THE OBSERVER'S HANDBOOK 1962

Fifty-fourth Year of Publication
THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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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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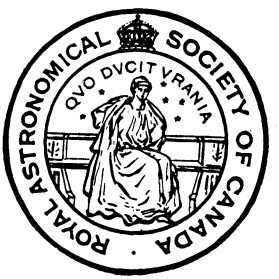
THE OBSERVER'S HANDBOOK 1962

EDITOR
RUTH J. NORTHCOTT



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CONTENTS

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THE OBSERVER'S HANDBOOK for 1962 is the 54th issue. The section on lunar occultations has been expanded to include all the predictions made for the Canadian Stations by the British Nautical Almanac Office; occultations of stars of magnitude 7.5 or brighter are listed. Comments are requested concerning the increased value of this enlarged section.

The longitude of the central meridian of the planet Jupiter has been added for planetary observers; this has been prepared by Geoffrey Gaherty, Jr.

Cordial thanks are offered to those who assisted in the preparation of this volume, to those who are named and to Barbara Gaizauskas, William Greig, Kulli Milles, Isabel Williamson, and Dorothy Yane. Special thanks are due to Gordon E. Taylor and the British Astronomical Association for the data on the planetary occultation 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 and for the preparation of new maps for this section.

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

RUTH J. NORTHCOTT

ANNIVERSARIES AND FESTIVALS, 1962

New Year's Day	Mon.	Jan. 1	Pentecost (Whit Sunday)	Sun.	June 10
Epiphany	Sat.	Jan. 6	Trinity Sunday	Sun.	June 17
Accession of Queen Elizabeth (1952)	Tue.	Feb. 6	Corpus Christi	Thu.	June 21
Septuagesima Sunday		Feb. 18	St. John Baptist (Mid-summer Day)	Sun.	June 24
St. David	Thu.	Mar. 1	Dominion Day	Sun.	July 1
Quinquagesima (Shrove Sunday)		Mar. 4	Birthday of Queen Mother Elizabeth (1900)	Sat.	Aug. 4
Ash Wednesday		Mar. 7	Labour Day	Mon.	Sept. 3
St. Patrick	Sat.	Mar. 17	Hebrew New Year (Rosh Hashanah)	Sat.	Sept. 29
Palm Sunday		Apr. 15	St. Michael (Michael-mas Day)	Sat.	Sept. 29
Good Friday		Apr. 20	Thanksgiving	Mon.	Oct. 8
Birthday of Queen Elizabeth (1926)	Sat.	Apr. 21	All Saints' Day	Thu.	Nov. 1
Easter Sunday		Apr. 22	Remembrance Day	Sun.	Nov. 11
St. George	Mon.	Apr. 23	St. Andrew	Fri.	Nov. 30
Victoria Day	Mon.	May 21	First Sunday in Advent		Dec. 2
Rogation Sunday		May 27	Christmas Day	Tue.	Dec. 25
Ascension Day	Thu.	May 31			

JULIAN DAY CALENDAR, 1962

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

Jan. 1	7,666	May 1	7,786	Sept. 1	7,909
Feb. 1	7,697	June 1	7,817	Oct. 1	7,939
Mar. 1	7,725	July 1	7,847	Nov. 1	7,970
Apr. 1	7,756	Aug. 1	7,878	Dec. 1	8,000

The Julian Day commences at noon. Thus J.D. 2,437,666.0 = Jan. 1.5 U.T.

SYMBOLS AND ABBREVIATIONS

SUN, MOON AND PLANETS

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

ASPECTS AND ABBREVIATIONS

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

SIGNS OF THE ZODIAC

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

THE GREEK ALPHABET

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

THE CONFIGURATIONS OF JUPITER'S SATELLITES

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

CALCULATIONS FOR ALGOL

The calculations for the minima of Algol are based on the epoch J.D. 2437208.7224 and period 2.8674 days as published in *Sky and Telescope*, 1961.

CELESTIAL DISTANCES

Celestial distances given herein are based on the standard value of 8.80″ for the sun's parallax.

