THE OBSERVER'S HANDBOOK 1960

Fifty-second Year of Publication

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

Price 75 cents

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

Incorporated 1890 — Royal Charter 1903

The National Headquarters of the Royal Astronomical Society of Canada is located at 252 College Street, Toronto 2B, Ontario. The business office of the Society, reading rooms and astronomical library, are housed here, as well as a large room for the accommodation of telescope making groups.

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THE OBSERVER'S HANDBOOK 1960

EDITOR
RUTH J. NORTHCOTT

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252 COLLEGE STREET, TORONTO 2B, ONTARIO

CONTENTS

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THE OBSERVER'S HANDBOOK for 1960 is the 52nd issue. Two additions have been made: the range of change during the year of the longitude of the moon's orbit and opposition ephemerides of the two brightest asteroids. Certain of the miscellaneous astronomical data and the section on time have been revised. The section on occultations has been extended to include stars of magnitude 5.3 or brighter.

Some changes in the form of the phenomena month by month and the phenomena of Jupiter's satellites have been necessary as a result of the unification of the British *Nautical Almanac* and the *American Ephemeris.*

Cordial thanks are offered to those who assisted with the preparation of this volume, Barbara Gaizauskas, K. S. McCormick, Kulli Milles, Helge Mairo, Isabel Williamson and Dorothy Yane. Special thanks are due to Malcolm M. Thomson and R. W. Tanner and the Dominion Observatory for preparing the revisions to the section on time, to Gordon E. Taylor and the British Astronomical Association for the data on planetary appulses and occultations 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 Office and to the *American Ephemeris* is thankfully acknowledged.

RUTH J. NORTHCOTT

ANNIVERSARIES AND FESTIVALS, 1960

New Year's Day	Fri.	Jan. 1
Epiphany	Wed.	Jan. 6
Accession of Queen Elizabeth (1952)	Sat.	Feb. 6
Septuagesima Sunday		Feb. 14
Quinquagesima (Shrove Sunday)		Feb. 28
St. David	Tue.	Mar. 1
Ash Wednesday		Mar. 2
St. Patrick	Thu.	Mar. 17
Palm Sunday		Apr. 10
Good Friday		Apr. 15
Easter Sunday		Apr. 17
Birthday of Queen Elizabeth (1926)	Thu.	Apr. 21
St. George	Sat.	Apr. 23
Rogation Sunday		May 22
Empire Day (Victoria Day)	Mon.	May 23
Ascension Day	Thu.	May 26
Pentecost (Whit Sunday)		June 5
Trinity Sunday		June 12
Corpus Christi	Thu.	June 16
St. John Baptist (Midsummer Day)	Fri.	June 24
Dominion Day	Fri.	July 1
Birthday of Queen Mother Elizabeth (1900)	Thu.	Aug. 4
Labour Day	Mon.	Sept. 5
Hebrew New Year (Rosh Hashanah)	Thu.	Sept. 22
St. Michael (Michaelmas Day)	Thu.	Sept. 29
Thanksgiving Day	Mon.	Oct. 10
All Saints' Day	Tue.	Nov. 1
Remembrance Day	Fri.	Nov. 11
First Sunday in Advent		Nov. 27
St. Andrew	Wed.	Nov. 30
Christmas Day	Sun.	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

Α, α	Alpha	Ι, ι	Iota	Ρ, ρ	Rho
Β, β	Beta	Κ, κ	Kappa	Σ, σ	Sigma
Γ, γ	Gamma	Λ, λ	Lambda	Τ, τ	Tau
Δ, δ	Delta	Μ, μ	Mu	Υ, υ	Upsilon
Ε, ϵ	Epsilon	Ν, ν	Nu	Φ, ϕ	Phi
Ζ, ζ	Zeta	Ξ, ξ	Xi	Χ, χ	Chi
Η, η	Eta	Ο, 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	$= 1.60935 \times 10^{5}$ cm.	= 1.60935 km.
1 astronomical unit	$= 1.49504 \times 10^{13}$ cm.	= 92,897,416 miles
1 light year	$= 9.463 \times 10^{17}$ cm.	$= 5.880 \times 10^{12}$ miles = 0.3069 parsecs
1 parsec	$= 30.84 \times 10^{17}$ cm.	$= 19.16 \times 10^{12}$ miles = 3.259 l.y
1 megaparsec	$= 30.84 \times 10^{23}$ cm.	$= 19.16 \times 10^{18}$ miles $= 3.259 \times 10^{6}$ l.y.

Units of Time

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

The Earth

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

Earth's Orbital Motion

Solar parallax = 8.″80; constant of aberration = 20.″47
Annual general precession = 50.″26; obliquity of ecliptic = 23° 26′ 40″ (1960)
Orbital velocity = 18.5 miles/sec.; parabolic velocity at ⊕ = 26.2 miles/sec.

Solar Motion

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

The Galactic System

North pole of galactic plane R.A. 12*h* 49*m*, Dec. + 27.°4 (1959)
Centre of galaxy R.A. 17*h* 42*m*, Dec. −29° (1950)
Distance to centre ~10,000 parsecs; diameter ~30,000 parsecs.
Rotational velocity (at sun) ~ 262 km./sec.
Rotational period (at sun) $\sim 2.2 \times 10^{8}$ years
Mass $\sim 2 \times 10^{11}$ solar masses

Extra-galactic Nebulae

Red shift ~+100 km./sec./megaparsec ~ 19 miles /sec./million l.y.

Radiation Constants

Velocity of light = 299,860 km./sec. = 186,324 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 $= 3 \times 10^{-6}$ meter candles
Total energy emitted by a star of zero absolute magnitude $= 5 \times 10^{25}$ horsepower

Miscellaneous

Constant of gravitation, $G = 6.670 \times 10^{-8}$ c.g.s. units
Mass of the electron, $m = 9.1083 \times 10^{-28}$ gm.; mass of the proton $= 1.6724 \times 10^{-24}$ gm.
Planck's constant, $h = 6.6234 \times 10^{-27}$ erg. sec.
Loschmidt's number $= 2.6872 \times 10^{19}$ molecules/cu. cm. of gas at N.T.P.
Absolute temperature = T° K = T°C + 273° = 5/9 (T° F + 459°)

1 radian = 57°.2958	π = 3.141,592,653,6
= 3437′.75	No. of square degrees in the sky
= 206,265″	= 41,253

1960 EPHEMERIS OF THE SUN AT 0h U.T.

Date 1960		Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
		h m s	m s	° ′
Jan.	1	18 41 40	+ 3 02	−23 05.8
	4	18 54 55	+ 4 27	−22 50.5
	7	19 08 06	+ 5 48	−22 31.1
	10	19 21 13	+ 7 05	−22 07.8
	13	19 34 14	+ 8 17	−21 40.6
	16	19 47 11	+ 9 24	−21 09.5
	19	20 00 01	+10 25	−20 34.9
	22	20 12 45	+11 19	−19 56.7
	25	20 25 22	+12 07	−19 15.1
	28	20 37 53	+12 48	−18 30.4
	31	20 50 16	+13 21	−17 42.6
Feb.	3	21 02 32	+13 47	−16 52.1
	6	21 14 40	+14 06	−15 58.8
	9	21 26 41	+14 17	−15 03.1
	12	21 38 34	+14 20	−14 05.2
	15	21 50 21	+14 17	−13 05.1
	18	22 02 01	+14 08	−12 03.1
	21	22 13 35	+13 52	−10 59.4
	24	22 25 03	+13 30	− 9 54.1
	27	22 36 25	+13 03	− 8 47.5
Mar.	1	22 47 43	+12 31	− 7 39.7
	4	22 58 56	+11 54	− 6 30.9
	7	23 10 04	+11 13	− 5 21.3
	10	23 21 09	+10 28	− 4 11.0
	13	23 32 11	+ 9 40	− 3 00.4
	16	23 43 10	+ 8 50	− 1 49.4
	19	23 54 07	+ 7 58	− 0 38.2
	22	0 05 03	+ 7 04	+ 0 32.9
	25	0 15 58	+ 6 10	+ 1 43.8
	28	0 26 54	+ 5 15	+ 2 54.4
	31	0 37 49	+ 4 21	+ 4 04.4
Apr.	3	0 48 45	+ 3 27	+ 5 13.8
	6	0 59 42	+ 2 35	+ 6 22.3
	9	1 10 41	+ 1 44	+ 7 29.9
	12	1 21 42	+ 0 55	+ 8 36.3
	15	1 32 45	+ 0 09	+ 9 41.4
	18	1 43 52	− 0 34	+10 45.0
	21	1 55 03	− 1 13	+11 47.1
	24	2 06 17	− 1 48	+12 47.4
	27	2 17 36	− 2 19	+13 45.9
	30	2 29 00	− 2 45	+14 42.3
May	3	2 40 28	− 3 07	+15 36.6
	6	2 52 01	− 3 24	+16 28.5
	9	3 03 38	− 3 35	+17 17.9
	12	3 15 21	− 3 42	+18 04.7
	15	3 27 09	− 3 44	+18 48.8
	18	3 39 02	− 3 40	+19 30.1
	21	3 51 01	− 3 32	+20 08.3
	24	4 03 04	− 3 18	+20 43.5
	27	4 15 12	− 3 00	+21 15.5
	30	4 27 24	− 2 37	+21 44.2
June	2	4 39 40	− 2 11	+22 09.5
	5	4 52 00	− 1 41	+22 31.3
	8	5 04 22	− 1 09	+22 49.5
	11	5 16 46	− 0 34	+23 04.2
	14	5 29 13	+ 0 03	+23 15.2
	17	5 41 41	+ 0 41	+23 22.5
	20	5 54 09	+ 1 20	+23 26.1
	23	6 06 38	+ 1 59	+23 26.0
	26	6 19 07	+ 2 38	+23 22.1
	29	6 31 34	+ 3 16	+23 14.6

Date 1960		Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
		h m s	m s	° ′
July	2	6 43 59	+ 3 51	+23 03.4
	5	6 56 21	+ 4 24	+22 48.6
	8	7 08 40	+ 4 53	+22 30.2
	11	7 20 56	+ 5 19	+22 08.3
	14	7 33 08	+ 5 42	+21 43.0
	17	7 45 16	+ 6 00	+21 14.4
	20	7 57 19	+ 6 13	+20 42.5
	23	8 09 17	+ 6 22	+20 07.4
	26	8 21 10	+ 6 25	+19 29.4
	29	8 32 58	+ 6 23	+18 48.4
Aug.	1	8 44 40	+ 6 15	+18 04.7
	4	8 56 16	+ 6 02	+17 18.3
	7	9 07 47	+ 5 44	+16 29.4
	10	9 19 13	+ 5 19	+15 38.1
	13	9 30 33	+ 4 50	+14 44.5
	16	9 41 49	+ 4 16	+13 48.8
	19	9 53 00	+ 3 38	+12 51.2
	22	10 04 07	+ 2 55	+11 51.6
	25	10 15 10	+ 2 08	+10 50.5
	28	10 26 09	+ 1 18	+ 9 47.7
	31	10 37 05	+ 0 23	+ 8 43.6
Sept.	3	10 47 57	− 0 34	+ 7 38.2
	6	10 58 47	− 1 33	+ 6 31.7
	9	11 09 35	− 2 35	+ 5 24.3
	12	11 20 22	− 3 38	+ 4 16.0
	15	11 31 08	− 4 41	+ 3 07.1
	18	11 41 54	− 5 45	+ 1 57.6
	21	11 52 40	− 6 49	+ 0 47.7
	24	12 03 27	− 7 52	− 0 22.4
	27	12 14 15	− 8 53	− 1 32.6
	30	12 25 04	− 9 53	− 2 42.6
Oct.	3	12 35 56	−10 51	− 3 52.4
	6	12 46 51	−11 46	− 5 01.8
	9	12 57 49	−12 38	− 6 10.6
	12	13 08 51	−13 25	− 7 18.7
	15	13 19 58	−14 08	− 8 26.0
	18	13 31 10	−14 45	− 9 32.1
	21	13 42 28	−15 17	−10 37.1
	24	13 53 51	−15 43	−11 40.6
	27	14 05 21	−16 03	−12 42.5
	30	14 16 57	−16 17	−13 42.6
Nov.	2	14 28 40	−16 24	−14 40.8
	5	14 40 30	−16 23	−15 36.8
	8	14 52 28	−16 15	−16 30.5
	11	15 04 34	−15 59	−17 21.7
	14	15 16 47	−15 36	−18 10.2
	17	15 29 08	−15 04	−18 55.9
	20	15 41 36	−14 26	−19 38.5
	23	15 54 12	−13 39	−20 18.0
	26	16 06 55	−12 46	−20 54.1
	29	16 19 44	−11 47	−21 26.6
Dec.	2	16 32 39	−10 41	−21 55.5
	5	16 45 40	− 9 30	−22 20.6
	8	16 58 46	− 8 14	−22 41.8
	11	17 11 57	− 6 53	−22 58.9
	14	17 25 11	− 5 28	−23 12.0
	17	17 38 28	− 4 01	−23 21.0
	20	17 51 46	− 2 32	−23 25.7
	23	18 05 06	− 1 02	−23 26.2
	26	18 18 25	+ 0 27	−23 22.5
	29	18 31 43	+ 1 56	−23 14.5

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

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

Planet	Mean Distance from Sun (a) ⊕ = 1	Mean Distance from Sun (a) millions of miles	Period of Revolution Sidereal (P)	Period of Revolution Mean Synodic	Eccentricity (e)	Inclination (i)	Long. of Node (☊)	Long. of Perihelion (π)	Mean Long. of Planet
				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	?	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 " *	Mean Dist. from Planet Miles	Revolution Period d	h	m	Diameter Miles	Discoverer
Satellite of the Earth								
Moon	−12.6	530	238,857	27	07	43	2160	
Satellites of Mars								
Phobos	12	8	5,800	0	07	39	10?	Hall, 1877
Deimos	13	21	14,600	1	06	18	5?	Hall, 1877
Satellites of Jupiter								
V	13	48	112,600	0	11	57	100?	Barnard, 1892
Io	5	112	261,800	1	18	28	2300	Galileo, 1610
Europa	6	178	416,600	3	13	14	2000	Galileo, 1610
Ganymede	5	284	664,200	7	03	43	3200	Galileo, 1610
Callisto	6	499	1,169,000	16	16	32	3200	Galileo, 1610
VI	14	3037	7,114,000	250	16		100?	Perrine, 1904
VII	16	3113	7,292,000	260	01		40?	Perrine, 1905
X	18	3116	7,300,000	260			15?	Nicholson, 1938
XI	18	5990	14,000,000	692			15?	Nicholson, 1938
VIII	16	6240	14,600,000	739			40?	Melotte, 1908
IX	17	6360	14,900,000	758			20?	Nicholson, 1914
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, SIDEREAL AND EPHEMERIS TIME

Any recurring event may be used to measure time. The various times commonly used are defined by the daily passages of the sun or stars caused by the rotation of the earth on its axis. The more uniform revolution of the earth about the sun, causing the return of the seasons, defines ephemeris time.

A sun-dial indicates *apparent solar time*, but this is far from uniform because of the earth's elliptical orbit and the inclination of the ecliptic. If the real sun is replaced by a fictitious mean sun moving uniformly in the equator, we have *mean* (solar) *time. Apparent time—mean time = equation of time.* This is the same as *correction to sun-dial* on page 7, with reversed sign.

If instead of the sun we use stars, we have *sidereal time.* The sidereal time is zero when the vernal equinox or first of Aries is on the meridian. As the earth makes one more revolution with respect to the stars than it does with respect to the sun, sidereal time gains on mean time 3^m56^s per day or 2 hours per month. Right Ascension (R.A.) is measured east from the vernal equinox, so that the R.A. of a body on the meridian is equal to the sidereal time.

Sidereal time is equal to mean time plus 12 hours plus the R.A. of the fictitious mean sun, so that by observation of one kind of time we can calculate the other.

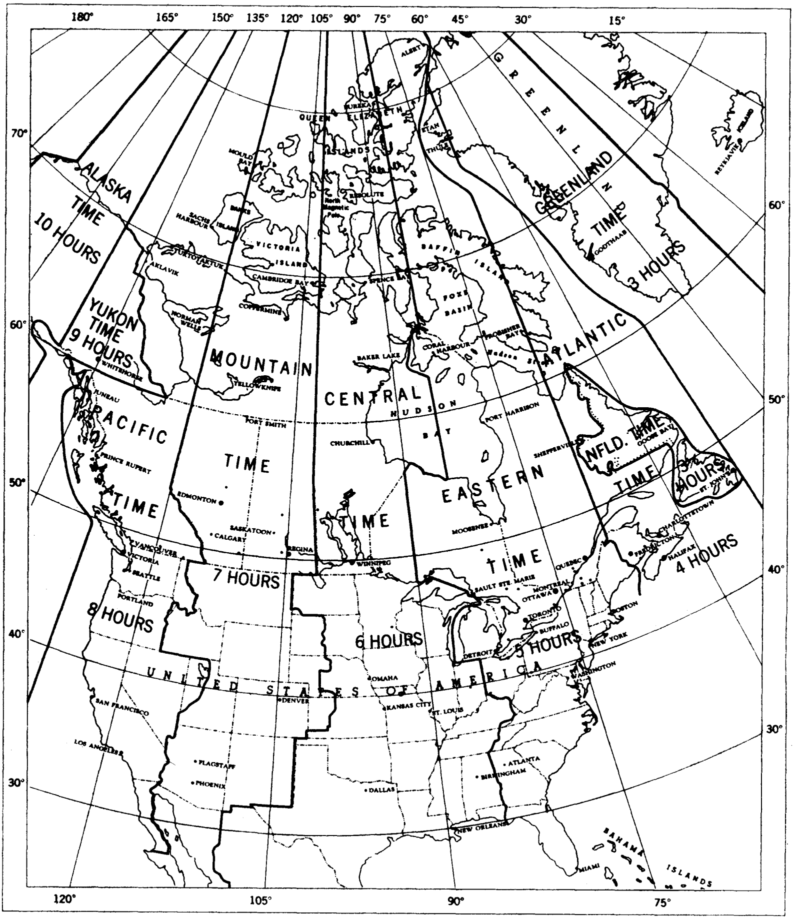
The foregoing refers to *local* time, in general different in different places on the earth. The local mean time of Greenwich, now known as *Universal Time* (UT) is used as a common basis for timekeeping. Navigation and surveying tables are generally prepared in terms of UT. When great precision is required, UT 1 and UT 2 are used differing from UT by polar variation and by the combined effects of polar variation and annual fluctuation respectively.

