooling down from its original high temperature, but from actual measurements of the radiation from it to the earth it has been deduced that the surface is at about −200°F. The spectroscope shows that its atmosphere is largely ammonia and methane.

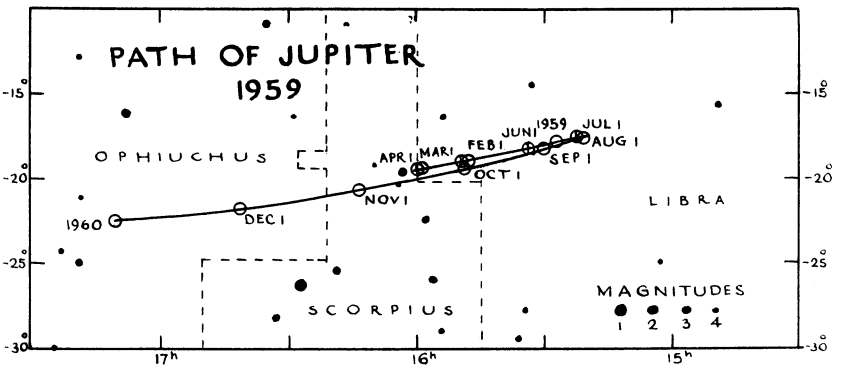
Jupiter is a fine object for the telescope. Many details of the surface as well as the flattening of the planet, due to its short rotation period, are visible, and the phenomena of its satellites provide a continual interest.

On Jan. 1, 1959, Jupiter is in the morning sky in the constellation Libra, crossing the meridian over three hours before the sun. Its stellar magnitude is −1.4. It comes into opposition with the sun on May 18, when it moves into the evening sky and is visible all night. Its magnitude has brightened to −2.1. It retrogrades from Mar. 18 to July 20 (*see map*). It is in conjunction with the sun on Dec. 5, and is in the morning sky for the rest of the year. On Dec. 31 it is in Ophiuchus but is still too close to the sun for easy observation.

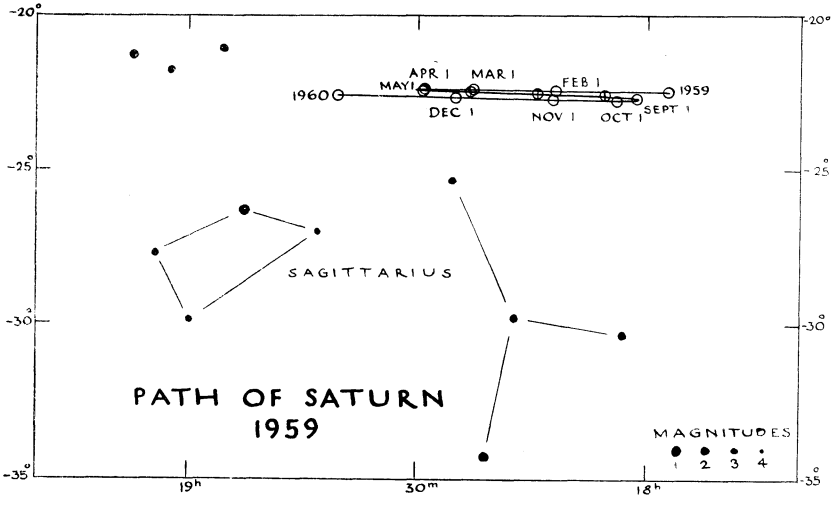
SATURN

Saturn was the outermost planet known until modern times. In size it is a good second to Jupiter. In addition to its family of nine satellites, this planet has a unique system of rings, and it is one of the finest of celestial objects in a good telescope. The plane of the rings makes an angle of 27° with the plane of the planet's orbit, and twice during the planet's revolution period of $29\frac{1}{2}$ years the rings appear to open out widest; then they slowly close in until, midway between the maxima, the rings are presented edgewise to the sun or the earth, at which times they are invisible. The rings were edgewise in 1937 and 1950, and at maximum in 1944 and in 1958.


PATH OF MARS
1959
HERCULES
BOOTES
SERPENS
OPHIUCHUS
LIBRA
VIRGO
CORVUS
LEO
CANCER
GEMINI
CANIS MINOR
HYDRA
ORION
TAURUS
ARIES
CANIS MAJOR
LEPUS
1960
DEC 1
NOV 1
OCT 1
SEPT 1
AUG 1
JULY 1
JUNE 1
MAY 1
APR 1
MAR 1
FEB 1
1959
MAGNITUDES
-2 -1 0 1 2 3 4
+20°
0°
-20°
18h
16h
14h
12h
10h
8h
6h
4h
2h


PATH OF JUPITER
1959
OPHIUCHUS
SCORPIUS
LIBRA
1960
DEC 1
NOV 1
OCT 1
SEP 1
AUG 1
JUL 1
1959
JUNE 1
MAY 1
APR 1
MAR 1
FEB 1
MAGNITUDES
1 2 3 4
-15°
-20°
-25°
-30°
17h
16h
15h

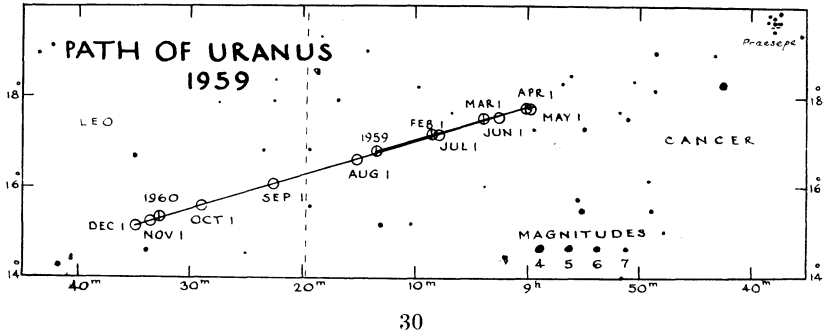
On Jan. 1, 1959, Saturn is in Sagittarius in the morning sky (*see map*). Its stellar magnitude is +0.7. On Apr. 16 it reaches a stationary point and begins to move westward, or retrograde. Opposition occurs on June 25, and it is visible most of the night with stellar magnitude +0.2. It continues to retrograde until Sept. 4, when it again begins to move eastward. Conjunction with the sun occurs on the last day of the year.



URANUS

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

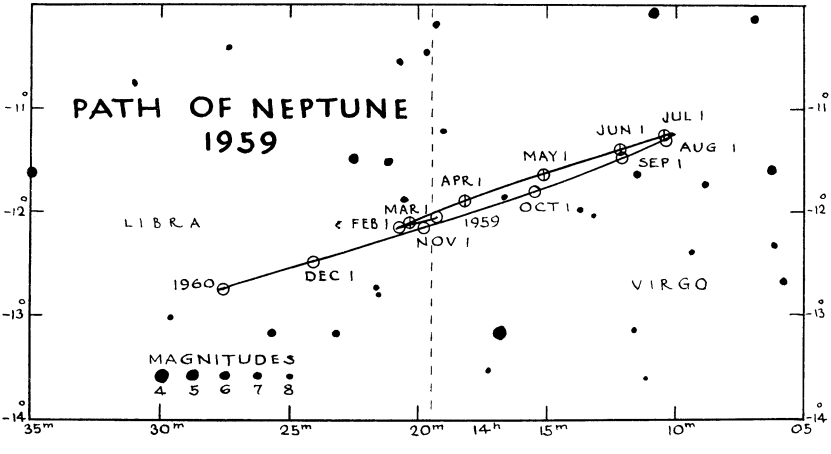
Uranus moves from Cancer into Leo during 1959 (*see map*). At the beginning of the year it is in the evening sky and is retrograding (direct motion is resumed



on Apr. 20). On Feb. 3 it is in opposition to the sun and is above the horizon all night; its apparent diameter is 3.9″ and its stellar magnitude is +5.8. By the time of conjunction on Aug. 9 its magnitude has faded to +6.0. For the rest of the year it is in the morning sky. It is to be noted that Mars passes close to the planet on June 23rd.

NEPTUNE

Neptune was discovered in 1846 after its existence in the sky had been predicted from independent calculations by Leverrier in France and Adams in England. It caused a sensation at the time. Its distance from the sun is 2791 million miles and its period of revolution is 165 years. A satellite was discovered in 1846 soon after the planet. A second satellite was discovered by G. P. Kuiper at the McDonald Observatory on May 1, 1949. Its magnitude is about 19.5, its period about a year, and diameter about 200 miles. It is named Nereid.



During 1959 Neptune is in the constellations Virgo and Libra (*see map*). It is in opposition to the sun on Apr. 26, when it is above the horizon all night. Its stellar magnitude is then +7.57, and during the year it fades slightly to +7.82. Thus it is too faint to be seen with the naked eye. In the telescope it shows a greenish tint and an apparent diameter of from 2.5″ to 2.3″. It is in conjunction with the sun on Oct. 30.

PLUTO

Pluto, the most distant known planet, was discovered at the Lowell Observatory in 1930 as a result of an extended search started two decades earlier by Percival Lowell. The faint star-like image was first detected by Clyde Tombaugh by comparing photographs taken on different dates. Further observations confirmed that the object was a distant planet. Its mean distance from the sun is 3671 million miles and its revolution period is 248 years. It appears as a 15th mag. star in the constellation Leo. It is in opposition to the sun on Feb. 22, at which time its astrometric position is R.A. $10^h\ 38^m$, Dec. +21° 52′.

THE SKY MONTH BY MONTH

By J. F. HEARD

THE SKY FOR JANUARY, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During January the sun's R.A. increases from 18h 43m to 20h 55m and its Decl. changes from 23° 05′ S. to 17° 22′ S. The equation of time changes from −3m 08s to −13m 31s. The earth is in perihelion or nearest the sun on the 1st.

For changes in the length of the day, see p. 13.

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

Mercury on the 15th is in R.A. 18h 27m, Decl. 23° 36′ S. and transits at 10h 53m. For the first few days of the month it may be seen as a morning star low in the south-east just before sunrise.

Venus on the 15th is in R.A. 20h 50m, Decl. 19° 16′ S., mag. −3.4, and transits at 13h 16m. It is an evening star seen low in the south-west for about an hour after sunset.

Mars on the 15th is in R.A. 3h 10m, Decl. 19° 45′ N., mag. −0.2, and transits at 19h 32m. In Aries, its well up in the eastern sky at sunset and is visible most of the night.

Jupiter on the 15th is in R.A. 15h 37m, Decl. 18° 25′ S., mag. −1.4, and transits at 8h 01m. In Libra, it rises some four hours before sunrise. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 18h 05m, Decl. 22° 30′ S., mag. +0.7, and transits at 10h 28m. It is in Sagittarius, a morning star, rising about two hours before the sun.

Uranus on the 15th is in R.A. 9h 11m, Decl. 16° 58′ N. and transits at 1h 35m. It rises about two hours after sunset.

Neptune on the 15th is in R.A. 14h 20m, Decl. 12° 08′ S. and transits at 6h 43m. It rises about two hours after midnight.

Pluto—For information in regard to this planet, see p. 31.

By RUTH J. NORTHCOTT

JANUARY

75th Meridian Civil Time

	d	h	m		Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 6h 45m
					°	h m	
Thu.	1	20		⊕ in Perihelion. Dist. from ☉, 91,344,000 mi.	165.25		31024
Fri.	2	0		☿ in Aphelion	177.40		03124
		5	50	☾ Last Quarter			
Sat.	3			Quadrantid meteors	189.56	10 44	21034
Sun.	4	0	58	☌♆☾ ♆ 0° 09′ N.	201.72		d2043
Mon.	5	6	24	☌♃☾ ♃ 2° 05′ S.	213.89		40132
		15		☾ in Perigee. Dist. from ⊕, 228,100 mi.			
Tue.	6				226.07	7 33	43102
Wed.	7	10	43	☌☿☾ ☿ 3° 58′ S.	238.25		43201
		18	18	☌♄☾ ♄ 3° 50′ S.			
Thu.	8				250.44		4310*
Fri.	9	0	34	● New Moon	262.63	4 23	4012*
Sat.	10	6	21	☌♀☾ ♀ 6° 20′ S.	274.82		41203
		23		☌☿♄ ☿ 0° 45′ S.			
Sun.	11				287.01		42013
Mon.	12	12		☿ in ♉	299.19	1 11	4023*
Tue.	13				311.38		31402
Wed.	14				323.55	22 00	32014
Thu.	15				335.73		31204
Fri.	16	16	26	◑ First Quarter	347.90		0124*
Sat.	17	12		☾ in Apogee. Dist. from ⊕, 251,200 mi.	0.06	18 50	12034
Sun.	18	17	38	☌♂☾ ♂ 4° 57′ N.	12.21		20134
Mon.	19				24.36		0234*
Tue.	20				36.51	15 39	31024
Wed.	21				48.65		32014
Thu.	22	19		☿ in Aphelion	60.78		31240
Fri.	23				72.91	12 28	43012
Sat.	24	13		☿ Greatest Hel. Lat. S.	85.04		41023
		14	32	○ Full Moon			
Sun.	25	12	11	☌♁☾ ♁ 5° 17′ N.	97.17		42013
Mon.	26				109.30	9 18	41023
Tue.	27	10		□♆☉ West	121.43		dd402
Wed.	28				133.56		43201
Thu.	29				145.70	6 07	34210
Fri.	30				157.84		34012
Sat.	31	1		☾ in Perigee. Dist. from ⊕, 230,100 mi.	169.99		10234
		6	51	☌♆☾ ♆ 0° 07′ S.			
		14	06	☾ Last Quarter			

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR FEBRUARY, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During February the sun's R.A. increases from 20h 55m to 22h 45m and its Decl. changes from 17° 22′ S. to 7° 57′ S. The equation of time changes from −13m 31s to a minimum of −14m 20s on the 12th and then to −12m 38s at the end of the month. For changes in the length of the day, see p. 13.

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

Mercury on the 15th is in R.A. 21h 56m, Decl. 14° 39′ S. and transits at 12h 22m. It is too close to the sun for observation, superior conjunction being on the 14th.

Venus on the 15th is in R.A. 23h 19m, Decl. 5° 52′ S., mag. −3.3, and transits at 13h 42m. It is an evening star seen low in the south-west for about two hours after sunset.

Mars on the 15th is in R.A. 3h 58m, Decl. 22° 30′ N., mag. +0.6, and transits at 18h 19m. Moving into Taurus, it is about on the meridian at sunset and is visible until after midnight.

Jupiter on the 15th is in R.A. 15h 54m, Decl. 19° 15′ S., mag. −1.6; and transits at 6h 15m. In Scorpius, it rises about two hours after midnight and reaches the meridian before dawn. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 18h 18m, Decl. 22° 26′ S., mag. +0.8, and transits at 8h 39m. In Sagittarius, it rises about three hours before the sun and may be seen low in the south-east at dawn.

Uranus on the 15th is in R.A. 9h 06m, Decl. 17° 21′ N. and transits at 23h 24m. It rises about at sunset, being in opposition to the sun on the 3rd.

Neptune on the 15th is in R.A. 14h 21m, Decl. 12° 09′ S. and transits at 4h 42m. It rises at about midnight.

Pluto—For information in regard to this planet, see p. 31.

FEBRUARY

75th Meridian Civil Time

	d	h	m		Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 5h 45m
					°	h m	
Sun.	1	19	32	☌♃☾ ♃ 2° 34′ S.	182.15	2 56	20134
Mon.	2				194.32		1034*
Tue.	3	16		☍☊☉ Dist. from ⊕, 1,622,000,000 mi.	206.49	23 45	03124
Wed.	4	7	13	☌♄☾ ♄ 4° 02′ S.	218.67		3204*
Thu.	5				230.86		32104
Fri.	6				243.05	20 35	30124
Sat.	7	8	32	☌☿☾ ☿ 6° 44′ S.	255.24		10324
		14	22	● New Moon			
Sun.	8	0		♆ Stationary in R.A.	267.43		24013
Mon.	9			Aurigid meteors	279.63	17 24	4103*
		13	01	☌♀☾ ♀ 4° 24′ S.			
Tue.	10			Aurigid meeteors	291.82		40132
Wed.	11				304.02		43210
Thu.	12	2		☿ Greatest Hel. Lat. S.	316.20	14 13	d4320
Fri.	13				328.39		43012
Sat.	14	0		☌☿☉ Superior	340.57		41032
		9		☾ in Apogee. Dist. from ⊕, 251,300 mi.			
Sun.	15	14	20	☽ First Quarter	352.74	11 03	24013
Mon.	16	0	19	☌♂☾ ♂ 5° 53′ N.	4.91		12043
Tue.	17				17.07		01324
Wed.	18				29.23	7 52	d3104
Thu.	19				41.38		32014
Fri.	20	2		□♃☉ West	53.53		3024*
Sat.	21	19	21	☌☊☾ ☊ 5° 21′ N.	65.67	4 41	13024
Sun.	22	3		☍ ♇☉ Dist. from ⊕, 3,072,000,000 mi.	77.81		20134
Mon.	23	3	54	☍ Full Moon	89.95		12043
Tue.	24				102.08	1 31	04132
Wed.	25				114.22		43102
Thu.	26	5		☾ in Perigee. Dist. from ⊕, 227,400 mi.	126.36	22 20	43201
		15		□☌☉ East			
Fri.	27	12	29	☌♆☾ ♆ 0° 17′ S.	138.51		4302*
Sat.	28				150.66		43102

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR MARCH, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During March the sun's R.A. increases from 22h 45m to 0h 39m and its Decl. changes from 7° 57′ S. to 4° 10′ N. The equation of time changes from −12m 38s to −4m 15s. On the 21st at 3h 55m E.S.T. the sun crosses the equator on its way north, enters the sign of Aries, and spring commences. This is the vernal equinox. For changes in the length of the day, see p. 14.

The Moon—For its phases, perigree and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 21. There is a partial eclipse of the moon on the 24th, invisible in North America.

Mercury on the 15th is in R.A. 0h 38m, Decl. 6° 52′ N. and transits at 13h 09m. On the 12th it is at greatest eastern elongation, so that for some days at that time it will be seen low in the west just after sunset. This is a favourable elongation for observing Mercury. However, by the 29th of the month the planet has reached inferior conjunction.

Venus on the 15th is in R.A. 1h 25m, Decl. 8° 33′ N., mag. −3.4, and transits at 13h 58m. It is an evening star prominent in the western sky for more than two hours following sunset. On the evening of the 11th it is in close conjunction with the new moon.

Mars on the 15th is in R.A. 4h 57m, Decl. 24° 33′ N., mag. +1.1, and transits at 17h 28m. In Taurus, it is past the meridian at sunset and sets about midnight. It is fading rapidly in brightness now.

Jupiter on the 15th is in R.A. 16h 00m, Decl. 19° 31′ S., mag. −1.8, and transits at 4h 32m. In Scorpius, it rises about at midnight. On the 18th it is stationary in right ascension and begins retrograde motion. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 18h 27m, Decl. 22° 21′ S., mag. +0.8, and transits at 6h 58m. In Sagittarius, it rises about two hours after midnight.

Uranus on the 15th is in R.A. 9h 02m, Decl. 17° 39′ N. and transits at 21h 30m. It is well placed, being well up in the east at sunset.

Neptune on the 15th is in R.A. 14h 20m, Decl. 12° 01′ S. and transits at 2h 51m. It rises about two hours before midnight.

Pluto—For information in regard to this planet, see p. 31.

MARCH 75th Meridian Civil Time				Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 4h 15m
	d	h	m	°	h m	
Sun.	1	5	08	☌☌☾ ♃ 2° 52′ S.	162.82	19 09	42013
		21	54	☾ Last Quarter			
Mon.	2				174.99		42103
Tue.	3	3		☿ in ♌	187.16		40123
		17	05	☌☾ ♄ 4° 14′ S.			
Wed.	4				199.35	15 58	41302
Thu.	5				211.53		32041
Fri.	6				223.73		3104*
Sat.	7	18		☿ in Perihelion	235.93	12 48	30124
Sun.	8				248.14		20134
Mon.	9	5	51	● New Moon	260.34		21034
Tue.	10	19	14	☌☿☾ ☿ 1° 16′ N.	272.55	9 37	01234
Wed.	11	18	39	☌♀☾ ♀ 0° 04′ N.	284.76		10324
Thu.	12	8		☿ Greatest elongation E., 18° 20′	296.96		32014
Fri.	13				309.17	6 26	3104*
Sat.	14	4		☾ in Apogee. Dist. from ⊕, 251,800 mi.	321.37		43012
Sun.	15				333.57		4203*
Mon.	16	13	35	☌☌☾ ♂ 6° 36′ N.	345.76	3 16	42103
Tue.	17	10	10	◑ First Quarter	357.94		40123
Wed.	18	0		☿ Greatest Hel. Lat. N.	10.13		41032
		20		♃ Stationary in R.A.			
Thu.	19	5		☿ Stationary in R.A.	22.30	0 05	43201
Fri.	20				34.47		34120
Sat.	21	3	53	☌♁☾ ♁ 5° 27′ N.	46.63	20 54	34012
		3	55	☉ enters ♈. Spring commences			
		20		♀ in ♌			
Sun.	22				58.80		d1034
Mon.	23				70.95		d2034
Tue.	24			Partial eclipse of ☾. See p. 59	83.10	17 43	01234
		15	02	♍ Full Moon			
Wed.	25				95.26		10324
Thu.	26	4		☾ in Perigee. Dist. from ⊕, 224,100, mi.	107.41		32014
		20		☌♆☾ ♆ 0° 18′ S.			
Fri.	27	23		□ ♄ ☉ West	119.57	14 33	31204
Sat.	28	12	35	☌☌☾ ♃ 2° 56′ S.	131.72		30124
Sun.	29	5		☌☿☉ Inferior	143.89		10324
Mon.	30				156.06	11 22	24013
Tue.	31	1	01	☌♄☾ ♄ 4° 20′ S.	168.24		40123
		6	06	☾ Last Quarter			

Explanation of symbols and abbrevations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR APRIL, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During April the sun's R.A. increases from 0h 39m to 2h 30m and its Decl. changes from 4° 10′ N. to 14° 47′ N. The equation of time changes from −4m 14s to +2m 48s being zero on the 16th. There is an annular eclipse of the sun on the 8th, invisible in North America. For changes in the length of the day, see p. 14.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 21.