THE CONSTELLATIONS

Latin Names with Pronunciations and Abbreviations

Andromeda, ăn-drŏm′ē-dȧ	And	Andr
Antlia, ănt′lĭ-ȧ	Ant	Antl
Apus, ā′pŭs	Aps	Apus
Aquarius, ȧ-kwâr′ĭ-ŭs	Aqr	Aqar
Aquila, ăk′wĭ-lȧ	Aql	Aqil
Ara, ā′rȧ	Ara	Arae
Aries, ā′rĭ-ēz	Ari	Arie
Auriga, ô-rī′gȧ	Aur	Auri
Boötes, bō-ō′tēz	Boo	Boot
Caelum, sē′lŭm	Cae	Cael
Camelopardalis, kȧ-mĕl′ō-pär′dȧ-lĭs	Cam	Caml
Cancer, kăn′sẽr	Cnc	Canc
Canes Venatici, kā′nēz vē-năt′ĭ-sī	CVn	CVen
Canis Major, kā′nĭs mā′jẽr	CMa	CMaj
Canis Minor, kā′nĭs mī′nẽr	CMi	CMin
Capricornus, kăp′rĭ-kôr′nŭs	Cap	Capr
Carina, kȧ-rī′nȧ	Car	Cari
Cassiopeia, kăs′ĭ-ō-pē′yȧ	Cas	Cass
Centaurus, sẽn-tô′rŭs	Cen	Cent
Cepheus, sē′fūs	Cep	Ceph
Cetus, sē′tŭs	Cet	Ceti
Chamaeleon, kȧ-mē′lē-ŭn	Cha	Cham
Circinus, sûr′sĭ-nŭs	Cir	Circ
Columba, kō-lŭm′bȧ	Col	Colm
Coma Berenices, kō′mȧ bĕr′ē-nī′sēz	Com	Coma
Corona Australis, kō-rō′nȧ ôs-trā′lĭs	CrA	CorA
Corona Borealis, kȧ-rō′nȧ bō′rē-ā′lĭs	CrB	CorB
Corvus, kôr′vŭs	Crv	Corv
Crater, krā′tẽr	Crt	Crat
Crux, krŭks	Cru	Cruc
Cygnus, sĭg′nŭs	Cyg	Cygn
Delphinus, dĕl-fī′nŭs	Del	Dlph
Dorado, dō-rä′dō	Dor	Dora
Draco, drā′kō	Dra	Drac
Equuleus, ē-kwōō′lē-ŭs	Equ	Equl
Eridanus, ē-rĭd′ȧ-nŭs	Eri	Erid
Fornax, fôr′năks	For	Forn
Gemini, jĕm′ĭ-nī	Gem	Gemi
Grus, grŭs	Gru	Grus
Hercules, hûr′kŭ-lēz	Her	Herc
Horologium, hŏr′ō-lō′jĭ-ŭm	Hor	Horo
Hydra, hī′drȧ	Hya	Hyda
Hydrus, hī′drŭs	Hyi	Hydi
Indus, ĭn′dŭs	Ind	Indi
Lacerta, lȧ-sûr′tȧ	Lac	Lacr
Leo, lē′ō	Leo	Leon
Leo Minor, lē′ō mī′nẽr	LMi	LMin
Lepus, lē′pŭs	Lep	Leps
Libra, lī′brȧ	Lib	Libr
Lupus, lū′pŭs	Lup	Lupi
Lynx, lĭngks	Lyn	Lync
Lyra, lī′rȧ	Lyr	Lyra
Mensa, mĕn′sȧ	Men	Mens
Microscopium, mī′krō-skō′pĭ-ŭm	Mic	Micr
Monoceros, mō-nŏs′ẽr-ŏs	Mon	Mono
Musca, mŭs′kȧ	Mus	Musc
Norma, nôr′mȧ	Nor	Norm
Octans, ŏk′tănz	Oct	Octn
Ophiuchus, ŏf′ĭ-ū′kŭs	Oph	Ophi
Orion, ô-rī′ŏn	Ori	Orio
Pavo, Pā′vō	Pav	Pavo
Pegasus, pĕg′ȧ-sŭs	Peg	Pegs
Perseus, pûr′sūs	Per	Pers
Phoenix, fē′nĭks	Phe	Phoe
Pictor, pĭk′tẽr	Pic	Pict
Pisces, pĭs′ēz	Psc	Pisc
Piscis Austrinus, pĭs′ĭs ôs-trī′nŭs	PsA	PscA
Puppis, pŭp′ĭs	Pup	Pupp
Pyxis, pĭk′sĭs	Pyx	Pyxi
Reticulum, rẽ-tĭk′ū-lŭm	Ret	Reti
Sagitta, sȧ-jĭt′ȧ	Sge	Sgte
Sagittarius, săj′ĭ-tā′rĭ-ŭs	Sgr	Sgtr
Scorpius, skôr′pĭ-ŭs	Sco	Scor
Sculptor, skŭlp′tẽr	Scl	Scul
Scutum, skū′tŭm	Sct	Scut
Serpens, sûr′pĕnz	Ser	Serp
Sextans, sĕks′tănz	Sex	Sext
Taurus, tô′rŭs	Tau	Taur
Telescopium, tĕl′ẽ-skō′pĭ-ŭm	Tel	Tele
Triangulum, trī-ăng′gū-lŭm	Tri	Tria
Triangulum Australe, trī-ăng′gū-lŭm ôs-trā′lē	TrA	TrAu
Tucana, tū-kā′nȧ	Tuc	Tucn
Ursa Major, ûr′sȧ mā′jẽr	UMa	UMaj
Ursa Minor, ûr′sȧ mī′nẽr	UMi	UMin
Vela, vē′lȧ	Vel	Velr
Virgo, vûr′gō	Vir	Virg
Volans, vō′lănz	Vol	Voln
Vulpecula, vŭl-pĕk′ū-lȧ	Vul	Vulp

ā fāte; ȧ chȧotic; ă tăp; *ă* finăl; ȧ ȧsk; *ȧ* ideȧ; â câre; ä älms; au aught; ē bē; ẽ crẽate; ĕ ĕnd; *ĕ* angĕl; ē makēr; ī tīme; ĭ bĭt; *ĭ* anĭmal; ō nōte; ŏ anatŏmy; ŏ hŏt; *ŏ* ŏccur; ô ôrb; o͞o mo͞on; o͝o bo͝ok; ou out; ū tūbe; ŭ ŭnite; ŭ sŭn; *ŭ* sŭbmit; û hûrl.

MISCELLANEOUS ASTRONOMICAL DATA

Units of Length

1 Angstrom unit	$= 10^{-8}$ cm.	
1 micron, μ	$= 10^{-4}$ cm. $= 10^{4}$ A.	
1 meter	$= 10^{2}$ cm.	$= 3.28084$ feet
1 kilometer	$= 10^{5}$ cm.	$= 0.62137$ miles
1 mile	$= 1.60935\times10^{5}$ cm.	$= 1.60935$ km.
1 astronomical unit	$= 1.49504\times10^{13}$ cm.	$= 92{,}897{,}416$ miles
1 light year	$= 9.463\times10^{17}$ cm.	$= 5.880\times10^{12}$ miles $= 0.3069$ parsecs
1 parsec	$= 30.84\times10^{17}$ cm.	$= 19.16\times10^{12}$ miles $= 3.259$ l.y.
1 megaparsec	$= 30.84\times10^{23}$ cm.	$= 19.16\times10^{18}$ miles $= 3.259\times10^{6}$ 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 $= 69.057 - 0.349 \cos 2\phi$ miles (at latitude ϕ)
1° of longitude $= 69.232 \cos \phi - 0.0584 \cos 3\phi$ miles
Mass of earth $= 6.6\times10^{21}$ tons; velocity of escape from $\oplus = 6.94$ miles/sec.