To avoid the inconveniences to travellers of a changing, local time, *standard time* is used. The earth is divided into 24 zones, each ideally 15 degrees wide, the zero zone being centered on the Greenwich meridian. All clocks within the same zone will read the same time.

In Canada and the United States there are 8 standard time zones as follows: Newfoundland (N), 3^h30^m slower than Greenwich; 60th meridian or Atlantic (A), 4 hours; 75th meridian or Eastern (E), 5 hours; 90th meridian or Central (C), 6 hours; 105th meridian or Mountain (M), 7 hours; 120th meridian or Pacific (P), 8 hours; 135th meridian or Yukon (Y), 9 hours; and 150th meridian or Alaska (AL), 10 hours slower than Greenwich.

Universal time, even after the corrections mentioned have been applied, is still somewhat variable, as shown by atomic clocks or the orbital motion of the moon. *Ephemeris Time* (ET) is used when these irregularities must be avoided. The second, formerly defined as 1/86,400 of the mean solar day, is now defined as 1/31,556,925.9747 of the tropical year Jan. 0 at 12 hours E.T. The difference, ΔT, between UT and ET is measured as a small error in the observed longitude of the moon, in the sense $\Delta T = ET - UT$. The moon's position is tabulated in ET, but observed in UT. ΔT was zero near the beginning of the century, but in 1960 will be about 35 seconds.

MAP OF STANDARD TIME ZONES



JULIAN DAY CALENDAR, 1960

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

Jan. 1.........6,935	May 1.........7,056	Sept. 1........7,179
Feb. 1.........6,966	June 1.........7,087	Oct. 1........7,209
Mar. 1.........6,995	July 1.........7,117	Nov. 1........7,240
Apr. 1.........7,026	Aug. 1.........7,148	Dec. 1........7,270

The Julian Day commences at noon. Thus J.D. 2,436,935.0 = Jan. 1.5 U.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.	Corr.		Lat.	Corr.		Lat.	Corr.
Athabaska	55°	+33M	Penticton	49°	−02P	Atlanta	34°	+37E
Baker Lake	64	+24C	Peterborough	44	+13E	Baltimore	39	+06E
Brandon	50	+40C	Port Harrison	59	+13E	Birmingham	33	−13C
Brantford	43	+21E	Port Arthur	48	+57E	Boston	42	−16E
Calgary	51	+36M	Prince Albert	53	+03M	Buffalo	43	+15E
Charlottetown	46	+12A	Prince Rupert	54	+41P	Chicago	42	−10C
Churchill	60	+17C	Quebec	47	−15E	Cincinnati	39	+38E
Cornwall	45	− 1E	Regina	50	−02M	Cleveland	42	+26E
Edmonton	54	+31M	St. Catharines	43	+17E	Dallas	33	+27C
Fort William	48	+57E	St. Hyacinthe	46	−08E	Denver	40	00M
Fredericton	46	+27A	St. John, N.B.	45	+24A	Detroit	42	+32E
Gander	49	+ 8N	St. John's, Nfld.	48	+01N	Fairbanks	65	−10AL
Glace Bay	46	00A	Sarnia	43	+29E	Flagstaff	35	+27M
Goose Bay	53	+ 2A	Saskatoon	52	+07M	Indianapolis	40	−15C
Granby	45	−09E	Sault Ste. Marie	47	+37E	Juneau	58	+58P
Guelph	44	+21E	Shawinigan Falls	47	−09E	Kansas City	39	+18C
Halifax	45	+14A	Sherbrooke	45	−12E	Los Angeles	34	−07P
Hamilton	43	+20E	Stratford	43	+24E	Louisville	38	−17C
Hull	45	+03E	Sudbury	47	+24E	Memphis	35	00C
Kapuskasing	49	+30E	Sydney	46	+01A	Miami	26	+21E
Kingston	44	+06E	The Pas	54	+45C	Milwaukee	43	−09C
Kitchener	43	+22E	Timmins	48	+26E	Minneapolis	45	+13C
London	43	+25E	Toronto	44	+18E	New Orleans	30	00C
Medicine Hat	50	+23M	Three Rivers	46	−10E	New York	41	−04E
Moncton	46	+19A	Trail	49	−09P	Omaha	41	+24C
Montreal	46	−06E	Truro	45	+13A	Philadelphia	40	+01E
Moosonee	51	+23E	Vancouver	49	+12P	Phoenix	33	+28M
Moose Jaw	50	+02M	Victoria	48	+13P	Pittsburg	40	+20E
Niagara Falls	43	+16E	Whitehorse	61	00Y	St. Louis	39	+01C
North Bay	46	+18E	Windsor	42	+32E	San Francisco	38	+10P
Ottawa	45	+03E	Winnipeg	50	+29C	Seattle	40	+09P
Owen Sound	45	+24E	Yellowknife	62	+38M	Washington	39	+08E

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
	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
February	**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° 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
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°		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
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
	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
June	**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 25	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, 1960. (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
Jan.		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1		09 15	20 34	09 22	20 28	09 31	20 20	09 41	20 11	09 50	20 03
2		09 57	21 38	10 01	21 33	10 07	21 29	10 14	21 24	10 20	21 18
3		10 34	22 38	10 37	22 37	10 39	22 35	10 43	22 34	10 46	22 32
4		11 09	23 37	11 10	23 38	11 10	23 39	11 09	23 41	11 10	23 42
5	☽	11 43	.. ..	11 41	.. ..	11 38	.. ..	11 35	.. ..	11 33	.. ..
6		12 17	00 34	12 13	00 37	12 07	00 42	12 02	00 46	11 56	00 51
7		12 51	01 29	12 45	01 35	12 38	01 41	12 29	01 49	12 20	01 57
8		13 28	02 23	13 20	02 30	13 10	02 40	12 59	02 50	12 47	03 01
9		14 07	03 16	13 57	03 25	13 46	03 36	13 32	03 49	13 18	04 02
10		14 48	04 08	14 37	04 19	14 25	04 31	14 10	04 45	13 55	05 00
11		15 33	04 58	15 22	05 10	15 09	05 22	14 53	05 38	14 37	05 54
12		16 22	05 47	16 11	05 59	15 58	06 11	15 42	06 27	15 26	06 43
13	○	17 13	06 33	17 02	06 44	16 51	06 56	16 36	07 11	16 21	07 26
14		18 07	07 16	17 58	07 25	17 47	07 37	17 35	07 50	17 21	08 04
15		19 03	07 56	18 55	08 04	18 47	08 13	18 36	08 25	18 26	08 36
16		20 00	08 34	19 55	08 40	19 48	08 47	19 41	08 56	19 33	09 04
17		20 58	09 10	20 55	09 14	20 51	09 18	20 47	09 25	20 43	09 30
18		21 57	09 45	21 56	09 47	21 56	09 49	21 54	09 51	21 54	09 54
19		22 57	10 20	22 59	10 20	23 01	10 19	23 04	10 18	23 06	10 17
20		23 59	10 57	.. ..	10 53	.. ..	10 50	.. ..	10 46	.. ..	10 41
21	☾	.. ..	11 35	00 04	11 29	00 08	11 23	00 15	11 16	00 21	11 08
22		01 03	12 17	01 09	12 09	01 17	12 01	01 27	11 50	01 36	11 39
23		02 08	13 04	02 16	12 54	02 27	12 43	02 39	12 30	02 52	12 16
24		03 13	13 56	03 24	13 45	03 36	13 32	03 50	13 17	04 06	13 01
25		04 17	14 54	04 28	14 43	04 41	14 29	04 57	14 13	05 14	13 57
26		05 17	15 58	05 29	15 46	05 41	15 33	05 57	15 18	06 14	15 02
27		06 13	17 04	06 23	16 54	06 35	16 43	06 49	16 29	07 04	16 15
28	●	07 03	18 11	07 11	18 03	07 22	17 54	07 33	17 44	07 44	17 33
29		07 48	19 17	07 54	19 12	08 01	19 06	08 10	18 58	08 18	18 51
30		08 29	20 21	08 32	20 18	08 37	20 15	08 42	20 11	08 46	20 08
31		09 05	21 22	09 07	21 22	09 08	21 22	09 11	21 21	09 12	21 22
Feb.											
1		09 41	22 21	09 41	22 24	09 39	22 26	09 38	22 30	09 36	22 32
2		10 16	23 19	10 13	23 23	10 09	23 29	10 04	23 35	10 00	23 41
3		10 50	.. ..	10 45	.. ..	10 39	.. ..	10 31	.. ..	10 24	.. ..
4	☽	11 27	00 14	11 19	00 21	11 11	00 28	11 00	00 38	10 50	00 47
5		12 05	01 08	11 56	01 16	11 46	01 27	11 32	01 38	11 20	01 51
6		12 45	02 01	12 35	02 11	12 24	02 22	12 08	02 36	11 54	02 50
7		13 29	02 52	13 18	03 02	13 05	03 15	12 49	03 31	12 34	03 46
8		14 16	03 41	14 04	03 52	13 52	04 05	13 36	04 21	13 20	04 37
9		15 06	04 28	14 55	04 39	14 43	04 52	14 28	05 07	14 13	05 23
10		15 59	05 12	15 50	05 23	15 38	05 34	15 25	05 48	15 11	06 02
11		16 55	05 53	16 48	06 03	16 37	06 12	16 25	06 25	16 15	06 36
12	○	17 52	06 33	17 46	06 40	17 39	06 48	17 30	06 57	17 22	07 07
13		18 51	07 10	18 47	07 15	18 42	07 21	18 36	07 28	18 32	07 34
14		19 51	07 46	19 49	07 49	19 47	07 52	19 45	07 56	19 43	07 59
15		20 51	08 22	20 52	08 23	20 53	08 22	20 55	08 23	20 56	08 23
16		21 53	08 59	21 57	08 56	22 00	08 54	22 05	08 51	22 10	08 48
17		22 55	09 36	23 02	09 32	23 08	09 26	23 17	09 20	23 25	09 14
18		23 59	10 17	.. ..	10 10	.. ..	10 02	.. ..	09 52	.. ..	09 43
19	☾	.. ..	11 01	00 08	10 53	00 17	10 42	00 29	10 30	00 39	10 17
20		01 03	11 50	01 12	11 40	01 25	11 28	01 38	11 12	01 52	10 58
21		02 05	12 44	02 16	12 33	02 29	12 20	02 45	12 04	03 00	11 48
22		03 05	13 43	03 17	13 32	03 30	13 18	03 45	13 03	04 01	12 47
23		04 01	14 46	04 12	14 36	04 24	14 23	04 39	14 09	04 54	13 54
24		04 52	15 51	05 01	15 42	05 12	15 33	05 25	15 20	05 38	15 08
25		05 39	16 57	05 46	16 50	05 54	16 43	06 04	16 33	06 14	16 24
26	●	06 21	18 01	06 26	17 57	06 31	17 52	06 38	17 47	06 45	17 42
27		07 00	19 04	07 02	19 02	07 05	19 01	07 09	18 59	07 12	18 56
28		07 36	20 05	07 37	20 06	07 36	20 07	07 37	20 08	07 37	20 10
29		08 12	21 04	08 10	21 08	08 07	21 11	08 04	21 17	08 01	21 21

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

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

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

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

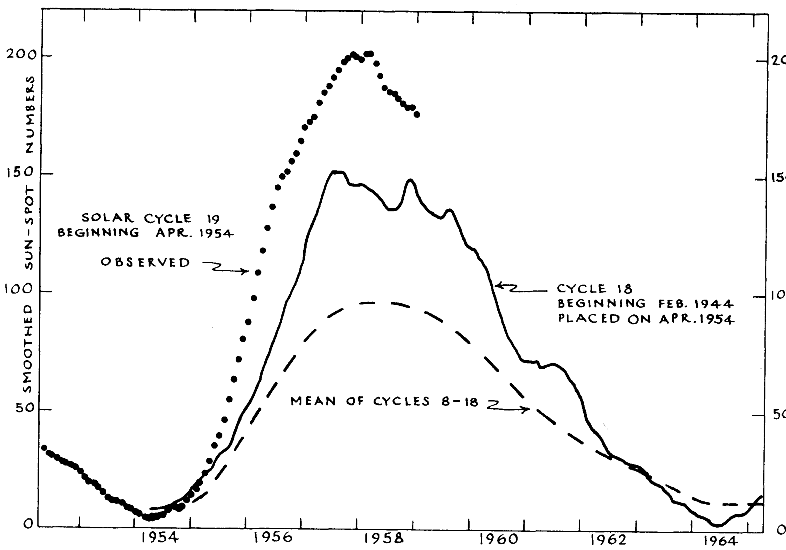
THE PLANETS FOR 1960

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.

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 1960

Elong. East – Evening Star			Elong. West – Morning Star		
Date	Distance	Mag.	Date	Distance	Mag.
Feb. 23	18°	−0.3	Apr. 7	28°	+0.6
June 19	25°	+0.7	Aug. 5	19°	+0.5
Oct. 15	25°	+0.1	Nov. 24	20°	−0.3

The most favourable elongations to observe are: in the evening, Feb. 23 and also June 19, and in the morning, Aug. 5 and Nov. 24. 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, 1960 Venus is in the morning sky and crosses the meridian about 3 hours before the sun. Its declination is −18° and it appears in the south-eastern sky at sunrise. Its stellar magnitude is −3.6. It continues to be a morning star until June 22, when it comes into superior conjunction with the sun. Then it is to be seen east of the sun and it is an evening star for the rest of the year. On Dec. 31 it is in declination −15° and transits the meridian about 3 hours after the sun. Its stellar magnitude is −3.8.

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 next opposition is on Dec. 30, 1960, although Mars is nearest the earth on Dec. 25. Then its distance from the earth is 56,370,000 miles, and the planet's stellar magnitude is −1.3.

On Jan. 1, 1960 Mars is in Ophiuchus but is so low in the south-east at dawn that it is difficult to see. It remains in the morning sky all year. 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 2½ 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.

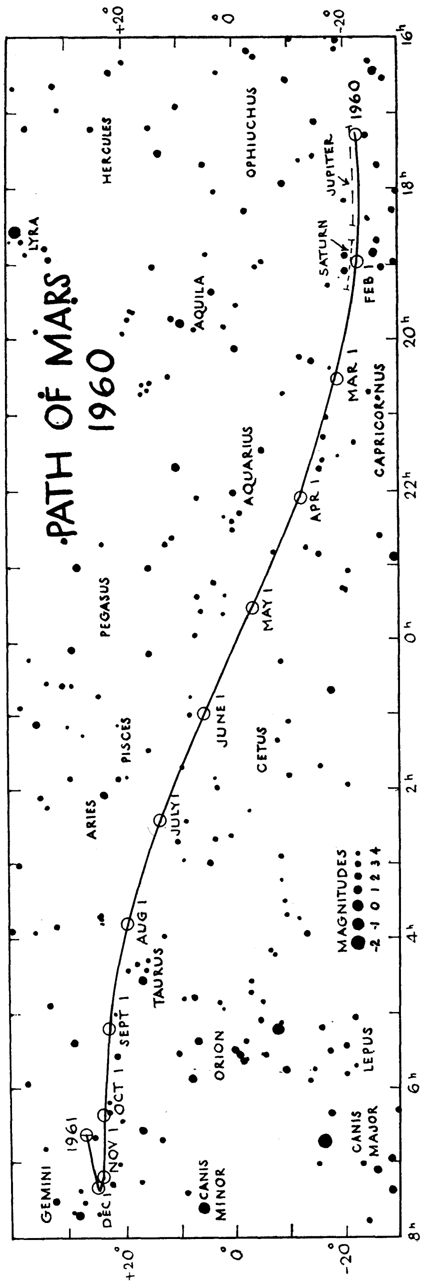
Jupiter is a fine object for the telescope. Many details of the surface as well as the flattening of the planet, due to its short rotation period, are visible, and the phenomena of its satellites provide a continual interest.

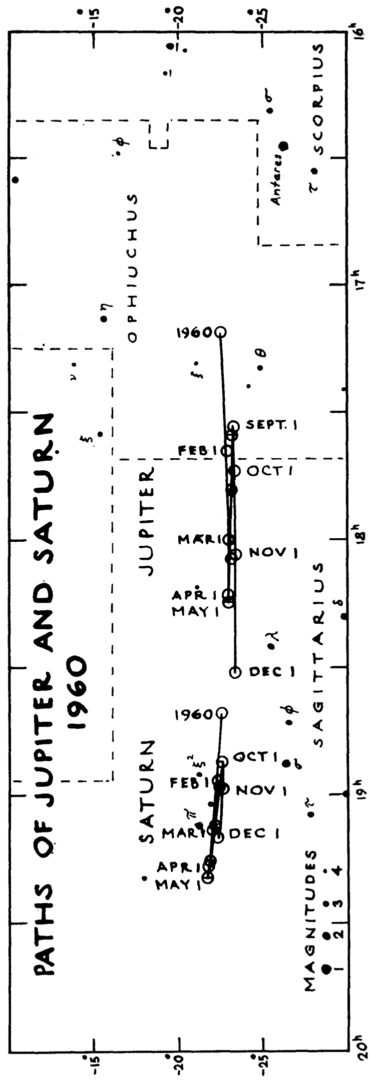
On Jan. 1, 1960 Jupiter is in Ophiuchus, not far from Mars, but is too close to the sun in the morning sky for easy observation; its stellar magnitude is −1.3. It comes into opposition with the sun on June 19, when it moves into the evening sky and is visible all night. Its magnitude has brightened to −2.2. It retrogrades from Apr. 20 to Aug. 20 (*see map*). On Dec. 31 it is in Sagittarius but is too close to the sun to be seen in the evening sky.