Mercury on the 15th is in R.A. 0h 05m, Decl. 0° 32′ N. and transits at 10h 34m. It is a morning star all month, being at greatest western elongation on the 26th. On and near this date it may be seen low in the east just before sunrise, although this is not a very favourable elongation.

Venus on the 15th is in R.A. 3h 51m, Decl. 21° 24′ N., mag. −3.5, and transits at 14h 22m. It is a prominent evening star seen in the west for about three hours after sunset.

Mars on the 15th is in R.A. 6h 11m, Decl. 25° 08′ N., mag. +1.5, and transits at 16h 40m. Moving into Gemini, it is well past the meridian at sunset and sets before midnight.

Jupiter on the 15th is in R.A. 15h 56m, Decl. 19° 15′ S., mag. −2.0, and transits at 2h 25m. In Scorpius it rises before midnight and dominates the southern sky all the rest of the night. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 18h 31m, Decl. 22° 18′ S., mag. +0.7, and transits at 4h 59m. In Sagittarius, it rises shortly after midnight and has passed the meridian before sunrise. On the 16th it is stationary in right ascension and begins to retrograde, i.e. move westward among the stars.

Uranus on the 15th is in R.A. 9h 00m, Decl. 17° 48′ N. and transits at 19h 26m. It is on the meridian just after sunset.

Neptune on the 15th is in R.A. 14h 17m, Decl. 11° 46′ S. and transits at 0h 46m. It rises about an hour after sunset. Opposition to the sun occurs on the 26th.

Pluto—For information in regard to this planet, see p. 31.

APRIL 75th Meridian Civil Time				Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 2h 45m
d	h	m		°	h m	
Wed. 1			.....	180.43		41O32
Thu. 2			.....	192.63	8 11	432O1
Fri. 3			.....	204.83		4321O
Sat. 4			.....	217.04		43O12
Sun. 5			.....	229.25	5 00	41O2*
Mon. 6	15	15	☌☿☾ ☿ 0° 02′ S.	241.47		42O13
Tue. 7	22	29	● New Moon	253.69		14O3*
Wed. 8			Annular eclipse of ☉. See p. 59	265.91	1 49	dO432
Thu. 9			.....	278.13		32O14
Fri. 10	11		☿ in ♉	290.36	22 38	321O4
	16		☿ Stationary in R.A.			
	18		☾ in Apogee. Dist. from ⊕, 252,300 mi.			
Sat. 11	1	24	☌♀☾ ♀ 4° 42′ N.	302.58		3O124
Sun. 12			.....	314.80		13O24
Mon. 13			.....	327.01	19 28	2O134
Tue. 14	5	31	☌☌☾ ♂ 6° 55′ N.	339.22		12O43
Wed. 15			.....	351.43		dO423
Thu. 16	2	32	◑ First Quarter	3.63	16 16	423O1
	10		♄ Stationary in R.A.			
Fri. 17	12	25	☌♁☾ ♁ 5° 27′ N.	15.83		4321O
Sat. 18			.....	28.02		43O21
Sun. 19			.....	40.20	13 06	431O2
Mon. 20	5		♁ Stationary in R.A.	52.38		42O13
	18		☿ in Aphelion			
Tue. 21			.....	64.55		412O3
Wed. 22			Lyrid meteors	76.72	9 55	4O123
Thu. 23	0	13	♋ Full Moon	88.89		dd4O*
	5	26	☌♆☾ ♆ 0° 13′ S.			
	13		☾ in Perigee. Dist. from ⊕, 222,100 mi.			
Fri. 24	9		♀ in Perihelion	101.06		321O4
	18	59	☌♃☾ ♃ 2° 46′ S.			
Sat. 25			.....	113.23	6 44	3O214
Sun. 26	5		☿ Greatest elongation W., 27° 11′	125.40		31O24
	9		☍♆☉ Dist. from ⊕, 2,724,000,000 mi.			
Mon. 27	8	33	☌♄☾ ♄ 4° 16′ S.	137.58		2O314
Tue. 28			.....	149.77	3 33	21O34
Wed. 29	15	38	☾ Last Quarter	161.96		O1234
Thu. 30			.....	174.16		1O234

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR MAY, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During May the sun's R.A. increases from 2h 30m to 4h 32m and its Decl. changes from 14° 47′ N. to 21° 55′ N. The equation of time changes from +2m 48s to a maximum of +3m 44s on the 15th and then to +2m 28s at the end of the month. For changes in the length of the day, see p. 15.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 22.

Mercury on the 15th is in R.A. 2h 09m, Decl. 10° 31′ N. and transits at 10h 42m. It is too close to the sun all month for observation.

Venus on the 15th is in R.A. 6h 22m, Decl. 25° 45′ N., mag. −3.6, and transits at 14h 55m. It is a prominent evening star seen in the west for about three hours following sunset.

Mars on the 15th is in R.A. 7h 27m, Decl. 23° 30′ N., mag. +1.7, and transits at 15h 58m. In Gemini, south of Castor and Pollux, it is well past the meridian at sunset and sets before midnight.

Jupiter on the 15th is in R.A. 15h 42m, Decl. 18° 33′ S., mag. −2.1, and transits at 0h 14m. Moving into Libra, it is in opposition on the 18th, and therefore is visible all night, being very prominent in the southern sky. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 18h 28m, Decl. 22° 20′ S., mag. +0.5, and transits at 2h 59m. In Sagittarius, it rises before midnight and is visible in the southern sky for the rest of the night.

Uranus on the 15th is in R.A. 9h 01m, Decl. 17° 42′ N. and transits at 17h 29m. It is past the meridian at sunset.

Neptune on the 15th is in R.A. 14h 14m, Decl. 11° 30′ S. and transits at 22h 41m. It is low in the south-east at sunset.

Pluto—For information in regard to this planet, see p. 31.

MAY 75th Meridian Civil Time				Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 1h 00m
	d	h	m	°	h m	
Fri.	1		.....	186.37	0 22	d2304
Sat.	2		.....	198.58		30241
Sun.	3	7	□♁☉ East.....	210.80	21 11	34102
Mon.	4		.....	223.03		42031
Tue.	5		η Aquarid meteors.....	235.26		42103
		9	43	☌☿☾ ☿ 2° 27′ S.....		
Wed.	6		.....	247.49	18 00	40123
Thu.	7	15	11	● New Moon.....	259.73		41023
		23		☾ in Apogee. Dist. from ⊕, 252,600 mi.		
Fri.	8		.....	271.97		42301
Sat.	9		.....	284.21	14 49	340**
Sun.	10		.....	296.44		34102
Mon.	11	2		☿ Greatest Hel. Lat. S.....	308.68		20314
		9	11	☌♀☾ ♀ 7° 24′ N.....		
Tue.	12	4		♂ Greatest Hel. Lat. N.....	320.91	11 38	21034
		21	49	☌♂☾ ♂ 6° 45′ N.....		
Wed.	13		.....	333.14		01234
Thu.	14	20	10	☌♁☾ ♁ 5° 18′ N.....	345.36		10234
Fri.	15	15	09	◑ First Quarter.....	357.58	8 27	23014
Sat.	16	8		♀ Greatest Hel. Lat. N.....	9.79		32104
Sun.	17		.....	22.00		31024
Mon.	18	15		☍♃☉ Dist. from ⊕, 405,800,000 mi...	34.20	5 16	23014
Tue.	19		.....	46.39		21403
Wed.	20	15	14	☌♆☾ ♆ 0° 11′ S.....	58.58		40213
Thu.	21		.....	70.76	2 05	41023
Fri.	22	0		☾ in Perigee. Dist. from ⊕, 221,900 mi.	82.94		42301
		0	43	☌♃☾ ♃ 2° 33′ S.....		
		7	56	○ Full Moon.....		
Sat.	23		.....	95.13	22 54	43210
Sun.	24	16	19	☌♄☾ ♄ 4° 09′ S.....	107.31		d4302
Mon.	25		.....	119.49		d4301
Tue.	26		.....	131.68	19 43	42103
Wed.	27		.....	143.88		40213
Thu.	28		.....	156.08		10234
Fri.	29	3	13	☾ Last Quarter.....	168.29	16 31	23014
		6		♄ in Aphelion.....		
Sat.	30	2		☿ in ♌.....	180.50		32104
Sun.	31		.....	192.72		30124

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR JUNE, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During June the sun's R.A. increases from 4h 32m to 6h 37m and its Decl. changes from 21° 55′ N. to 23° 10′ N. The equation of time changes from +2m 28s to zero on the 14th and then to −3m 30s at the end of the month. The solstice is on the 21st at 22h 50m E.S.T. For changes in the length of the day, see p. 15.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 22.

Mercury on the 15th is in R.A. 6h 30m, Decl. 25° 12′ N. and transits at 13h 04m. Superior conjunction is on the 2nd, and the planet remains too close to the sun all month for observation.

Venus on the 15th is in R.A. 8h 45m, Decl. 20° 16′ N., mag. −3.9, and transits at 15h 15m. It is a prominent evening star well above the western horizon at sunset and setting about three hours later. Greatest eastern elongation is on the 23rd (see Mars).

Mars on the 15th is in R.A. 8h 45m, Decl. 19° 29′ N., mag. +1.9, and transits at 15h 13m. Moving from Gemini to Leo, it is now quite faint, well down in the west at sunset. On the evening of the 14th it will be interestingly close to Venus.

Jupiter on the 15th is in R.A. 15h 27m, Decl. 17° 48′ S., mag. −2.0, and transits at 21h 52m. In Libra, it is well up in the south-east at sunset and remains visible most of the night. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 57.

Saturn on the 15th is in R.A. 18h 20m, Decl. 22° 25′ S., mag. +0.3, and transits at 0h 49m. Opposition of Saturn is on the 25th so that it is above the horizon all night, rising about at sunset and setting about at sunrise.

Uranus on the 15th is in R.A. 9h 05m, Decl. 17° 34′ N. and transits at 15h 32m. It is well down in the west at sunset.

Neptune on the 15th is in R.A. 14h 11m, Decl. 11° 18′ S. and transits at 20h 37m. It is well up in the south-east at sunset.

Pluto—For information in regard to this planet, see p. 31.

JUNE 75th Meridian Civil Time				Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 23h 45m
	d	h	m	°	h m	
Mon.	1		.....	204.95	13 20	21O34
Tue.	2	23	☌☿☉ Superior.....	217.19		O143*
Wed.	3	17	☿ in Perihelion.....	229.43		1O423
Thu.	4	3	☾ in Apogee. Dist. from ⊕, 252,500 mi.	241.67	10 09	d42O1
Fri.	5		.....	253.92		4321O
Sat.	6	6	53 ● New Moon.....	266.16		43O12
		15	48 ☌☿☾ ☿ 5° 56′ N.....			
Sun.	7		.....	278.41	6 58	431O2
Mon.	8		.....	290.66		d42O3
Tue.	9		.....	302.91		4O13*
Wed.	10	9	52 ☌♀☾ ♀ 7° 05′ N.....	315.15	3 47	41O23
		13	15	☌♂☾ ♂ 6° 04′ N.....		
Thu.	11	3	32 ☌♁☾ ♁ 5° 02′ N.....	327.39		42O31
Fri.	12		.....	339.63		321O4
Sat.	13		.....	351.86	0 36	3O124
Sun.	14	0	☿ Greatest Hel. Lat. N.....	4.08		31O24
		0	22 ☽ First Quarter.....			
		8	☌♀♂ ♀ 0° 51′ N.....			
Mon.	15		.....	16.30	21 24	2O134
Tue.	16	23	45 ☌♆☾ ♆ 0° 18′ S.....	28.50		2O34*
Wed.	17	23	♂ in Aphelion.....	40.71		1O234
Thu.	18	6	02 ☌♃☾ ♃ 2° 30′ S.....	52.90	18 13	2O314
Fri.	19	8	☾ in Perigee. Dist. from ⊕, 223,500 mi.	65.10		321O4
		22	☌♀♁ ♀ 1° 17′ N.....			
Sat.	20	15	00 ○ Full Moon.....	77.29		3O421
		23	51 ☌♄☾ ♄ 4° 04′ S.....			
Sun.	21	22	50 ☉ enters ♋. Summer commences..	89.47	15 02	341O2
Mon.	22		.....	101.66		42O1*
Tue.	23	3	♀ Greatest elongation E., 45° 25′..	113.85		42O3*
		19	☌♂♁ ♂ 0° 39′ N.....			
Wed.	24		.....	126.05	11 50	41O23
Thu.	25	22	☍♄☉ Dist. from ⊕, 840,700,000 mi...	138.25		d4O13
Fri.	26		.....	150.45		4231O
Sat.	27	17	12 ☾ Last Quarter.....	162.67	8 39	34O21
Sun.	28		.....	174.88		314O2
Mon.	29		.....	187.11		2O14*
Tue.	30		.....	199.34	5 28	21O34

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR JULY, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During July the sun's R.A. increases from 6h 37m to 8h 42m and its Decl. changes from 23° 10′ N. to 18° 16′ N. The equation of time changes from −3m 30s to a minimum of −6m 25s on the 27th and then to −6m 18s at the end of the month. On the 5th the earth is in aphelion or farthest from the sun. For changes in the length of the day, see p. 16.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 23.

Mercury on the 15th is in R.A. 9h 16m, Decl. 14° 17′ N. and transits at 13h 46m. Greatest eastern elongation is on the 8th. For some days at this time it may be seen as an evening star low in the west just after sunset.

Venus on the 15th is in R.A. 10h 27m, Decl. 9° 17′ N., mag. −4.1, and transits at 14h 57m. It dominates the western sky for about two hours after sunset. Greatest brilliancy is on the 26th. On the 7th Venus occults Regulus (see p. 59).

Mars on the 15th is in R.A. 9h 57m, Decl. 13° 43′ N., and transits at 14h 27m. In Leo near Regulus, it is very low in the west at sunset.

Jupiter on the 15th is in R.A. 15h 20m, Decl. 17° 26′ S., mag. −1.9, and transits at 19h 47m. In Libra it is about on the meridian at sunset and sets about midnight. On the 20th it is stationary in right ascension and resumes direct (i.e. eastward) motion among the stars. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 57.

Saturn on the 15th is in R.A. 18h 10m, Decl. 22° 31′ S., mag. +0.3, and transits to 22h 37m. In Sagittarius it is risen at sunset and is visible in the south until nearly sunrise.

Uranus on the 15th is in R.A. 9h 11m, Decl. 16° 56′ N., and transits at 13h 40m. It is too close to the sun for easy observation.

Neptune on the 15th is in R.A. 14h 10m, Decl. 11° 14′ S. and transits at 18h 38m. It is past the meridian at sunset.

Pluto—For information in regard to this planet, see p. 31.

JULY 75th Meridian Civil Time				Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 22h 30m
	d	h	m		°	d m	
Wed.	1	14		☾ in Apogee. Dist. from ⊕, 251,900 mi.	211.57		dO234
Thu.	2			.....	223.82		O1234
Fri.	3			.....	236.06	2 16	231O4
Sat.	4			.....	248.31		3O14*
Sun.	5	2		⊕ in Aphelion. Dist. from ☉, 94,455,000 mi.	260.56	23 05	31O24
		21		New Moon			
Mon.	6			.....	272.81		23O14
Tue.	7	10		☿ in ♉	285.07		214O3
Wed.	8	5	28	☌☿☾ ☿ 4° 06′ N.	297.32	19 54	4O123
		11	34	☌♁☾ ♁ 4° 47′ N.			
		16		☿ Greatest elongation E., 26° 14′ ..			
Thu.	9	3	34	☌♂☾ ♂ 4° 51′ N.	309.57		4O23*
		17	31	☌♀☾ ♀ 3° 18′ N.			
Fri.	10			.....	321.81		4231O
Sat.	11	9		♀ in ♉	334.05	16 42	43O1*
Sun.	12	15		☌☿♁ ☿ 1° 48′ S.	346.28		431O2
Mon.	13	7	01	☽ First Quarter	358.51		432O1
Tue.	14	6	21	☌♆☾ ♆ 0° 32′ S.	10.73	13 31	421O3
Wed.	15	11	36	☌♃☾ ♃ 2° 43′ S.	22.94		4O123
Thu.	16			.....	35.15		1O243
Fri.	17	5		♆ Stationary in R.A.	47.35	10 20	213O4
		9		☾ in Perigee. Dist. from ⊕, 226,300 mi.			
		17		☿ in Aphelion			
Sat.	18	6	23	☌♄☾ ♄ 4° 08′ S.	59.54		32O14
Sun.	19	22	33	☍ Full Moon	71.74		'31O24
Mon.	20	12		♃ Stationary in R.A.	83.92	7 08	32O14
Tue.	21	9		♆ in Aphelion	96.12		21O34
		19		☿ Stationary in R.A.			
Wed.	22			.....	108.30		O1243
Thu.	23			.....	120.50	3 57	1O423
Fri.	24			.....	132.70		d24O3
Sat.	25			.....	144.90		432O1
Sun.	26	15		♀ Greatest brilliancy, mag. −4.2 ..	157.11	0 45	431O2
Mon.	27	9	22	☾ Last Quarter	169.32		d43O1
		20		□♆☉ East			
Tue.	28			.....	181.54	21 34	421O3
Wed.	29			δ Aquarid meteors	193.76		4O213
		6		☌☿♁ ☿ 5° 29′ S.			
		7		☾ in Apogee. Dist. from ⊕, 251,400 mi.			
Thu.	30			.....	205.99		41O23
Fri.	31			.....	218.23	18 23	42O31

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR AUGUST, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitudes are for an observer in latitude 45° N.

The Sun—During August the sun's R.A. increases from 8h 42m to 10h 38m and its Decl. changes from 18° 16′ N. to 8° 38′ N. The equation of time changes from −6m 18s to −0m 19s. For changes in the length of the day, see p. 16.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 23.

Mercury on the 15th is in R.A. 8h 37m, Decl. 15° 19′ N. and transits at 11h 04m. Inferior conjunction is on the 5th and by the 23rd Mercury has reached greatest western elongation. At about that time it is well placed for observation low in the east just before sunrise.

Venus on the 15th is in R.A. 10h 58m, Decl. 0° 03′ S., mag. −4.0, and transits at 13h 24m. At the beginning of the month it is a prominent evening star seen low in the west for about an hour after sunset, but by the end of the month it is too close to the sun for observation.

Mars on the 15th is in R.A. 11h 10m, Decl. 6° 22′ N., and transits at 13h 38m. It is too close to the sun for easy observation.

Jupiter on the 15th is in R.A. 15h 24m, Decl. 17° 47′ S., mag. −1.7, and transits at 17h 50m. In Libra, it is well past the meridian at sunset and sets before midnight. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 57.

Saturn on the 15th is in R.A. 18h 04m, Decl. 22° 37′ S., mag. +0.5, and transits at 20h 29m. In Sagittarius, it is well up in the south-east at sunset and sets over an hour after midnight.

Uranus on the 15th is in R.A. 9h 19m, Decl. 16° 22′ N. and transits at 11h 45m. It is too close to the sun for observation.

Neptune on the 15th is in R.A. 14h 11m, Decl. 11° 21′ S. and transits at 16h 37m. It is well down in the south-west at sunset.

Pluto—For information in regard to this planet, see p. 31.

	d	h	m	AUGUST 75th Meridian Civil Time	Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 21h 15m
					°	h m	
Sat.	1			.....	230.47		3204*
Sun.	2			.....	242.72		3102 4
Mon.	3			.....	254.96	15 11	3021 4
Tue.	4	9	34	● New Moon.....	267.21		2103 4
		12	31	☌☿☾ ☿ 0° 55′ S.....			
		21	11	☌♁☾ ♁ 4° 38′ N.....			
Wed.	5	12		☌☿☉ Inferior.....	279.46		0134*
Thu.	6	17	16	☌☌☾ ♂ 3° 12′N.....	291.71	12 00	1023 4
		21	55	☌♀☾ ♀ 2° 55′ S.....			
Fri.	7	1		☿ Greatest Hel. Lat. S.....	303.95		2013 4
Sat.	8	10		♀ Stationary in R.A.....	316.20		3210 4
Sun.	9	20		☌♁☉.....	328.43	8 48	d3042
Mon.	10	11	59	☌♆☾ ♆ 0° 48′ S.....	340.67		3401 2
		21		☌♀☌ ♀ 6° 46′ S.....			
Tue.	11	12	10	◑ First Quarter.....	352.89		4210*
		18	39	☌♃☾ ♃ 3° 05′ S.....			
Wed.	12			Perseid meteors.....	5.11	5 37	4013*
Thu.	13	11		☾ in Perigee. Dist. from ⊕, 229,200 mi.	17.31		4102 3
Fri.	14	11	43	☌♄☾ ♄ 4° 19′ S.....	29.52		4201 3
		20		♀ in Aphelion.....			
Sat.	15	2		☿ Stationary in R.A.....	41.71	2 25	4231 0
Sun.	16	16		□♃☉ East.....	53.90		4301 2
Mon.	17			.....	66.09	23 14	3402*
Tue.	18	7	50	☺ Full Moon.....	78.27		2130 4
Wed.	19			.....	90.46		2013 4
Thu.	20			.....	102.64	20 02	1023 4
Fri.	21			.....	114.83		2013 4
Sat.	22			.....	127.01		2130 4
Sun.	23	13		☿ Greatest elongation W., 18° 25′ .	139.21	16 51	3012 4
Mon.	24			.....	151.41		3024*
Tue.	25			.....	163.61		2310 4
Wed.	26	1		☾ in Apogee, Dist. from ⊕, 251,100 mi.	175.81	13 40	2401 3
		2		☿ in ♌.....			
		3	03	☾ Last Quarter.....			
Thu.	27	19		☌ ♇☉.....	188.03		4102 3
Fri.	28	18		☌☿♁ · ☿ 0° 04′ S.....	200.25		d4013
Sat.	29			.....	212.47	10 28	4213 0
Sun.	30	17		☿ in Perihelion.....	224.70		4302 1
Mon.	31			.....	236.93		4310 2

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR SEPTEMBER, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During September the sun's R.A. increases from 10h 38m to 12h 26m and its Decl. changes from 8° 38′ N. to 2° 48′ S. The equation of time changes from −0m 18s to +9m 58s, the apparent sun passing to the west of the mean sun on the second. On the 23rd at 14h 09m E.S.T. the sun crosses the equator moving southward, enters the sign of Libra, and autumn commences. For changes in the length of the day, see p. 17.