Earth's Orbital Motion

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

Solar Motion

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

The Galactic System

North pole of galactic plane R.A. $12^h\ 49^m$, Dec. $+\ 27.°4$ (1959)
Centre of galaxy R.A. $17^h\ 42^m$, Dec. $-29°$ (1950)
Distance to centre $\sim$10,000 parsecs; diameter $\sim$30.000 parsecs
Rotational velocity (at sun) ~ 262 km./sec.
Rotational period (at sun) $\sim 2.2\times10^{8}$ years
Mass $\sim 2\times10^{11}$ solar masses

Extra-galactic Nebulae

Red shift $\sim +100$ 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 $= 3\times10^{-6}$ meter candles
Total energy emitted by a star of zero absolute magnitude $= 5\times10^{25}$ horsepower

Miscellaneous

Constant of gravitation, $G = 6.670\times10^{-8}$ c.g.s. units
Mass of the electron, $m = 9.1083\times10^{-28}$ gm.; mass of the proton $= 1.6724\times10^{-24}$ gm.
Planck's constant, $h = 6.6234\times10^{-27}$ erg. sec.
Loschmidt's number $= 2.6872\times10^{19}$ molecules/cu. cm. of gas at N.T.P.
Absolute temperature $= T°\ \mathrm{K} = T°\ \mathrm{C} + 273° = 5/9\ (T°\ \mathrm{F} + 459°)$

1 radian $= 57°.2958$	$\pi = 3.141{,}592{,}653{,}6$
$= 3437'.75$	No. of square degrees in the sky $= 41{,}253$
$= 206{,}265''$	1 gram $= 0.03527$ oz.