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 29½ 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.

Saturn was in conjunction with the sun on Dec. 31, 1959. It emerges from the sun in the morning sky and reaches opposition on July 7 when its stellar magni-


PATH OF MARS
1960
MAGNITUDES
-2 -1 0 1 2 3 4

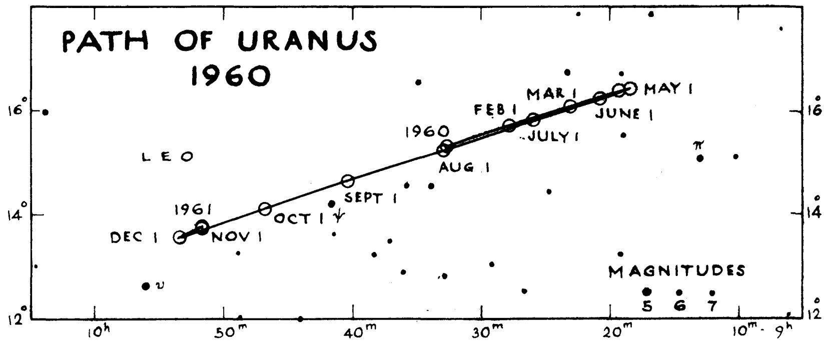

PATHS OF JUPITER AND SATURN
1960
MAGNITUDES
1 2 3 4

tude is +0.3. It retrogrades, or moves westward among the stars, from Apr. 27 to Sept. 15 (*see map*). By the end of the year it is getting close to the sun in the evening sky; its stellar magnitude is +0.8. It remains in Sagittarius during 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.

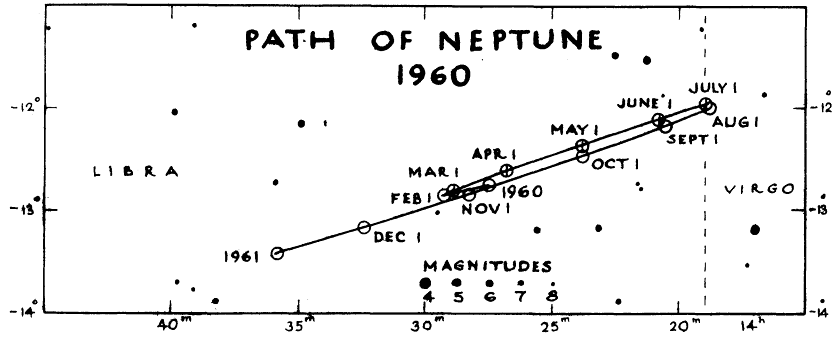
Uranus is in Leo during most of the year (*see map*). At the beginning of the year it rises over three hours after sunset and is retrograding (direct motion is resumed on Apr. 24). On Feb. 8 it is in opposition to the sun and is above the horizon all night; its apparent diameter is 3.9″ and its stellar magnitude is +5.7. By the time of conjunction on Aug. 14 its magnitude has faded to +5.9. For the rest of the year it is in the morning sky.



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.

Neptune is in Virgo during most of 1960 (*see map*). It is in opposition to the sun on April. 27, when it is above the horizon all night. Its stellar magnitude is then +7.70, and during the year it fades slightly to +7.84. 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 Nov. 1.



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. 24, at which time its astrometric position is R.A. $10^h\ 46^m$, Dec. $+21°\ 32'$.

THE SKY MONTH BY MONTH

By J. F. Heard

THE SKY FOR JANUARY, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During January the sun's R.A. increases from 18h 42m to 20h 54m and its Decl. changes from 23° 06′ S to 17° 26′ S. The equation of time changes from −3m 02s to −13m 31s. The earth is in perihelion or closest to the sun on the 4th.

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. On Jan. 9th–10th, Aldebaran will be occulted by the moon. See p. 61. Times of moonrise and moonset are given on p. 20.

Mercury on the 15th is in R.A. 19h 13m, Decl. 23° 58′ S., and transits at 11h 41m. It is too close to the sun for observation, being in superior conjunction on the 26th.

Venus on the 15th is in R.A. 16h 57m, Decl. 20° 47′ S., mag. −3.5, and transits at 9 h 23m. It is close to Antares and so is a morning star, rising in the south-east two to three hours before the sun. Venus is only about one degree north of Jupiter on the morning of the 21st.

Mars on the 15th is in R.A. 18h 03m, Decl. 23° 58′ S., and transits at 10h 28m. It is in Sagittarius and rises about an hour before the sun, but is difficult to observe.

Jupiter on the 15th is in R.A. 17h 24m, Decl. 22° 43′ S., mag. −1.4, and transits at 9 h 48m. It rises about two hours before sunrise and may be seen low in the south-east. See Venus.

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 48m, Decl. 22° 27′ S., and transits at 11h 12m. It is a morning star but too close to the sun for observation.

Uranus on the 15th is in R.A. 9h 31m, Decl. 15° 30′ N., and transits at 1h 56m. It rises in the east about two hours after sunset.

Neptune on the 15th is in R.A. 14h 29m, Decl. 12° 49′ S. and transits at 6h 53m. It rises about two hours after midnight.

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

ASTRONOMICAL PHENOMENA MONTH BY MONTH

By Ruth J. Northcott

d	h	m	JANUARY E.S.T.	Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 6h 30m
				°	h m	
Fri. 1			....	295.08		32O14
Sat. 2			....	307.26	14 17	13O24
Sun. 3			....			
Mon. 4			Quadrantid meteors..................	319.44		O1234
	14		⊕ at Perihelion. Dist. from ☉, 91,342,000 mi.	331.61		12O34
Tue. 5	13	53	☽ First Quarter..................	343.78	11 06	2O134
Wed. 6			....	355.94		13O24
Thu. 7			....	8.10		3O124
Fri. 8			....	20.24	7 55	32O4*
Sat. 9			☿ at Aphelion..................	32.39		431O*
Sun. 10	8		☾ at Apogee. Dist. from ⊕, 252,300 mi.	44.53		4O132
	23		☌ ☿ ♄ ☿ 1.8° S...........			
Mon. 11			....	56.66	4 45	412O3
Tue. 12			....	68.79		42O13
Wed. 13	18	51	○ Full Moon..................	80.92		d41O2
Thu. 14			....	93.05	1 34	43O12
Fri. 15			....	105.18		4321O
Sat. 16	2		☌ ♅ ☾ ♅ 4° N............	117.31	22 23	d342O
Sun. 17			....	129.44		O4132
Mon. 18			....	141.58		d1O43
Tue. 19			....	153.72	19 12	2O134
Wed. 20			....	165.86		1O324
Thu. 21	6		☌ ♀ ♃ ♀ 1.1° N.........	178.01		3O124
	10	01	☾ Last Quarter..................			
Fri. 22	0		☌ ♆ ☾ ♆ 2° S.............	190.17	16 02	321O4
Sat. 23			....	202.34		32O14
Sun. 24			....	214.51		O324*
Mon. 25	3		☌ ♃ ☾ ♃ 5° S.............	226.69	12 51	1O423
	10		☌ ♀ ☾ ♀ 4° S.............			
Tue. 26	4		☌ ♂ ☾ ♂ 6° S.............	238.88		24O13
	5		☾ at Perigee. Dist. from ⊕, 224,800 mi.			
	10		☌ ♄ ☾ ♄ 4° S..............			
	10		☌ ☿ ☉ Superior			
Wed. 27			....	251.07		41O23
Thu. 28	1	16	● New Moon..................	263.26	9 40	43O12
Fri. 29	19		□ ♆ ☉ West	275.45		4321O
Sat. 30			☿ Greatest Hel. Lat. S............	287.65		432O1
Sun. 31	6		☌ ♂ ♄ ♂ 1.2° S...........	299.83	6 30	4O2**

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During February the sun's R.A. increases from 20h 54m to 22h 48m and its Decl. changes from 17° 26′ S. to 7° 40′ S. The equation of time changes from −13m 31s to a minimum of −14m 21s on the 12th and then to −12m 31s at the end of the month.

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

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

Mercury on the 15th is in R.A. 22h 46m, Decl. 8° 29′ S, and transits at 13h 12m. It is at greatest eastern elongation on the 23rd, and for a few evenings about that time may be seen low in the west just after sunset. This is a favourable elongation.

Venus on the 15th is in R.A. 19h 39m, Decl. 21° 10′ S., mag. −3.4, and transits at 10h 04m. It is a morning star visible briefly low in the south-east before sunrise. On the morning of the 7th Venus passes within about 12′ north of Saturn, and on the morning of the 17th Venus is very close to Mars.

Mars on the 15th is in R.A. 19h 43m, Decl. 22° 11′ S., and transits at 10h 07m. It rises more than an hour before sunrise, but is difficult to observe. See Venus.

Jupiter on the 15th is in R.A. 17h 50m, Decl. 22° 59′ S., mag. −1.5, and transits at 8h 12m. It is in Sagittarius, rising about three hours before sunrise. 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. 19h 03m, Decl. 22° 09′ S., mag. +0.8, and transits at 9h 25m. In Sagittarius, east of Jupiter, it rises about two hours before sunrise. See Venus.

Uranus on the 15th is in R.A. 9h 26m, Decl. 15° 55′ N. and transits at 23h 45m. It rises at about sunset. Opposition is on the 8th.

Neptune on the 15th is in R.A. 14h 29m, Decl. 12° 51′ S. and transits at 4h 52m. It rises at about midnight.

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

d	h	m	FEBRUARY E.S.T.	Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 5h 30m
				°	h m	
Mon. 1			....	312.02		41O23
Tue. 2			....	324.20		24O13
Wed. 3			....	336.38	3 19	1O43*
Thu. 4	9	27	☽ First Quarter..................	348.55		3O124
Fri. 5			....	0.71		312O4
Sat. 6			....	12.87	0 08	32O14
Sun. 7	1		☾ at Apogee. Dist. from ⊕, 251,700 mi.	25.03		13O24
	6		☌ ♀ ♄ ♀ 0.2° N...........			
Mon. 8	14		☍ ♅ ☉ Dist. from ⊕, 1,618,000,000 mi.	37.18	20 57	dO234
Tue. 9			....	49.32		2O134
Wed. 10	9		♆ Stationary in R.A..............	61.46		12O43
Thu. 11			....	73.60	17 47	3O412
Fri. 12	7		☌ ♅ ☾ ♅ 4° N.............	85.74		3412O
	12	24	○ Full Moon....................			
Sat. 13			....	97.87		432O1
Sun. 14			....	110.01	14 36	431O2
Mon. 15			....	122.14		4O123
Tue. 16	22		☌ ♀ ♂ ♀ 1.1° N...........	134.29		42O3*
Wed. 17			....	146.43	11 25	421O3
Thu. 18			☿ at ☊	158.58		d4O12
	5		☌ ♆ ☾ ♆ 2° S..............			
Fri. 19	18	48	☾ Last Quarter..................	170.74		d314O
Sat. 20			....	182.91	8 15	32O14
Sun. 21			♀ at ☋	195.08		31O24
	19		☌ ♃ ☾ ♃ 5° S..............			
Mon. 22			☿ at Perihelion	207.26		O1324
	22		☾ at Perigee. Dist. from ⊕, 228, 400mi.			
	23		☌ ♄ ☾ ♄ 4° S..............			
Tue. 23	19		☿ Greatest elongation E., 18°.....	219.45	5 04	21O34
Wed. 24	2		☌ ♂ ☾ ♂ 5° S..............	231.64		d2O34
	7		☍ ♇ ☉ Dist. from ⊕, 3,050,000,000 mi.			
	8		☌ ♀ ☾ ♀ 4° S..............			
Thu. 25			....	243.84		O3124
Fri. 26	13	24	● New Moon...................	256.04	1 53	31O24
Sat. 27	19		☌ ☿ ☾ ☿ 3° N.............	268.24		32O14
Sun. 28			....	280.44	22 43	314O2
Mon. 29	21		☿ Stationary in R.A..............	292.65		4O312

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR MARCH, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During March the sun's R.A. increases from 22h 48m to 0h 41m and its Decl. changes from 7° 40′ S. to 4° 28′ N. The equation of time changes from −12m 31s to −4m 03s. On the 20th at 9h 43m 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. There is a partial eclipse of the sun on the 27th. 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. Aldebaran will be occulted by the moon on Mar. 4th. See p. 61. There is an eclipse of the moon during the night of the 12th–13th. Times of moonrise and moonset are given on p. 21.

Mercury on the 15th is in R.A. 23h 05m, Decl. 2° 37′ S., and transits at 11h 30m, It is too close to the sun for observation, being in inferior conjunction on the 10th.

Venus on the 15th is in R.A. 22h 05m, Decl. 12° 51′ S. mag. −3.3, and transits at 10h 35m. It is a morning star, but its altitude in the south-east at sunrise is only about 10 degrees.

Mars on the 15th is in R.A. 21h 15m, Decl. 17° 08′ S., and transits at 9h 44m. It rises two hours or less before sunrise and is difficult to observe in the twilight sky.

Jupiter on the 15th is in R.A. 18h 07m, Decl. 23° 00′ S., mag. −1.7, and transits at 6h 35m. In Sagittarius, it rises about four hours before sunrise and is a prominent object in the south-east. 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. 19h 13m, Decl. 21° 53′ S., mag. +0.8, and transits at 7h 41m. In Sagittarius, east of Jupiter, it rises about three hours before the sun.

Uranus on the 15th is in R.A. 9 h 21m, Decl. 16° 15′ N. and transits at 21h 46m. It is well up in the east at sunset.

Neptune on the 15th is in R.A. 14h 28m, Decl. 12° 44′ S. and transits at 2h 56m. It rises about two hours before midnight.

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

MARCH E.S.T.				Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 4h 30m
d	h	m		°	h m	
Tue. 1			. . . .	304.85		42103
Wed. 2			. . . .	317.04	19 32	42013
Thu. 3			. . . .	329.24		4032*
Fri. 4			☿ Greatest Helio. Lat. N.	341.42		43102
Sat. 5	6	06	☽ First Quarter.	353.60	16 21	43201
	21		☾ at Apogee. Dist. from ⊕, 251,300 mi.			
Sun. 6			. . . .	5.78		4310*
Mon. 7			. . . .	17.95		4012*
Tue. 8			. . . .	30.12	13 10	12043
Wed. 9			. . . .	42.28		20134
Thu. 10	13		☌ ⛢ ☾ ⛢ 4° N.	54.43		0234*
	16		☌ ☿ ☉ Inferior.			
Fri. 11			. . . .	66.59	10 00	31024
Sat. 12			. . . .	78.74		32014
Sun. 13	3	26	◯ Full Moon. Eclipse, see p. 59.	90.89		31204
Mon. 14			. . . .	103.03	6 49	30124
Tue. 15			. . . .	115.18		d1043
Wed. 16	11		☌ ♆ ☾ ♆ 2° S.	127.34		24013
Thu. 17			. . . .	139.49	3 38	41023
Fri. 18			. . . .	151.66		d4302
Sat. 19	2		☾ at Perigee. Dist. from ⊕, 229,800 mi.	163.83		43201
Sun. 20	1	41	☾ Last Quarter.	176.00	0 27	43210
	6		☌ ♃ ☾ ♃ 5° S.			
	9	43	☉ enters ♈. Spring commences. . . .			
Mon. 21	9		☌ ♄ ☾ ♄ 4° S.	188.19		43012
Tue. 22	8		□ ♃ ☉ West.	200.38	21 17	41023
Wed. 23	2		☿ Stationary in R.A.	212.58		42013
	23		☌ ♂ ☾ ♂ 4° S.			
Thu. 24			. . . .	224.79		14023
Fri. 25	4		☌ ☿ ♀ ☿ 1.9° N.	236.99	18 06	30124
	7		☌ ☿ ☾ ☿ 0.7° S. Occ., see p. 61			
	7		☌ ♀ ☾ ♀ 2° S.			
Sat. 26			♀ at Aphelion.	249.21		3204*
Sun. 27			☿ at ☋.	261.43		32104
	2	38	● New Moon. Eclipse, see p. 59. . . .			
Mon. 28			. . . .	273.64	14 55	30124
Tue. 29			. . . .	285.86		10234
Wed. 30			. . . .	298.08		20134
Thu. 31			. . . .	310.29	11 44	10234

Explanation of symbols and abbrevations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR APRIL, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During April the sun's R.A. increases from 0h 41m to 2h 33m and its Decl. changes from 4° 28′ N. to 15° 01′ N. The equation of time changes from −4m 03s to +2° 53′, being zero on the 15th. 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. 23h 59m, Decl. 2° 55′ S., and transits at 10h 27m. It is at greatest western elongation on the 7th and so for a few mornings at that time it may be seen low in the south-east before sunrise. However, this is not a favourable elongation.

Venus on the 15th is in R.A. 0h 28m, Decl. 1° 19′ N., mag. −3.3, and transits at 10h 55m. It is a morning star, but so close to the sun as to be difficult to observe before sunrise.

Mars on the 15th is in R.A. 22h 47m, Decl. 9° 07′ S., mag. +1.3, and transits at 9h 14m. In Aquarius, it rises about two hours before sunrise and stands about 15 degrees above the south-eastern horizon at sunrise.

Jupiter on the 15th is in R.A. 18h 16m, Decl. 22° 59′ S., mag. −1.9, and transits at 4h 41m. In Sagittarius, it rises about at midnight and is past the meridian at sunrise. It is stationary on the 20th and begins to retrograde, or move westward 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. 19h 19m, Decl. 21° 44′ S., mag. +0.7, and transits at 5h 45m. In Sagittarius, east of Jupiter, it rises after midnight. On the 27th it is stationary and begins to retrograde.

Uranus on the 15th is in R.A. 9h 19m, Decl. 16° 26′ N., and transits at 19h 42m. It is east of the meridian at sunset.