The Moon—For its phases, perigree and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 24.

Mercury on the 15th is in R.A. 11h 22m, Decl. 5° 59′ N. and transits at 11h 51m. It is too close to the sun all month for observation, superior conjunction being on the 17th.

Venus on the 15th is in R.A. 10h 01m, Decl. 3° 51′ N., mag. −3.9, and transits at 10h 26m. It is in inferior conjunction on the 1st and so not observable for a couple of weeks, but by mid-month it may be seen again, now as a morning star low in the east just before sunrise.

Mars on the 15th is in R.A. 12h 23m, Decl. 1° 43′ S., and transits at 12h 48m. It is too close to the sun for easy observation.

Jupiter on the 15th is in R.A. 15h 38m, Decl. 18° 44′ S., mag. −1.5, and transits at 16h 02m. In Libra, it is well down in the south-west at sunset and sets about three hours later. For the configurations of Jupiter's satellites, see opposite page, and for their eclipses, etc., see p. 57.

Saturn on the 15th is in R.A. 18h 02m, Decl. 22° 42′ S., mag. +0.6, and transits at 18h 26m. In Sagittarius, it is about on the meridian at sunset and sets before midnight. On the 4th it is stationary in right ascension and resumes direct (i.e. eastward) motion among the stars.

Uranus on the 15th is in R.A. 9h 26m, Decl. 15° 49′ N. and transits at 9h 51m. It is a morning star, above the horizon only a few hours before sunrise.

Neptune on the 15th is in R.A. 14h 14m, Decl. 11° 36′ S. and transits at 14h 38m. It is low in the south-west at sunset.

Pluto—For information in regard to this planet, see p. 31.

SEPTEMBER

75th Meridian Civil Time

	d	h	m		Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 19h 45m
					°	h m	
Tue.	1	1		☌☿☉ Inferior	249.17	7 17	43201
		8	33	☌♁☾ ♁ 4° 33′ N.			
		20	31	☌☿☾ ☿ 4° 46′ N.			
Wed.	2	12	03	☌☿☾ ☿ 6° 30′ S.	261.41		4203*
		20	55	● New Moon			
Thu.	3				273.64		41023
Fri.	4	7	12	☌☌☾ ☌ 1° 16′ N.	285.88	4 05	02143
		20		♄ Stationary in R.A.			
Sat.	5	15		☌☿☿ ☿ 10° 57′ N.	298.12		21034
Sun.	6	6		☿ Greatest Hel. Lat. S.	310.35		3014*
		18	34	☌♆☾ ♆ 1° 00′ S.			
Mon.	7	12		☾ in Perigee. Dist. from ⊕, 229,100 mi.	322.58	0 54	31024
Tue.	8	4	40	☌⚳☾ ⚳ 3° 29′ S.	334.81		32014
Wed.	9	17	07	☽ First Quarter	347.02	21 42	204**
		23		☿ Greatest Hel. Lat. N.			
Thu.	10	16	56	☌♄☾ ♄ 4° 30′ S.	359.23		10234
Fri.	11				11.43		01243
Sat.	12				23.62	18 31	21403
Sun.	13				35.81		43201
Mon.	14				47.99		43102
Tue.	15				60.17	15 20	43201
Wed.	16	19	51	○ Full Moon	72.34		42103
Thu.	17	16		☌☿☉ Superior	84.51		d4023
Fri.	18				96.68	12 08	40123
Sat.	19				108.85		42103
Sun.	20	21		☿ Stationary in R.A.	121.03		32401
Mon.	21				133.20	8 57	31042
Tue.	22	20		☾ in Apogee. Dist. from ⊕, 251,500 mi.	145.38		d3014
Wed.	23	14	09	☉ in ♎. Autumn commences	157.57		21304
Thu.	24	9		□♄☉ East	169.76	5 45	01234
		21	22	☾ Last Quarter			
Fri.	25				181.96		0234*
Sat.	26				194.15		21034
Sun.	27				206.36	2 34	23014
Mon.	28	20	45	☌♁☾ ♁ 4° 31′ N.	218.57		31042
Tue.	29	13	03	☌☿☾ ☿ 2° 20′ S.	230.79	23 23	34021
Wed.	30	3		☌☿☌ ☿ 0° 10′ S.	243.01		42130

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR OCTOBER, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During October the sun's R.A. increases from 12h 26m to 14h 22m and its Decl. changes from 2° 48′ S. to 14° 07′ S. The equation of time changes from +9m 58s to +16m 20s. There is a total eclipse of the sun on the 2nd, visible as a partial eclipse in eastern North America. For changes in the length of the day, see p. 17.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 24.

Mercury on the 15th day is in R.A. 14h 24m, Decl. 15° 40′ S. and transits at 12h 54m. It is too close to the sun all month for easy observation.

Venus on the 15th is in R.A. 10h 35m, Decl. 6° 17′ N., mag. −4.3, and transits at 9h 03m. It is a very prominent morning star, rising about three hours before the sun. Greatest brilliancy is on the 8th.

Mars on the 15th is in R.A. 13h 36m, Decl. 9° 33′ S., and transits at 12h 04m. It is too close to the sun for observation, conjunction being on the 29th.

Jupiter on the 15th is in R.A. 15h 59m, Decl. 19° 56′ S., mag. −1.4, and transits at 14h 25m. Moving back into Scorpius, it is very low in the south-west at sunset and sets shortly after. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 57.

Saturn on the 15th is in R.A. 18h 08m, Decl. 22° 45′ S., mag. +0.8, and transits at 16h 33m. In Sagittarius, it is past the meridian at sunset and sets a few hours later.

Uranus on the 15th is in R.A. 9h 31m, Decl. 15° 23′ N. and transits at 7h 58m. It rises after midnight.

Neptune on the 15th is in R.A. 14h 17m, Decl. 11° 56′ S. and transits at 12h 44m. It is too close to the sun for observation.

Pluto—For information in regard to this planet, see p. 31.

OCTOBER 75th Meridian Civil Time				Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 18h 30m
	d	h	m	°	h m	
Thu.	1		.....	255.23		4013*
Fri.	2		Total eclipse of ☉. See p. 59.....	267.46	20 11	41023
		7	31 ● New Moon.....			
		22	19 ☌☌☾ ♂ 0° 47′ S.....			
Sat.	3	2	54 ☌☿☾ ☿ 1° 34′ S.....	279.68		d4203
		9	☿ in ♉.....			
Sun.	4	3	40 ☌♆☾ ♆ 1° 06′ S.....	291.90		42301
		16	☾ in Perigee. Dist. from ⊕, 226,000 mi.			
Mon.	5	18	42 ☌⚳☾ ⚳ 3° 49′ S.....	304.12	17 00	43102
Tue.	6		.....	316.34		34021
Wed.	7	23	59 ☌♄☾ ♄ 4° 35′ S.....	328.55		23140
Thu.	8	6	☿ Greatest brilliancy, mag. −4.3..	340.75	13 49	20134
		23	22 ◑ First Quarter.....			
Fri.	9		.....	352.95		10234
Sat.	10		Giacobinid meteors.....	5.13		20134
Sun.	11		.....	17.31	10 37	2034*
Mon.	12		.....	29.49		31024
Tue.	13	16	☌☿♆ ☿ 3° 05′ S.....	41.66		30124
		16	☿ in Aphelion.....			
Wed.	14		.....	53.82	7 26	32104
Thu.	15		.....	65.98		20341
Fri.	16	10	58 ○ Full Moon.....	78.14		41023
Sat.	17		.....	90.29	4 15	42013
Sun.	18		.....	102.45		42103
Mon.	19		.....	114.60		43102
Tue.	20	14	☾ in Apogee. Dist. from ⊕, 252,100 mi.	126.76	1 04	43012
Wed.	21		Orionid meteors.....	138.92		43210
Thu.	22		.....	151.09	21 52	4201*
Fri.	23		.....	163.26		41023
Sat.	24	15	22 ☾ Last Quarter.....	175.43		02413
Sun.	25		.....	187.61	18 41	21034
Mon.	26	8	04 ☌♇☾ ♇ 4° 24′ N.....	199.80		d3024
Tue.	27		.....	211.99		30124
Wed.	28	8	40 ☌♀☾ ♀ 0° 55′ N.....	224.19	15 30	32104
Thu.	29	21	☌☌☉.....	236.39		
Fri.	30	16	☌♆☉.....	248.59		
Sat.	31	15	12 ☌☌☾ ♂ 2° 42′ S.....	260.80	12 19	
		15	26 ☌♆☾ ♆ 1° 10′ S.....			
		17	41 ● New Moon.....			
		21	☌☌♆ ♂ 1° 33′ S.....			

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57

THE SKY FOR NOVEMBER, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During November the sun's R.A. increases from 14h 22m to 16h 25m and its Decl. changes from 14° 07′ S. to 21° 39′ S. The equation of time changes from +16m 20s to a minimum of 16m 24s on the 4th and then to +11m 20s at the end of the month. For changes in the length of the day, see p. 18.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 25.

Mercury on the 15th is in R.A. 16h 31m, Decl. 23° 55′ S., and transits at 12h 54m. During the first week of the month it may be seen very low in the south-west just after sunset, greatest eastern elongation being on the 3rd. However, this is poor elongation for observation of the planet. By the 24th it is in inferior conjunction.

Venus on the 15th is in R.A. 12h 21m, Decl. 0° 57′ S., mag. −4.0, and transits at 8h 48m. Greatest western elongation is on the 11th so that Venus is an excellent morning star during this month, rising about three hours before the sun.

Mars on the 15th is in R.A. 14h 58m, Decl. 16° 46′ S., and transits at 11h 24m. It is too close to the sun for observation.

Jupiter on the 15th is in R.A. 16h 26m, Decl. 21° 09′ S., mag. −1.3, and transits at 12h 51m. It is too close to the sun for easy observation.

Saturn on the 15th is in R.A. 18h 18m, Decl. 22° 46′ S., mag. +0.8, and transits at 14h 42m. In Sagittarius, it is well down in the south-west at sunset and sets about two hours later.

Uranus on the 15th is in R.A. 9h 35m, Decl. 15° 09′ N. and transits at 6h 59m. It rises about at midnight.

Neptune on the 15th is in R.A. 14h 22m, Decl. 12° 19′S., and transits at 10h 46m. It is too close to the sun for observation.

Pluto—For information in regard to this planet, see p. 31.

NOVEMBER

75th Meridian Civil Time

	d	h	m		Sun's Selen. Colong.	Min. of Algol
					°	h m
Sun.	1	13		☿ in ♌	273.01	
		20		☾ in Perigee. Dist. from ⊕, 223,100 mi.		
Mon.	2	6	57	☌☿☾ ☿ 7° 20′ S.	285.22	
		12	45	☌♃☾ ♃ 4° 03′ S.		
Tue.	3	0		☿ Greatest Hel. Lat. S.	297.43	9 07
		5		☿ Greatest elongation E., 23° 33′		
Wed.	4	10	37	☌♄☾ ♄ 4° 33′ S.	309.63	
Thu.	5				321.82	
Fri.	6			Taurid meteors	334.01	5 56
Sat.	7	5		☌☿♃ ☿ 3° 23′ S.	346.19	
		8	23	☽ First Quarter		
Sun.	8				358.37	
Mon.	9				10.54	2 45
Tue.	10				22.70	
Wed.	11	19		☿ Greatest elongation W., 46° 37′	34.85	23 34
Thu.	12				47.01	
Fri.	13	22		□♁☉ West	59.15	
Sat.	14	0		☿ Stationary in R.A.	71.29	20 23
Sun.	15	4	42	♋ Full Moon	83.44	
Mon.	16				95.58	
Tue.	17			Leonid meteors	107.72	17 12
		1		☌☿♃ ☿ 2° 04′ S.		
		2		☾ in Apogee. Dist. from ⊕, 252,500 mi.		
Wed.	18				119.86	
Thu.	19				132.00	
Fri.	20				144.15	14 01
Sat.	21				156.30	
Sun.	22	1		☿ in ♌	168.46	10 50
		16	43	☌♁☾ ♁ 4° 11′ N.		
Mon.	23	8	03	☾ Last Quarter	180.62	
Tue.	24	6		☌☿☉ Inferior	192.79	
Wed.	25	23		☌ in ♉	204.96	7 39
Thu.	26	16		☿ in Perihelion	217.14	
		21	10	☌♀☾ ♀ 0° 37′ N.		
Fri.	27	6		♁ Stationary in R.A.	229.32	
Sat.	28	4	13	☌♆☾ ♆ 1° 17′ S.	241.51	4 28
		16		☌☿☌ ☿ 2° 05′ N.		
Sun.	29	8	19	☌☿☾ ☿ 1° 58′ S.	253.71	
		10	04	☌☌☾ ☌ 4° 15′ S.		
Mon.	30	3	46	● New Moon	265.90	
		7		☾ in Perigee. Dist. from ⊕, 221,600 mi.		
		9	37	☌♃☾ ♃ 4° 15′ S.		

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57. Jupiter being near the sun, configurations of the satellites are not given from October 29 to December 29.

THE SKY FOR DECEMBER, 1959

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 10. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During December the sun's R.A. increases from 16h 25m to 18h 42m and its Decl. changes from 21° 39′ S. to 23° 06′ S. The equation of time changes from +11m 20s to zero on the 25th and then to −3m 02s at the end of the month. The solstice is on the 22nd at 9h 35m E.S.T. For changes in the length of the day, see p. 18.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 25.

Mercury on the 15th is in R.A. 15h 59m, Decl. 18° 31′ S., and transits at 10h 28m. Greatest western elongation is on the 12th, so that for some days at that time the planet may be seen low in the south-east just before sunrise.

Venus on the 15th is in R.A. 14h 27m, Decl. 11° 58′ S., mag. −3.8, and transits at 8h 56m. It is a morning star visible in the south-east for three hours or more before sunrise.

Mars on the 15th is in R.A. 16h 25m, Decl. 21° 50′ S. and transits at 10h 53m. It is a morning star but too close to the sun for easy observation.

Jupiter on the 15th is in R.A. 16h 55m, Decl. 22° 06′ S. and transits at 11h 21m. It is too close to the sun for observation, conjunction being on the 5th. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 57.

Saturn on the 15th is in R.A. 18h 32m, Decl. 22° 40′ S., mag. +0.7, and transits at 12h 58m. It is too close to the sun for easy observation, conjunction being on the 31st.

Uranus on the 15th is in R.A. 9h 34m, Decl. 15° 12′ N. and transits at 4h 01m. It rises over two hours before midnight.

Neptune on the 15th is in R.A. 14h 26m, Decl. 12° 37′ S. and transits at 8h 52m. It is a morning star, rising a few hours before the sun.

Pluto—For information in regard to this planet, see p. 31.

DECEMBER 75th Meridian Civil Time				Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 8h 30m
	d	h	m	°	h m	
Tue.	1		.....	278.10	1 17	
Wed.	2	1	02	☌♄☾ ♄ 4° 27′ S.....	290.29	
Thu.	3	15		☿ Stationary in R.A.....	302.48	22 06
Fri.	4			.....	314.67	
Sat.	5	7		♀ in Perihelion.....	326.85	
		14		☌♃☉.....		
Sun.	6	21	11	☽ First Quarter.....	339.03	18 55
		22		☿ Greatest Hel. Lat. N.....		
Mon.	7			.....	351.19	
Tue.	8			.....	3.35	
Wed.	9			.....	15.51	15 44
Thu.	10			.....	27.66	
Fri.	11			.....	39.80	
Sat.	12	2		☿ Greatest elongation W., 21° 03′.	51.94	12 33
Sun.	13			Geminid meteors.....	64.07	
Mon.	14	2		☾ in Apogee. Dist. from ⊕, 252,600 mi.	76.20	
		11		☌♀♆ ♀ 0° 46′ N.....		
		23	49	☍ Full Moon.....		
Tue.	15			.....	88.33	9 22
Wed.	16			.....	100.46	
Thu.	17			.....	112.59	
Fri.	18			.....	124.73	6 11
Sat.	19	22	17	☌♁☾ ♁ 3° 58′ N.....	136.86	
Sun.	20			.....	149.00	
Mon.	21			.....	161.15	3 00
Tue.	22	9	35	☉ enters ♑. Winter commences.....	173.30	
		22	28	☾ Last Quarter.....		
Wed.	23			Ursid meteors.....	185.45	23 49
Thu.	24			.....	197.61	
Fri.	25	8		☌☿♂ ☿ 0° 57′ N.....	209.78	
		15	32	☌♆☾ ♆ 1° 31′ S.....		
Sat.	26	14	00	☌♀☾ ♀ 1° 39′ S.....	221.95	20 39
		20		☌☿♃ ☿ 0° 02′ S.....		
Sun.	27	1		♀ Greatest Hel. Lat. N.....	234.13	
Mon.	28	6	37	☌♂☾ ♂ 5° 16′ S.....	246.32	
		7	06	☌♃☾ ♃ 4° 27′ S.....		
		10	21	☌☿☾ ☿ 4° 43′ S.....		
		20		☾ in Perigee. Dist. from ⊕, 222,300 mi.		
		20		☌♂♃ ♂ 0° 49′ S.....		
Tue.	29	14	09	● New Moon.....	258.51	17 28
		17	36	☌♄☾ ♄ 4° 23′ S.....		
Wed.	30	9		☿ in ♑.....	270.70	
Thu.	31	16		☌♄☉.....	282.89	

	42013
	43102
	d3024

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 57. Jupiter being near the sun, configurations of the satellites are not given from October 29 to December 29.

JANUARY

d	h	m	Sat.	Phen.
1	5	59	II	OR
2	4	26	III	OR
4	5	02	I	SI
	5	57	I	TI
5	5	29	I	OR
8	4	28	II	ED
9	4	44	III	ER
	6	33	III	OD
11	6	56	I	SI
12	4	16	I	ED
13	4	34	I	Te
16	6	31	III	ED
17	4	21	II	TI
	4	29	II	Se
	6	37	II	Te
19	6	09	I	ED
20	4	23	I	TI
	5	27	I	Se
	6	32	I	Te
21	3	53	I	OR
24	4	48	II	SI
26	3	31	II	OR
27	5	11	III	TI
	5	11	I	SI
	6	20	I	TI
28	5	49	I	OR
29	2	57	I	Te

FEBRUARY

d	h	m	Sat.	Phen.
2	3	47	II	ER
	3	55	II	OD
	6	11	II	OR
3	4	28	III	SI
	6	37	III	Se
4	4	24	I	ED
5	2	44	I	TI
	3	41	I	Se
	4	53	I	Te
9	4	04	II	ED
	6	21	II	ER
	6	34	II	OD
11	3	53	II	Te
	6	17	I	ED
12	3	26	I	SI
	4	39	I	TI
	5	35	I	Se
13	4	08	I	OR
14	3	24	III	OD
	5	28	III	OR
18	4	01	II	Se
	4	14	II	TI
19	5	19	I	SI
20	2	38	I	ED
	6	02	I	OR
21	1	56	I	Se
	2	17	III	ED
	3	10	I	Te
	4	28	III	ER
25	4	19	II	SI
27	3	20	II	OR
	4	31	I	ED
28	1	41	I	SI
	2	55	I	TI
	3	50	I	Se
	5	03	I	Te

MARCH

d	h	m	Sat.	Phen.
1	2	22	I	OR
4	1	20	III	TI
	3	18	III	Te
6	1	08	II	ED
	3	25	II	ER
	3	38	II	OD
	5	53	II	OR
7	3	34	I	SI
	4	47	I	TI
	5	43	I	Se
8	0	45	II	Te
	0	52	I	ED
	4	13	I	OR
9	1	23	I	Te
11	2	24	III	Se
	5	09	III	TI
13	3	43	II	ED
14	5	28	I	SI
15	0	57	II	Se
	1	00	II	TI
	2	45	I	ED
	3	12	II	Te
16	1	05	I	TI
	2	05	I	Se
	3	13	I	Te
17	0	31	I	OR
18	4	12	III	SI
22	0	38	III	OR
	1	15	II	SI
	3	25	II	TI
	3	30	II	Se
	4	38	I	ED
	5	37	II	Te
23	1	49	I	SI
	2	55	I	TI
	3	59	I	Se
	5	03	I	Te
24	0	04	II	OR
	2	19	I	OR
29	0	16	III	ER
	2	19	III	OD
	3	47	II	SI
	4	14	III	OR
30	3	43	I	SI
	4	43	I	TI
31	0	59	I	ED
	2	29	II	OR
	4	07	I	OR
	23	10	I	TI

APRIL

d	h	m	Sat.	Phen.
1	0	21	I	Se
	1	19	I	Te
5	2	01	III	ED
	4	13	III	ER
7	0	48	II	ED
	2	52	I	ED
	4	52	II	OR
8	0	05	I	SI
	0	58	I	TI
	2	14	I	Se
	3	06	I	Te
	23	31	II	Te
9	0	20	I	OR
14	3	24	II	ED
	4	45	I	ED
15	1	59	I	SI
	2	44	I	TI
	4	08	I	Se
	4	52	I	Te
	22	09	II	SI
	22	14	III	Se
	23	10	III	TI
	23	14	I	ED
	23	38	II	TI
16	0	26	II	Se
	1	02	III	Te
	1	49	II	Te
	2	06	I	OR
	22	37	I	Se
	23	19	I	Te
22	3	52	I	SI
	4	29	I	TI
23	0	00	III	SI
	0	42	II	SI
	1	07	I	ED
	1	54	II	TI
	2	12	III	Se
	2	33	III	TI
	2	59	II	Se
	3	51	I	OR
	4	06	II	Te
	4	25	III	Te
	22	21	I	SI
	22	56	I	TI
24	0	31	I	Se
	1	04	I	Te
	22	17	I	OR
	22	42	II	OR
30	3	00	I	ED
	3	15	II	SI
	3	58	III	SI
	4	09	II	TI