1962 EPHEMERIS OF THE SUN AT 0h U.T.

Date 1962	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.	Date 1962	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
	h m s	m s	° ′		h m s	m s	° ′
Jan. 1	18 43 54	+ 3 14	−23 03.5	July 3	6 46 06	+ 3 56	+23 01.2
4	18 57 08	+ 4 39	−22 47.5	6	6 58 28	+ 4 29	+22 45.7
7	19 10 19	+ 6 00	−22 27.5	9	7 10 47	+ 4 59	+22 26.7
10	19 23 25	+ 7 17	−22 03.5	12	7 23 03	+ 5 24	+22 04.3
13	19 36 26	+ 8 28	−21 35.6	15	7 35 14	+ 5 46	+21 38.4
16	19 49 22	+ 9 34	−21 03.9	18	7 47 20	+ 6 03	+21 09.2
19	20 02 11	+10 33	−20 28.7	21	7 59 22	+ 6 15	+20 36.7
22	20 14 54	+11 26	−19 49.9	24	8 11 19	+ 6 23	+20 01.2
25	20 27 30	+12 13	−19 07.8	27	8 23 12	+ 6 25	+19 22.6
28	20 39 58	+12 52	−18 22.6	30	8 34 58	+ 6 22	+18 41.1
31	20 52 20	+13 24	−17 34.4				
				Aug. 2	8 46 40	+ 6 14	+17 56.9
Feb. 3	21 04 34	+13 49	−16 43.3	5	8 58 16	+ 6 00	+17 10.1
6	21 16 42	+14 06	−15 49.6	8	9 09 46	+ 5 41	+16 20.7
9	21 28 42	+14 16	−14 53.5	11	9 21 11	+ 5 16	+15 29.0
12	21 40 34	+14 19	−13 55.2	14	9 32 31	+ 4 46	+14 35.1
15	21 52 20	+14 15	−12 54.7	17	9 43 45	+ 4 11	+13 39.0
18	22 03 59	+14 04	−11 52.4	20	9 54 55	+ 3 32	+12 41.1
21	22 15 31	+13 47	−10 48.5	23	10 06 01	+ 2 48	+11 41.3
24	22 26 58	+13 24	− 9 43.0	26	10 17 03	+ 2 00	+10 39.8
27	22 38 19	+12 56	− 8 36.2	29	10 28 02	+ 1 09	+ 9 36.8
Mar. 2	22 49 36	+12 23	− 7 28.2	Sept. 1	10 38 57	+ 0 15	+ 8 32.4
5	23 00 48	+11 46	− 6 19.2	4	10 49 50	− 0 42	+ 7 26.8
8	23 11 56	+11 04	− 5 09.5	7	11 00 40	− 1 42	+ 6 20.1
11	23 23 01	+10 19	− 3 59.1	10	11 11 28	− 2 44	+ 5 12.5
14	23 34 03	+ 9 31	− 2 48.3	13	11 22 14	− 3 47	+ 4 04.1
17	23 45 02	+ 8 40	− 1 37.3	16	11 33 00	− 4 51	+ 2 55.1
20	23 55 59	+ 7 48	− 0 26.2	19	11 43 45	− 5 55	+ 1 45.5
23	0 06 54	+ 6 54	+ 0 44.9	22	11 54 31	− 6 59	+ 0 35.6
26	0 17 49	+ 5 59	+ 1 55.7	25	12 05 18	− 8 02	− 0 34.5
29	0 28 44	+ 5 04	+ 3 06.2	28	12 16 06	− 9 03	− 1 44.6
Apr. 1	0 39 39	+ 4 10	+ 4 16.2	Oct. 1	12 26 57	−10 02	− 2 51.7
4	0 50 36	+ 3 16	+ 5 25.4	4	12 37 49	−10 59	− 4 04.5
7	1 01 33	+ 2 24	+ 6 33.8	7	12 48 45	−11 53	− 5 13.8
10	1 12 33	+ 1 34	+ 7 41.2	10	12 59 44	−12 44	− 6 22.5
13	1 23 34	+ 0 46	+ 8 47.4	13	13 10 47	−13 31	− 7 30.5
16	1 34 39	+ 0 01	+ 9 52.3	16	13 21 54	−14 13	− 8 37.5
19	1 45 46	− 0 41	+10 55.7	19	13 33 07	−14 50	− 9 43.4
22	1 56 57	− 1 20	+11 57.5	22	13 44 25	−15 22	−10 48.1
25	2 08 12	− 1 55	+12 57.5	25	13 55 49	−15 47	−11 51.3
28	2 19 32	− 2 25	+13 55.6	28	14 07 20	−16 06	−12 53.0
				31	14 18 58	−16 18	−13 52.8
May 1	2 30 56	− 2 50	+14 51.7				
4	2 42 25	− 3 11	+15 45.6	Nov. 3	14 30 42	−16 23	−14 50.6
7	2 53 59	− 3 27	+16 37.1	6	14 42 34	−16 21	−15 46.3
10	3 05 38	− 3 37	+17 26.1	9	14 54 33	−16 12	−16 39.6
13	3 17 22	− 3 43	+18 12.5	12	15 06 39	−15 55	−17 30.3
16	3 29 11	− 3 44	+18 56.1	15	15 18 53	−15 30	−18 18.3
19	3 41 05	− 3 39	+19 36.9	18	15 31 15	−14 58	−19 03.5
22	3 53 04	− 3 30	+20 14.6	21	15 43 45	−14 19	−19 45.6
25	4 05 07	− 3 16	+20 49.2	24	15 56 22	−13 31	−20 24.4
28	4 17 16	− 2 57	+21 20.7	27	16 09 06	−12 37	−20 59.9
31	4 29 29	− 2 34	+21 48.8	30	16 21 56	−11 36	−21 31.8
June 3	4 41 46	− 2 07	+22 13.5	Dec. 3	16 34 53	−10 29	−22 00.1
6	4 54 06	− 1 36	+22 34.7	6	16 47 55	− 9 17	−22 24.5
9	5 06 29	− 1 03	+22 52.3	9	17 01 01	− 8 00	−22 45.0
12	5 18 54	− 0 27	+23 06.4	12	17 14 12	− 6 39	−23 01.5
15	5 31 21	+ 0 10	+23 16.7	15	17 27 26	− 5 14	−23 13.9
18	5 43 49	+ 0 48	+23 23.4	18	17 40 43	− 3 47	−23 22.1
21	5 56 17	+ 1 27	+23 26.4	21	17 54 02	− 2 18	−23 26.1
24	6 08 46	+ 2 06	+23 25.6	24	18 07 21	− 0 48	−23 25.9
27	6 21 14	+ 2 44	+23 21.2	27	18 20 41	+ 0 41	−23 21.4
30	6 33 41	+ 3 21	+23 13.0	30	18 33 59	+ 2 10	−23 12.8

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

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

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

PHYSICAL ELEMENTS

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

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

SATELLITES OF THE SOLAR SYSTEM

Name	Stellar Mag.	Mean Dist. from Planet		Revolution Period			Diameter Miles	Discoverer
		" *	Miles	d	h	m		
SATELLITE OF THE EARTH								
Moon	−12.6	530	238,857	27	07	43	2160	
SATELLITES OF MARS								
Phobos	12	8	5,800	0	07	39	10?	Hall, 1877
Deimos	13	21	14,600	1	06	18	5?	Hall, 1877
SATELLITES OF JUPITER								
V	13	48	112,600	0	11	57	100?	Barnard, 1892
Io	5	112	261,800	1	18	28	2300	Galileo, 1610
Europa	6	178	416,600	3	13	14	2000	Galileo, 1610
Ganymede	5	284	664,200	7	03	43	3200	Galileo, 1610
Callisto	6	499	1,169,000	16	16	32	3200	Galileo, 1610
VI	14	3037	7,114,000	250	16		100?	Perrine, 1904
VII	16	3113	7,292,000	260	01		40?	Perrine, 1905
X	18	3116	7,300,000	260			15?	Nicholson, 1938
XI	18	5990	14,000,000	692			15?	Nicholson, 1938
VIII	16	6240	14,600,000	739			40?	Melotte, 1908
IX	17	6360	14,900,000	758			20?	Nicholson, 1914
XII	18	—	—	631			15?	Nicholson, 1951
SATELLITES OF SATURN								
Mimas	12	27	115,000	0	22	37	400?	W. Herschel, 1789
Enceladus	12	34	148,000	1	08	53	500?	W. Herschel, 1789
Tethys	11	43	183,000	1	21	18	800?	G. Cassini, 1684
Dione	11	55	234,000	2	17	41	700?	G. Cassini, 1684
Rhea	10	76	327,000	4	12	25	1100?	G. Cassini, 1672
Titan	8	177	759,000	15	22	41	2600?	Huygens, 1655
Hyperion	13	214	920,000	21	06	38	300?	G. Bond, 1848
Iapetus	11	515	2,210,000	79	07	56	1000?	G. Cassini, 1671
Phoebe	14	1870	8,034,000	550			200?	W. Pickering, 1898
SATELLITES OF URANUS								
Miranda	17	9	81,000	1	09	56		Kuiper, 1948
Ariel	16	14	119,000	2	12	29	600?	Lassell, 1851
Umbriel	16	19	166,000	4	03	28	400?	Lassell, 1851
Titania	14	32	272,000	8	16	56	1000?	W. Herschel, 1787
Oberon	14	42	364,000	13	11	07	900?	W. Herschel, 1787
SATELLITES OF NEPTUNE								
Triton	13	16	220,000	5	21	03	3000?	Lassell, 1846
Nereid	19	260	3,460,000	359			200?	Kuiper, 1949

*As seen from the sun.