Neptune on the 15th is in R.A. 14h 25m, Decl. 12° 29′ S. and transits at 0h 52m. It rises about one hour after sunset.

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

	d	h	m	APRIL E.S.T.	Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 3h 30m
	d	h	m		°	h m	
Fri.	1				322.50		O3412
Sat.	2	17		☾ at Apogee. Dist. from ⊕, 251,300 mi.	334.71		3421O
Sun.	3				346.91	8 32	d432O
Mon.	4	2	05	☽ First Quarter	359.11		43O12
Tue.	5				11.30		41O32
Wed.	6			☿ at Aphelion	23.48	5 23	42O13
		21		☌ ♅ ☾ ♅ 4° N.			
Thu.	7	8		☿ Greatest elongation W., 28°	35.67		41O3*
		19		□♄☉ West			
Fri.	8				47.84		4O312
Sat.	9				60.01	2 12	3412O
Sun.	10				72.18		32O14
Mon.	11	15	28	○ Full Moon	84.34	23 01	3O24*
Tue.	12	18		☌ ♆ ☾ ♆ 2° S.	96.51		1O324
Wed.	13				108.67		2O134
Thu.	14	14		☾ at Perigee. Dist. from ⊕, 227,100 mi.	120.84	19 50	12O34
Fri.	15				133.01		O3124
Sat.	16	14		☌ ♃ ☾ ♃ 5° S.	145.18		d31O4
Sun.	17	16		☌ ♄ ☾ ♄ 4° S.	157.36	16 39	32O14
Mon.	18			♀ Greatest Helio. Lat. S.	169.55		3O42*
		7	57	☾ Last Quarter			
Tue.	19				181.75		41O2*
Wed.	20	0		♃ Stationary in R.A.	193.96	13 28	42O13
Thu.	21			Lyrid meteors	206.17		421O3
		20		☌ ♂ ☾ ♂ 2° S.			
Fri.	22				218.39		4O132
Sat.	23	20		☌ ☿ ☾ ☿ 1° S.	230.61	10 17	431O2
Sun.	24	8		☌ ♀ ☾ ♀ 0.7° N.	242.84		432O1
		8		♅ Stationary in R.A.			
Mon.	25	16	45	● New Moon	255.07		431O2
Tue.	26				267.30	7 06	d43O2
Wed.	27			☿ Greatest Helio. Lat. S.	279.54		2O143
		10		♄ Stationary in R.A.			
		21		☍ ♆ ☉ Dist. from ⊕, 2,724,000,000 mi.			
Thu.	28				291.77		21O43
Fri.	29				304.00	3 56	O1234
Sat.	30	11		☾ at Apogee. Dist. from ⊕, 251,800 mi.	316.23		13O24

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR MAY, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During May the sun's R.A. increases from 2 h 33m to 4 h 36m and its Decl. changes from 15° 01′ N. to 22° 01′ N. The equation of time changes from +2m 53s to a maximum of +3m 44s on the 14th and then to +2m 20s 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. 3h 14m, Decl. 17° 48′ N., and transits at 11h 47m. It is too close to the sun for observation, being in superior conjunction on the 17th.

Venus on the 15th is in R.A. 2h 46m, Decl. 14° 56′ N., mag. −3.4, and transits at 11h 16m. It is a morning star but too close to the sun for easy observation.

Mars on the 15th is in R.A. 0h 13m, Decl. 0° 12′ S., mag. +1.2, and transits at 8h 41m. Moving into Pisces, it now stands about 20 degrees above the eastern horizon at sunrise.

Jupiter on the 15th is in R.A. 18h 12m, Decl. 23° 02′ S., mag. −2.1, and transits at 2h 39m. In Sagittarius, it rises before midnight and is well past the meridian at sunrise. 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. 19h 19m, Decl. 21° 46′ S., mag. +0.6, and transits at 3h 46m. In Sagittarius, east of Jupiter, it rises at about midnight.

Uranus on the 15th is in R.A. 9h 19m, Decl. 16° 23′ N. and transits at 17h 45m. It is past the meridian at sunset.

Neptune on the 15th is in R.A. 14h 22m, Decl. 12° 14′ S. and transits at 22h 47m. It is low in the south-east at sunset.

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

d	h	m	MAY E.S.T.	Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 2h 15m
d	h	m		°	h m	
Sun. 1			♂ Greatest Helio. Lat. S.	328.46		32O14
Mon. 2			....	340.67	0 45	31O4*
Tue. 3	20	01	☽ First Quarter	352.89		3O124
Wed. 4			♄ Aquarid meteors	5.10	21 34	2O43*
	5		☌ ♅ ☾ ♅ 4° N.			
Thu. 5			....	17.30		214O3
	21		☌ ☿ ♀ ☿ 0.2° S.			
Fri. 6			....	29.50		4O123
Sat. 7	19		□ ♅ ☉ East	41.69	18 23	413O2
Sun. 8			....	53.88		432O1
Mon. 9			....	66.06		431O*
Tue. 10	2		☌ ♆ ☾ ♆ 2° S.	78.24	15 12	43O12
Wed. 11	0	43	○ Full Moon	90.42		412O3
Thu. 12	13		☾ at Perigee. Dist. from ⊕, 224,000 mi.	102.59		d42O3
Fri. 13	20		☌ ♃ ☾ ♃ 5° S.	114.77	12 01	4O123
Sat. 14	22		☌ ♄ ☾ ♄ 4° S.	126.96		d1O24
Sun. 15			....	139.14		32O14
Mon. 16			☿ at ☊	151.34	8 50	312O4
Tue. 17	10		☌ ☿ ☉ Superior	163.54		3O124
	14	55	☾ Last Quarter			
Wed. 18			....	175.75		d1O34
Thu. 19	2		♇ Stationary in R.A.	187.96	5 39	d2O34
Fri. 20			☿ at Perihelion	200.19		O1234
	17		☌ ♂ ☾ ♂ 0.1° S.			
	22		Vesta Stationary in R.A.			
Sat. 21			....	212.41		1O342
Sun. 22			....	224.65	2 28	324O1
Mon. 23			....	236.89		3412O
Tue. 24			....	249.13	23 16	43O12
Wed. 25	7	27	● New Moon	261.37		41O23
Thu. 26			♂ at Perihelion	273.62		42O13
Fri. 27	23		☾ at Apogee. Dist. from ⊕, 252,400 mi.	285.86	20 05	4O23*
Sat. 28			....	298.11		41O32
Sun. 29			....	310.35		342O1
Mon. 30			....	322.59	16 54	321O4
Tue. 31			☿ Greatest Helio. Lat. N.			
	13		☌ ♅ ☾ ♅ 4° N.	334.82		3O124

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR JUNE, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During June the sun's R.A. increases from 4h 36m to 6h 40m and its Decl. changes from 22° 01′ N. to 23° 08′ N. The equation of time changes from +2m 20s to zero on the 13th and then to −3m 39s at the end of the month. The solstice is on the 21st at 4h 43m. 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. 7h 20m, Decl. 23° 39′ N., and transits at 13h 47m. It is at greatest eastern elongation on the 19th, and is close to Pollux, so that for a few evenings at that time it may be seen low in the west after sunset.

Venus on the 15th is in R.A. 5h 24m, Decl. 23° 15′N, mag. −3.5, and transits at 11h 52m. It is too close to the sun for observation, being in superior conjunction on the 22nd.

Mars on the 15th is in R.A. 1h 39m, Decl. 8° 46′ N., mag. +1.0, and transits at 8h 05m. Moving from Pisces into Aries, it now rises about three hours before sunrise.

Jupiter on the 15th is in R.A. 17h 57m, Decl. 23° 07′ S., mag. −2.2, and transits at 0h 23m. In Sagittarius, it rises about at sunset and dominates the southern sky all night. Opposition is on the 19th. 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. 19h 12m, Decl. 21° 59′ S., mag. +0.4, and transits at 1h 38m. In Sagittarius, it rises about an hour after sunset.

Uranus on the 15th is in R.A. 9h 23m, Decl. 16° 04′ N. and transits at 15h 47m. It sets about three hours after sunset.

Neptune on the 15th is in R.A. 14h 20m, Decl. 12° 01′ S. and transits at 20h 42m. It is well up in the south-east at sunset.

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

			JUNE E.S.T.	Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 0h 15m
d	h	m		°	h m	
Wed. 1			. . . .	347.05		1024*
Thu. 2	11	02	☽ First Quarter	359.28	13 43	20134
Fri. 3			. . . .	11.49		1034*
Sat. 4			. . . .	23.70		d0324
Sun. 5			. . . .	35.91	10 32	32014
Mon. 6	12		☌♆☾ ♆ 2° S.	48.11		32104
Tue. 7			. . . .	60.30		30412
Wed. 8			. . . .	72.49	7 21	41302
Thu. 9	8	02	◯ Full Moon.	84.67		42013
	21		☾ at Perigee. Dist. from ⊕, 222,100 mi.			
Fri. 10	2		☌♃☾ ♃ 5° S.	96.86		41203
Sat. 11	5		☌♄☾ ♄ 4° S.	109.05	4 09	40132
Sun. 12			. . . .	121.24		4320*
Mon. 13			♀ at ☊	133.43		43210
Tue. 14			. . . .	145.63	0 58	43012
Wed. 15	23	36	☾ Last Quarter.	157.84		14302
Thu. 16			. . . .	170.05	21 47	20413
Fri. 17			. . . .	182.27		12043
Sat. 18	14		☌♂☾ ♂ 2° N.	194.50		01234
Sun. 19	9		☿ Greatest elongation E., 25°.	206.74	18 36	d3104
	21		☍♃☉ Dist. from ⊕, 393,800,000 mi. . . .			
Mon. 20			. . . .	218.97		32104
Tue. 21	4	43	☉ enters ♋. Summer commences. .	231.22		30124
Wed. 22	11		☌♀☉ Superior.	243.47	15 24	31024
Thu. 23			☿ at ☋			
	22	27	● New Moon.	255.71		20143
Fri. 24			☿ at ☋	267.97		12403
	5		☾ at Apogee. Dist. from ⊕, 252,700 mi.			
Sat. 25			. . . .	280.22	12 13	40123
Sun. 26	4		☌☿☾ ☿ 3° N.	292.47		d4102
Mon. 27	21		☌♅☾ ♅ 3° N.	304.72		d4320
Tue. 28	16		Ceres stationary in R.A.	316.96	9 02	43012
Wed. 29			. . . .	329.20		43102
Thu. 30			. . . .	341.44		42013

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR JULY, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During July the sun's R.A. increases from 6h 40m to 8h 45m and its Decl. changes from 23° 08′ N. to 18° 05′ N. The equation of time changes from −3m 39s to a minimum of −6m 25s on the 26th and then to −6m 15s at the end of the month. On the 2nd 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. At dawn on July 19th, Aldebaran will be occulted by the moon. See p. 61. Times of moonrise and moonset are given on p. 23.

Mercury on the 15th is in R.A. 7h 47m, Decl. 16° 18′ N., and transits at 12h 11m. It is too close to the sun for observation, being in inferior conjunction on the 16th.

Venus on the 15th is in R.A. 8h 04m, Decl. 21° 31′ N., mag. −3.4, and transits at 12h 34m. It is an evening star, but too close to the sun for easy observation.

Mars on the 15th is in R.A. 3h 02m, Decl. 15° 57′ N., mag. +0.9, and transits at 7h 30m. Moving from Aries into Taurus, it is now fairly prominent in the eastern sky for about three hours before sunrise.

Jupiter on the 15th is in R.A. 17h 42m, Decl. 23° 07′ S., mag. −2.1 and transits at 22h 05m. In Sagittarius it is well up at sunset and sets before sunrise.
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. 19h 03m, Decl. 22° 16′ S., mag. +0.3, and transits at 23h 27m. In Sagittarius, it rises about at sunset and sets just before sunrise. It is at opposition on the 7th.

Uranus on the15th is in R.A. 9h 29m, Decl. 15° 36′ N., and transits at 13h 55m. It is low in the west at sunset.

Neptune on the 15th is in R.A. 14h 19m, Decl. 11° 57′ S. and transits at 18h 43m. It is past the meridian at sunset.

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

			JULY E.S.T.	Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 22h 15m
d	h	m		°	h m	
Fri. 1	22	49	☽ First Quarter..................	353.67	5 50	4O123
Sat. 2	9		☍ Vesta ☉. See p. 57..................	5.90		1O324
	15		☿ Stationary in R.A..............			
	17		⊕ in Aphelion. Dist. from ☉, 94,452,000 mi.			
Sun. 3			☿ at Aphelion....................	18.11		32O14
	20		☌ ♆ ☾ ♆ 2° S..............			
Mon. 4			....	30.32	2 39	31O4*
Tue. 5			....	42.53		31O24
Wed. 6			....	54.73	23 28	2O134
Thu. 7	1		☍ ♄ ☉ Dist. from ⊕, 839,400,000 mi.....	66.92		21O34
	7		☌ ♃ ☾ ♃ 5° S..............			
Fri. 8	6		☾ at Perigee. Dist. from ⊕, 221,900 mi.	79.11		O1234
	13		☌ ♄ ☾ ♄ 4° S..............			
	14	37	○ Full Moon..................			
Sat. 9			....	91.30	20 16	1O342
Sun. 10			....	103.49		324O1
Mon. 11			....	115.68		4321O
Tue. 12			....	127.88	17 05	d43O2
Wed. 13			....	140.07		42O1*
Thu. 14			....	152.28		421O3
Fri. 15	10	43	☾ Last Quarter..................	164.49	13 54	4O123
Sat. 16	20		☌ ☿ ☉ Inferior.............	176.71		41O32
Sun. 17			♀ at Perihelion..................	188.94		234O1
	12		☌ ♂ ☾ ♂ 3° N.............			
Mon. 18	17		♆ Stationary in R.A.............	201.17	10 42	312O4
Tue. 19			....	213.41		3O124
Wed. 20			....	225.65		dO4**
Thu. 21	9		☾ at Apogee. Dist. from ⊕, 252,500 mi.	237.89	7 31	21O34
Fri. 22			....	250.14		O2134
Sat. 23	13	31	● New Moon..................	262.39		1O324
Sun. 24			☿ Greatest Helio. Lat. S..........	274.64	4 19	23O14
Mon. 25	6		☌ ♅ ☾ ♅ 3° N.............	286.89		321O4
Tue. 26			....	299.14		3O412
Wed. 27	6		☿ Stationary in R.A.............	311.39	1 08	431O2
Thu. 28			....	323.63		421O3
Fri. 29			δ Aquarid meteors...................	335.87	21 57	4O213
	6		□ ♆ ☉ East...............			
Sat. 30			....	348.10		41O23
Sun. 31	3		☌ ♆ ☾ ♆ 2° S..............	0.32		423O1
	7	39	☽ First Quarter..................			

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR AUGUST, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During August the sun's R.A. increases from 8h 45m to 10h 41m and its Decl. changes from 18° 05′ N. to 8° 22′ N. The equation of time changes from −6m 15s to −0m 05s. 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. 19° 10′ N., and transits at 11h 06m. It is at greatest western elongation on the 5th, and so for a few mornings at this time it may be seen low in the east just before sunrise. By the 30th it is in superior conjunction.

Venus on the 15th is in R.A. 10h 36m, Decl. 10° 21′ N., mag. −3.3, and transits at 13h 03m. It is an evening star, but only about 5 degrees above the western horizon at sunset.

Mars on the 15th is in R.A. 4h 27m, Decl. 20° 54′ N., mag. +0.7, and transits at 6h 53m. Moving through Taurus (5 degrees north of Aldebaran on the 17th), it rises about midnight and is prominent in the eastern sky until sunrise.

Jupiter on the 15th is in R.A. 17h 33m, Decl. 23° 07′ S., mag. −2.0, and transits at 19h 55m. In Ophinchus, it is nearly to the meridian at sunset and sets about at midnight. On the 20th it is stationary 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 55m, Decl. 22° 31′ S., mag. +0.4 and transits at 21h 17m. In Sagittarius, east of Jupiter, it is well up in the south-east at sunset and sets before sunrise.

Uranus on the 15th is in R.A. 9h 36m, Decl. 15° 00′ N. and transits at 12h 00m. It is too close to the sun for observation.

Neptune on the 15th is in R.A. 14h 19m, Decl. 12° 03′ S. and transits at 16h 42m. It is well down in the south-west at sunset.

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

			AUGUST E.S.T.	Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 20h 45m
d	h	m		°	h m	
Mon. 1	10		☌ ♀ ⛢ ♀ 1.8° N.	12.54	18 45	4321O
Tue. 2			....	24.75		43O12
Wed. 3	13		☌ ♃ ☾ ♃ 5° S.	36.95		431O2
Thu. 4	20		☌ ♄ ☾ ♄ 4° S.	49.15	15 34	2O143
Fri. 5	14		☿ Greatest elongation W., 19°	61.34		O43**
	15		☾ at Perigee. Dist. from ⊕, 223,500 mi.			
Sat. 6	21	41	🌕 Full Moon. Eclipse, see p. 59	73.53		1O234
Sun. 7			♀ Greatest Helio. Lat. N.	85.71	12 22	d2O14
Mon. 8			....	97.90		321O4
Tue. 9			....	110.08		3O124
Wed. 10			....	122.27	9 11	31O24
Thu. 11			Perseid Meteors	134.47		2O134
Fri. 12			☿ at ☊	146.66		42O3*
Sat. 13	22		Vesta stationary in R.A.	158.87	5 59	41O23
Sun. 14	0		☌ ⛢ ☉	171.08		42O31
	0	37	☾ Last Quarter			
	15		☍ Ceres ☉. See p. 57.			
Mon. 15	9		☌ ♂ ☾ ♂ 4° N.	183.30		4321O
Tue. 16			☿ at Perihelion	195.52	2 48	43O21
Wed. 17	20		☾ at Apogee. Dist. from ⊕, 252,000 mi.	207.74		431O2
Thu. 18			....	219.97	23 36	42O13
Fri. 19			....	232.21		421O3
Sat. 20	13		♃ Stationary in R.A.	244.45		d4O23
Sun. 21			....	256.69	20 25	dO134
Mon. 22	4	16	🌑 New Moon	268.93		231O4
Tue. 23	17		☌ ♀ ☾ ♀ 1° N.	281.18		3O214
Wed. 24			....	293.42	17 14	31O24
Thu. 25			....	305.66		2O314
Fri. 26			....	317.89		21O34
Sat. 27			☿ Greatest Helio. Lat. N.	330.12	14 02	O1234
	9		☌ ♆ ☾ ♆ 2° S.			
Sun. 28			....	342.35		O243*
Mon. 29	1		☌ ♇ ☉	354.57		2341O
	14	23	☽ First Quarter			
Tue. 30	19		☌ ☿ ☉ Superior	6.77	10 51	34O1*
	20		☌ ♃ ☾ ♃ 5° S.			
Wed. 31			....	18.98		431O2

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR SEPTEMBER, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During September the sun's R.A. increases from 10h 41m to 12h 29m and its Decl. changes from 8° 22′ N. to 3° 06′ S. The equation of time changes from −0m 05s to +10m 13s, being zero during the first day of the month. On the 22nd at 20h 00m E.S.T. the sun crosses the equator moving southward, enters the sign of Libra, and autumn commences. There is a partial eclipse of the sun on the 20th. 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. There is a total eclipse of the moon during the night of the 4th–5th. Times of moonrise and moonset are given on p. 24.