MAY

d	h	m	Sat.	Phen.
1	0	15	I	SI
	0	40	I	TI
	2	25	I	Se
	2	49	I	Te
	21	29	I	ED
	21	55	II	ED
2	0	01	I	OR
	0	59	II	OR
	20	53	I	Se
	21	15	I	Te
3	21	21	III	OR
8	2	09	I	SI
	2	25	I	TI
	4	19	I	Se
	4	33	I	Te
	23	22	I	ED
9	0	31	II	ED
	1	45	I	OR
	3	16	II	OR
	20	37	I	SI
	20	51	I	TI
	22	48	I	Se
	23	00	I	Te
10	21	23	II	Se
	21	43	II	Te
	21	49	III	ED
11	0	39	III	OR
15	4	03	I	SI
	4	09	I	TI
16	1	16	I	ED
	3	08	II	ED
	3	28	I	OR
	22	32	I	SI
	22	35	I	TI
17	0	42	I	Se
	0	44	I	Te
	21	39	II	SI
	21	43	II	TI
	21	54	I	OR
	23	56	II	Te
	23	57	II	Se
18	1	47	III	ED
	4	02	III	ER
23	3	04	I	OD
24	0	19	I	TI
	0	26	I	SI
	2	28	I	Te
	2	36	I	Se
	21	30	I	OD
	23	48	I	ER
	23	57	II	TI
25	0	13	II	SI
	2	10	II	Te
	2	31	II	Se
	20	54	I	Te
	21	05	I	Se
26	21	22	II	ER
28	20	59	III	Te
	22	07	III	Se
31	2	03	I	TI
	2	21	I	SI
	23	14	I	OD

JUNE

d	h	m	Sat.	Phen.
1	1	42	I	ER
	2	11	II	TI
	2	47	II	SI
	20	29	I	TI
	20	49	I	SI
	22	38	I	Te
	23	00	I	Se
2	20	10	I	ER
	20	56	II	OD
	23	59	II	ER
4	22	18	III	TI
	23	50	III	SI
5	0	18	III	Te
	2	05	III	Se
8	0	58	I	OD
	22	14	I	TI
	22	44	I	SI
9	0	24	I	Te
	0	54	I	Se
	22	04	I	ER
	23	14	II	OD
10	2	36	II	ER
11	20	56	II	Se
12	1	37	III	TI
16	0	00	I	TI
	0	39	I	SI
	2	09	I	Te
	21	09	I	OD
	23	59	I	ER

d	h	m	Sat.	Phen.
17	1	32	II	OD
	20	36	I	Te
	21	17	I	Se
18	21	12	II	SI
	22	05	II	Te
	23	31	II	Se
22	20	41	III	OR
	21	39	III	ED
	23	57	III	ER
23	1	47	I	TI
	22	56	I	OD
24	1	53	I	ER
	20	14	I	TI
	21	02	I	SI
	22	23	I	Te
	23	12	I	Se
25	20	22	I	ER
	22	09	II	TI
	23	47	II	SI
26	0	25	II	Te
27	21	08	II	ER
29	22	01	III	OD
30	0	12	III	OR

JULY

d	h	m	Sat.	Phen.
1	0	43	I	OD
	22	02	I	TI
	22	57	I	SI
2	0	11	I	Te
	1	07	I	Se
	22	16	I	ER
3	0	30	II	TI
4	23	45	II	ER
8	23	54	I	TI
9	0	52	I	SI
	20	58	I	OD
10	0	11	I	ER
	20	27	I	Te
	21	31	I	Se
	22	02	III	Se
11	21	51	II	OD
13	20	33	II	Se
16	22	48	I	OD
17	20	08	I	TI
	21	16	I	SI
	21	24	III	Te
	22	18	I	Te
	23	26	I	Se
	23	44	III	SI
18	20	35	I	ER
20	20	49	II	Te
	20	49	II	SI
	23	09	II	Se
24	22	00	I	TI
	22	52	III	TI
	23	11	I	SI
25	22	30	I	ER
27	21	00	II	TI
	23	18	II	Te
	23	25	II	SI
29	20	54	II	ER

AUGUST

d	h	m	Sat.	Phen.
1	20	59	I	OD
2	20	30	I	Te
	21	44	I	Se
4	21	33	III	ED
5	20	56	II	OR
	21	09	II	ED
8	22	53	I	OD
9	20	14	I	TI
	21	30	I	SI
	22	24	I	Te
10	20	48	I	ER
11	20	19	III	OD
	22	43	III	OR
12	21	10	II	OD
14	20	15	II	Se
16	22	09	I	TI
18	20	03	I	Se
21	20	18	II	Te
	20	31	II	SI
22	19	40	III	SI
	22	01	III	Se
24	21	11	I	OD
25	19	49	I	SI
	20	43	I	Te
28	20	36	II	TI
29	20	58	III	Te
30	20	37	II	ER

SEPTEMBER

d	h	m	Sat.	Phen.
1	20	30	I	TI
2	21	03	I	ER
6	20	47	II	OR
	20	51	II	ED
9	19	35	I	OD
	19	53	III	ER
10	19	07	I	Te
	20	17	I	Se
15	20	00	II	Se
16	19	18	III	OR
17	18	55	I	TI
	20	03	I	SI
18	19	22	I	ER
26	18	36	I	Se

OCTOBER

d	h	m	Sat.	Phen.
3	18	21	I	SI
	19	33	I	Te
8	18	40	II	OD
17	18	13	II	Te
18	18	33	I	OD
19	18	04	I	Te
26	17	54	I	TI
27	17	55	I	ER

Jupiter being near the sun, phenomena of the satellites are not given from Oct. 29 to Dec. 29.

DECEMBER

d	h	m	Sat.	Phen.
31	6	32	I	TI

E—eclipse, O—occultation, T—transit, S—shadow, D—disappearance, R—reappearance, I—ingress, e—egress; 75th Meridian Civil Time. (For other times, see p. 10.)

THE PHYSICAL OBSERVATION OF THE MOON

The sun's selenographic colongitude is essentially a convenient way of indicating the position of the sunrise terminator as it moves across the face of the moon. It provides an accurate method of recording the exact conditions of illumination (angle of illumination), and makes it possible to observe the moon under exactly the same lighting conditions at a later date.

The sun's selenographic colongitude is numerically equal to the selenographic longitude of the sunrise terminator reckoned eastward from the mean centre of the disk. Its value increases at the rate of nearly 12.2° per day or about $\frac{1}{2}$° per hour; it is approximately 270°, 0°, 90° and 180° at New Moon, First Quarter, Full Moon and Last Quarter respectively. (See the tabulated values for 0h G.C.T. starting on p. 33.)

Sunrise will occur at a given point *east* of the central meridian of the moon when the sun's selenographic colongitude is equal to the eastern selenographic longitude of the point; at a point *west* of the central meridian when the sun's selenographic colongitude is equal to 360° minus the western selenographic longitude of the point. The longitude of the sunset terminator differs by 180° from that of the sunrise terminator.

The sun's selenographic latitude varies between $+1\frac{1}{2}$° and $-1\frac{1}{2}$° during the year.

EPHEMERIS FOR THE PHYSICAL OBSERVATION OF THE SUN, 1959

For 0h Greenwich Civil Time

Date	P	B_0	L_0	Date	P	B_0	L_0
	°	°	°		°	°	°
Jan. 1	+ 2.37	−3.02	19.92	July 5	− 1.21	+3.29	98.22
6	− 0.06	−3.59	314.07	10	+ 1.06	+3.82	32.04
11	− 2.48	−4.13	248.23	15	+ 3.31	+4.31	325.87
16	− 4.86	−4.65	182.39	20	+ 5.51	+4.78	259.71
21	− 7.16	−5.12	116.55	25	+ 7.67	+5.22	193.56
26	− 9.40	−5.56	50.72	30	+ 9.74	+5.62	127.42
31	−11.53	−5.95	344.89	Aug. 4	+11.74	+5.98	61.29
Feb. 5	−13.56	−6.29	279.06	9	+13.65	+6.30	355.18
10	−15.46	−6.58	213.22	14	+15.45	+6.58	289.08
15	−17.23	−6.83	147.39	19	+17.13	+6.81	222.99
20	−18.86	−7.02	81.54	24	+18.70	+7.00	156.91
25	−20.34	−7.15	15.69	29	+20.14	+7.13	90.85
Mar. 2	−21.68	−7.23	309.83	Sept. 3	+21.45	+7.22	24.80
7	−22.85	−7.25	243.96	8	+22.61	+7.25	318.76
12	−23.85	−7.22	178.08	13	+23.63	+7.23	252.74
17	−24.71	−7.13	112.18	18	+24.50	+7.16	186.73
22	−25.38	−6.99	46.26	23	+25.21	+7.03	120.73
27	−25.88	−6.79	340.33	28	+25.75	+6.86	54.74
Apr. 1	−26.21	−6.55	274.38	Oct. 3	+26.12	+6.63	348.76
6	−26.35	−6.26	208.41	8	+26.33	+6.35	282.79
11	−26.31	−5.92	142.41	13	+26.34	+6.03	216.83
16	−26.09	−5.54	76.40	18	+26.18	+5.65	150.88
21	−25.69	−5.12	10.37	23	+25.82	+5.24	84.93
26	−25.11	−4.67	304.32	28	+25.26	+4.79	18.99
May 1	−24.33	−4.18	238.24	Nov. 2	+24.51	+4.29	313.06
6	−23.38	−3.67	172.15	7	+23.57	+3.77	247.13
11	−22.25	−3.13	106.05	12	+22.43	+3.21	181.21
16	−20.95	−2.57	39.92	17	+21.10	+2.63	115.30
21	−19.49	−1.99	333.79	22	+19.57	+2.03	49.39
26	−17.87	−1.40	267.64	27	+17.88	+1.41	343.49
31	−16.11	−0.80	201.47	Dec. 2	+16.02	+0.77	277.59
June 5	−14.23	−0.20	135.31	7	+14.01	+0.14	211.70
10	−12.23	+0.40	69.13	12	+11.87	−0.51	145.82
15	−10.13	+1.00	2.95	17	+ 9.63	−1.14	79.94
20	− 7.96	+1.60	296.76	22	+ 7.30	−1.77	14.08
25	− 5.74	+2.18	230.57	27	+ 4.91	−2.39	308.21
30	− 3.49	+2.74	164.40				

P—The position angle of the axis of rotation, measured eastward from the north point of the disk.

B_0—The heliographic latitude of the centre of the disk.

L_0—The heliographic longitude of the centre of the disk, from Carrington's solar meridian.

CARRINGTON'S ROTATION NUMBERS—GREENWICH DATE OF COMMENCEMENT OF SYNODIC ROTATIONS, 1959

No.	Commences	No.	Commences	No.	Commences
1409	Jan. 2.51	1414	May 19.02	1419	Oct. 2.15
1410	Jan. 29.85	1415	June 15.22	1420	Oct. 29.44
1411	Feb. 26.19	1416	July 12.42	1421	Nov. 25.75
1412	Mar. 25.51	1417	Aug. 8.64	1422	Dec. 23.07
1413	Apr. 21.79	1418	Sept. 4.88		

ECLIPSES, 1959

In the year 1959 there will be three eclipses, two of the sun and one of the moon.

I. *A Partial Eclipse of the Moon*, March 24, 1959. This eclipse is visible in Australia, Asia, Europe, and Africa, but not in America.

II. *An Annular Eclipse of the Sun*, April 8, 1959. The path of this eclipse is from the Indian Ocean across Australia and into the Pacific.

III. *A Total Eclipse of the Sun*, October 2, 1959. The path of totality begins in New England at sunrise, crosses the Atlantic Ocean and Africa and ends in the Indian Ocean. Canadians and Americans east of Lake Michigan will see the sun at least partially eclipsed at sunrise.

PLANETARY APPULSES AND OCCULTATIONS

The close approach of a planet to a star is of interest to observers. Surprisingly few observable appulses of planets and stars of 9th magnitude or brighter occur during a year. An even rarer occurrence is the observable occultation of a star by a planet.

The following details have been kindly supplied by Mr. Gordon E. Taylor and the British Astronomical Association. The data include the E.S.T. of conjunction of the planet and star, the magnitude of the star, the angular separation of the star and planet as seen from the centre of the earth (geocentric separation), and the horizontal parallax of the planet.

Planet	Date	Conj. E.S.T.	Star	Mag.	Geoc. Sepn.	Hor. Par.
		h m			″	″
Venus	July 7	9 29	Regulus	1.3	4	15
Mars	Jan. 26	22 33	B.D.+20°572	8.3	15	9
	Apr. 11	1 58	B.D.+25°1105	8.5	19	5
	Dec. 21	1 18	C.D.—22°11630	8.1	3	4
	Dec. 21	22 22	C.D.—22°11659	8.4	16	4

It may also be noted that Saturn passes in front of the open cluster M 21 between Jan. 8 and Jan. 10. Unfortunately Saturn will be only about 15° from the sun.

Venus will occult Regulus on July 7. The occultation will be visible from eastern North America, although Venus will be low in the east in daylight. The altitude at Montreal will be only 12°. Times and position angles are given:

	E.S.T. h m	P. °
Disappearance	9 15	93
Reappearance	9 27	323

LUNAR OCCULTATIONS

When the moon passes between the observer and a star that star is said to be occulted by the moon and the phenomenon is known as a lunar occultation. The passage of the star behind the east limb of the moon is called the immersion and its re-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 1959 *British Nautical Almanac* and the *American Ephemeris*, give the times of immersion or emersion or both for occultations visible at Toronto Montreal, Edmonton and Vancouver. Stars of magnitude 5.0 or brighter are included as well as daytime occultations of very bright stars and planets. Since an occultation at the bright limb of the moon is difficult to observe the predictions are limited to phenomena occurring 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 the standard stations. Thus if λ_0, ϕ_0, be the longitude and latitude of the standard station and λ, ϕ, the longitude and latitude of the neighbouring station then for the neighbouring station we have:

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

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

The observation of lunar occultations can become a fascinating hobby. Amateurs with small telescopes may find it particularly attractive, and for them the lists of fainter occultations given in the almanacs would be of interest. Occultations accurately timed to a fraction of a second are useful for orbital and geodetic problems.

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1959

Date	Star	Mag.	I or E	Age of Moon	Toronto				Montreal			
					E.S.T.	a	b	P	E.S.T.	a	b	P
				d	h m	m	m	°	h m	m	m	°
Feb. 19	λ Gem	3.6	I	12.2	Sun	..	..	..	17 33.0	−1.0	+0.8	105
Apr. 28	ρ Sgr	4.0	I	20.3	3 49.9	−1.7	+0.2	111	4 00.4	−1.8	0.0	108
May 12	λ Gem	3.6	I	5.1	Sun	..	..	..	19 14.2	−1.2	−1.0	80
June 21	ρ Sgr	4.0	I	15.7	22 31.3	−1.3	+2.0	52	22 43.0	−1.4	+2.0	45
June 21	ρ Sgr	4.0	E	15.7	23 30.7	−1.4	+0.2	299	23 39.3	−1.5	−0.1	304
Sep. 22	α Tau	1.1	I	20.2	23 19.1	−0.2	+1.4	91	23 23.5	−0.4	+1.4	92
Sep. 23	α Tau	1.1	E	20.2	0 22.5	−0.4	+2.0	244	0 29.2	−0.6	+2.1	243
Oct. 5	θ Lib	4.3	I	3.5	19 01.3	−0.9	−1.4	101	Low	..	..	..
Oct. 20	α Tau*	1.1	I	18.0	9 27.7	+0.4	−2.2	126	9 21.6	+0.4	−1.8	115

*Daytime Occultation.

LUNAR OCCULTATIONS VISIBLE AT EDMONTON AND VANCOUVER, 1959

Date	Star	Mag.	I or E	Age of Moon	Edmonton				Vancouver			
					M.S.T.	a	b	P	P.S.T.	a	b	P
				d	h m	m	m	°	h m	m	m	°
Mar. 20	α Cnc	4.3	I	11.8	23 56.8	−1.8	+0.5	51	22 39.0	−1.8	−0.2	76
June 10	α Cnc	4.3	I	4.7	No occ.	..	..	..	21 29.6	0.0	−1.8	112
Sep. 11	ρ Sgr	4.0	I	9.2	22 45.4	−1.1	−0.9	86	21 35.8	−1.4	−0.6	85
Sep. 22	α Tau	1.1	E	20.2	22 31.9	0.0	+1.2	288	No occ.	..	..	..
Sep. 26	λ Gem	3.6	I	23.4	3 16.1	−0.5	+1.8	80	2 05.1	−0.3	+1.6	85
Sep. 26	λ Gem	3.6	E	23.4	4 25.1	−1.0	+0.9	286	3 11.5	−0.8	+1.2	279
Oct. 20	α Tau	1.1	I	18.0	7 02.6	−0.5	−2.6	121	6 09.5	−0.6	−4.2	144
Oct. 20	α Tau	1.1	E	18.0	7 59.7	−0.6	−0.6	234	6 50.1	−1.3	+1.3	211
Dec. 13	α Tau	1.1	I	13.7	17 44.5	−0.1	+1.4	99	16 39.5	+0.2	+1.2	99
Dec. 13	α Tau	1.1	E	13.7	18 42.1	−0.1	+2.2	238	17 33.8	+0.1	+2.0	238

METEORS, FIREBALLS AND METEORITES

By Peter M. Millman

Meteoroids are small solid particles moving in orbits about the sun. On entering the earth's atmosphere at velocities ranging from 10 to 45 miles per second they become luminous and appear as meteors or fireballs and, if large enough to avoid complete vapourization, in rare cases they may fall to the earth as meteorites.

Meteors are visible on any night of the year. At certain times of the year the earth encounters large numbers of meteors all moving together along the same orbit. Such a group is known as a meteor shower and the accompanying list gives the most important showers visible in 1959.

On the average an observer sees 7 meteors per hour which are not associated with any recognized shower. These have been included in the hourly rates listed in the table. The radiant is the position among the stars from which the meteors of a given shower seem to radiate. The appearance of any very bright fireball should be reported immediately to the nearest astronomical group or organization. If sounds are heard accompanying such a phenomenon there is a possibility that a meteorite may have fallen and the astronomers must rely on observations made by the general public to track it down.

There is a possibility that the Giacobinid meteor shower will appear in some strength in 1959. However, any predictions of a spectacular display must be accompanied by a word of caution. In the past the great displays of 1933 and 1946 took place when the earth crossed the comet orbit some distance behind the comet. In 1959 the earth crosses the orbit of comet Giacobini-Zinner approximately 22 days ahead of the comet, just after 1 hour E.S.T., October 10. Hence, if any shower appears, it will be on the night of October 9–10 and the peak may occur at any time between midnight and 7 a.m. E.S.T. It is suggested that all meteor observers carry out a programme of work on this night.

Meteor Showers for 1959

Shower	Shower Maximum			Radiant				Single Observer Hourly Rate	Normal Duration to $\frac{1}{4}$ strength of Max.
	Date	E.S.T.	Moon	Position at Max. α	Position at Max. δ	Daily Motion α	Daily Motion δ		
				°	°	°	°		(days)
Quadrantids	Jan. 3	18h	L.Q.	232	+50			40	0.6
Lyrids	Apr. 22	12	F.M.	274	+34	+1.1	0.0	15	2.3
η Aquarids	May 5	11	N.M.	336	00	+0.9	+0.4	20	18
δ Aquarids	Jul. 29	19	L.Q.	339	−17	+0.85	+0.17	20	20
Perseids	Aug. 12	15	F.Q.	046	+58	+1.35	+0.12	50	5.0
Giacobinids	Oct. 10	07	F.Q.	262	+54	+2.1	−0.1	?	0.05
Orionids	Oct. 21	02	L.Q.	095	+15	+1.23	+0.13	25	8
Taurids	Nov. 6	02	F.Q.	053	+14	+0.67	+0.13	15	(30)
Leonids	Nov. 17	01	F.M.	152	+22	+0.70	−0.42	15	4
Geminids	Dec. 13	19	F.M.	113	+32	+1.05	−0.07	50	6.0
Ursids	Dec. 23	00	L.Q.	217	+76			15	2.2

THE BRIGHTEST STARS

By Donald A. MacRae

The 286 stars brighter than apparent magnitude 3.55.

Star. If the star is a visual double the letter *A* indicates that the data are for the brighter component. The brightness and separation of the second component *B* are given in the last column. Sometimes the double is too close to be conveniently resolved and the data refer to the combined light, *AB*; in interpreting such data the magnitudes of the two components must be considered.

Visual Magnitude (*V*). These magnitudes are based on *photoelectric observations*, with a few exceptions, which have been adjusted to match the yellow colour-sensitivity of the eye. The photometric system is that of Johnson and Morgan in *Ap. J.*, vol. 117, p. 313, 1953. It is as likely as not that the true magnitude is within 0.03 mag. of the quoted figure, on the average. Variable stars are indicated with a "v". The type of variability, range, *R*, in magnitudes, and period in days are given.

Colour index (*B–V*). The blue magnitude, *B*, is the brightness of a star as observed photoelectrically through a blue filter. The difference *B–V* is therefore a measure of the colour of a star. The table reveals a close relaton between *B–V* and spectral type. Some of the stars are slightly reddened by interstellar dust. The probable error of a value of *B–V* is only 0.01 or 0.02 mag.