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

SOLAR, 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. Sidereal time = Standard time (0h at midnight) − correction for longtitude (p. 12) + 12 h + R. A. sun (p. 7) − correction to sun-dial (p. 7). (Note that it is necessary to obtain R. A. of the sun at the standard time involved.)

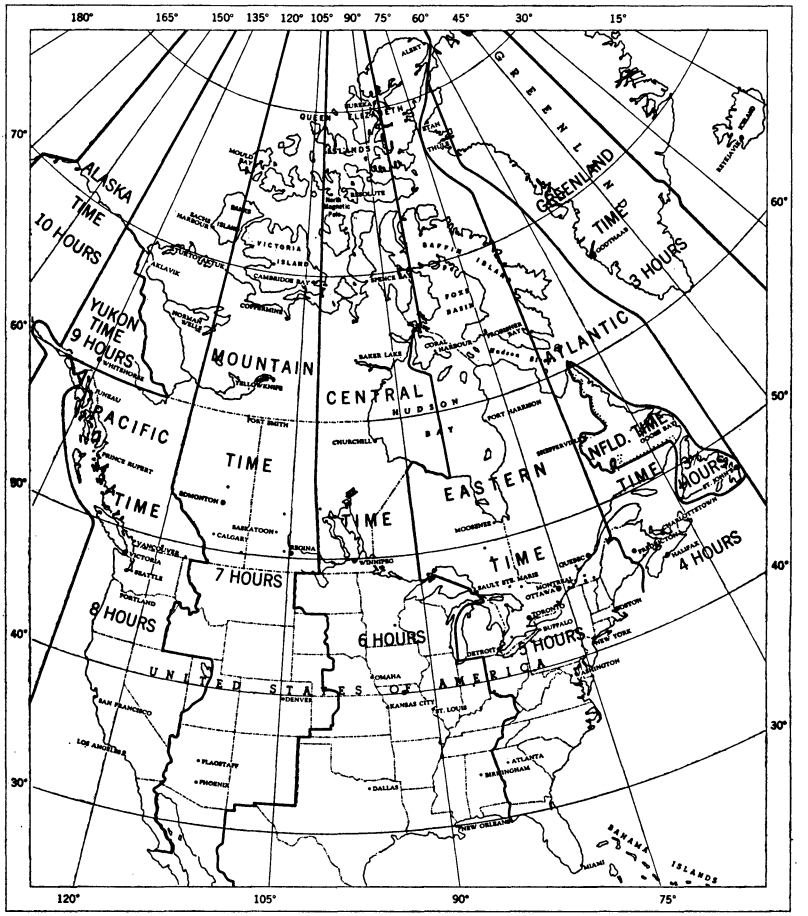
The foregoing refers to *local* time, in general different in different places on the earth. The local mean time of Greenwich, now known as *Universal Time* (UT) is used as a common basis for timekeeping. Navigation and surveying tables are generally prepared in terms of UT. When great precision is required, 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 for 1900 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 ΔT = 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 1962 will be about 34 seconds.

MAP OF STANDARD TIME ZONES



RADIO TIME SIGNALS

Many national observatories and some standards laboratories transmit time signals. A complete listing of stations emitting time signals may be found in the "List of Radiodetermination and Special Service Stations" prepared by the General Secretariat of the International Telecommunication Union, Geneva. For use in Canada and adjacent areas, the following is a brief list of controlled frequency stations.

CHU Ottawa, Canada—3330, 7335, 14670 kilocycles
WWV Beltsville, Maryland—2.5, 5, 10, 15, 20, 25 megacycles
WWVH Maui, Hawaii—5, 10, 15 megacycles
NBA Balboa, Canal Zone—18 kilocycles.

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 for the 5 h meridian 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 the places named, 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. The correction is the number of minutes of time that the place is west (plus) or east (minus) of the standard meridian. The corrections for places not listed may be obtained by converting the longitude found from an atlas into time (360° = 24 h).

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

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

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

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

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

BEGINNING OF MORNING AND ENDING OF EVENING TWILIGHT

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

The above table gives the local mean time of the beginning of morning twilight, and of the ending of evening twilight, for various latitudes. To obtain the corresponding standard time, the method used is the same as for correcting the sunrise and sunset tables, as described on page 12. The entry —— in the above table indicates that at such dates and latitudes, twilight lasts all night. This table, taken from the American Ephemeris, is computed for *astronomical* twilight, i.e. for the time at which the sun is 108° from the zenith (or 18° below the horizon).