Mercury on the 15th is in R.A. 12h 18m, Decl. 1° 21′ S., and transits at 12h 43m. It is too close to the sun for observation.

Venus on the 15th is in R.A. 12h 56m, Decl. 5° 12′ S., mag. −3.3, and transits at 13h 21m. It is an evening star which may be seen very low in the west just after sunset. On the evening of the 20th it passes 3 degrees north of Spica.

Mars on the 15th is in R.A. 5h 46m, Decl. 23° 10′ N., mag. +0.5, and transits at 6h 09m. Moving from Taurus to Gemini and becoming rapidly brighter, it rises before midnight and is nearly to the meridian at sunrise.

Jupiter on the 15th is in R.A. 17h 37m, Decl. 23° 14′ S., mag. −1.8, and transits at 17h 58m. In Ophinchus, it is west of 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 51m, Decl. 22° 39′ S., mag. +0.6, and transits at 19h 12m. In Sagittarius, east of Jupiter, it is nearly to the meridian at sunset and sets before midnight. On the 15th it is stationary and resumes direct, or eastward, motion among the stars.

Uranus on the 15th is in R.A. 9h 44m, Decl. 14° 23′ N., and transits at 10h 05m. It rises about two hours before the sun.

Neptune on the 15th is in R.A. 14h 22m, Decl. 12° 18′ S., and transits at 14h 43m. It is low in the south-west at sunset.

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

	SEPTEMBER E.S.T.			Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 19h 45m
d	h	m		°	h m	
Thu. 1	3		☌♄☾ ♄ 4° S.	31.17		4201*
Fri. 2	16		☾ at Perigee. Dist. from ⊕, 226,400 mi.	43.36	7 39	42103
Sat. 3				55.55		40123
Sun. 4				67.72		41023
Mon. 5	6	19	🌕 Full Moon. Eclipse, see p. 59.	79.90	4 28	d2430
Tue. 6				92.07		3041*
Wed. 7				104.25		31024
Thu. 8				116.42	1 16	23014
Fri. 9				128.60		21034
Sat. 10				140.79	22 05	01234
Sun. 11				152.98		10234
Mon. 12			Perseid meteors	165.17		d2304
	17	20	☾ Last Quarter			
Tue. 13	5		☌♂☾ ♂ 5° N.	177.37	18 54	3204*
Wed. 14	13		☾ at Apogee. Dist from ⊕, 251,400 mi.	189.58		31042
Thu. 15	15		♄ Stationary in R.A.	201.79		43201
Fri. 16				214.01	15 42	42103
Sat. 17	6		□♃☉ East	226.23		40213
Sun. 18	2		☌♅☾ ♅ 3° N.	238.45		41023
Mon. 19			☿ at ☋	250.68	12 31	d4201
Tue. 20	18	13	🌑 New Moon. Eclipse, see p. 59.	262.91		4320*
Wed. 21				275.14		43102
Thu. 22	1		☌☿☾ ☿ 3° S.	287.37	9 19	d3401
	17		☌♀☾ ♀ 3° S.			
	20	00	☉ in ♎. Autumn commences			
Fri. 23	16		☌♆☾ ♆ 3° S.	299.59		21043
Sat. 24	19		□♂☉ West	311.82		02143
Sun. 25			♂ at ☊	324.03	6 08	10234
Mon. 26				336.25		20314
Tue. 27	5		☌♃☾ ♃ 5° S.	348.45		32104
	20	13	☽ First Quarter			
Wed. 28	9		☌♄☾ ♄ 4° S.	0.65	2 57	d3024
Thu. 29			☿ at Aphelion	12.84		30124
	17		☾ at Perigee. Dist. from ⊕, 229,400 mi.			
Fri. 30				25.02	23 45	21034

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR OCTOBER, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During October the sun's R.A. increases from 12h 29m to 14h 25m and its Decl. changes from 3° 06′ S. to 14° 22′ S. The equation of time changes from +10m 13s to +16m 22s. 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. On Oct. 9th Aldebaran will be occulted by the moon. See p. 61. Times of moonrise and moonset are given on p. 24.

Mercury on the 15th is in R.A. 14h 52m, Decl. 19° 26′ S., and transits at 13h 18m. On the 15th it is at greatest eastern elongation, and so for a few evenings at this time it may be seen very low in the south-west just after sunset. However, this is an unfavourable elongation.

Venus on the 15th is in R.A. 15h 17m, Decl. 18° 46′ S., mag. −3.4, and transits at 13h 44m. It is an evening star which may be seen low in the south-west for about an hour after sunset.

Mars on the 15th is in R.A. 6h 47m, Decl. 23° 33′ N., mag. +0.1, and transits at 5h 12m. In Gemini, it rises in the late evening and is prominently seen all the rest of the night.

Jupiter on the 15th is in R.A. 17h 52m, Decl. 23° 24′ S., mag. −1.6 and transits at 16h 15m. In Sagittarius, it is well past the meridian 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 54m, Decl. 22° 38′ S., mag. +0.7, and transits at 17h 17m. In Sagittarius, east of Jupiter, it is about on the meridian at sunset and sets before midnight.

Uranus on the 15th is in R.A. 9h 49m, Decl. 13° 55′ N. and transits at 8h 13m. It rises about one hour after midnight.

Neptune on the 15th is in R.A. 14h 26m, Decl. 12° 38′ S. and transits at 12h 49m. It is too close to the sun for observation.

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

	d	h	m	OCTOBER E.S.T.	Sun's Selen. Colong. °	Min. of Algol d m	Config. of Jupiter's Sat. 18h 30m
Sat.	1			....	37.20		O413*
Sun.	2			♀ at ☋	49.37		41O23
Mon.	3	22		☌♀♆ ♀ 1.9° S............	61.54	20 34	42O31
Tue.	4	17	17	🌕 Full Moon. Harvest Moon.......	73.70		4321O
Wed.	5	0		□♄☉ East	85.85		43O12
Thu.	6			....	98.01	17 23	43O2*
Fri.	7			....	110.17		421O3
Sat.	8	1		Ceres stationary in R.A.................	122.34		42O13
		17		☌☿♆ ☿ 4.3° S...........			
Sun.	9			....	134.51	14 11	14O23
Mon.	10			....	146.67		2O413
Tue.	11	17		☌♂☾ ♂ 5° N.............	158.85		231O4
Wed.	12	8		☾ at Apogee. Dist. from ⊕, 251,200 mi.	171.03	11 00	3O124
		12	26	☾ Last Quarter................			
Thu.	13			....	183.22		31O24
Fri.	14			....	195.41		d23O4
Sat.	15	13		☌♅☾ ♅ 3° N.............	207.60	7 49	2O134
		17		☿ Greatest elongation E., 25°......			
Sun.	16			....	219.81		1O234
Mon.	17			....	232.01		dO143
Tue.	18			....	244.22	4 37	2134O
Wed.	19			....	256.43		34O21
Thu.	20			Orionid meteors.....................	268.64		431O2
				☿ Greatest Helio. Lat. S..........			
		7	03	🌑 New Moon..................			
Fri.	21	23		☌☿☾ ☿ 8° S..............	280.86	1 26	d423O
Sat.	22	16		☌♀☾ ♀ 6° S..............	293.07		42O3*
Sun.	23			....	305.28	22 15	41O23
Mon.	24	15		☾ at Perigee. Dist. from ⊕, 229,000 mi.	317.48		4O213
		17		☌♃☾ ♃ 5° S..............			
Tue.	25	16		☌♄☾ ♄ 4° S...............	329.68		4213O
Wed.	26			....	341.87	19 04	34O1*
Thu.	27	2	34	☽ First Quarter.................	354.06		31O42
		14		☿ Stationary in R.A.............			
Fri.	28			....	6.24		32O14
Sat.	29			....	18.41	15 52	2O34*
Sun.	30			....	30.57		1O234
Mon.	31			....	42.72		O1234

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR NOVEMBER, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During November the sun's R.A. increases from 14h 25m to 16h 28m and its Decl. changes from 14° 22′ S. to 21° 46′ S. The equation of time changes from +16m 22s to a maximum of +16m 24s on the 3rd and then to +11m 04s 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. 14h 26m, Decl. 12° 28′ S., and transits at 10h 47m. It is in inferior conjunction on the 7th on which day it transits the sun (see p. 59), but by the 24th it is at greatest western elongation and so, for a few mornings at this time, it may be seen low in the south-east just before sunrise.

Venus on the 15th is in R.A. 17h 58m, Decl. 25° 20′ S., mag. −3.5, and transits at 14h 23m. It is an evening star which may be seen low in the south-west for about two hours after sunset. On the evening of the 18th Venus and Jupiter are close together, and on the evening of the 27th Venus and Saturn.

Mars on the 15th is in R.A. 7h 21m, Decl. 23° 53′ N., mag. −0.5, and transits at 3h 43m. In Gemini, it now rises in the late evening and is prominently seen all night. On the 21st it is stationary and begins to retrograde, or move westward among the stars.

Jupiter on the 15th is in R.A. 18h 16m, Decl. 23° 24′ S., mag. −1.5, and transits at 14h 37m. In Sagittarius, it is well down in the south-west at sunset and sets about two hours later. See Venus. 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. 19h 03m, Decl. 22° 28′ S., mag. +0.8, and transits at 15h 24m. In Sagittarius, east of Jupiter, it is west of the meridian at sunset and sets about three hours later. See Venus.

Uranus on the 15th is in R.A. 9h 53m, Decl. 13° 38′ N. and transits at 6h 15m. It rises about one hour before midnight.

Neptune on the 15th is in R.A. 14h 30m, Decl. 13° 00′ S. and transits at 10h 51m. It is too close to the sun for observation.

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

			NOVEMBER E.S.T.	Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 17h 30m
d	h	m		°	h m	
Tue. 1	2		☌♆☉	54.87	12 41	21O34
Wed. 2				67.02		3O14*
Thu. 3	6	58	🌕 Full Moon. Hunter's Moon	79.17		31O42
Fri. 4			♃ at ☋	91.31	9 30	324O1
Sat. 5			Taurid meteors	103.46		421O3
Sun. 6			♀ at Aphelion	115.60		d4O23
Mon. 7	12		☌☿☉ Inferior. Transit over ☉, see p.59.	127.75	6 19	4O123
Tue. 8			☿ at ☊	139.90		421O3
	19		☌♂☾ ♂ 6° N.			
Wed. 9	4		☾ at Apogee. Dist. from ⊕, 251,500 mi.	152.06		432O1
Thu. 10				164.22	3 08	431O2
Fri. 11	8	48	☾ Last Quarter	176.38		432O1
	23		☌♅☾ ♅ 2° N.			
Sat. 12			☿ at Perihelion	188.55	23 57	214O*
	20		☌☿☾ ☿ 0.2° S.			
Sun. 13				200.73		O1243
Mon. 14				212.91		O234*
Tue. 15				225.10	20 46	21O34
Wed. 16			Leonid meteors	237.29		32O14
	9		☿ Stationary in R.A.			
Thu. 17	11		☌☿☾ ☿ 2° S.	249.49		31O24
	13		☌♆☾ ♆ 3° S.			
	19		□♅☉ West			
Fri. 18	18	47	🌑 New Moon	261.69	17 34	d3O14
	21		☌♀♃ ♀ 2.0° S.			
Sat. 19				273.89		21O4*
Sun. 20	14		☌☿♆ ☿ 0.8° N.	286.09		O2143
	23		☾ at Perigee. Dist. from ⊕, 225,700 mi.			
Mon. 21	0		♂ Stationary in R.A.	298.28	14 23	41O23
	10		☌♃☾ ♃ 5° S.			
	14		☌♀☾ ♀ 7° S.			
Tue. 22	3		☌♄☾ ♄ 4° S.	310.48		d42O3
	13		□♅☉ West			
Wed. 23			☿ Greatest Helio. Lat. N.	322.66		423O1
Thu. 24	3		☿ Greatest elongation W., 20°	334.84	11 12	431O2
Fri. 25	10	42	☽ First Quarter	347.02		43O21
Sat. 26				359.18		4213O
Sun. 27				11.34	8 01	4O13*
Mon. 28			☿ Greatest Helio. Lat. S.	23.50		41O23
	2		☌♄♀ ♀ 2.4° S.			
Tue. 29				35.64		d2O3*
Wed. 30				47.78	4 50	23O4*

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56

THE SKY FOR DECEMBER, 1960

Positions of the sun and planets are given at 0h U.T.

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. Estimates of altitude are for an observer in latitude 45° N.

The Sun—During December the sun's R. A. increases from 16h 28m to 18h 45m and its Decl. changes from 21° 46′ S. to 23° 02′ S. The equation of time changes from +11m 04s to −3m 22s, being zero on the 25th. The solstice is on the 21st at 15h 27m 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. Aldebaran will be occulted by the moon on Dec. 2 and again on Dec 29th–30th. See p. 61. Times of moonrise and moonset are given on p. 25.

Mercury on the 15th is in R.A. 16h 38m, Decl. 21° 55′ S., and transits at 11h 05m. It is too close to the sun for observation.

Venus on the 15th is in R.A. 20h 34m, Decl. 21° 01′ S., mag. −3.7, and transits at 15h 00m. It is an evening star which may be seen in the south-west for about three hours after sunset.

Mars on the 15th is in R.A. 7h 05m, Decl. 25° 47′ N., mag. −1.2, and transits at 1h 29m. In Gemini, Mars is now spectacularly bright. Being in opposition on the 30th, it is now well up in the east at sunset, transits the meridian about midnight and has not yet set at sunrise. It is closest to the earth on the 25th.

Jupiter on the 15th is in R.A. 18h 44m, Decl. 23° 07′ S., and transits at 13h 07m. In Sagittarius, it may barely be glimpsed very low in the south-west just after sunset. 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. 19h 16m, Decl. 22° 09′ S., and transits at 13h 39m. In Sagittarius, not far east of Jupiter, it may be seen briefly low in the south-west just after sunset.

Uranus on the 15th is in R.A. 9h 53m, Decl. 13° 39′ N. and transits at 4h 17m. It rises over two hours before midnight.

Neptune on the 15th is in R.A. 14h 34m, Decl. 13° 18′ S. and transits at 8h 57m. It is a morning star, rising a few hours before the sun.

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

DECEMBER E.S.T.					Sun's Selen. Colong.	Min. of Algol	Config. of Jupiter's Sat. 17h 00m
	d	h	m		°	h m	
Thu.	1	6		♅ Stationary in R.A.	59.92		31O24
Fri.	2	23	25	🌕 Full Moon	72.06		3O214
Sat.	3			. . . .	84.19	1 39	213O4
Sun.	4			. . . .	96.32		2O134
Mon.	5			. . . .	108.45	22 28	1O234
Tue.	6	1		☌ ♂ ☾ ♂ 7° N.	120.59		2O134
		22		☾ at Apogee. Dist. from ⊕, 252,100 mi.			
Wed.	7			. . . .	132.72		d2O4*
Thu.	8			. . . .	144.87	19 17	341O2
Fri.	9	7		☌ ♅ ☾ ♅ 2° N.	157.01		34O12
Sat.	10			. . . .	169.16		
Sun.	11	4	39	☾ Last Quarter	181.32	16 06	
Mon.	12			. . . .	193.48		
Tue.	13			Geminid meteors	205.65		
Wed.	14			. . . .	217.82	12 56	
Thu.	15	1		☌ ♆ ☾ ♆ 3° S.	230.00		
		22		♇ Stationary in R.A.			
Fri.	16			☿ at ☋	242.19		
Sat.	17			. . . .	254.38	9 45	
Sun.	18	5	47	● New Moon	266.57		
Mon.	19	6		☾ at Perigee. Dist. from ⊕, 222,800 mi.	278.76		
		17		☌ ♄ ☾ ♄ 4° S.			
Tue.	20			. . . .	290.95	6 34	
Wed.	21	10		☌ ♀ ☾ ♀ 4° S.	303.14		
		15	27	☉ enters ♑. Winter commences. . . .			
Thu.	22			Ursid meteors	315.32		
Fri.	23			. . . .	327.50	3 23	
Sat.	24	21	30	☽ First Quarter	339.67		
Sun.	25	1		♂ nearest ⊕. Dist. from ⊕, 56,370,000 mi.	351.83		
Mon.	26			☿ at Aphelion.	3.99	0 12	
Tue.	27			. . . .	16.13		
Wed.	28			. . . .	28.28	21 01	
Thu.	29			. . . .	40.42		
Fri.	30	5		☍ ♂ ☉ Dist. from ⊕, 56,640,000 mi.	52.55		
Sat.	31			. . . .	64.68	17 50	

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56
Jupiter being near the sun, configurations of the satellites are not given after Dec. 9

During 1960 the ascending node of the moon's orbit occurs near the position of the autumnal equinox (☊ from 179° to 159°). Thus the range in declination of the moon is close to its minimum value. Every month the moon will pass within a fraction of a degree of Aldebaran.