Type. The customary spectral (temperature) classification is given first. The Roman numerals are indicators of *luminosity class.* They are to be interpreted as follows: Ia—most luminous supergiants; Ib—less luminous supergiants; II—bright giants; III—normal giants; IV—subgiants; V—main sequence stars. Intermediate classes are sometimes used, e.g. Iab. Approximate absolute magnitudes can be assigned to the various spectral and luminosity class combinations. Other symbols used in this column are: p—a peculiarity; e—emission lines; v—the spectrum is variable; m—lines due to metallic elements are abnormally strong; f—the O-type spectrum has several broad emission lines; n or nn—unusually wide or diffuse lines. A composite spectrum, e.g. M1 Ib+B, shows up when a star is composed of two nearly equal but unresolved components. In the far southern sky, spectral types in italics were provided through the kindness of Prof. R. v. d. R. Woolley, Australian Commonwealth Observatory. Types in parentheses are less accurately defined (g—giant, d—dwarf, c–exceptionally high luminosity). All other types were very kindly provided especially for this table by Dr. W. W. Morgan, Yerkes Observatory.

Parallax (π). From "General Catalogue of Trigonometric Stellar Parallaxes" by Louise F. Jenkins, Yale Univ. Obs., 1952.

Absolute visual magnitude (M_V), and *distance in light-years* (D). If π is greater than 0.030″ the distance corresponds to this trigonometric parallax and the absolute magnitude was computed from the formula $M_V = V + 5 + 5 \log \pi$. Otherwise a generally more accurate absolute magnitude was obtained from the luminosity class. In this case the formula was used to *compute* π and the distance corresponds to this "spectroscopic" parallax. The formula is an expression of the inverse square law for decrease in light intensity with increasing distance. The effect of absorption of light by interstellar dust was neglected, except for three stars, ζ Per, σ Sco and ζ Oph, which are significantly reddened and would therefore be about a magnitude brighter if they were in the clear.

Annual proper motion (μ), and *radial velocity* (R). From "General Catalogue of Stellar Radial Velocities" by R. E. Wilson, Carnegie Inst. Pub. 601, 1953. Italics indicate an average value of a variable radial velocity.

The star names are given for all the officially designated navigation stars and a few others. Throughout the table, a *colon* (:) indicates an uncertainty.

We are indebted to Dr. Daniel L. Harris, Yerkes Observatory, particularly for his compilation of the photometric data from numerous sources.

Star	Right Ascension	Declination	Visual Magnitude	Colour Index	Spectral Classification	Parallax	Absolute Magnitude	Distance light-years	Proper Motion	Radial Velocity	
	R.A. 1960	Dec.	V	$B-V$	Type	π	M_V	D	μ	R	
	h m	° ′				″		l.y.	″	km./sec.	
Sun			−26.89	+0.63	G2 V		+4.68				***Sun***
α And	00 06.3	+28 52	2.06	−0.08	B9p	0.024	−0.1	90	0.209	*−11.7*	Manganese star ***Alpheratz***
β Cas	07.0	+58 56	2.26	+0.34	F2 IV	0.072	+1.6	45	0.555	+11.8	***Caph***
γ Peg	11.2	+14 58	2.84v	−0.23	B2 IV	−.004	−3.4	570	0.010	+04.1	β CMa type, R in V 2.83–2.85, 0.15^d
β Hyi	23.7	−77 29	2.78	+0.62	*G1 IV*	0.153	+3.7	21	2.255	+22.8	γ Peg = ***Algenib***
α Phe	24.3	−42 31	2.39	+1.08	*K0 III*	0.035	+0.1	93	0.442	*+74.6*	***Ankaa***
δ And *A*	37.2	+30 39	3.25:	+1.26	K3 III	0.024	−0.2	160	0.161	−07.3	*B* 12^m 28″
α Cas	38.2	+56 19	2.16	+1.18	K0 II–III	0.009	−1.1	150	0.058	−03.8	Var.? ***Schedar***
β Cet	41.6	−18 12	2.02	+1.03	K1 III	0.057	+0.8	57	0.234	+13.1	***Diphda***
η Cas *A*	46.7	+57 36	3.47	+0.56	G0 V	0.182	+4.8	18	1.221	+09.4	*B* 7.26^m 9″
γ Cas *A*	54.3	+60 30	2.13v	−0.16v	B0 IV: pe	0.034	−0.3:	96:	0.026	−06.8	Var. *B* 8.18^m 2″
β Phe *AB*	01 04.3	−46 56	3.30	+0.88	*G8 III*	0.017	+0.3	190	0.035	−01.1	*A* 4.1^m *B* 4.1^m 2″
η Cet	06.6	−10 24	3.47	+1.16	K3 III	0.032	+1.0	102	0.250	+11.5	
β And	07.5	+35 25	2.02	+1.57	M0 III	0.043	+0.2	76	0.211	+00.3	***Mirach***
δ Cas	23.2	+60 02	2.67	+0.13	A5 V	0.029	+2.1	43	0.301	+06.7	Ecl.? *R* 0.08:^{m} 759^d
γ Phe	26.6	−43 31	3.44	+1.56	*K5 Ib*	−.003	−4.6	1300	0.209	*+25.7*	
α Eri	36.2	−57 26	0.51	−0.16	*B5 IV:*	0.023	−2.3	118	0.098	+19	***Achernar***
τ Cet	42.2	−16 09	3.50	+0.72	G8 Vp	0.275	+5.70	12	1.921	−16.2	

Star	R.A. 1960 h m	Dec. ° ′	V	$B-V$	Type	π	M_V	D	μ	R	
						″		l.y.	″	km./sec.	
α Tri	01 50.8	+29 23	3.45	+0.46	F6 IV	0.050	+2.0	65	0.230	*−12.6*	
ϵ Cas	51.5	+63 28	3.33	−0.15	B3 IV: p	0.007	−2.7	520	0.038	−08.1	
β Ari	52.4	+20 37	2.68	+0.14	A5 V	0.063	+1.7	52	0.147	*−01.9*	
α UMi *A*	55.5	+89 05	1.99v	+0.60v	F8 Ib	0.003	−4.6	680	0.046	*−17.4*	Cep., *R* 0.11^m 4.0^d, *B* 8.9^m 18″ *Polaris*
α Hyi	57.5	−61 46	2.84	+0.28	*F0 V*		+2.9	31	0.265	+07	
											γ And = *Almach*
γ And *A*	02 01.4	+42 08	2.14:	+1.16:	K3 II	0.005	−2.4	260	0.068	−11.7	*B* 5.4^m *C* 6.2^m *A–BC* 10″ *B–C* 0.7″
α Ari	04.9	+23 16	2.00	+1.15	K2 III	0.043	+0.2	76	0.241	−14.3	*Hamal*
β Tri	07.2	+34 48	3.00	+0.13	A5 III	0.012	−0.1	140	0.156	*+09.9*	
o Cet *A*	17.3	−03 09	2.0v		(gM6e)	0.013	−0.5	103	0.232	+63.8	LP, *R* 2.0–10.1, 332^d, *B* 10^m 1″ *Mira*
γ Cet *AB*	41.2	+03 04	3.48	+0.11	A2 V	0.048	+2.0	68	0.203	−05.1	*A* 3.57^m *B* 6.23^m 3″
θ Eri *AB*	56.7	−40 28	2.92	+0.13	*A3 V*	0.028	+1.7	65	0.061	*+11.9*	*A* 3.25^m *B* 4.36^m 8″ *Acamar*
α Cet	03 00.2	+03 56	2.54	+1.63	M2 III	0.003	−0.5	130	0.075	−25.9	*Menkar*
γ Per	01.9	+53 21	2.91:	+0.72:	G8III: +A3:	0.011	+0.3	113	0.004	*+02.5*	
ρ Per	02.6	+38 41	3.5v		M4 II–III	0.008	−1.0	260	0.172	+28.2	Irr. *R* 3.2–3.8
β Per	05.6	+40 48	2.06v	−0.07	B8 V	0.031	−0.5	105	0.006	*+04.0*	Ecl. *R* 2.06–3.28, 2.87^d *Algol*
α Per	21.5	+49 43	1.80	+0.48	F5 Ib	0.029	−4.4	570	0.035	−02.4	*Mirfak*
δ Per	40.1	+47 40	3.03	−0.14	B5 III	0.007	−3.3	590	0.046	−09	
η Tau	45.1	+23 59	2.86	−0.09	B7 III	0.005	−3.2	541	0.050	+10.1	in Pleiades *Alcyone*
γ Hyi	47.8	−74 22	3.30	+1.61	*M2 II–III*	−.001	−1.5	300	0.125	+16.0	
ζ Per *A*	51.6	+31 46	2.83	+0.13	B1 Ib	0.007	−6.1	1000	0.015	+20.6	*B* 9.36^m 13″
ϵ Per *A*	55.2	+39 54	2.88	−0.17	B0.5 V	−.001	−3.7	680	0.036	−01	*B* 7.99^m 9″
γ Eri	56.2	−13 37	3.01	+1.58	M0 III	0.003	−0.5	160	0.126	+61.7	
α Ret *A*	04 13.9	−62 34	3.33	+0.91	*G6 II*	0.008	−2.1	390	0.064	+35.6	*B* 12^m 49″
ϵ Tau	26.3	+19 06	3.54	+1.02	K0 III	0.018	+0.1	160	0.118	+38.6	
θ^2 Tau	26.4	+15 47	3.42	+0.17	A7 III	0.025	+0.2	140	0.108	*+39.5*	
α Dor	33.1	−55 08	3.28	−0.08	*A0 IIIp*	0.011	−1.2	260	0.051	+25.6	Silicon star
α Tau *A*	33.6	+16 26	0.86v	+1.52	K5 III	0.048	−0.7	68	0.202	+54.1	Irr.? *R*0.78–0.93, *B*13^{m}31″ ***Aldebaran***
π^3 Ori	47.7	+06 54	3.17	+0.45	F6 V	0.125	+3.65	26	0.468	+24.3	
ι Aur	54.4	+33 06	2.64:	+1.49	K3 II	0.015	−2.4	330	0.021	+17.5	

α UMi, *Polaris:* R.A. 1 h 53.6 m; Dec. +89° 04′ (1957).

Star	R.A. 1960 h m	Dec. ° ′	V	$B-V$	Type	π ″	M_V	D l.y.	μ ″	R km./sec.	
ϵ Aur	04 59.1	+43 46	3.0v	+0.50:	F0 Iap	0.004	−7.1	3400	0.008	*−02.5*	Ecl. R 0.81^m 9886^d
η Aur	05 03.7	+41 11	3.17	−0.18	B3 V	0.013	−2.1	370	0.077	+07.4	
ϵ Lep	03.8	−22 25	3.21	+1.46	*K5 III*	0.006	−0.4	170	0.077	+01.0	
β Eri	05.9	−05 08	2.79	+0.13	A3 III	0.042	+0.9	78	0.122	−08	
μ Lep	11.1	−16 15	3.29	−0.09	*B9 IIIp*	0.018	−2.1	390	0.049	+27.7	Manganese star
β Ori A	12.6	−08 15	0.14v	−0.04	B8 Ia	−.003	−7.1	900	0.001	*+20.7*	Irr.? R 0.08–0.20, B 6.65^m 9″ **Rigel**
α Aur	13.7	+45 58	0.05	+0.80	G8III: +F	0.073	−0.6	45	0.435	*+30.2*	**Capella**
η Ori AB	22.5	−02 26	3.32v	−0.18	B0.5 V	0.004	−3.7	940	0.008	*+19.8*	Ecl. R 3.32–3.50, 8.0^d, A 3.59^m B 4.98^m 1″
γ Ori	23.0	+06 19	1.64	−0.23	B2 III	0.026	−4.2	470	0.015	+18.2	*Bellatrix*
β Tau	23.8	+28 35	1.65	−0.13	B7 III	0.018	−3.2	300	0.178	+08.0	*Elnath*
β Lep A	26.5	−20 47	2.81	+0.82	G5 III	0.014	+0.1	113	0.090	−13.5	B 9.4^m 3″
δ Ori A	30.0	−00 20	2.20v	−0.20	O9.5 II	0.004	−6.1	1500	0.002	*+16.0*	Ecl. R 2.20–2.35 5.7^d, B 6.74^m 53″
α Lep	31.0	−17 51	2.58	+0.22	F0 Ib	0.002	−4.6	900	0.006	+24.7	
λ Ori AB	32.9	+09 55	3.40	−0.18	O8	0.006	−5.1	1800	0.006	+33.5	A 3.56^m B 5.54^m 4″ C 10.92^m 29″
ι Ori AB	33.5	−05 56	2.76	−0.24	O9 III	0.021	−6.1	2000	0.005	*+21.5*	A 2.78^m B 7.31^m 11″
ϵ Ori	34.2	−01 14	1.70	−0.19	B0 Ia	−.007	−6.8	1600	0.000	+26.1	*Alnilam*
ζ Tau	35.3	+21 07	3.07:	−0.13:	B2 III: p	−.002	−4.2	940	0.023	*+24.3*	Shell star
α Col A	38.2	−34 06	2.64	−0.11	*B8 Ve*	−.005	−0.6	140	0.026	+35	B 12^m 12″
ζ Ori AB	38.7	−01 58	1.79	−0.22	O9.5 Ib	0.022	−6.6	1600	0.004	+18.1	A 1.91^m B 4.05^m 3″
κ Ori	45.9	−09 41	2.06	−0.17	B0.5 Ia	0.009	−6.9	2100	0.004	+20.6	
β Col	49.5	−35 47	3.12	+1.16	(gK1)	0.023	+0.0	140	0.402	+89.4	
α Ori	53.0	+07 24	0.41v	+1.87:	M2 Iab	0.005	−5.6	520	0.028	*+21.0*	Irr.? R 0.06:–0.75:^{m} **Betelgeuse**
β Aur	56.6	+44 57	1.86	+0.06	A2 V	0.037	−0.3	88	0.051	*−18.2*	
θ Aur AB	57.0	+37 13	2.65	−0.07	B9.5pv	0.018	+0.1	108	0.097	+29.3	Silicon star A 2.67^m B 7.14^m 3″
η Gem A	06 12.5	+22 31	3.33v	+1.58	M3 III	0.013	−0.6	200	0.066	*+19.0*	R 0.27^m, B 6.70^m 1″
ζ CMa	18.8	−30 03	3.04	−0.18	B2.5 V	−.003	−2.4	390	0.004	*+32.2*	
μ Gem	20.5	+22 32	2.92v	+1.63	M3 III	0.021	−0.6	160	0.129	+54.8	R 0.14^m
β CMa	20.9	−17 56	1.96	−0.24	B1 II–III	0.014	−4.8	750	0.004	*+33.7*	β CMa type variable
α Car	23.1	−52 40	−0.72	+0.16	F0 Ib–II	0.018	−3.1	98	0.025	+20.5	**Canopus**
γ Gem	35.4	+16 26	1.93	0.00	A0 IV	0.031	−0.6	105	0.066	*−12.5*	

Star	R.A. 1960 h m	Dec. ° ′	V	$B-V$	Type	π	M_V	D	μ	R	
						″		l.y.	″	km./sec.	
ν Pup	06 36.5	−43 10	3.19	−0.10	*B7 III*		−3.2	620	0.010	+28.2	
ϵ Gem	41.5	+25 10	3.00	+1.39	G8 Ib	0.009	−4.6	1080	0.016	+09.9	
ξ Gem	43.0	+12 56	3.38	+0.43	F5 IV	0.051	+1.9	64	0.224	+25.3	
α CMa *A*	43.4	−16 40	−1.42	+0.01	A1 V	0.375	+1.45	8.7	1.324	*−07.6*	*B* 8.66m 1960: 9″, θ = 90° **Sirius**
α Pic	47.8	−61 54	3.27	+0.21	*A5 V*		+2.1	57	0.272	+20.6	
τ Pup	48.9	−50 34	2.97	+1.17	*K0 III*		+0.1	124	0.079	*+36.4*	
ϵ CMa *A*	57.1	−28 55	1.48:	−0.18:	B2 II		−5.1	680	0.004	+27.4	*B* 7.5m 8″ **Adhara**
o^2 CMa	07 01.4	−23 46	3.02	−0.09	B3 Ia		−7.1	3400	0.000	+48.4	
δ CMa	06.8	−26 20	1.85	+0.65	F8 Ia	−.018	−7.1	2100	0.005	+34.3	
L_2 Pup	12.3	−44 34			(gM5e)	0.016	−3.1	650	0.342	+53.0	LP, *R* 3.4–6.2, 141d
π Pup	15.7	−37 01	2.81	+1.56:	(gK4)	0.023	−0.3	140	0.008	+15.8	
η CMa	22.5	−29 13	2.46	−0.08	B5 Ia		−7.1	2700	0.008	+41.1	
β CMi	25.0	+08 22	2.91	−0.09	B7 V	0.020	−1.1	210	0.065	+22	
σ Pup *A*	28.0	−43 13	3.28	+1.49	(gK5)	0.013	−0.4	180	0.195	*+88.1*	*B* 9.4m 22″
α Gem *A*	32.0	+31 59	1.97	+0.00:	A1 V	0.072	+1.3	45	0.199	+06.0	5″, *B*−*V*+0.02, *C* 9.08vm 73″ *Castor*
α Gem *B*	32.0	+31 59	2.95	+0.07:	A5m	0.072	+2.3	45	0.199	−01.2	
α CMi *A*	37.2	+05 20	0.37	+0.41	F5 IV–V	0.288	+2.7	11.3	1.250	−03.2	*B* 10.7m 5″ **Procyon**
β Gem	42.9	+28 07	1.16	+1.02	K0 III	0.093	+1.0	35	0.625	+03.3	**Pollux**
ξ Pup	47.6	−24 45	3.34	+1.23	G3 Ib	−.003	−4.6	1240	0.005	*+02.7*	
χ Car	55.8	−52 52	3.48	−0.18	(B3)		−2.1	430	0.039	+19.1	
ζ Pup	08 02.2	−39 53	2.23	−0.26	O5f		−7.1	2400	0.033	−24	
ρ Pup	05.8	−24 11	2.80v	+0.42	F6 IIp	0.031	+0.3:	105:	0.098	+46.6	Var. *R* 2.72–2.87
γ Vel *A*	08.3	−47 14	1.88	−0.26	*WC7*		−4.1	520	0.011	+35	*B* 4.31m 41″
ϵ Car	21.7	−59 23	1.97	+1.14:	(K0 + B)		−3.1:	340	0.030	+11.5	*Avior*
o UMa *A*	27.0	+60 51	3.37	+0.83	G5 III	0.004	+0.1	150	0.171	+19.8	*B* 15m 7″
δ Vel *AB*	43.6	−54 34	1.95	+0.05	*A0 V*	0.043	+0.2	76	0.086	+02.2	*A* 2.0m *B* 5.1m 3″ *CD* 10m 69″
ϵ Hya *ABC*	44.7	+06 34	3.39	+0.68	G0 comp.	0.010	+0.6	140	0.198	*+36.4*	*A*3.7m*B*5.2m0.2″15y, *C*6.8m3″*D*12m20″
ζ Hya	53.3	+06 06	3.11	+1.00	K0 II–III	0.029	−1.1	220	0.101	+22.8	
ι UMa *A*	56.5	+48 12	3.12	+0.19	A7 V	0.066	+2.2	49	0.505	+12.2	*BC* 10.8m 7″

Star	R.A. 1960 h m	Dec. ° ′	V	$B-V$	Type	π ″	M_V	D l.y.	μ ″	R km./sec.		
λ Vel	09 06.5	−43 16	2.24	+1.64:	*K5 Ib*	0.015	−4.6	750	0.026	+18.4		*Suhail*
a Car	09.9	−58 48	3.43	−0.17	*B3 IV*		−2.9	590	0.028	*+23.3*		
β Car	12.8	−69 33	1.67	+0.01	*A0 III*	0.038	−0.4	86	0.183	−05		*Miaplacidus*
ι Car	16.0	−59 06	2.25	+0.17	*F0 Ib*		−4.6	750	0.019	+13.3		
α Lyn	18.6	+34 34	3.17	+1.54	M0 III	0.021	−0.5	180	0.217	+37.6		
κ Vel	20.9	−54 50	2.45	−0.15	*B2 IV*	0.007	−3.4	470	0.012	*+21.9*		
α Hya	25.6	−08 29	1.98	+1.44	K4 III	0.017	−0.3	94	0.034	−04.3		*Alphard*
N Vel	30.0	−56 51	3.19	+1.56	(gK5)	0.015	−0.4	170	0.036	−13.9		
θ UMa *A*	30.2	+51 52	3.19	+0.46	F6 IV	0.052	+1.8	63	1.094	+15.4	*B* 14^m 5″	
ε Leo	43.6	+23 58	2.99	+0.81	G0 II	0.002	−2.1	340	0.048	+05.0		
l Car	44.1	−62 19	4.1		(cG0)	0.019	−5.5	2700	0.016	*+04.0*	Cep. max. 3.4^m min. 4.8^m, 35.52^d	
υ Car *AB*	46.1	−64 53	2.95	+0.26	*A7 II*	0.020	−2.1	340	0.012	+13.6	*A* 3.02^m *B* 6.03^m 5″	
α Leo *A*	10 06.2	+12 10	1.36	−0.11	B7 V	0.039	−0.7	84	0.248	+03.5	*B* 8.1^m 177″	***Regulus***
ω Car	12.8	−69 50	3.33	−0.08	*B8.5 IV*		−1.5	300	0.029	+04		
ζ Leo	14.5	+23 37	3.46	+0.30	F0 III	0.009	+0.5	130	0.023	−15.0		
λ UMa	14.7	+43 07	3.45	+0.03	A2 IV	−.010	+0.1	150	0.170	+18.3		
q Car	15.8	−61 08	3.41v	+1.55	*K5 Ib*	0.018	−4.6	1300	0.023	+08.6	Var. *R* 3.38–3.44	
γ Leo *AB*	17.8	+20 03	1.99	+1.13	K0 IIIp	0.019	+0.1	90	0.350	−36.6	*A* 2.29^m *B* 3.54^m 4″	
μ UMa	20.0	+41 42	3.05	+1.55	M0 III	0.031	+0.5	105	0.086	*−20.5*		
p Car	30.6	−61 29	3.30v	−0.11	*B5 IVpe*		−2.3	430	0.021	+26.0	Var. *R* 3.22–3.39	
θ Car	41.5	−64 11	2.74	−0.22	*B0 Vp*		−4.0	710	0.018	+24		
μ Vel *AB*	45.0	−49 12	2.67	+0.89	*G5 III*		+0.1	108	0.085	+06.9	*A* 2.7^m *B* 7.2^m 2″	
ν Hya	47.6	−15 59	3.12	+1.25	K3 III	0.022	−0.2	150	0.221	−01.0		
β UMa	59.4	+56 36	2.37	−0.03	A1 V	0.042	+0.5	78	0.087	−12.0		*Merak*
α UMa *AB*	11 01.3	+61 58	1.81	+1.06	K0 III	0.031	−0.7	105	0.138	−08.9	*A* 1.88^m *B* 4.82^m 1″	*Dubhe*
ψ UMa	07.4	+44 43	3.00	+1.14	K1 III		+0.0	130	0.072	−03.8		
δ Leo	12.0	+20 45	2.57	+0.13	A4 V	0.040	+0.6	82	0.201	−20.6		
θ Leo	12.1	+15 39	3.34	0.00	A2 V	0.019	+1.1	90	0.104	+07.8		
λ Cen	33.9	−62 48	3.15	−0.05	*B9 III*		−2.1	370	0.039	+07.9		
β Leo	47.0	+14 48	2.14	+0.09	A3 V	0.076	+1.5	43	0.511	−00.1		*Denebola*