TIME OF MOONRISE AND MOONSET, 1962 (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		01 57	13 26	02 02	13 20	02 07	13 13	02 15	13 05	02 21	12 57
2		02 56	14 04	03 03	13 55	03 12	13 46	03 22	13 34	03 32	13 23
3		03 57	14 46	04 06	14 35	04 18	14 24	04 31	14 10	04 44	13 55
4		04 59	15 34	05 10	15 22	05 24	15 09	05 40	14 52	05 56	14 35
5		06 02	16 30	06 14	16 17	06 28	16 03	06 46	15 45	07 04	15 27
6	●	07 02	17 31	07 14	17 19	07 28	17 04	07 46	16 47	08 04	16 29
7		07 58	18 37	08 09	18 26	08 22	18 13	08 39	17 58	08 55	17 42
8		08 49	19 45	08 58	19 37	09 10	19 27	09 23	19 14	09 36	19 02
9		09 35	20 54	09 42	20 49	09 50	20 41	10 01	20 32	10 10	20 24
10		10 16	22 03	10 20	21 59	10 26	21 55	10 32	21 51	10 38	21 46
11		10 55	23 09	10 56	23 08	10 58	23 08	11 01	23 08	11 03	23 07
12		11 31	.. ..	11 30	.. ..	11 29	.. ..	11 28	.. ..	11 27	.. ..
13	☽	12 08	00 13	12 04	00 16	12 00	00 19	11 55	00 22	11 50	00 26
14		12 45	01 17	12 39	01 22	12 32	01 28	12 23	01 36	12 15	01 43
15		13 25	02 19	13 16	02 26	13 06	02 36	12 54	02 46	12 42	02 57
16		14 06	03 19	13 56	03 30	13 44	03 41	13 29	03 55	13 15	04 08
17		14 52	04 18	14 40	04 29	14 27	04 42	14 09	04 59	13 53	05 15
18		15 40	05 13	15 28	05 25	15 14	05 39	14 56	05 57	14 38	06 14
19		16 31	06 05	16 19	06 17	16 05	06 31	15 48	06 49	15 30	07 06
20	○	17 25	06 52	17 14	07 03	17 01	07 17	16 44	07 33	16 29	07 50
21		18 19	07 34	18 10	07 45	17 58	07 56	17 44	08 11	17 30	08 25
22		19 14	08 12	19 06	08 21	18 56	08 31	18 46	08 43	18 35	08 55
23		20 08	08 48	20 03	08 54	19 55	09 02	19 48	09 11	19 40	09 20
24		21 02	09 20	20 59	09 24	20 54	09 29	20 50	09 36	20 46	09 41
25		21 56	09 51	21 55	09 53	21 54	09 55	21 52	09 59	21 51	10 02
26		22 50	10 21	22 52	10 21	22 54	10 21	22 55	10 21	22 57	10 20
27		23 46	10 52	23 49	10 49	23 54	10 46	23 59	10 43	.. ..	10 39
28	☾	.. ..	11 24	.. ..	11 19	.. ..	11 13	.. ..	11 07	00 04	11 01
29		00 42	11 59	00 48	11 51	00 55	11 43	01 04	11 33	01 12	11 24
30		01 40	12 37	01 49	12 28	01 58	12 17	02 10	12 04	02 22	11 52
31		02 40	13 21	02 50	13 10	03 03	12 58	03 18	12 42	03 32	12 27
Feb.											
1		03 42	14 12	03 53	14 00	04 07	13 45	04 24	13 28	04 41	13 11
2		04 42	15 09	04 54	14 57	05 09	14 42	05 27	14 24	05 45	14 07
3		05 40	16 13	05 52	16 02	06 06	15 48	06 24	15 30	06 41	15 14
4	●	06 35	17 22	06 45	17 12	06 58	17 00	07 13	16 46	07 27	16 31
5		07 25	18 33	07 33	18 25	07 42	18 16	07 54	18 06	08 06	17 55
6		08 10	19 44	08 15	19 39	08 21	19 34	08 30	19 27	08 38	19 21
7		08 51	20 53	08 53	20 52	08 57	20 50	09 01	20 48	09 05	20 46
8		09 30	22 02	09 29	22 03	09 30	22 05	09 30	22 07	09 30	22 09
9		10 08	23 08	10 05	23 12	10 02	23 17	09 58	23 22	09 54	23 28
10		10 45	.. ..	10 40	.. ..	10 34	.. ..	10 26	.. ..	10 19	.. ..
11	☽	11 25	00 12	11 17	00 19	11 07	00 26	10 57	00 36	10 46	00 46
12		12 06	01 14	11 57	01 23	11 44	01 33	11 31	01 46	11 17	01 59
13		12 50	02 13	12 39	02 24	12 25	02 37	12 10	02 52	11 54	03 07
14		13 37	03 09	13 25	03 21	13 11	03 35	12 53	03 52	12 36	04 09
15		14 27	04 01	14 15	04 13	14 01	04 28	13 43	04 45	13 25	05 03
16		15 19	04 49	15 08	05 01	14 55	05 15	14 38	05 32	14 21	05 48
17		16 13	05 33	16 03	05 43	15 51	05 56	15 36	06 11	15 21	06 27
18		17 07	06 12	16 59	06 21	16 49	06 32	16 37	06 45	16 25	06 58
19	○	18 02	06 48	17 56	06 55	17 47	07 04	17 39	07 14	17 30	07 24
20		18 56	07 21	18 52	07 26	18 46	07 33	18 41	07 40	18 35	07 46
21		19 50	07 52	19 48	07 56	19 46	07 59	19 43	08 04	19 41	08 07
22		20 44	08 23	20 45	08 24	20 45	08 24	20 46	08 26	20 47	08 26
23		21 38	08 53	21 41	08 52	21 45	08 49	21 48	08 48	21 53	08 45
24		22 34	09 25	22 39	09 20	22 45	09 16	22 53	09 10	23 00	09 05
25		23 30	09 57	23 38	09 51	23 47	09 44	23 58	09 36	.. ..	09 27
26		.. ..	10 33	.. ..	10 25	.. ..	10 15	.. ..	10 04	00 08	09 52
27	☾	00 28	11 14	00 38	11 04	00 49	10 52	01 03	10 37	01 16	10 23
28		01 26	12 00	01 38	11 48	01 51	11 34	02 07	11 18	02 24	11 02