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 ½° 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 U.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 +1½° and −1½° during the year.

OPPOSITION EPHEMERIDES OF THE BRIGHTEST ASTEROIDS, 1960

The asteroids are many small objects revolving around the sun mainly between the orbits of Mars and Jupiter. The largest, Ceres, is only 480 miles in diameter. Vesta, though smaller than Ceres, is considerably brighter. The next brightest asteroids, Pallas and Juno, are in the 9th magnitude at maximum brightness.

Ephemerides for the two brightest asteroids, Vesta and Ceres, are given when the asteroids are near opposition. Right ascensions and declinations are for 0h G.C.T. and the equinox of 1950.0.

Vesta (No. 4) Opp. July 2 in Sgr			Mag. 6.0
June 12	19^h	04.3^m	−20°25′
17	19	00.5	−20 51
22	18	56.1	−21 18
27	18	51.2	−21 46
July 2	18	46.2	−22 14
7	18	41.1	−22 42
12	18	36.2	−23 09
17	18	31.6	−23 34
22	18	27.6	−23 58

Ceres (No. 1) Opp. Aug. 14 in PsA			Mag. 7.9
July 25	22^h	13.1^m	−25°09′
30	22	09.9	−25 45
Aug. 4	22	06.2	−26 20
9	22	02.2	−26 53
14	21	58.0	−27 25
19	21	53.6	−27 53
24	21	49.2	−28 17
29	21	45.0	−28 36
Sept. 3	21	40.9	−28 52

JANUARY

d	h	m	Sat.	Phen.
16	6	33	I	Se
23	6	16	I	SI

FEBRUARY

d	h	m	Sat.	Phen.
8	5	29	I	TI
10	5	21	II	ED
12	5	03	II	Te
19	5	14	II	TI
	5	31	II	Se
23	5	36	I	ED
24	4	57	I	Se
25	5	40	III	Se
26	5	37	II	SI
28	4	40	II	OR

MARCH

d	h	m	Sat.	Phen.
2	4	39	I	SI
3	5	24	I	OR
7	4	42	III	OR
10	3	52	I	ED
11	4	26	I	Te
13	4	53	II	ED
14	3	35	III	ER
15	5	08	II	Te
18	4	09	I	TI
	5	05	I	Se
19	3	43	I	OR
21	4	47	III	ED
25	4	47	I	SI
27	2	43	I	Te
31	4	28	II	OR

APRIL

d	h	m	Sat.	Phen.
1	3	51	III	TI
2	4	00	I	ED
3	2	23	I	TI
	3	20	I	Se
	4	35	I	Te
8	2	43	III	SI
9	2	04	II	Te
10	3	02	I	SI
	4	15	I	TI
11	3	48	I	OR
16	1	58	II	TI
	2	10	II	Se
18	2	15	I	ED
19	1	21	III	OD
	1	35	I	Se
	2	45	I	Te
23	2	12	II	SI
25	1	12	II	OR
26	1	17	I	SI
	2	22	I	TI
	3	27	III	ER
	3	29	I	Se
27	1	54	I	OR

MAY

d	h	m	Sat.	Phen.
2	3	36	II	OR
3	3	10	I	SI
4	0	30	I	ED
	3	41	I	OR
5	0	49	I	Te
7	1	15	III	Te
9	1	32	II	ED
11	0	53	II	Te
	2	23	I	ED
12	0	24	I	TI
	1	45	I	Se
	2	37	I	Te
	23	54	I	OR
14	1	25	III	Se
	1	51	III	TI
18	0	37	II	TI
	1	43	II	Se
	3	12	II	Te
19	1	26	I	SI
	2	10	I	TI
20	1	40	I	OR
21	2	30	III	SI
25	1	43	II	SI
	2	54	II	TI
26	3	20	I	SI
	23	48	II	OR
27	0	38	I	ED
28	0	02	I	Se
	0	34	I	Te

JUNE

d	h	m	Sat.	Phen.
1	1	12	III	OR
2	22	38	II	ED
3	2	05	II	OR
	2	32	I	ED
	23	43	I	SI
4	0	06	I	TI
	1	56	I	Se
	2	19	I	Te
	23	35	I	OR
8	0	25	III	ED
10	1	14	II	ED
11	1	37	I	SI
	1	50	I	TI
	22	43	II	Se
	22	54	I	ED
	23	05	II	Te
12	1	18	I	OR
	22	19	I	Se
	22	29	I	Te
18	21	22	III	Se
	21	27	III	Te
	22	41	II	SI
	22	44	II	TI
19	0	48	I	ED
	1	17	II	Se
	1	19	II	Te
	3	02	I	OR
	22	00	I	TI
	22	00	I	SI
20	0	13	I	Te
	0	14	I	Se
	21	29	I	ER
25	21	50	III	TI
	22	24	III	SI
26	0	43	III	Te
	0	58	II	TI
	1	15	II	SI
	1	22	III	Se
	2	33	I	OD
	23	44	I	TI
	23	55	I	SI
27	1	58	I	Te
	2	08	I	Se
	20	59	I	OD
	22	26	II	ER
	23	24	I	ER

JULY

d	h	m	Sat.	Phen.
3	1	07	III	TI
4	1	29	I	TI
	1	49	I	SI
	21	40	II	OD
	22	43	I	OD
5	1	03	II	ER
	1	18	I	ER
	22	08	I	Te
	22	32	I	Se
11	23	57	II	OD
12	0	27	I	OD
	21	40	I	TI
	22	13	I	SI
	23	54	I	Te
13	0	27	I	Se
	21	09	II	Te
	21	41	I	ER
	22	17	II	Se
	23	19	III	ER
19	23	26	I	TI
20	0	08	I	SI
	20	39	I	OD
	20	52	II	TI
	21	25	III	OD
	22	15	II	SI
	23	26	II	Te
	23	35	I	ER
21	0	52	II	Se
	20	51	I	Se
27	22	26	I	OD
	23	10	II	TI
28	20	32	I	SI
	21	53	I	Te
	22	46	I	Se
29	22	15	II	ER
31	21	22	III	Se

AUGUST

d	h	m	Sat.	Phen.
4	21	29	I	TI
	22	27	I	SI
	23	42	I	Te
5	21	53	I	ER
7	21	12	III	Te
	22	21	III	SI
11	23	18	I	TI
12	20	29	I	OD
12	22	37	II	OD
13	21	05	I	Se
14	21	53	III	TI
	21	54	II	Se
19	22	19	I	OD
20	20	47	I	SI
	21	50	I	Te
21	20	11	I	ER
	21	51	II	SI
	22	07	II	Te
25	20	14	III	ED
27	21	29	I	TI
28	22	01	II	TI
	22	06	I	ER
30	22	06	II	ER

SEPTEMBER

d	h	m	Sat.	Phen.
1	22	09	III	OR
4	20	31	I	OD
5	20	03	I	Te
	21	20	I	Se
12	19	44	I	TI
	21	02	I	SI
13	20	25	I	ER
19	20	08	III	Te
21	19	40	I	Se
24	19	18	II	ER
27	20	44	I	OD
28	19	22	I	SI
	20	19	I	Te
30	19	23	III	ER

OCTOBER

d	h	m	Sat.	Phen.
5		03	I	TI
8	19	21	II	OD
10	18	41	II	Se
13	19	08	I	OD
14	18	44	I	Te
	19	25	III	OD
17	18	57	II	Te
21	18	29	I	TI
22	18	59	I	ER
25	18	20	III	SI
30	18	14	I	Se

NOVEMBER

d	h	m	Sat.	Phen.
1	18	17	III	TI
4	18	14	IV	SI
6	17	55	I	SI

Jupiter being near the sun, phenomena of the satellites are not given after Dec. 9.

E—eclipse, O—occultation, T—transit, S—shadow, D—disappearance, R—reappearance, I—ingress, e—egress; E.S.T. (For other times see p. 10.)
The phenomena are given for latitude 45° N., for Jupiter one hour above the horizon, and the sun one hour below the horizon.

EMPHEMERIS FOR THE PHYSICAL OBSERVATION OF THE SUN, 1960

For 0h U.T.

Date	P	B_0	L_0	Date	P	B_0	L_0
	°	°	°		°	°	°
Jan. 1	+ 2.49	−2.99	242.36	July 4	− 1.32	+3.26	320.66
6	+ 0.06	−3.56	176.51	9	+ 0.95	+3.79	254.49
11	− 2.36	−4.11	110.66	14	+ 3.20	+4.29	188.32
16	− 4.74	−4.62	44.82	19	+ 5.40	+4.76	122.16
21	− 7.05	−5.10	338.99	24	+ 7.56	+5.20	56.01
26	− 9.29	−5.53	273.15	29	+ 9.64	+5.60	349.87
31	−11.43	−5.93	207.32	Aug. 3	+11.65	+5.97	283.74
Feb. 5	−13.46	−6.27	141.49	8	+13.56	+6.29	217.62
10	−15.37	−6.57	75.66	13	+15.36	+6.57	151.52
15	−17.15	−6.82	9.82	18	+17.05	+6.80	85.43
20	−18.78	−7.01	303.98	23	+18.63	+6.99	19.35
25	−20.28	−7.14	238.13	28	+20.07	+7.13	313.29
Mar. 1	−21.62	−7.22	172.27	Sept. 2	+21.38	+7.21	247.24
6	−22.80	−7.25	106.40	7	+22.56	+7.25	181.20
11	−23.82	−7.22	40.52	12	+23.58	+7.23	115.18
16	−24.67	−7.14	334.62	17	+24.46	+7.16	49.17
21	−25.35	−7.00	268.70	22	+25.17	+7.04	343.17
26	−25.86	−6.80	202.77	27	+25.73	+6.87	277.18
31	−26.19	−6.56	136.82	Oct. 2	+26.11	+6.64	211.20
Apr. 5	−26.35	−6.27	70.85	7	+26.32	+6.37	145.23
10	−26.32	−5.94	4.86	12	+26.35	+6.04	79.26
15	−26.11	−5.56	298.84	17	+26.19	+5.68	13.31
20	−25.71	−5.14	232.81	22	+25.84	+5.26	307.37
25	−25.13	−4.69	166.76	27	+25.30	+4.81	241.43
30	−24.37	−4.21	100.69	Nov. 1	+24.56	+4.32	175.49
May 5	−23.43	−3.69	34.60	6	+23.62	+3.79	109.56
10	−22.31	−3.16	328.49	11	+22.49	+3.24	43.64
15	−21.02	−2.60	262.37	16	+21.17	+2.66	337.73
20	−19.56	−2.02	196.23	21	+19.66	+2.06	271.82
25	−17.95	−1.43	130.09	26	+17.97	+1.44	205.92
30	−16.20	−0.83	63.93	Dec. 1	+16.12	+0.81	140.02
June 4	−14.32	−0.23	357.76	6	+14.12	+0.17	74.14
9	−12.33	+0.37	291.58	11	+11.98	−0.47	8.25
14	−10.24	+0.97	225.39	16	+ 9.74	−1.11	302.37
19	− 8.08	+1.57	159.21	21	+ 7.42	−1.74	236.51
24	− 5.85	+2.15	93.03	26	+ 5.03	−2.36	170.65
29	− 3.59	+2.71	26.84	31	+ 2.61	−2.96	104.79

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, 1960

No.	Commences	No.	Commences	No.	Commences
1423	Jan. 19.40	1428	June 3.83	1432	Sept. 20.72
1424	Feb. 15.75	1429	July 1.03	1433	Oct. 18.01
1425	Mar. 14.07	1430	July 28.23	1434	Nov. 14.31
1426	Apr. 10.37	1431	Aug. 24.46	1435	Dec. 11.63
1427	May 7.62				

ECLIPSES, 1960

In 1960 there will be four eclipses, two of the sun and two of the moon.

I. *A Total Eclipse of the Moon* on the night of March 12–13, visible in North and South America.

☾ enters umbra	1h 38m E.S.T.
Totality begins	2h 41m E.S.T.
Totality ends	4h 16m E.S.T.
☾ leaves umbra	5h 18m E.S.T.

II. *A Partial Eclipse of the Sun* on March 27, visible in Australia and Antarctica.

III. *A Total Eclipse of the Moon* on the night of September 4–5, the beginning visible in North America except the extreme north-eastern part, and the end visible on the west coast.

☾ enters umbra	4h 36m E.S.T.
Totality begins	5h 38m E.S.T.
Totality ends	7h 06m E.S.T.
☾ leaves umbra	8h 08m E.S.T.

IV. *A Partial Eclipse of the Sun*, September 20, visible in all of North America except the very eastern strip (where it begins after sunset). Apart from this exception, in the eastern half of the continent the eclipse is still in progress at sunset, in the western half it is completed before sunset.

TRANSIT OF MERCURY

On the morning of November 7th Mercury will transit the sun's disk, the phenomenon being visible in North America, except that the transit will already be in progress at sunrise for observers west of a line through 37° N., 120° W. and 61° N., 100° W.

Over the continent the variations in times of ingress and egress amount to less than 30 seconds, ingress being somewhat earlier in the south, and egress being somewhat earlier in the east. The following times are valid within 10 seconds for the eastern half of the continent:

Exterior ingress	9h 35m 20s E.S.T.
Interior ingress	9h 37m 20s E.S.T.
Interior egress	14h 10m 20s E.S.T.
Exterior egress	14h 12m 20s E.S.T.

The position angle (reckoned from the north limb of the sun toward the east) of ingress is 148°, of egress 262°.

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			″	″
Mars	Jan. 28	22 08	C.D. −23°14758	8.7	5	4
	Apr. 2	19 12	B.D. −12°6218	8.3	9	4
	May 15	22 53	B.D. − 0°35	8.6	3	5
	June 8	22 06	B.D. + 6°216	9.0	6	5
Jupiter	Feb. 9	2 39	C.D. −22°12237	8.4	0	2
	July 1	23 54	C.D. −23°13598	8.4	27	2
	Oct. 6	4 37	C.D. −23°13589	8.3	3	2
	Nov. 4	23 38	C.D. −23°14011	9.0	8	2
	Dec. 6	22 21	C.D. −23°14580	6.8	21	1
	Dec. 10	4 43	C.D. −23°14633	9.0	48	1
Saturn	Apr. 23	20 57	B.D. −21°5359	9.0	14	1
	Apr. 30	20 11	B.D. −21°5359	9.0	1	1
	Sept. 4	0 23	C.D. −22°13397	8.0	17	1

Saturn and its rings will occult the star B.D. −21°5359 (Mag. 9.0) between Apr. 29 and May 1. As Saturn is near its stationary point no accurate form of prediction is possible (the planet's motion is only 1″ an hour). Very approximate times only are given.

	Disappearance E.S.T.	P.	Reappearance E.S.T.	P.
	d h	°	d h	°
Outer edge of rings	Apr. 29 23	258	May 1 13	75
Limb of Saturn	Apr. 30 10	261	May 1 6	71

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 data supplied by the British Nautical Almanac Office and give the times of immersion or emersion or both for occultations visible at Toronto, Montreal, Edmonton and Vancouver. Stars of magnitude 5.3 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.