Star	R.A. 1960 h m	Dec. ° ′	V	$B-V$	Type	π	M_V	D	μ	R	
						″		l.y.	″	km./sec.	
γ UMa	11 51.7	+53 55	2.44	0.00	A0 V	0.020	+0.2	90	0.094	−12.9	*Phecda*
δ Cen	12 06.3	−50 30	2.59v	−0.15:	*B2 Ve*		−2.7	370	0.042	+09	Var. *R* 2.56–2.62
ϵ Crv	08.1	−22 24	3.04	+1.33	K3 III		−0.2	140	0.069	+04.9	
δ Cru	13.0	−58 32	2.81v	−0.23	*B2 IV*		−3.4	570	0.041	+26.4	Var. *R* 2.78–2.84
δ UMa	13.5	+57 15	3.30	+0.07	A3 V	0.052	+1.9	63	0.106	−12.9	*Megrez*
γ Crv	13.7	−17 19	2.59	−0.10	B8 III		−3.1	450	0.163	−04.2	*Gienah*
α Cru *A*	24.4	−62 53	1.39	−0.25	*B1 IV*		−3.9	370	0.042	*−11.2*	} 5″, *C* 4.90^m 89″ ***Acrux***
α Cru *B*	24.4	−62 53	1.86	−0.25	(B3)		−3.4	370	0.042	*−00.6*	
δ Crv *A*	27.8	−16 18	2.97	−0.04	B9.5 V: n	0.018	+0.1	124	0.255	+09	*B* 8.26^m 24″
γ Cru	28.9	−56 53	1.69	+1.55	*M3 II*		−2.5	220	0.274	+21.3	*Gacrux*
β Crv	32.3	−23 11	2.66	+0.89	G5 III	0.027	+0.1	108	0.059	−07.7	
α Mus	34.8	−68 55	2.70v	−0.20	*B3 IV*		−2.9	430	0.037	+18	Var. *R* 2.66–2.73
γ Cen *AB*	39.3	−48 44	2.17	+0.00	*A0 IV:*	0.006	−0.5	160	0.197	−07.5	*A* 2.9^m *B* 2.9^m 1″
γ Vir *AB*	39.6	−01 14	2.76	+0.34	F0 V	0.101	+3.5	32	0.567	−19.7	*A* 3.50^m *B* 3.52^m 4″
β Mus *AB*	43.8	−67 53	3.06	−0.17:	*B3 V*		−2.1	470	0.041	+42	*A* 3.7^m *B* 4.0^m 1″
β Cru	45.4	−59 28	1.28	−0.25	*B0 III*		−4.6	490	0.049	+20.0	***Beta Crucis***
ϵ UMa	52.3	+56 11	1.79	−0.03	A0pv	0.008	+0.2	68	0.113	−09.3	Chromium-europium star *Alioth*
α CVn *A*	54.2	+38 32	2.90	−0.10	B9.5pv	0.023	+0.1	118	0.238	*−03.3*	Silicon-europium star. *B* 5.61^m 20″
ϵ Vir	13 00.2	+11 10	2.86	+0.93	G9 II–III	0.036	+0.6	90	0.274	−14.0	
γ Hya	16.7	−22 58	2.98	+0.92	G8 III	0.021	+0.3	113	0.086	−05.4	
ι Cen	18.3	−36 30	2.76	+0.05	*A2 V*	0.046	+1.1	71	0.351	+00.1	
ζ UMa *A*	22.3	+55 08	2.26	+0.02	A2 V	0.037	+1.1	88	0.127	*−09.0*	*B* 3.94^m 14″ *Mizar*
α Vir	23.1	−10 57	0.91v	−0.24	B1 V	0.021	−3.3	220	0.054	*+01.0*	Ecl. *R* 0.91–1.01, 4.0^d ***Spica***
ζ Vir	32.7	−00 24	3.40	+0.10	A3 Vn	0.035	+1.1	93	0.287	−13.2	
ϵ Cen	37.3	−53 16	2.33	−0.23	*B1 IV*		−3.9	570	0.033	+05.6	
η UMa	46.0	+49 31	1.87	−0.20	B3 V	0.004	−2.1	210	0.123	−10.9	*Alkaid*
ν Cen	47.1	−41 29	3.42	−0.22	B2 IV		−3.4	750	0.037	*+09.0*	
μ Cen	47.2	−42 17	3.12v	−0.13:	B2 V: pne		−2.7	470	0.032	+12.6	Var. *R* 3.08–3.17
η Boo	52.8	+18 36	2.69	+0.59	G0 IV	0.102	+2.7	32	0.370	*−00.1*	
ζ Cen	53.0	−47 06	2.56	−0.23:	*B2 IV*		−3.4	520	0.076	*+06.5*	

Star	R.A. 1960 h m	Dec. ° ′	V	$B-V$	Type	π	M_V	D	μ	R		
						″		l.y.	″	km./sec.		
β Cen AB	14 01.0	−60 11	0.63	−0.23:	*B1 II:*	0.016	−5.2	490	0.035	*−12*	A 0.7^m B 3.9^m 1″	***Hadar***
π Hya	04.1	−26 29	3.25	+1.13	K2 III	0.039	+1.2	84	0.156	+27.2		
θ Cen	04.3	−36 10	2.04	+1.03	K0 III–IV	0.059	+0.9	55	0.738	+01.3		*Menkent*
α Boo	13.8	+19 23	−0.06	+1.23	K2 IIIp	0.090	−0.3	36	2.284	−05.2		***Arcturus***
γ Boo	30.5	+38 29	3.05	+0.19	A7 III	0.016	+0.2	118	0.186	−35.5		
η Cen	33.0	−41 59	2.39v	−0.21	B1.5 V:ne		−3.0	390	0.049	−00.2	Var. R 2.33–2.45	
α Cen A	36.9	−60 40	0.01	+0.68	*G2 V*	.751	+4.39	4.3	3.676	−24.6	18″	***Rigil Kentaurus***
α Cen B	36.9	−60 40	1.40:	+0.73:	(dK1)		+5.8	4.3		−20.7		
α Cir AB	39.2	−64 48	3.18	+0.25	*F0 Vp*	0.049	+1.6	66	0.308	+07.4	Strontium star.	A 3.19^m B 8.61^m 16″
α Lup	39.3	−47 13	2.32	−0.22	B1 V		−3.3	430	0.033	+07.3		
ϵ Boo AB	43.2	+27 14	2.37	+0.96	K1: III: + A	0.013	+0.0	103	0.051	−16.5	A 2.47^m B 5.04^m 3″	
α Lib A	48.5	−15 50	2.76	+0.15	A3m	0.049	+1.2	66	0.130	−10	B 5.15^m 231″	*Zubenelgenubi*
β UMi	50.8	+74 19	2.04	+1.47	K4 III	0.031	−0.5	105	0.033	+16.9		*Kochab*
β Lup	55.9	−42 58	2.69	−0.23	B2 IV		−3.4	540	0.066	−00.3		
κ Cen	56.5	−41 57	3.15	−0.21	B2 V		−2.7	470	0.033	+09.1		
β Boo	15 00.4	+40 33	3.48	+0.95	G8 III	0.022	+0.3	140	0.059	−19.9		
σ Lib	01.7	−25 08	3.31	+1.65	M4 III	0.056	+2.0:	58:	0.089	−04.3		
ζ Lup A	09.4	−51 57	3.42	+0.90:	*K0 III*	0.036	+1.2	90	0.135	−09.7	B 7.8^m 71″	
δ Boo A	13.9	+33 28	3.47	+0.95	G8 III	0.028	+0.3	140	0.148	−12.2	B 7.84^m 105″	
β Lib	14.8	−09 14	2.61	−0.11	B8 V	−.012	−0.6	140	0.101	−35.2		
γ TrA	15.1	−68 32	2.94	−0.01	*A0 Vp*	0.005	+0.2	113	0.067	00	Europium star	
δ Lup	18.7	−40 30	3.24	−0.23	B2 IV		−3.4	680	0.032	+02		
γ UMi	20.8	+71 59	3.08	+0.06	A3 II-III	−.005	−1.5	270	0.026	*−03.9*		
ι Dra	24.0	+59 06	3.28	+1.18	K2 III	0.032	+0.8	102	0.012	−11.0		
γ Lup AB	32.5	−41 02	2.80	−0.22	B2 Vn		−2.7	570	0.037	+06	A 3.5^m B 3.7^m 1″	
α CrB	33.0	+26 51	2.23v	−0.02	A0 V	0.043	+0.4	76	0.154	*+01.7*	Ecl. R 0.11^m, 17.4^d	*Alphecca*
α Ser	42.3	+06 33	2.65	+1.17	K2 III	0.046	+1.0	71	0.139	+02.9		
β TrA	51.6	−63 19	2.87	+0.28:	*F2 V*	0.078	+2.3	42	0.448	−00.3		
π Sco	56.4	−26 00	2.92	−0.19	B1 V	0.005	−3.3	570	0.034	*−03*		
η Lup AB	57.5	−38 17	3.45	−0.23	B2 V		−2.7	570	0.042	+07	A 3.47^m B 7.70^m 15″	
δ Sco	58.0	−22 51	2.34	−0.13	B0 V		−4.0	590	0.032	−14		

Star	R.A. 1960 h m	Dec. ° ′	V	$B-V$	Type	π	M_V	D	μ	R	
						″		l.y.	″	km./sec.	
β Sco *AB*	16 03.1	−19 42	2.65	−0.09	B0.5 V	0.004	−3.7	650	0.027	*−06.6*	*A* 2.78^m *B* 5.04^m 1″, *C* 4.93^m 14″
δ Oph	12.2	−03 36	2.72	+1.59	M1 III	0.029	−0.5	140	0.156	−19.9	
ϵ Oph	16.2	−04 36	3.22	+0.97	G9 III	0.036	+1.0	90	0.089	−10.3	
σ Sco *A*	18.8	−25 30	2.86v	+0.14	B1 III		−4.4	570	0.030	*−00.4*	β CMa *R* 2.82–2.90, 0.25^d, *B* 8.49^m 20″
η Dra *A*	23.4	+61 36	2.71	+0.92	G8 III	0.043	+0.9	76	0.062	−14.3	*B* 8.7^m 6″
α Sco *A*	26.9	−26 21	0.92v	+1.84	M1 Ib+B	0.019	−5.1	520	0.029	−03.2	*A* 0.86^m–1.02^m *B* 5.07^m 3″ ***Antares***
β Her	28.5	+21 35	2.78	+0.92	G8 III	0.017	+0.3	103	0.105	*−25.5*	
τ Sco	33.4	−28 08	2.85	−0.25	B0 V		−4.0	750	0.030	−00.7	
ζ Oph	35.0	−10 29	2.57	+0.00	O9.5 V	−.007	−4.3	520	0.022	−19	
ζ Her *AB*	39.8	+31 40	2.81	+0.64	G0 IV	0.110	+3.1	30	0.608	*−69.9*	*A* 2.91^m *B* 5.46^m 1″
η Her	41.5	+39 00	3.46	+0.92	G7 III–IV	0.053	+2.1	62	0.097	+08.3	
α TrA	44.4	−68 57	1.93	+1.43	*K2 III*	0.024	−0.1	82	0.044	−03.6	*Atria*
ϵ Sco	47.6	−34 13	2.28	+1.16	*K2 III–IV*	0.049	+0.7	66	0.664	−02.5	
μ^1 Sco	49.2	−37 59	2.99v	−0.20	B1.5 V		−3.0	520	0.033	*−25*	Ecl. *R* 2.99–3.09, 1.4^d
ζ Ara	55.3	−55 56	3.16	+1.61	(gK5)	0.036	+0.9	90	0.042	−06.0	
κ Oph	55.8	+09 26	3.18	+1.15	K2 III	0.026	−0.1	150	0.293	−55.6	
η Oph *AB*	17 08.1	−15 41	2.46	+0.06	A2.5 V	0.047	+1.4	69	0.097	−00.9	*A* 3.0^m *B* 3.4^m 1″ *Sabik*
ζ Dra	08.7	+65 46	3.20	−0.12	B6 III	0.017	−3.2	620	0.026	−14.1	
η Sco	09.3	−43 11	3.33	+0.38	*F2 III*	0.063	+2.3	52	0.293	−28.4	
α Her *AB*	12.8	+14 26	3.10v	+1.41	M5 II	−.007	−2.3	410	0.032	−33.1	*A* 3.2^m ± 0.3 *B* 5.4^m 5″ *Ras-Algethi*
δ Her	13.4	+24 53	3.14	+0.09	A3 IV	0.034	+0.8	96	0.164	−41	
π Her	13.7	+36 51	3.13	+1.43	K3 II	0.020	−2.4	410	0.029	−25.7	
θ Oph	19.6	−24 58	3.29	−0.22	B2 IV		−3.4	710	0.025	−03.6	
β Ara	22.0	−55 30	2.90	+1.45:	*K3 Ib*	0.026	−4.6	1030	0.035	−00.4	
γ Ara *A*	22.0	−56 21	3.32	−0.16	*B1 V*		−3.3	680	0.017	−04	*B* 10^m 18″
υ Sco	28.0	−37 16	2.71	−0.22	*B2 IV*		−3.4	540	0.039	*+18*	
α Ara	28.7	−49 51	2.95	−0.18:	B2.5 V		−2.4	390	0.083	*−02*	
β Dra *A*	29.5	+52 20	2.77	+0.96	G2 II	0.009	−2.1	310	0.019	−20.0	*B* 11.49^m 4″
λ Sco	30.9	−37 05	1.60	−0.24	B1 V		−3.3	310	0.031	00	*Shaula*
α Oph	33.1	+12 35	2.09	+0.16	A5 III	0.056	+0.8	58	0.260	+12.7	*Rasalhague*
θ Sco	34.4	−42 58	1.86	+0.39	*F0 Ib*	0.020	−4.6	650	0.012	+01.4	

Star	R.A. 1960 h	m	Dec. °	′	V	$B-V$	Type	π	M_V	D	μ	R	
								″		l.y.	″	km./sec.	
κ Sco	17	39.7	−39	01	2.39	−0.21	*B2 IV*		−3.4	470	0.031	−10	
β Oph		41.5	+04	35	2.77	+1.16	K2 III	0.023	−0.1	124	0.160	−12.0	
ι^1 Sco		44.8	−40	07	2.99	+0.49	F2 Ia	0.013	−7.1	3400	0.004	*−27.6*	
μ Her *A*		44.9	+27	45	3.42	+0.75	G5 IV	0.108	+3.6	30	0.811	−15.6	*BC* 9.78^m 33″
G Sco		47.1	−37	02	3.21	+1.18	(gK1)	0.032	+0.7	102	0.064	+24.7	
γ Dra		55.7	+51	30	2.21	+1.52	K5 III	0.017	−0.4	108	0.026	−27.6	*Eltanin*
ν Oph		56.8	−09	46	3.32	+1.00	G9 III	0.015	+0.2	140	0.118	+12.4	
γ Sgr	18	03.2	−30	26	2.97	+1.00	*K0 III*	0.018	+0.1	124	0.200	*+22.1*	
η Sgr *A*		14.9	−36	47	3.17	+1.55	*M3 II*	0.038	+1.1:	86:	0.218	+00.5	*B* 10^m 4″
δ Sgr		18.4	−29	51	2.71	+1.39	*K2 III*	0.039	+0.7	84	0.050	−20.0	
η Ser		19.2	−02	55	3.23	+0.94	K0 III–IV	0.054	+1.9	60	0.894	+08.9	
ϵ Sgr		21.5	−34	24	1.81	−0.02	*B9 IV*	0.015	−1.1	124	0.135	−11	*Kaus Australis*
λ Sgr		25.5	−25	27	2.80	+1.05	*K2 III*	0.046	+1.1	71	0.194	−43.3	
α Lyr		35.6	+38	45	0.04	0.00	A0 V	0.123	+0.5	26.5	0.345	−13.9	***Vega***
ϕ Sgr		43.2	−27	02	3.20	−0.11	*B8 III*		−3.1	590	0.052	+21.5	
β Lyr *A*		48.6	+33	19	3.38v	−0.05:	Bpe	−.011	−4.6	1300	0.007	*−19.2*	Ecl. *R* 3.38–4.36, 12.9^d, *B* 7.8^m 46″
σ Sgr		52.8	−26	21	2.12	−0.21	B2 V		−2.7	300	0.059	−11	*Nunki*
ξ^2 Sgr		55.3	−21	10	3.51	+1.18:	(gK1)	0.006	+0.0	160	0.035	−19.9	
γ Lyr		57.4	+32	38	3.25	−0.05	B9 III	0.011	−2.1	370	0.007	−21.5	
ζ Sgr *AB*	19	00.1	−29	56	2.61	+0.08	*A2 IV*	0.020	+0.1	140	0.020	+22	*A* 3.3^m *B* 3.5^m 1″
ζ Aql *A*		03.6	+13	48	2.99	+0.01	A0 V: nn	0.036	+0.8	90	0.101	−26.3	*B* 12^m 5″
λ Aql		04.1	−04	57	3.44	−0.07	B9: V: n	0.025	−0.1	160	0.092	−14	
τ Sgr		04.4	−27	44	3.30	+1.18	(gK1)	0.038	+1.2	86	0.261	*+45.4*	
π Sgr *ABC*		07.4	−21	05	2.89	+0.35	F2 II–III	0.016	−0.7	250	0.040	−09.8	*A* 3.7^m *B* 3.8^m *C* 6.0^m < 1″
δ Dra		12.6	+67	35	3.06	+1.00	G9 III	0.028	+0.2	124	0.130	+24.8	
δ Aql		23.5	+03	02	3.38	+0.31	F0 IV	0.062	+2.3	53	0.267	*−29.9*	
β Cyg *A*		29.1	+27	52	3.07	+1.12	K3 II: + B:	0.004	−2.4	410	0.009	−24.0	*B* 5.11^m 35″ *Albireo*
δ Cyg *AB*		43.7	+45	02	2.87	−0.03	B9.5 III	0.021	−1.7	270	0.060	−21	*A* 2.91^m *B* 6.44^m 2″
γ Aql		44.4	+10	31	2.67	+1.48	K3 II	0.006	−2.4	340	0.012	−02.1	
α Aql		48.8	+08	46	0.77	+0.22	A7 IV, V	0.198	+2.2	16.5	0.658	−26.3	***Altair***

Star	R.A. 1960 h m	Dec. ° ′	V	$B-V$	Type	π ″	M_V	D l.y.	μ ″	R km./sec.	
θ Aql	20 09.2	−00 56	3.31	−0.07	B9.5 III	0.008	−1.7	330	0.034	*−27.3*	
β Cap *A*	18.8	−14 55	3.06	+0.76	comp.	0.005	+0.1	130	0.039	−18.9	Type gK0: + late B; *B* 5.97m 205″
γ Cyg	20.8	+40 08	2.22	+0.66	F8 Ib	−.006	−4.6	750	0.001	−07.5	
α Pav	22.5	−56 52	1.95	−0.20	*B3 IV*		−2.9	310	0.087	*+02.0*	*Peacock*
α Ind	34.8	−47 26	3.11	+1.00	*K0 III*	0.039	+1.1	84	0.082	−01.1	
α Cyg	40.1	+45 08	1.26	+0.09	A2 Ia	−.013	−7.1	1600	0.003	−04.6	***Deneb***
β Pav	41.4	−66 21	3.45	+0.16	*A5 III*	0.026	−0.1	160	0.046	+09.8	
η Cep	44.5	+61 41	3.41	+0.92	K0 IV	0.071	+2.7	46	0.825	−87.3	
ϵ Cyg	44.6	+33 49	2.46	+1.03	K0 III	0.044	+0.7	74	0.481	*−10.3*	
ζ Cyg	21 11.2	+30 04	3.25:		G8 II	0.021	−2.2	390	0.056	+17.4	
α Cep	17.6	+62 25	2.44	+0.24	A7 IV, V	0.063	+1.4	52	0.156	−10	*Alderamin*
β Cep	28.2	+70 23	3.15v	−0.22v	B2 III	0.005	−4.2	980	0.014	−08.2	β CMa *R* 3.14–3.16, 0.19d
β Aqr	29.5	−05 45	2.86	+0.82	G0 Ib	0.000	−4.6	1030	0.017	+06.5	
ϵ Peg *A*	42.2	+09 41	2.31	+1.55	K2 Ib	−.005	−4.6	780	0.025	+04.7	*B* 11m 82″ *Enif*
δ Cap	44.8	−16 19	2.92v	+0.29	A6m	0.065	+2.0	50	0.392	*−06.3*	Var. *R* 2.88–2.95
γ Gru	51.5	−37 33	3.03	−0.10	*B8 III:*	0.008	−3.1	540	0.102	−02.1	
α Aqr	22 03.7	−00 31	2.96	+0.96	G2 Ib	0.003	−4.6	1080	0.016	+07.5	
α Gru	05.7	−47 09	1.76	−0.14	*B5 V*	0.051	+0.3:	64:	0.194	+11.8	*Al Na'ir*
ζ Cep	09.5	+58 00	3.31	+1.55	K1 Ib	0.019	−4.6	1240	0.015	*−18.4*	
α Tuc	15.8	−60 28	2.87	+1.40	*K3 III–IV*	0.019	+1.5	62	0.079	*+42.2*	
δ Cep *A*	27.7	+58 13	3.96v	+0.66v	F5–G2 Ib	0.005	−4.0	1300	0.012	*−16.8*	Cep. *R* 3.51–4.42, 5.4d, *B* 6.19m 41″
ζ Peg	39.5	+10 37	3.40:	−0.08:	B8 V	−.004	−0.6	210	0.077	+07	
β Gru	40.3	−47 06	2.17v	+1.59	*M3 II*	0.003	−2.5	280	0.134	+01.6	Var. *R* 2.11–2.23
η Peg	41.1	+30 01	2.95	+0.85	G8 II: + F?	−.002	−2.2	360	0.027	*+04.3*	
δ Aqr	52.5	−16 02	3.28	+0.08	A3 V	0.039	+1.2	84	0.047	+18.0	
α PsA	55.4	−29 50	1.19	+0.10	A3 V	0.144	+2.0	22.6	0.367	+06.5	***Fomalhaut***
β Peg	23 01.8	+27 52	2.5 v	+1.67	M2 II–III	0.015	−1.5	210	0.234	+08.7	Var. *R* 2.4–2.7 *Scheat*
α Peg	02.8	+14 59	2.50	−0.03	B9.5 III	0.030	−0.1	109	0.071	−03.5	*Markab*
γ Cep	37.7	+77 25	3.20	+1.02	K1 IV	0.064	+2.2	51	0.168	−42.4	

TABLE OF PRECESSION FOR 50 YEARS

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

THE NEAREST STARS

By R. M. Petrie and Jean K. McDonald

Perhaps the most difficult problem in observational astronomy is the determination of the distances to the stars. The reason, of course, is that the distances are so enormous as to require the measurement of vanishingly small angular displacements. As the earth goes in its orbit around the sun the stars show a small change in their positions and it is this small apparent movement which is called the annual parallax. If we can measure the parallax we can at once calculate the distance to the star concerned.