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

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

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

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

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

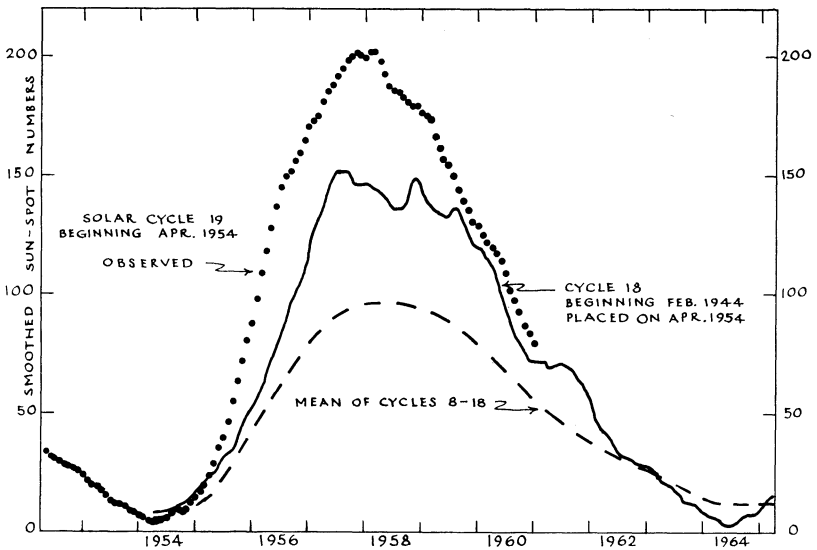
THE PLANETS FOR 1962

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.

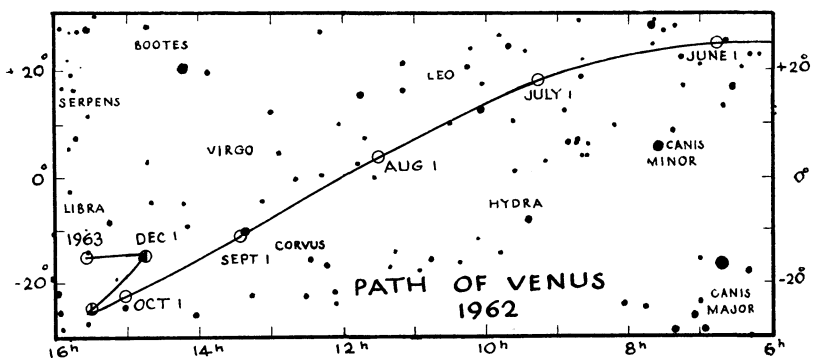
When the elongation of Mercury is east of the sun it is an evening star, setting soon after the sun. When the elongation is west, it is a morning star and rises shortly before the sun. Its brightness when it is treated as a star is considerable but it is always viewed in the twilight sky and one must 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 1962

Elong. East—Evening Star			Elong. West—Morning Star		
Date	Dist.	Mag.	Date	Dist.	Mag.
Jan. 20	19°	−0.4	Mar. 3	27°	+0.4
May 13	22°	+0.6	July 1	22°	+0.6
Sept. 10	27°	+0.4	Oct. 21	18°	−0.3

The most favourable elongations to observe are: in the evening, May 13, and in the morning, Oct. 21. At these times Mercury looks like a half-moon in a telescope. On May 13 and Oct. 21 it is respectively about 8″ and 7″ in apparent diameter and about 78 and 91 million miles from the earth.



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, 1962, Venus is very close to the sun in the morning sky, crossing the meridian less than half an hour before the sun. By Jan. 27 it is in superior conjunction with the sun and moves into the evening sky. It reaches greatest elongation east, 46°, on Sept. 3; its declination is −13°, and it transits the meridian almost 3 hours after the sun. Greatest brilliancy, mag. −4.3, is attained on

Oct. 8. By Nov. 12 it is in inferior conjunction with the sun, and becomes a morning star. It again attains greatest brilliancy, mag. −4.4, on Dec. 18. It remains in the morning sky for the rest of the year. On Dec. 31 it is in declination −15° and transits the meridian about 3 hours before the sun. It is still very brilliant, with stellar magnitude −4.3. For its position near elongations, see the map.

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.

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 last opposition was on Dec. 30, 1960; the next on Feb. 4, 1963.