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1960

Date	Star	Mag.	I or E	Age of Moon	Toronto E.S.T.	Toronto a	Toronto b	Toronto P	Montreal E.S.T.	Montreal a	Montreal b	Montreal P
				d	h m	m	m	°	h m	m	m	°
Jan 10	75 Tau	5.3	I	11.4	0 43.5	−0.7	−4.6	144	0 40.9	−0.7	−3.2	131
Jan. 11	111 Tau	5.1	I	12.5	4 24.4	—	—	166	Low	..	..	..
Jan. 16	ξ Leo	5.1	E	17.5	1 48.1	—	—	352	No occ	..	..	..
Jan. 24	24 Sco	5.0	E	25.6	Low	..	..	..	4 50.6	+0.2	−1.4	343
Feb. 9	26 Gem	5.1	I	11.9	0 01.6	−1.7	−0.8	85	0 09.2	−1.5	−0.6	75
Mar. 4	α Tau	1.1	I	7.2	18 26.3	−2.1	+0.3	79	18 38.3	−1.9	+0.1	74
Mar. 4	α Tau	1.1	E	7.2	19 55.6	−1.8	−0.7	265	20 03.3	−1.5	−1.2	272
Mar. 8	λ Gem	3.6	I	10.5	1 55.7	+0.2	−2.4	138	1 50.5	+0.2	−2.1	128
Mar. 11	48 Leo	5.2	I	14.4	21 56.6	−2.5	+3.2	56	No occ.	..	..	..
Mar. 14	θ Vir	4.4	I	17.4	21 29.8	−0.7	+1.9	76	21 39.2	−1.1	+2.7	63
Mar. 14	θ Vir	4.4	E	17.4	22 21.5	−0.5	−0.8	329	22 21.7	−0.3	−1.6	343
Mar. 25	Merc.	1.1	I	27.7	Low	..	..	..	5 31.9	−0.4	+2.7	22
Mar. 25	Merc.*	1.1	E	27.7	6 08.3	−0.4	+0.8	297	6 13.0	−0.7	+0.7	301
Apr. 14	24 Sco	5.0	E	18.9	Low	..	..	..	23 36.1	−0.6	+0.4	303
Apr. 28	α Tau*	1.1	I	2.8	9 04.9	+0.1	+2.2	48	9 09.1	−0.1	+2.3	50
Apr. 28	α Tau*	1.1	E	2.8	10 02.2	−0.8	+1.0	284	10 09.5	−1.0	+1.1	282
May 9	κ Vir	4.3	I	14.2	20 03.4	−1.5	+2.2	66	20 19.5	—	—	46
July 19	α Tau	1.1	I	25.3	3 54.5	—	—	12	3 58.0	+0.5	+3.9	15
July 19	α Tau*	1.1	E	25.3	4 22.9	—	—	320	4 30.8	−1.6	−0.6	316
Aug. 15	γ Tau	3.9	I	22.6	2 23.9	−0.4	+1.8	70	2 30.2	−0.6	+1.8	71
Aug. 15	γ Tau	3.9	E	22.6	3 33.8	−1.0	+1.6	258	3 43.0	−1.1	+1.6	256
Aug. 15	α Tau*	1.1	I	22.9	13 13.6	—	—	6	No occ.	..	..	..
Aug. 15	α Tau*	1.1	E	22.9	13 22.3	—	—	350	No oc c	..	..	..
Aug. 29	24 Sco	5.0	I	7.7	22 06.5	−0.9	−1.3	95	Low	..	..	..
Oct. 2	φ Aqr	4.4	I	12.2	21 19.7	−2.1	+0.1	108	21 32.1	−2.2	−0.3	111
Oct. 8	71 Tau	4.6	E	18.2	22 41.3	+0.2	+3.1	205	22 46.1	+0.2	+3.3	203
Oct. 8	θ^1 Tau	4.0	I	18.3	23 06.1	−0.5	+1.7	75	23 12.7	−0.7	+1.7	76
Oct. 8	θ^2 Tau	3.6	I	18.3	23 08.0	−0.7	+1.2	96	23 15.0	−0.9	+1.2	98
Oct. 9	θ^2 Tau	3.6	E	18.3	0 12.8	−0.7	+2.3	232	0 21.7	−0.9	+2.4	231
Oct. 9	θ^1 Tau	4.0	E	18.3	0 16.1	−1.0	+1.7	254	0 25.4	−1.1	+1.7	253
Oct. 9	264BTau	4.8	E	18.3	1 33.2	−1.8	+0.7	276	1 45.0	−1.9	+0.5	276
Oct. 9	α Tau	1.1	I	18.4	3 57.9	−1.9	+1.5	55	4 11.1	−1.8	+1.4	50
Oct. 9	α Tau	1.1	E	18.4	5 17.0	−1.8	−1.5	286	5 23.6	−1.5	−2.0	293
Oct. 10	111 Tau	5.1	E	19.4	3 06.5	−1.3	+3.4	215	3 20.8	−1.6	+3.0	218
Oct. 29	λ Aqr	3.8	I	9.5	18 03.4	−1.1	+2.1	38	18 13.8	−1.2	+1.9	39
Nov. 12	A Leo	4.6	E	23.0	5 47.3	−1.3	−2.2	330	5 48.8	−0.9	−3.5	345
Nov. 30	ξ^1 Cet	4.5	I	11.2	0 06.5	−1.3	+0.6	50	0 14.7	−1.1	+0.5	47
Dec. 2	α Tau	1.1	I	14.1	18 31.4	+0.3	+2.5	33	18 34.7	+0.2	+2.6	34
Dec. 2	α Tau	1.1	E	14.1	19 16.7	−0.8	+0.6	298	19 23.3	−1.0	+0.7	296
Dec. 29	γ Tau	3.9	I	11.5	Sun	..	..	..	16 50.3	−0.4	+1.6	83
Dec. 29	75 Tau	5.3	I	11.7	22 22.1	−1.8	+1.6	53	22 35.2	−1.7	+1.4	49
Dec. 29	264BTau	4.8	I	11.7	23 48.0	−1.9	−2.2	116	23 54.4	−1.6	−1.9	109
Dec. 30	α Tau	1.1	I	11.9	3 02.8	−0.6	−0.9	73	3 04.4	−0.5	−0.7	64
Dec. 30	α Tau	1.1	E	11.9	4 04.6	0.0	−1.6	280	4 00.8	+0.2	−1.8	290
Dec. 31	115 Tau	5.3	I	12.9	3 28.9	−1.0	−0.2	54	3 34.4	−0.9	+0.3	42

*Daytime Occultation

Date	Star		I or E	Age of Moon	Edmonton M.S.T.	a	b	P	Vancouver P.S.T.	a	b	P
				d	h m	m	m	°	h m	m	m	°
Jan. 9	75 Tau	5.3	I	11.4	21 26.4	−1.7	−0.3	101	20 09.1	−1.9	−0.1	107
Jan. 10	α Tau	1.1	I	11.6	2 12.8	−0.4	−2.2	113	1 18.8	−0.5	−3.2	133
Jan. 10	α Tau	1.1	E	11.6	3 12.1	−0.4	−0.9	242	2 08.0	−0.9	+0.2	222
Jan. 11	111 Tau	5.1	I	12.5	1 52.5	—	—	162	No occ.	..	..	..
Jan. 23	θ Lib	4.3	I	24.8	Sun	..	..	..	7 03.8	−0.9	−1.1	155
Feb. 8	26 Gem	5.1	I	11.9	21 04.1	−1.5	+1.5	65	19 43.4	−1.4	+1.5	76
Feb. 17	82 Vir	5.2	E	20.2	5 48.2	−1.6	−0.4	254	4 27.8	—	—	233
Mar. 4	α Tau*	1.1	I	7.2	15 59.6	−0.4	+4.0	20	14 41.4	−0.1	+3.7	22
Mar. 4	α Tau*	1.1	E	7.2	16 42.1	−2.1	−1.6	315	15 26.1	−2.0	−0.7	311
Mar. 7	λ Gem	3.6	I	10.5	23 21.6	−0.6	−3.0	145	Graze	..	..	..
Mar. 11	48 Leo	5.2	I	14.4	No occ.	..	..	..	18 23.4	−0.2	+4.1	44
Mar. 15	k Vir	4.3	E	18.6	No occ.	..	..	..	23 26.0	−0.3	−0.8	336
Mar. 31	θ^1 Tau	4.0	I	4.9	22 06.3	0.0	−2.0	110	21 16.0	0.0	−2.7	129
Mar. 31	θ^2 Tau	3.6	I	4.9	22 16.6	+0.3	−2.9	136	No occ.	..	..	..
Mar. 31	75 Tau	5.3	I	4.9	No occ.	..	..	..	21 27.2	—	—	17
Mar. 31	264BTau	4.8	I	4.9	Low	..	..	..	22 09.2	0.0	−1.1	77
Apr. 30	26 Gem	5.1	I	5.3	22 31.0	−0.7	+0.2	33	21 26.5	−0.6	−0.7	58
June 1	48 Leo	5.2	I	7.7	23 43.3	−0.4	−1.1	57	22 42.9	−0.6	−1.2	71
July 16	ξ^1 Cet	4.5	I	22.4	Sun	..	..	..	2 41.3	0.0	+3.0	15
July 16	ξ^1 Cet	4.5	E	22.4	Sun	..	..	..	3 22.9	−1.5	+0.5	301
July 30	κ Vir	4.3	I	7.4	21 46.9	−0.8	−1.7	111	20 44.6	−1.0	−1.6	117
Aug. 8	φ Aqr	4.4	I	16.6	23 50.3	−1.0	+1.3	83	22 35.5	−0.8	+1.4	84
Aug. 8/9	φ Aqr	4.4	E	16.6	0 57.3	−1.1	+1.3	234	23 40.7	−1.0	+1.6	235
Aug. 15	γ Tau	3.9	E	22.6	1 23.9	−0.4	+0.7	311	Low	..	..	..
Aug. 15	71 Tau	4.6	E	22.7	Sun	..	..	..	3 36.3	−0.2	+3.2	208
Aug. 15	θ^1 Tau	4.0	I	22.8	Sun	..	..	..	4 03.6	−1.0	+1.8	72
Aug. 15	θ^2 Tau	3.6	I	22.8	Sun	..	..	..	4 05.2	−1.2	+1.2	94
Aug. 15	α Tau*	1.1	I	22.9	No occ.	..	..	..	9 24.1	—	—	25
Aug. 15	α Tau*	1.1	E	22.9	No occ.	..	..	..	10 04.8	—	—	323
Sep. 5	λ Aqr‡	3.8	E	14.0	2 43.0	−0.8	−0.2	236	—	—	—	—
Oct. 2	φ Aqr	4.4	I	12.2	18 50.9	−0.6	+1.7	75	Sun	..	..	..
Oct. 8	θ^1 Tau	4.0	I	18.3	21 28.9	+0.5	+2.4	27	Low	..	..	..
Oct. 8	θ^1 Tau	4.0	E	18.3	22 06.2	−0.4	+0.8	307	Low	..	..	..
Oct. 8	θ^2 Tau	3.6	E	18.3	22 14.5	−0.2	+1.4	280	Low	..	..	..
Oct.9/10	111 Tau	5.1	E	19.4	0 50.8	−0.7	+1.5	271	23 38.5	−0.5	+1.5	270
Nov. 5	γ Tau	3.9	I	15.9	3 03.4	−1.6	−2.8	130	1 59.1	—	—	149
Nov. 5	γ Tau	3.9	E	15.9	3 53.6	−1.3	+1.8	210	2 26.8	—	—	188
Nov. 7	26 Gem	5.1	E	18.7	21 46.5	+0.5	+2.6	219	Low	..	..	..
Nov. 12	A Leo	4.6	E	23.0	No occ.	..	..	..	1 53.2	−0.7	−2.2	346
Nov. 13	59 Leo	5.1	E	24.1	No occ.	..	..	..	4 37.7	—	—	6
Nov. 14	β Vir	3.8	I	25.1	6 11.8	−1.2	+1.3	88	4 56.9	−0.9	+0.9	106
Nov. 14	β Vir	3.8	E	25.1	Sun	..	..	..	6 08.8	−1.1	+0.1	300
Nov. 26	λ Aqr	3.8	I	7.2	23 01.5	−0.2	+0.2	31	21 56.8	−0.5	+0.3	36
Dec. 12	η Vir	4.0	I	23.6	5 52.8	−1.1	−0.2	126	4 45.1	−0.8	−0.9	147
Dec. 12	η Vir	4.0	E	23.6	7 08.2	−1.4	−0.2	285	5 50.6	−1.8	+0.9	264
Dec. 29	θ^1 Tau	4.0	I	11.7	19 30.8	−1.0	+1.3	90	18 15.7	−0.8	+1.5	90
Dec. 29	θ^2 Tau	3.6	I	11.7	19 37.3	−1.4	+0.6	114	18 21.8	−1.1	+0.8	114
Dec. 29	264BTau	4.8	I	11.7	20 47.9	−1.2	+1.5	66	19 29.8	−1.0	+1.8	68
Dec.29/30	α Tau	1.1	I	11.9	0 22.3	−1.3	+0.4	54	23 05.5	−1.7	+0.5	66
Dec. 30	α Tau	1.1	E	11.9	1 29.9	−1.0	−2.1	290	0 25.0	−1.4	−1.3	276
Dec.30/31	115 Tau	5.3	I	12.9	0 47.5	−1.5	+1.8	37	23 25.2	−1.7	+1.4	53

*Daytime Occultation
‡During Lunar Eclipse

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 1960.

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.

Meteor Showers for 1960

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	δ	Daily Motion α	δ		
				°	°	°	°		(days)
Quadrantids	Jan. 4	00^h	F.Q.	232	+50			40	0.6
Lyrids	Apr. 21	18	L.Q.	274	+34	+1.1	0.0	15	2.3
η Aquarids	May 4	18	F.Q.	336	00	+0.9.	+0.4	20	18
δ Aquarids	July 29	01	F.Q.	339	−17	+0.85	+0.17	20	20
Perseids	Aug. 11	21	L.Q.	046	+58	+1.35	+0.12	50	5.0
Orionids	Oct. 20	08	N.M.	095	+15	+1.23	+0.13	25	8
Taurids	Nov. 5	09	F.M.	053	+14	+0.67	+0.13	15	(30)
Leonids	Nov. 16	07	N.M.	152	+22	+0.70	−0.42	15	4
Geminids	Dec. 13	02	L.Q.	113	+32	+1.05	−0.07	50	6.0
Ursids	Dec. 22	07	F.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.

	Right Ascension	Declination	Visual Magnitude	Colour Index	Spectral Classification		Parallax	Absolute Magnitude	Distance light-years	Proper Motion	Radial Velocity		
Star	R.A. 1960	Dec.	V	$B-V$	Type		π	M_V	D	μ	R		
	h m	° ′					″		l.y.	″	km./sec.		
SUN			-26.73	+0.63	G2	V		+4.84					***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	γ Peg = *Algenib*
β Hyi	23.7	−77 29	2.78	+0.62	*G1*	*IV*	0.153	+3.7	21	2.255	+22.8		
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	Dec.	V	$B-V$	Type	π	M_V	D	μ	R	
	h m	° ′				″		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	Dec.	V	$B-V$	Type	π	M_V	D	μ	R	
	h m	° ′				″		l.y.	″	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	Dec.	V	$B-V$	Type	π	M_V	D	μ	R		
	h m	° ′				″		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* 8.66^m 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* 7.5^m 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, 141^d	
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* 9.4^m 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* 9.08v^m 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* 10.7^m 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* 4.31^m 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* 15^m 7″	
δ Vel *AB*	43.6	−54 34	1.95	+0.05	*A0 V*	0.043	+0.2	76	0.086	+02.2	*A* 2.0^m *B* 5.1^m 3″ *CD* 10^m 69″	
ϵ Hya *ABC*	44.7	+06 34	3.39	+0.68	G0 comp.	0.010	+0.6	140	0.198	*+36.4*	*A* 3.7^m *B* 5.2^m 0.2″ 15^y, *C* 6.8^m 3″ *D* 12^m 20″	
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* 10.8^m 7″	

Star	R.A. 1960	Dec.	V	$B-V$	Type	π	M_V	D	μ	R		
	h m	° ′				″		l.y.	″	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	Dec.	V	$B-V$	Type	π	M_V	D	μ	R		
	h m	° ′				″		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	+0.1	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	Dec.	V	$B-V$	Type	π	M_V	D	μ	R		
	h m	° ′				″		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	Dec.	*V*	*B−V*	Type	π	M_V	D	μ	R		
	h m	° ′				″		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* 2.78ᵐ *B* 5.04ᵐ 1″, *C* 4.93ᵐ 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, 0.25ᵈ, *B* 8.49ᵐ 20″	
η Dra *A*	23.4	+61 36	2.71	+0.92	G8 III	0.043	+0.9	76	0.062	−14.3	*B* 8.7ᵐ 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* 0.86ᵐ–1.02ᵐ *B* 5.07ᵐ 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* 2.91ᵐ *B* 5.46ᵐ 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		
μ¹ Sco	49.2	−37 59	2.99v	−0.20	B1.5 V		−3.0	520	0.033	*−25*	Ecl. *R* 2.99–3.09, 1.4ᵈ	
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* 3.0ᵐ *B* 3.4ᵐ 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* 3.2ᵐ ± 0.3 *B* 5.4ᵐ 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* 10ᵐ 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* 11.49ᵐ 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	Dec.	V	$B-V$	Type	π	M_V	D	μ	R		
	h m	° ′				″		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	Dec.	V	$B-V$	Type	π	M_V	D	μ	R	
	h m	° ′				″		l.y.	″	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* 5.97^{m} 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, 0.19^{d}
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* 11^{m} 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, 5.4^{d}, *B* 6.19^{m} 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	.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.
		δ = +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	′	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.

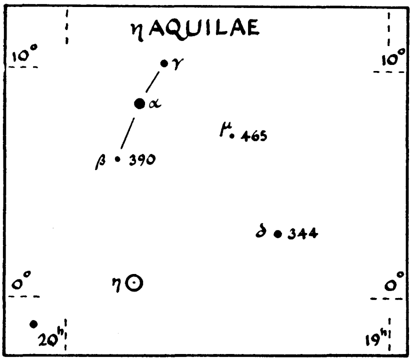
Star	1950 α		δ		Sp.	π	D	μ	R	m	L
	h	m	°	′		″	l.y.	″	km./sec.		
Sun					G0					-26.9	1.0
α Cen A	14	36	−60	38	G0	0.760	4.3	3.68	34	0.3	1.0
B					K5					1.7	0.28
C	14	26	−62	28	M5*e*					11	0.000052
Barnard's *	17	55	+ 4	33	M5	.545	6.0	10.30	141	9.5	0.00040
Wolf 359	10	54	+ 7	20	M6*e*	.421	7.7	4.84	56	13.5	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
o² 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

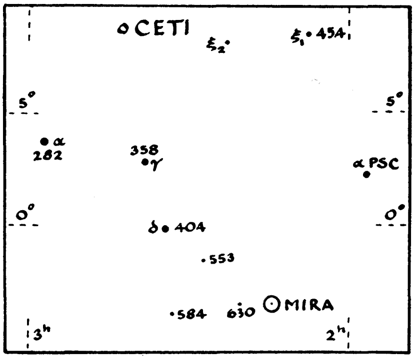
*Star has an unseen component.

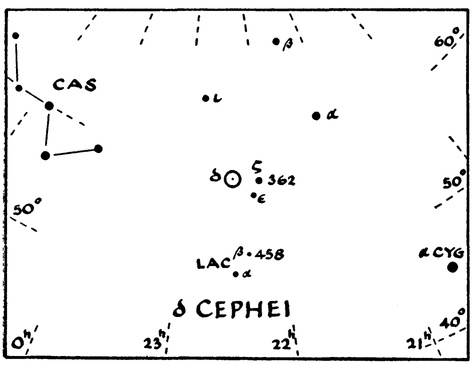
VARIABLE STARS

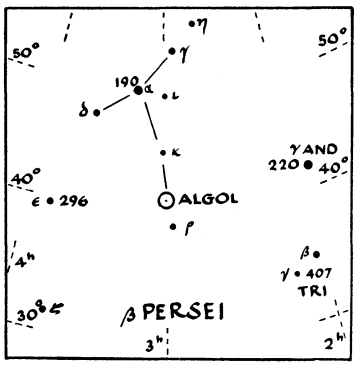
Maps of the fields of four bright variable stars are given below. In each case the magnitudes of several suitable comparison stars are given. Note that the decimal points are omitted: a star 362 is of mag. 3.62. Use two comparison stars, one brighter and one fainter than the variable, and estimate the 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*, 1959, International Supplement.