Astronomers speak of stellar distances in terms of light-years or, alternatively, parsecs. A light-year is the distance light travels in one year with its speed of 186,000 miles per second. If we know the parallax in seconds of arc we obtain the distance in light-years by dividing 3.26 by the parallax. Thus the star Sirius, which has an annual parallax of 0.″375, is 8.7 light-years distant. The reciprocal of the parallax gives the distance in parsecs; Sirius is 2.7 parsecs from the sun.

The apparent motion, per year, of a star across the sky, called proper motion, is a good indication of a star's distance. Obviously, the nearer stars will appear to move more rapidly than their more distant fellows and this fact has many times been instrumental in the discovery of nearby stars.

The table accompanying this note lists, in order of distance, all known stars within sixteen light-years. Including the sun it contains fifty-five stars, but it does not contain the unseen companions of double and multiple stars entered in the table. The table is taken from a paper by Professor van de Kamp, published in 1953. In addition to the name and position for each star, the table gives spectral type, Sp.; parallax, π; distance in light-years, D; proper motion in second of arc per year, μ; total velocity with respect to the sun in km./sec., R; apparent visual magnitude, m; and finally, luminosity in terms of the sun, L. In column four, *wd* indicates a white dwarf, and *e* indicates an emission-line star.

The stars within sixteen light-years form an important astronomical table because the annual parallaxes are large enough to be well determined. This means that we have accurate knowledge of the distances, speeds, and luminosities of these stars. Furthermore this sample is probably quite representative of the stellar population in our part of the galaxy, and as such is well worth our study.

It is interesting to note that most of the stars are cool red dwarfs, of type M. This must be the most populous of all the stellar varieties. Only ten of these nearby stars are bright enough to be seen with the unaided eye (magnitude less than five). Only three stars, Sirius, Altair, and Procyon, are brighter than the sun while the great majority are exceedingly faint. Not one giant star is contained in the list nor is there a B-type star. This is a consequence of the extreme rarity of very hot and very bright stars. One may conclude that stars brighter than the sun are very scarce.

Another striking fact is the prevalence of double and multiple stars, there being sixteen such systems if we count unseen components. Obviously double and multiple stars are quite common in the stellar population, and must be explained by any acceptable theory of stellar formation and evolution.

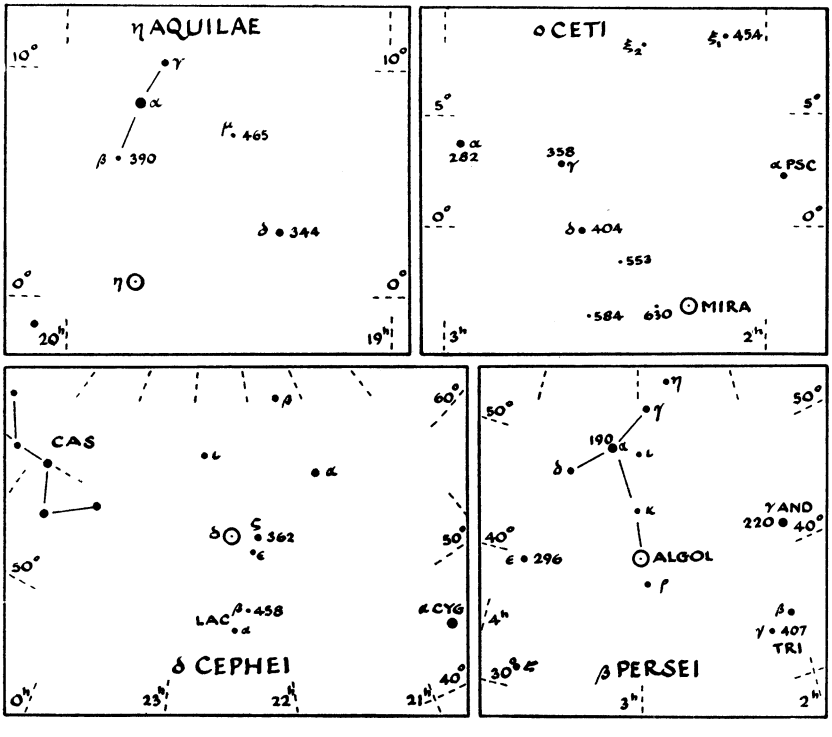
Star	1950 α h	1950 α m	1950 δ °	1950 δ ′	Sp.	π ″	D l.y.	μ ″	R km./sec.	m	L
Sun					G0					−26.9	1.0
α Cen A	14	36	−60	38	G0	0.760	4.3	3.68	34	0.3	1.0
B					K5					1.7	0.28
C	14	26	−62	28	M5*e*					11	0.000052
Barnard's *	17	55	+ 4	33	M5	.545	6.0	10.30	141	9.5	0.00040
Wolf 359	10	54	+ 7	20	M6*e*	.421	7.7	4.84	56	13.5	0.000017
Luy. 726-8A	1	36	−18	13	M6*e*	.410	7.9	3.35	48	12.5	0.00004
B					M6*e*					13.0	0.00003
Lal. 21185*	11	01	+36	18	M2	.398	8.2	4.78	103	7.5	0.0048
Sirius A	6	43	−16	39	A0	.375	8.7	1.32	18	−1.6	23.
B					*wd*					7.1	0.008
Ross 154	18	47	−23	53	M5*e*	.351	9.3	0.67	10	10.6	0.00036
Ross 248	23	39	+43	55	M6*e*	.316	10.3	1.58	84	12.2	0.00010
ε Eri	3	31	− 9	38	K2	.303	10.8	0.97	21	3.8	0.25
Ross 128	11	45	+ 1	07	M5	.298	10.9	1.40	26	11.1	0.00030
61 Cyg* A	21	05	+38	30	K6	.293	11.1	5.22	106	5.6	0.052
B					M0					6.3	0.028
Luy. 789-6	22	36	−15	37	M6	.292	11.2	3.27	80	12.2	0.00012
Procyon A	7	37	+ 5	21	F5	.288	11.3	1.25	20	0.5	5.8
B					*wd*					10.8	0.00044
ε Ind	22	00	−57	00	K5	.285	11.4	4.67	87	4.7	0.12
Σ 2398 A	18	42	+59	33	M4	.280	11.6	2.29	38	8.9	0.0028
B					M4					9.7	0.0013
Groom. 34 A	0	16	+43	44	M2*e*	.278	11.7	2.91	51	8.1	0.0058
B					M4*e*					10.9	0.00044
τ Ceti	1	42	−16	12	G4	.275	11.8	1.92	37	3.6	0.36
Lac. 9352	23	03	−36	09	M2	.273	11.9	6.87	118	7.2	0.013
BD +50°1668	7	25	+ 5	29	M4	.263	12.4	3.73	72	10.1	0.0010
Lacaille 8760	21	14	−39	04	M1	.255	12.8	3.46	68	6.6	0.028
Kapteyn's	5	10	−45	00	M0	.251	13.0	8.79	275	9.2	0.0025
Kruger 60 A	22	26	+57	27	M4	.249	13.1	0.87	29	9.9	0.0013
B					M5*e*					11.4	0.00033
Ross 614*	6	27	− 2	47	M5*e*	.248	13.1	0.97	30	10.9	0.00052
BD−12°4523	16	28	−12	32	M5	.244	13.4	1.24	27	10.0	0.0013
van Mannen's	0	46	+ 5	10	*wd*F	.236	13.8	2.98	64	12.3	0.00016
Wolf 424 A	12	31	+ 9	18	M6*e*	.223	14.6	1.87	40	12.6	0.00014
B					M6*e*					12.6	0.00014
Groom. 1618	10	08	+49	42	K5	.222	14.7	1.45	41	6.8	0.030
CD−37°15492	0	02	−37	36	M3	.219	14.9	6.09	134	8.6	0.0058
CD−46°11540	17	25	−46	51	M4	.213	15.3	1.15		9.7	0.0023
BD+20°2465*	10	17	+20	07	M4*e*	.211	15.4	0.49	15	9.5	0.0028
CD−44°11909	17	34	−44	16	M5	.209	15.6	1.14		11.2	0.00058
CD−49°13515	21	30	−49	13	M3	.209	15.6	0.78		9	0.0044
AOe 17415-6	17	37	+68	23	M3	.206	15.8	1.31	34	9.1	0.0040
Ross 780	22	50	−14	31	M5	.206	15.8	1.12	28	10.2	0.0014
Lal. 25372	13	43	+15	10	M2	.205	15.9	2.30	55	8.6	0.0063
CC 658	11	43	−64	33	*wd*	.203	16.0	2.69		11	0.0008
o^2 Eri A	4	13	− 7	44	K0	.200	16.3	4.08	105	4.5	0.30
B					*wd*A					9.2	0.0040
C					M5*e*					11.0	0.0008
70 Oph A	18	03	+ 2	31	K1	.199	16.4	1.13	28	4.2	0.40
B					K5					5.9	0.083
Altair	19	48	+ 8	44	A5	.198	16.5	0.66	31	0.9	8.3
BD+43°4305	22	45	+44	05	M5*e*	.198	16.5	0.84	20	10.2	0.0016
AC 79°3888	11	44	+78	57	M4	0.196	16.6	0.87	121	11.0	0.0008

*Star has an unseen component.

VARIABLE STARS

Maps of the fields of four bright variable stars are given below. In each case the magnitudes of several suitable comparison stars are given. Note that the decimal points are omitted: a star 362 is of mag. 3.62. Use two comparison stars, one brighter and one fainter than the variable, and estimate the brightness of the variable in terms of these two stars. Record the date and time of observation. When a number of observations have been made, a graph may be plotted showing the magnitude estimate as ordinates against the date (days and tenths of a day) as abscissae. Each type of variable has a distinctive shape of light curve.

In the tables the first column, the Harvard designation of the star, gives the 1900 position: the first four figures give the hours and minutes of R.A., the last two figures give the Dec. in degrees, italicised for southern declinations. The column headed *Max.* gives the mean maximum magnitude. The *Period* is in days. The *Epoch* gives the predicted date of the *earliest* maximum occurring this year; by adding the period to this epoch other dates of maximum may be found. The list of long-period variables has been prepared by the American Association of Variable Star Observers and includes the variables with maxima brighter than mag. 8.0, and north of Dec. −20°. These variables may reach maximum two or three weeks before or after the listed epoch and may remain at maximum for several weeks. The second table contains stars which are representative of other types of variable. The data are taken from "The General Catalogue of Variable Stars" by Kukarkin and Parenago and for eclipsing binaries from *Rocznik Astronomiczny Obserwatorium Krakowskiego*, 1958, International Supplement.



LONG-PERIOD VARIABLE STARS

Variable		Max. m	Per. d	Epoch 1959	Variable		Max. m	Per. d	Epoch 1959
001755	T Cas	7.8	445	..	142539	V Boo	7.9	260	Aug. 17
001838	R And	7.0	410	Jan. 1	143227	R Boo	7.3	224	May 11
021143	W And	7.5	397	Sept. 16	151731	S CrB	7.5	361	May 24
0214*03*	*o* Cet	3.7	332	Aug. 21	154639	V CrB	7.4	358	Mar. 1
0228*13*	U Cet	7.5	235	June 18	154615	R Ser	6.8	357	Mar. 28
023133	R Tri	6.3	266	Apr. 13	162119	U Her	7.6	405	Sept. 14
0455*14*	R Lep	6.7	428	Dec. 23	1621*12*	V Oph	7.5	298	July 1
050953	R Aur	7.8	458	July 26	163266	R Dra	7.6	245	Apr. 11
054920a	U Ori	6.6	372	May 18	164715	S Her	7.6	307	July 27
0617*02*	V Mon	7.1	334	Jan. 20	1702*15*	R Oph	7.6	302	May 28
065355	R Lyn	7.9	378	Oct. 1	171723	RS Her	8.0	219	Jan. 12
070122a	R Gem	7.1	370	Apr. 10	180531	T Her	8.0	165	June 6
072708	S CMi	7.5	335	Oct. 26	181136	W Lyr	8.0	197	Jan. 24
0728*20*b	Z Pup	7.9	512	..	183308	X Oph	6.9	335	Aug. 26
081112	R Cnc	6.8	361	Apr. 6	190108	R Aql	6.3	300	Sept. 23
081617	V Cnc	8.0	272	Apr. 16	1910*19*	R Sgr	7.2	269	Feb. 22
084803	S Hya	7.9	258	Jan. 9	193449	R Cyg	7.3	425	Dec. 7
0850*08*	T Hya	7.7	289	Mar. 23	194048	RT Cyg	7.4	190	Jan. 31
093934	R LMi	7.2	372	Dec. 13	194632	χ Cyg	5.3	406	Sept. 23
094211	R Leo	5.9	313	May 31	200938	RS Cyg	7.4	420	Nov. 9
103769	R UMa	7.6	301	Oct. 14	201647	U Cyg	7.6	463	Apr. 24
1214*18*	R Crv	7.6	317	June 15	2044*05*	T Aqr	7.9	202	May 8
122001	SS Vir	6.9	358	July 16	210868	T Cep	5.8	390	Nov. 7
123160	T UMa	7.9	257	May 1	230110	R Peg	7.9	377	July 6
123307	R Vir	6.9	145	Mar. 25	230759	V Cas	7.9	228	May 26
123961	S UMa	7.9	226	June 14	231508	S Peg	8.0	320	Mar. 27
131546	V CVn	7.1	193	Mar. 23	233451	SV Cas	7.5	278	May 29
1327*06*	S Vir	7.1	377	Aug. 12	2338*15*	R Aqr	7.3	386	Jan. 7
134440	R CVn	7.7	326	Apr. 23	235350	R Cas	6.5	430	July 22

OTHER TYPES OF VARIABLE STARS

Variable		Max. m	Min. m	Type	Sp. Cl.	Period d	Epoch 1959 E.S.T.
005381	U Cep	6.8	9.8	Ecl	B8+gG2	2.49295	Jan. 5.06*
025838	ρ Per	3.2	3.8	SemiR	M4	50	
035512	λ Tau	3.5	4.0	Ecl	B3	3.952952	Jan. 2.84*
0439*11*	RZ Eri	8.0	9.7	Ecl	dF5+G8	39.2826	Jan. 13.39*
060822	η Gem	3.1	3.9	SemiR	M3	234	Mar. 5*
061907	T Mon	5.8	6.8	δ Cep	F7–K1	27.018	Jan. 26.96
065820	ζ Gem	3.7	4.1	δ Cep	F7–G3	10.153527	Jan. 3.20
154428	R CrB	5.8	14	R CrB	cG0ep		
171014	α Her	3.0	4.0	SemiR	M5	100	
1842*05*	R Sct	5.0	8.4	RVTau	G0–M5	144	
184633	β Lyr	3.4	4.3	Ecl	B8p	12.931163	Jan. 4.89*
192242	RR Lyr	7.3	8.1	RR Lyr	A2–F0	0.56683500	Jan. 1.00
194700	η Aql	3.7	4.4	δ Cep	F6–G4	7.176678	Jan. 2.89
201437a	P Cyg	3.5	6.0	Nova	B1 eq		
222557	δ Cep	3.8	4.6	δ Cep	F5–G2	5.366306	Jan. 5.80

*Minima

REPRESENTATIVE DOUBLE STARS

Star	α 1950 h m	δ ° ′	Mag. and Spect.	d ″	D L.Y.	Remarks
π And	00 34.2	+33 27	4.4B3; 8.5	36	470	†
η Cas	00 46.0	+57 33	3.6F8; 7.2M0	8	18	526y; 66AU
α UMi	01 48.8	+89 02	var. F8; 8.8	19	407	Polaris
γ Ari	01 50.8	+19 03	4.8A0; 4.8A0	8.3	150	
α Pis	01 59.4	+02 31	5.2A2; 4.3A2	2.4	130	††
γ And	02 00.8	+42 05	2.3K0; 5.4A0; 6.6	10, 0.7	410	56y; 23AU
6 Tri	02 09.5	+30 04	5.4G4; 7.0F3	3.6	330	††
η Per	02 47.0	+55 41	3.9K0; 8.5	28	540	
32 Eri	03 51.8	−03 06	5.0G5; 6.3A	6.7	300	
β Ori	05 12.1	−08 15	0.3B8; 7.0	9	540	†
θ Ori	05 32.8	−05 25	5.4;6.8; 6.8; 7.9; O	13, 17	540	Trapezium
β Mon	06 26.4	−07 00	4.7B2; 5.2; 5.6	7, 25	470	†
12 Lyn	06 41.8	+59 30	5.3A2; 6.2; 7.4	1.7, 8	180	†
α CMa	06 43.0	−16 39	−1.6A0; 8.5F	11	9	50y; 20AU
δ Gem	07 17.1	+22 05	3.5F0; 8.0M0	6.8	58	†
α Gem	07 31.4	+32 00	2.0A0; 2.8A0; 9M10	4, 70	47	340y; 79AU
ζ Cnc	08 09.3	+17 48	5.6G0; 6.0; 6.2	1, 5	78	60y; 21AU
γ Leo	10 17.2	+20 06	2.6K0; 3.8G5	4	160	400y
ξ UMa	11 15.5	+31 48	4.4G0; 4.9G0	2	25	††60y; 20AU
ι Leo	11 21.3	+10 48	4.1F3; 6.8F3	2	69	
γ Vir	12 39.1	−01 10	3.6F0; 3.7F0	6	34	171y; 42AU
α CVn	12 53.7	+38 35	2.9A0; 5.4A0	20	140	††
ζ UMa	13 21.9	+55 11	2.4A2; 4.0A2	14	78	††
π Boo	14 38.4	+16 38	4.9A0; 5.1A0	6	360	†
ε Boo	14 42.8	+27 17	2.7K0; 5.1A0	3	220	
ξ Boo	14 49.1	+19 18	4.8G5; 6.7	3	22	151y; 31AU
δ Ser	15 32.4	+10 42	4.2F0; 5.2F0	4	170	
ξ Sco	16 01.6	−11 14	5.1F3; 4.8; 7G7	1, 7	84	44.7y; 19AU
α Her	17 12.4	+14 27	var.M5; 5.4G	5	540	†
δ Her	17 13.0	+24 54	3.2A0; 8.1G2	11	100	† Optical
ε Lyr	18 42.7	+39 37	5.1, 6.0A3; 5.1, 5.4A5	3, 2	200	Pairs 207″
β Cyg	19 28.7	+27 51	3.2K0; 5.4B9	34	410	†
α Cap	20 14.9	−12 40	3.8G5; 4.6G0	376		Optical
γ Del	20 44.3	+15 57	4.5G5; 5.5F8	10	110	
61 Cyg	21 04.6	+38 30	5.6K5; 6.3K5	23	11	
β Cep	21 28.1	+70 20	var.B1; 8.0A3	14	540	†
ζ Aqr	22 26.2	−00 17	4.4F2; 4.6F1	3	140	
δ Cep	22 27.3	+58 10	var.G0; 7.5A0	41	650	
8 Lac	22 33.6	+39 23	5.8B3; 6.5B5	22	1100	†
σ Cas	23 56.5	+55 29	5.1B2; 7.2B3	3	820	

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

STAR CLUSTERS

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

N.G.C.	M	Con.	α 1960 h m	δ ° ′	Cl.	Diam. ′	Mag. B.S.	No.	Int. mag.	Dist l.y.
869		h Per	02 16.2	+56 58	Op	30	7			4,300
884		χPer	02 19.6	+56 56	Op	30	7			4,300
1039	34	Per	02 39.4	+42 37	Op	30	9	80		1,500
Pleiades	45	Tau	03 45.1	+23 59	Op	120	4.2	250		490
Hyades		Tau	04 18	+15 31	Op	400	4.0	100		120
1912	38	Aur	05 26.0	+35 48	Op	18	9.7	100		2,800
2099	37	Aur	05 49.7	+32 33	Op	24	9.7	150		2,700
2168	35	Gem	06 06.4	+24 21	Op	29	9.0	120		2,700
2287	41	C Ma	06 45.3	−20 42	Op	32	9	50		1,300
2632	44	Cnc	08 37.8	+20 07	Op	90	6.5	350		490
5139		ωCen	13 24.3	−47 16	Gl	23	12.9		3	22,000
5272	3	C Vn	13 40.4	+28 35	Gl	10	14.2		4.5	40,000
5904	5	Ser	15 16.5	+02 13	Gl	13	14.0		3.6	35,000
6121	4	Sco	16 21.2	−26 26	Gl	14	13.9		5.2	24,000
6205	13	Her	16 40.2	+36 32	Gl	10	13.8		4.0	34,000
6218	12	Oph	16 45.2	−01 53	Gl	9	14.0		6.0	36,000
6254	10	Oph	16 55.0	−04 03	Gl	8	14.1		5.4	36,000
6341	92	Her	17 15.9	+43 11	Gl	8	13.9		5.1	36,000
6494	23	Sgr	17 54.6	−19 01	Op	27	10.2	120		2,200
6611	16	Ser	18 16.6	−13 48	Op	8	10.6	55		6,700
6656	22	Sgr	18 34.0	−23 57	Gl	17	12.9		3.6	22,000
7078	15	Peg	21 28.0	+11 59	Gl	7	14.3		5.2	43,000
7089	2	Aqr	21 31.4	−01 00	Gl	8	14.6		5.0	45,000
7092	39	Cyg	21 30.8	+48 15	Op	32	6.5	25		1,000
7654	52	Cas	23 22.4	+61 23	Op	13	11 0	120		4,400

GALACTIC NEBULAE

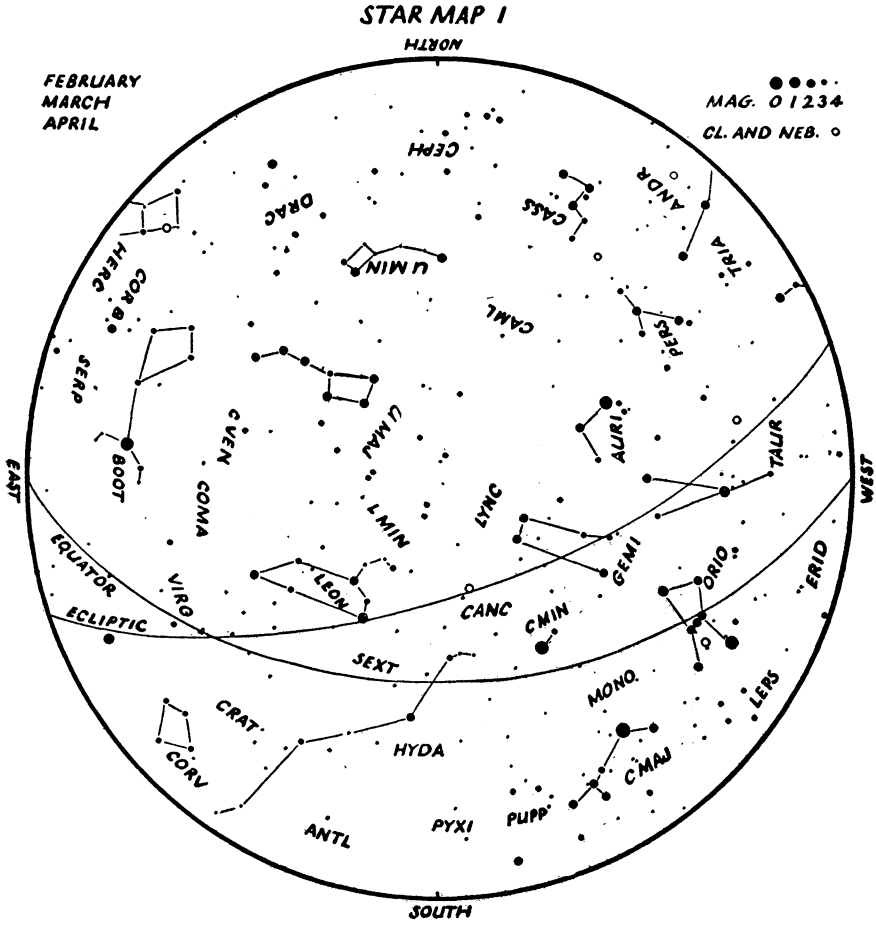
The galactic nebulae here listed have been selected to include the most readily observable representatives of planetary nebulae such as the Ring Nebula in Lyra, diffuse bright nebulae like the Orion nebula and dark absorbing nebulosities such as the Coal Sack. These objects are all located in our own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

N.G.C.	M	Con	α 1960 h m	δ ° ′	Cl	Size ′	m n	m *	Dist. l.y.	Name
650	76	Per	01 39.7	+51 22	Pl	1.5	11	17	15,000	
1952	1	Tau	05 32.1	+22 00		6	11	16	4,100	Crab
1976	42	Ori	05 33.3	−05 25	Dif	30			1,800	Orion
B33		Ori	05 38.9	−02 29	Drk	4			300	Horsehead
2261		Mon	06 37.0	+08 46	Dif	2				Hubble's var.
2392		Gem	07 26.8	+21 00	Pl	0.3	8	10	2,800	
2440		Pup	07 40.1	−18 07	Pl	0.9	11	16	8,600	
3587	97	UMa	11 12.5	+55 14	Pl	3.3	11	14	12,000	Owl
		Cru	12 49	−63	Drk	300			300	Coalsack
6210		Her	16 42.8	+23 52	Pl	0.3	10	12	5,600	
B72		Oph	17 21.2	−23 35	Drk	20			400	S nebula
6514	20	Sgr	18 00.0	−23 02	Dif	24			3,200	Trifid
B86		Sgr	18 00.5	−27 53	Drk	5				
6523	8	Sgr	18 01.2	−24 23	Dif	50			3,600	Lagoon
6543		Dra	17 58.6	+66 37	Pl	0.4	9	11	3,500	
6572		Oph	18 10.2	+06 50	Pl	0.2	9	12	4,000	
B92		Sgr	18 13.2	−18 15	Drk	15				
6618	17	Sgr	18 18.5	−16 12	Dif	26			3,000	Horseshoe
6720	57	Lyr	18 52.1	+32 59	Pl	1.4	9	14	5,400	Ring
6826		Cyg	19 43.7	+50 26	Pl	0.4	9	11	3,400	
6853	27	Vul	19 57.9	+22 36	Pl	8	8	13	3,400	Dumb-bell
6960		Cyg	20 44.0	+30 34	Dif	60				Network
7000		Cyg	20 57.4	+44 10	Dif	100				N. America
7009		Aqr	21 02.0	−11 32	Pl	0.5	8	12	3,000	
7662		And	23 24.0	+42 19	Pl	0.3	9	13	3,900	

EXTERNAL GALAXIES

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

N.G.C.	M	Con	α 1960 h m	δ ° ′	Cl	Dimens. ′ ′	Mag.	Distance millions of l.y.	Vel. km / sec
221	32	And	00 40.5	+40 39	E	3×3	8.8	1.6	− 185
224	31	And	00 40.5	+41 03	Sb	160×40	5.0	1.6	− 220
SMC		Tuc	00 53	−72 35	I	220×220	1.5	0.17	+ 170
598	33	Tri	01 31.6	+30 28	Sc	60×40	7.0	1.4	− 70
LMC		Dor	05 21	−69 26	I	430×530	0.5	0.17	+ 280
3031	81	UMa	09 52.4	+69 16	Sb	16×10	8.3	4.8	− 30
3034	82	UMa	09 52.7	+69 53	I	7× 2	9.0	5.2	+ 290
3368	96	Leo	10 44.6	+12 02	Sa	7× 4	10.0	11.4	+ 940
3623	65	Leo	11 16.8	+13 19	Sb	8× 2	9.9	10.0	+ 800
3627	66	Leo	11 18.2	+13 13	Sb	8× 2	9.1	8.6	+ 650
4258		CVn	12 17.0	+47 32	Sb	20× 6	8.7	9.2	+ 500
4374	84	Vir	12 23.0	+13 06	E	3× 2	9.9	12.0	+1050
4382	85	Com	12 23.4	+18 25	E	4× 2	10.0	7.4	+ 500
4472	49	Vir	12 27.8	+08 13	E	5× 4	10.1	11.4	+ 850
4565		Com	12 34.4	+26 12	Sb	15× 1	11.0	15.2	+1100
4594		Vir	12 37.9	−11 24	Sa	7× 2	9.2	14.4	+1140
4649	60	Vir	12 41.7	+11 46	E	4× 3	9.5	15.0	+1090
4736	94	CVn	12 49.0	+41 20	Sb	5× 4	8.4	6.0	+ 290
4826	64	Com	12 54.8	+21 54	Sb	8× 4	9.2	2.6	+ 150
5005		CVn	13 09.0	+37 16	Sc	5× 2	11.1	13.2	+ 900
5055	63	CVn	13 14.0	+42 14	Sb	8× 3	9.6	7.2	+ 450
5194	51	CVn	13 28.2	+47 24	Sc	12× 6	7.4	6.0	+ 250
5236	83	Hya	13 34.8	−29 40	Sc	10× 8	8	5.8	+ 500
6822		Sgr	19 42.7	−14 52	I	20×10	11	2.0	− 150
7331		Peg	22 35.2	+34 12	Sb	9× 2	10.4	10.4	+ 500

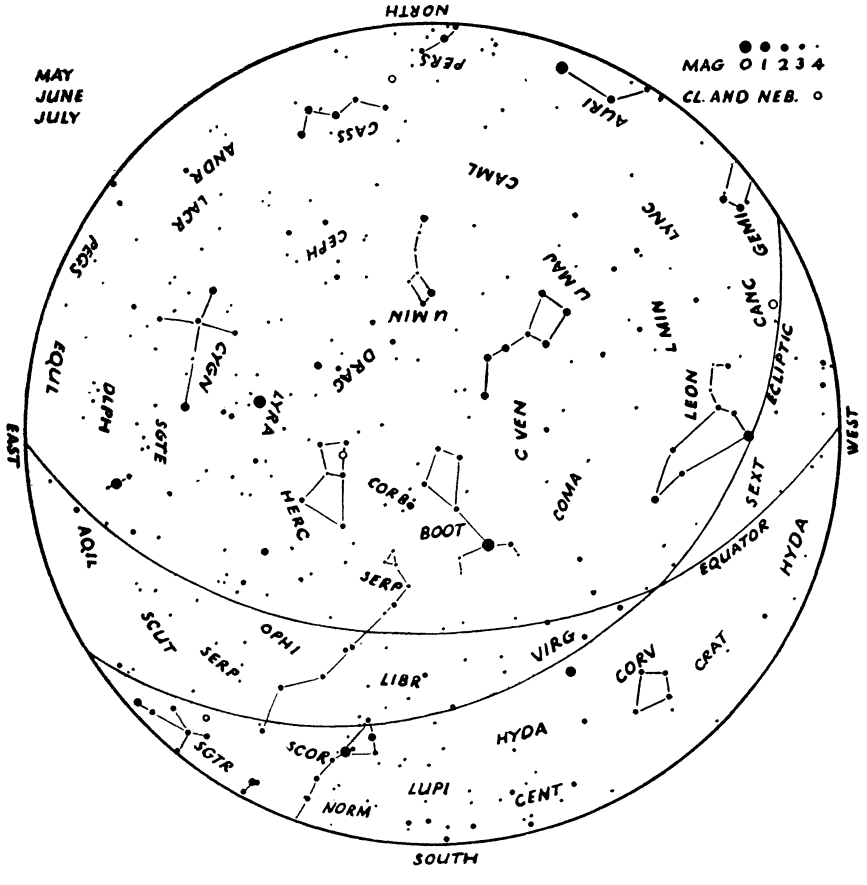


The above map represents the evening sky at

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.

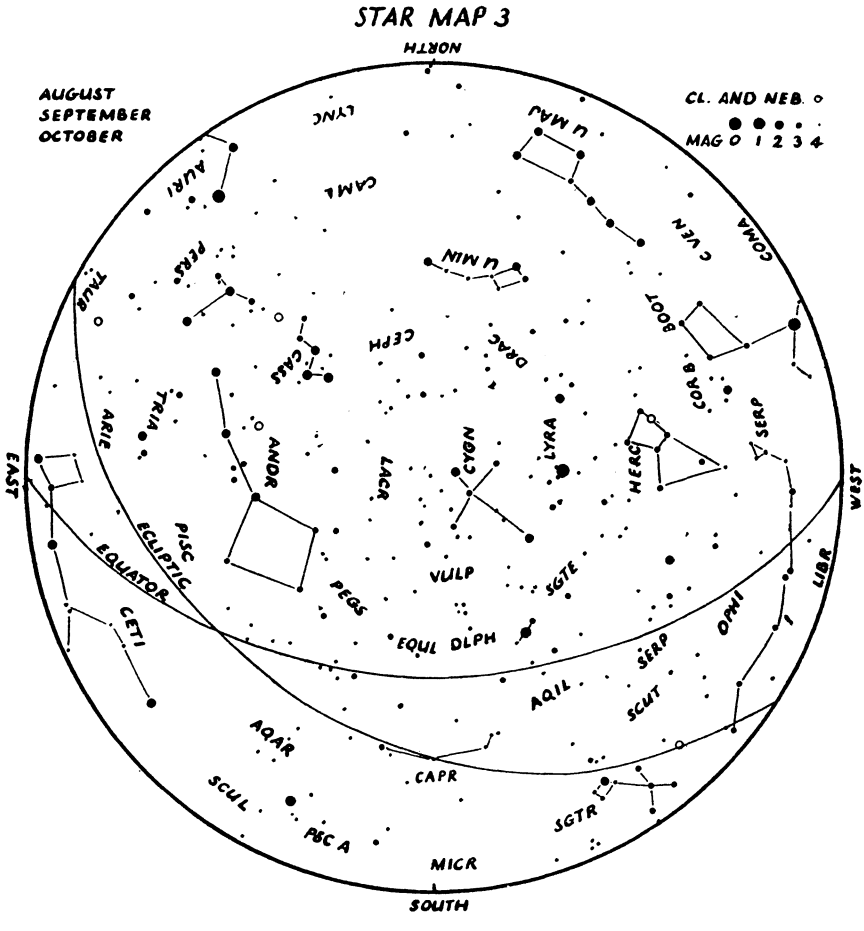
STAR MAP 2



The above map represents the evening sky at

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

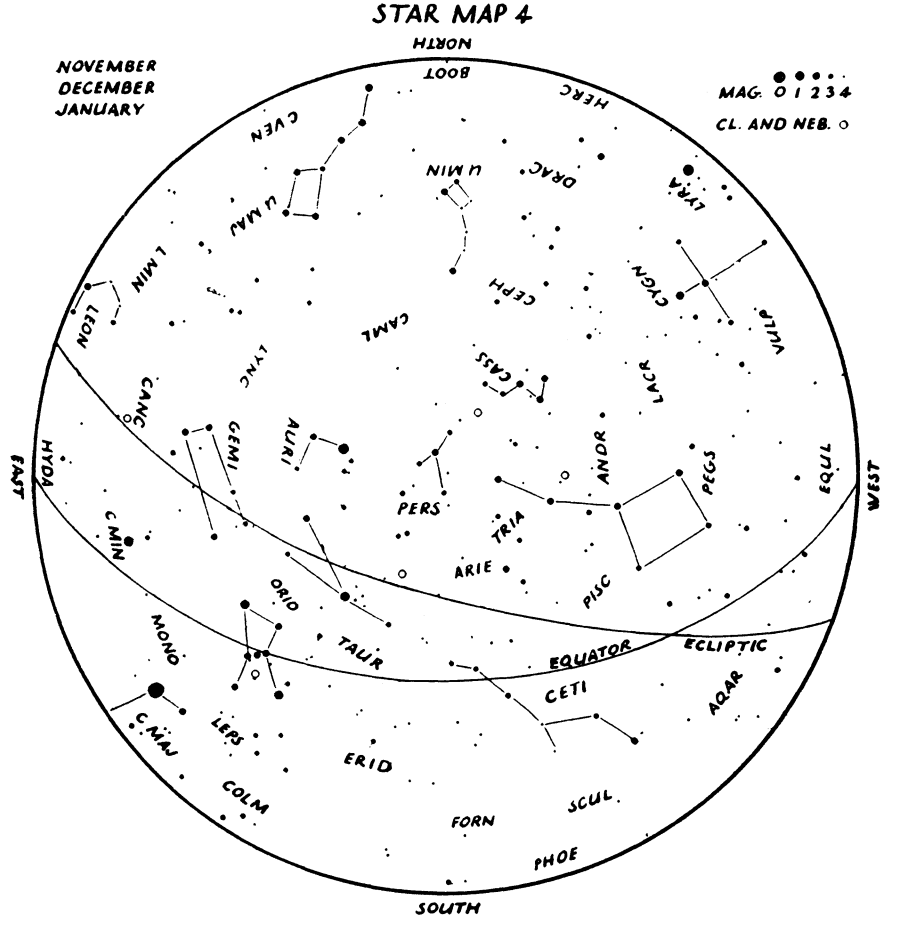
The centre of the map is the zenith the circumference the horizon. To identify the stars hold the map so that the part of the horizon you are facing is down.



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.



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.

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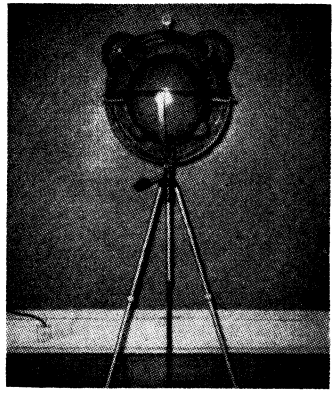

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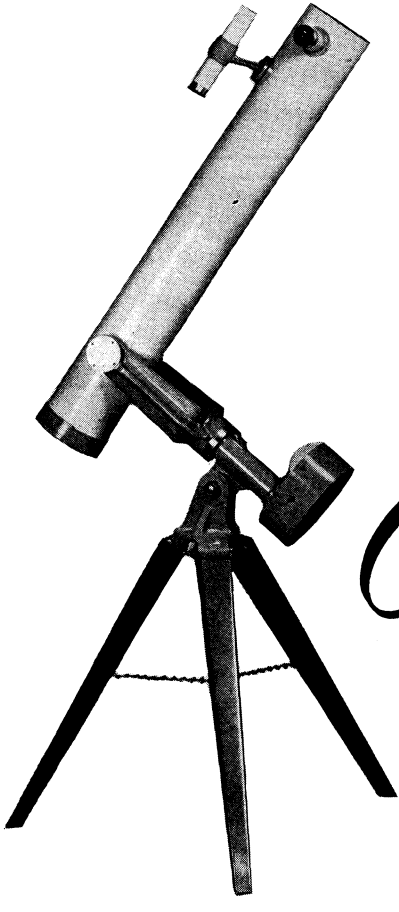

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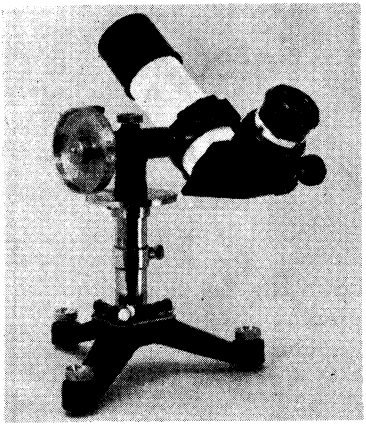

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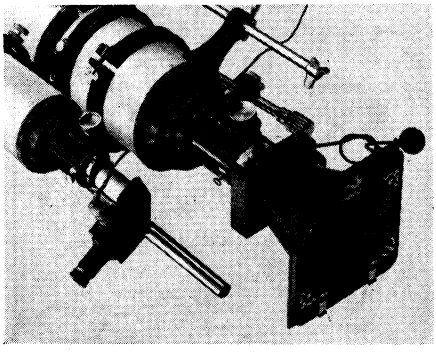

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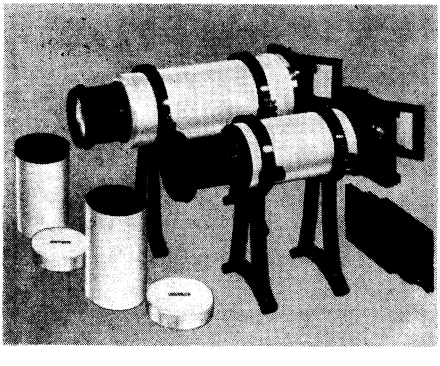

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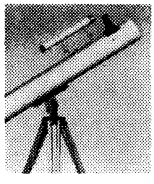

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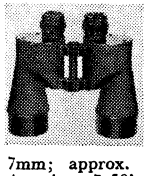

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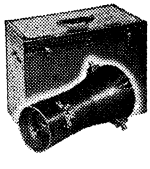

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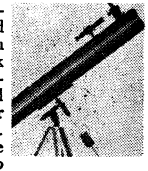

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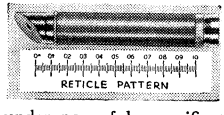

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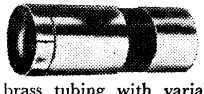

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ANTENNA EQUIPMENT

D. S. KENNEDY & CO.

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CALENDAR 1959

Jan.

S	M	T	W	T	F	S
..	..	..	..	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Feb.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

Mar.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	..	..	..	..

April

S	M	T	W	T	F	S
..	..	..	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	..	..

May

S	M	T	W	T	F	S
..	..	..	..	..	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	..	..	..	..	..	..

June

S	M	T	W	T	F	S
..	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	..	..	..	..

July

S	M	T	W	T	F	S
..	..	..	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	..

Aug.

S	M	T	W	T	F	S
..	..	..	..	..	..	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	..	..	..	..	..

Sept.

S	M	T	W	T	F	S
..	..	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	..	..	..

Oct.

S	M	T	W	T	F	S
..	..	..	..	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Nov.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	..	..	..	..	..

Dec.

S	M	T	W	T	F	S
..	..	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	..	..

UNITRON's New 6" Refractor on left, 4" on right

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