LONG-PERIOD VARIABLE STARS

Variable		Max. m	Per. d	Epoch 1960
001755	T Cas	7.3	445	Feb. 17
001838	R And	7.0	409	Feb. 8
021143	W And	7.4	397	Oct. 11
0214*03*	*o* Cet	3.4	332	July 20
0228*13*	U Cet	7.5	235	Feb. 5
023133	R Tri	6.2	266	Jan. 9
043065	T Cam	8.0	374	Sept. 1
0455*14*	R Lep	6.8	432	..
050953	R Aur	7.7	459	Oct. 23
054920a	U Ori	6.3	372	May 24
0617*02*	V Mon	7.0	335	Nov. 14
065355	R Lyn	7.9	379	Oct. 13
070122a	R Gem	7.1	370	Mar. 31
070310	R CMi	8.0	338	Jan. 15
072708	S CMi	7.5	332	Sept. 17
081112	R Cnc	6.8	362	Mar. 23
081617	V Cnc	7.9	272	Jan. 13
084803	S Hya	7.8	257	May 28
0850*08*	T Hya	7.8	288	Sept. 25
093934	R LMi	7.1	372	Dec. 31
094211	R Leo	5.8	313	Mar. 29
103769	R UMa	7.5	302	Aug. 13
1214*18*	R Crv	7.5	317	Apr. 23
122001	SS Vir	6.8	355	June 30
123160	T UMa	7.7	257	Jan. 16
123307	R Vir	6.9	146	Jan. 8
123961	S UMa	7.8	226	Jan. 29
131546	V CVn	6.8	192	Apr. 10
1327*06*	S Vir	7.0	378	Aug. 27
134440	R CVn	7.7	328	Mar. 10
142584	R Cam	7.9	270	Sept. 12
142539	V Boo	7.0	258	May 11
143227	R Boo	7.2	223	July 31
151731	S CrB	7.3	361	May 19
154639	V CrB	7.5	358	Feb. 17
154615	R Ser	6.9	357	Mar. 9
160625	RU Her	8.0	484	July 29
162119	U Her	7.5	406	Oct. 4
1621*12*	V Oph	7.5	298	Apr. 27
163266	R Dra	7.6	245	Aug. 10
164715	S Her	7.6	307	June 4
1702*15*	R Oph	7.9	302	Mar. 11
171723	RS Her	7.9	219	Mar. 27
180531	T Her	8.0	165	May 3
181136	W Lyr	7.9	196	Feb. 25
183308	X Oph	6.8	334	July 21
190108	R Aql	6.1	300	July 11
1910*17*	T Sgr	8.0	392	Mar. 3
1910*19*	R Sgr	7.3	269	Aug. 2
193449	R Cyg	7.5	426	..
194048	RT Cyg	7.3	190	Feb. 13
194632	χ Cyg	5.2	407	Oct. 30
200938	RS Cyg	7.2	418	Dec. 27
201647	U Cyg	7.2	465	Aug. 27
2044*05*	T Aqr	7.7	202	June 16
210868	T Cep	6.0	390	Nov. 9
213753	RU Cyg	8.0	234	Mar. 22
230110	R Peg	7.8	378	July 19
230759	V Cas	7.9	228	Jan. 15
231508	S Peg	8.0	319	Feb. 12
2338*15*	R Aqr	6.5	387	Feb. 2
235350	R Cas	7.0	431	Sept. 25
2357*15*	W Cet	7.6	351	Aug. 16

OTHER TYPES OF VARIABLE STARS

Variable		Max. m	Min. m	Type	Sp. Cl.	Period d	Epoch 1960 E.S.T.
005381	U Cep	6.8	9.8	Ecl	B8+gG2	2.49295	Jan. 1.55*
025838	ρ Per	3.2	3.8	SemiR	M4	33–55	
035512	λ Tau	3.5	4.0	Ecl	B3	3.952952	Jan. 1.51*
060822	η Gem	3.1	3.9	SemiR	M3	233.4	May 16*
061907	T Mon	5.8	6.8	δ Cep	F7–K1	27.0205	Jan. 13.22
065820	ζ Gem	3.7	4.1	δ Cep	F7–G3	10.15172	Jan. 10.57
154428	R CrB	5.8	14	R CrB	cG0ep		
171014	α Her	3.0	4.0	SemiR	M5		
1842*05*	R Sct	5.0	8.4	RVTau	G0–M5	144	
184633	β Lyr	3.4	4.3	Ecl	B8p	12.931163	Jan. 2.51*
192242	RR Lyr	7.3	8.1	RR Lyr	A2–F0	0.56683735	Jan. 1.02
194700	η Aql	3.7	4.4	δ Cep	F6–G4	7.176641	Jan. 4.78
222557	δ Cep	3.8	4.6	δ Cep	F5–G2	5.366341	Jan. 5.75

*Minima

REPRESENTATIVE DOUBLE STARS

Star		α 1950	δ	Mag. and Spect.	d	D	Remarks
		h m	° ′		″	L.Y.	
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		χ Per	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		ω Cen	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.

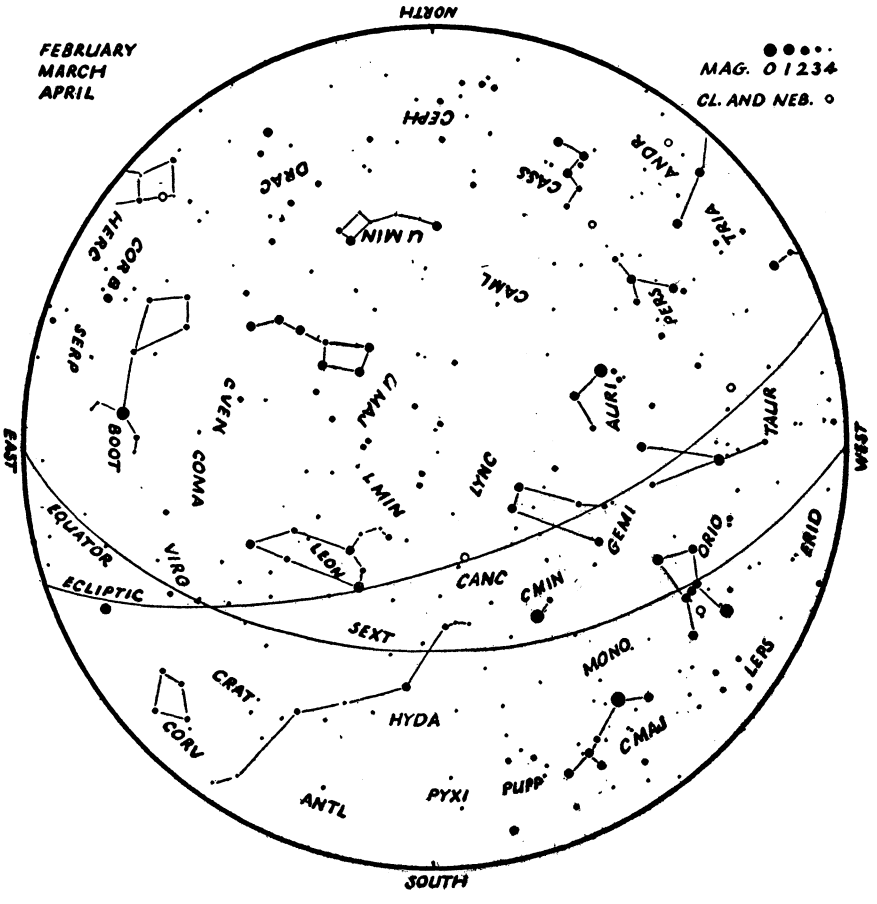
N.G.C.	M	Con	α 1960 h m	δ ° ′	Cl	Size ′	m n	m *	Dist. l.y.	Name
650	76	Per	01 39.7	+51 22	Pl	1.5	11	17	15,000	
1952	1	Tau	05 32.1	+22 00		6	11	16	4,100	Crab
1976	42	Ori	05 33.3	−05 25	Dif	30			1,800	Orion
B33		Ori	05 38.9	−02 29	Drk	4			300	Horsehead
2261		Mon	06 37.0	+08 46	Dif	2				Hubble's var.
2392		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

STAR MAP I

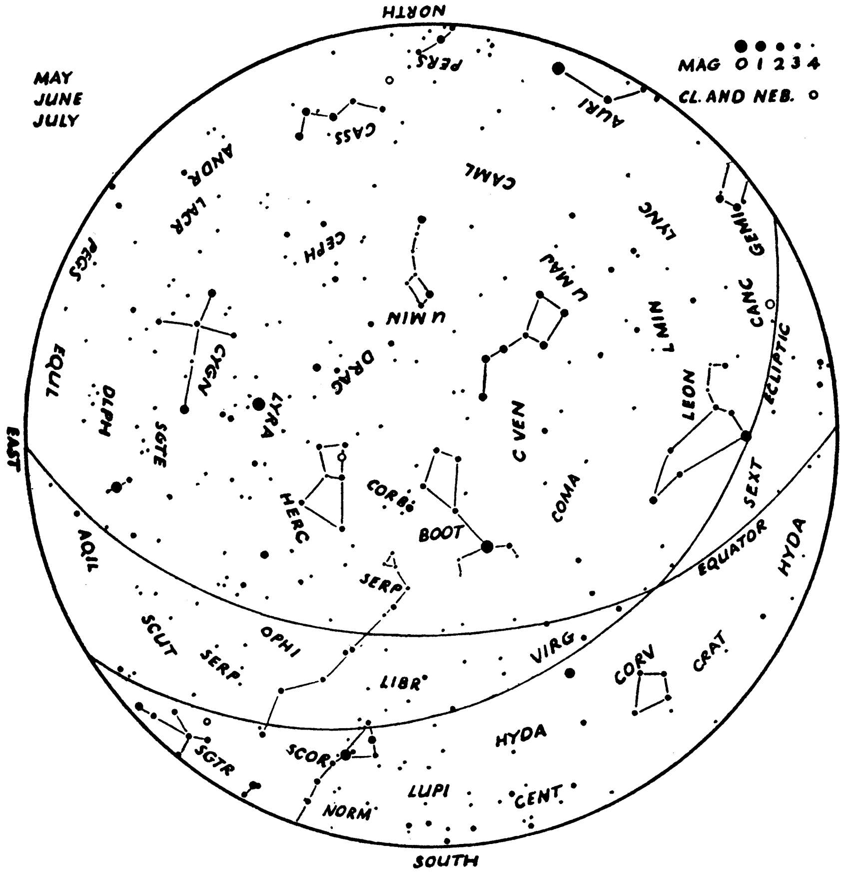


The above map represents the evening sky at

Midnight	.... Feb.	6
11 p.m.	.... "	21
10 "	.... Mar.	7
9 "	.... "	22
8 "	.... Apr.	6
7 "	.... "	21

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

STAR MAP 2

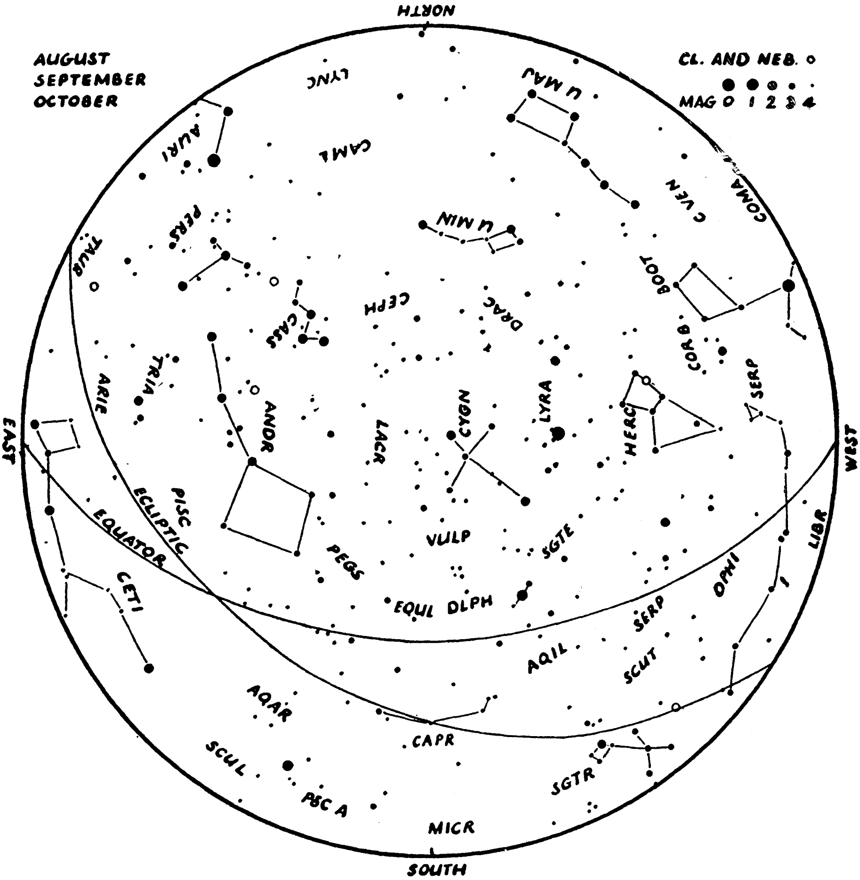


The above map represents the evening sky at

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

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

STAR MAP 3

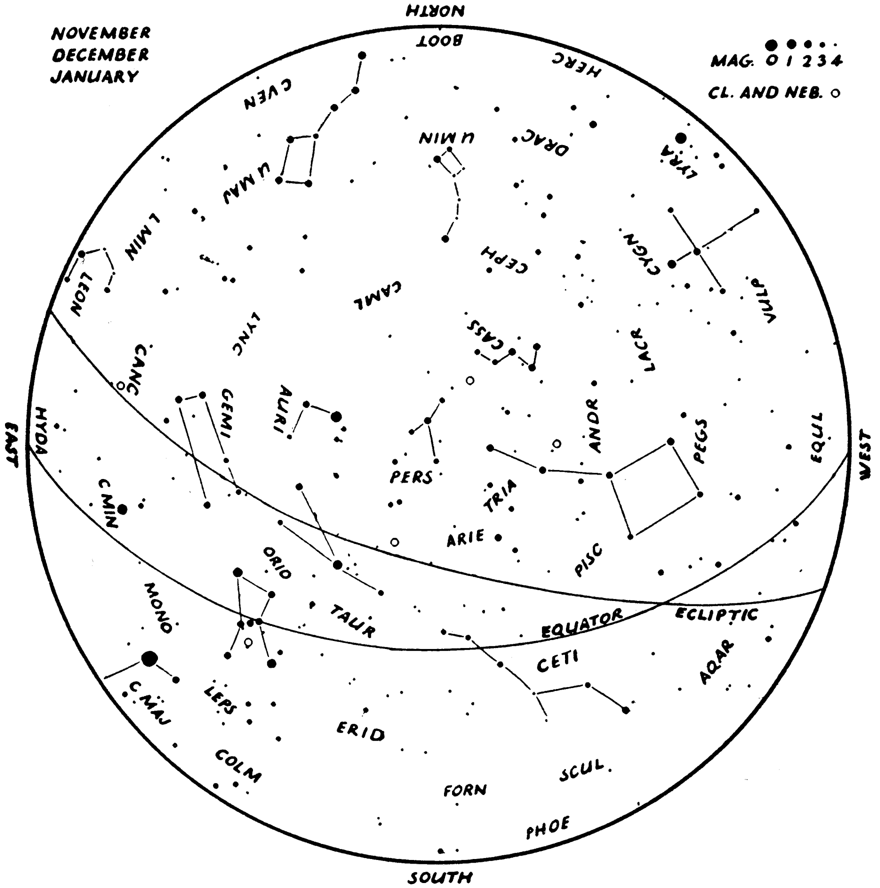


The above map represents the evening sky at

Midnight	...........Aug.	5
11 p.m.	.... "	21
10 "	............Sept.	7
9 "	.... "	23
8 "	............Oct.	10
7 "	.... "	26
6 "	............Nov.	6
5 "	.... "	21

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

STAR MAP 4



The above map represents the evening sky at

Midnight	....	Nov.	6
11 p.m.	....	"	21
10 "	....	Dec.	6
9 "	....	"	21
8 "	....	Jan.	5
7 "	....	"	20
6 "	....	Feb.	6

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

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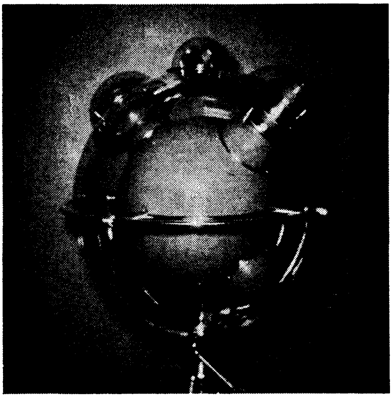

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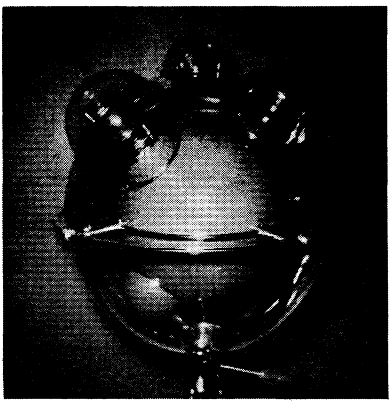

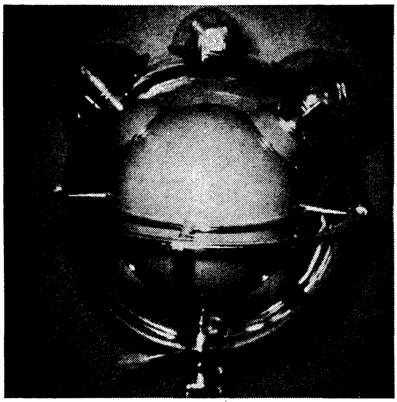

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CALENDAR 1960

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	29	....	....	....	....	....

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