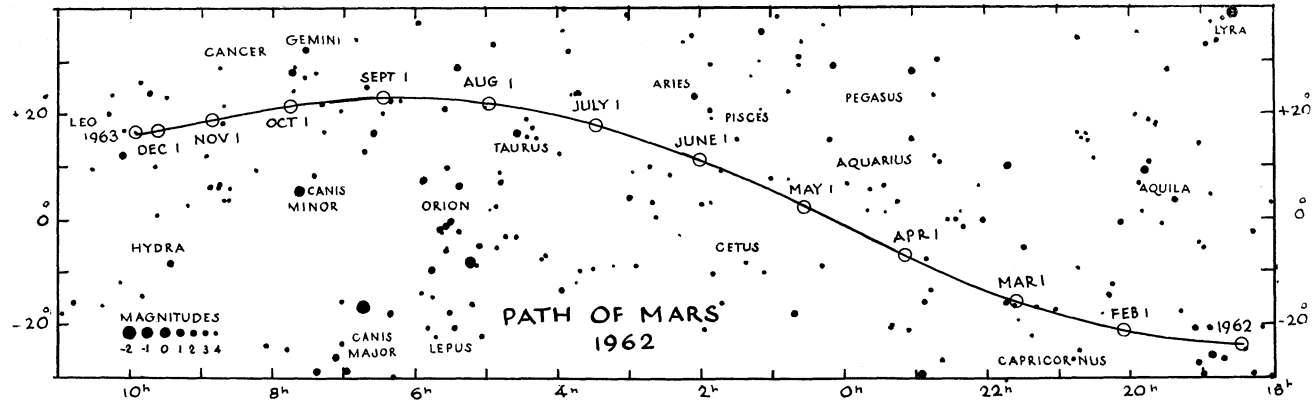
On Jan. 1, 1962, Mars is in the morning sky in the constellation Sagittarius, but it is too close to the sun for observation. It remains in the morning sky all year, becoming brighter (mag. 0) towards the end of the year. On Dec. 31 it is in declination +17° in the constellation Leo and transits the meridian about 9 hours before the sun. For its position throughout the year see the map.

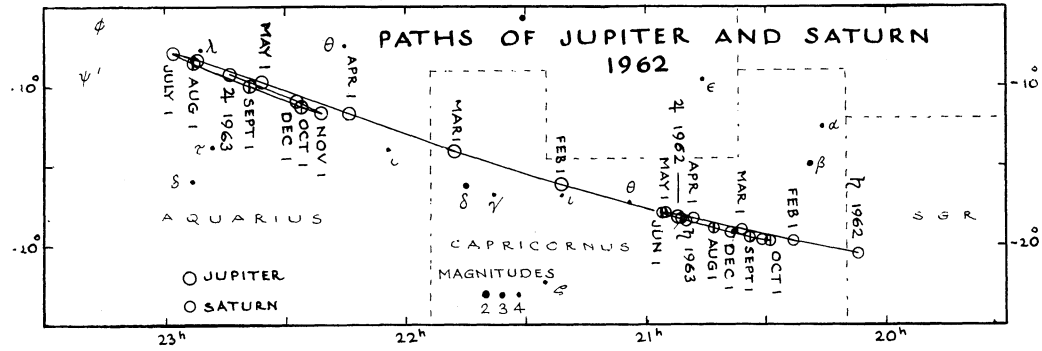
JUPITER

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

Jupiter is a fine object for the telescope. Many details of the cloud belts 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, 1962, Jupiter is in the evening sky, not far from the sun in the constellation Capricornus; by Feb. 8 it is in conjunction with the sun and then


PATH OF MARS
1962
CANCER
GEMINI
LEO
1963
DEC 1
NOV 1
OCT 1
SEPT 1
AUG 1
JULY 1
JUNE 1
MAY 1
APR 1
MAR 1
FEB 1
1962
ARIES
PISCES
PEGASUS
TAURUS
AQUARIUS
AQUILA
LYRA
CANIS MINOR
ORION
HYDRA
CETUS
CANIS MAJOR
LEPUS
CAPRICORNUS
MAGNITUDES
-2 -1 0 1 2 3 4
+20°
0°
-20°
10h
8h
6h
4h
2h
0h
22h
20h
18h

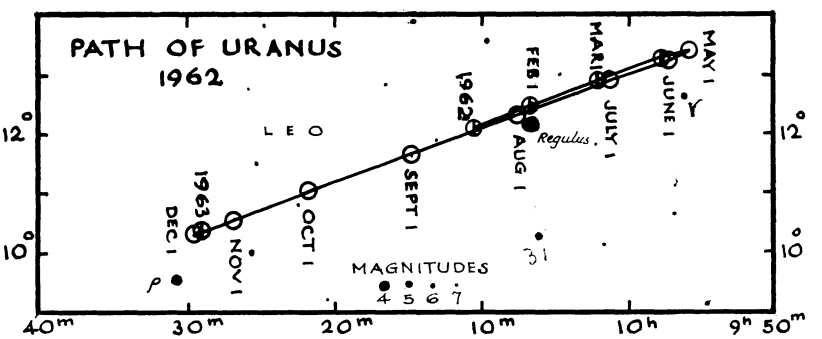

PATHS OF JUPITER AND SATURN
1962
JULY 1
AUG 1
SEPT 1
OCT 1
NOV 1
DEC 1
1963
MAY 1
APR 1
MAR 1
FEB 1
JUN 1
1962
AQUARIUS
CAPRICORNUS
JUPITER
SATURN
MAGNITUDES
2 3 4
-10°
-20°
23h
22h
21h
20h

emerges in the morning sky. It comes into opposition with the sun on Aug. 31, when it moves into the evening sky and is visible all night. It is then in Aquarius, with stellar magnitude −2.4. It retrogrades from July 2 to Oct. 29 (see map; circles with vertical lines denote retrograde motion). On Dec. 31 it is still in Aquarius, and is just past the meridian at sunset in declination −9°; its stellar magnitude has faded to −1.8.

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 1950, and will be again in 1966; the northern face of the rings was at maximum in 1958 and the southern will be in 1973.

On Jan. 1, 1962, Saturn is close to the sun in the evening sky, and by Jan. 21 it is in conjunction with the sun. It reaches opposition with the sun on July 32, when its stellar magnitude is +0.4 and it is visible all night. It retrogrades from May 22 to Oct. 9 (see map; circles with vertical lines denote retrograde motion). On Dec. 31 it is still in Capricornus, in the south-western sky at sunset (mag. +0.9).

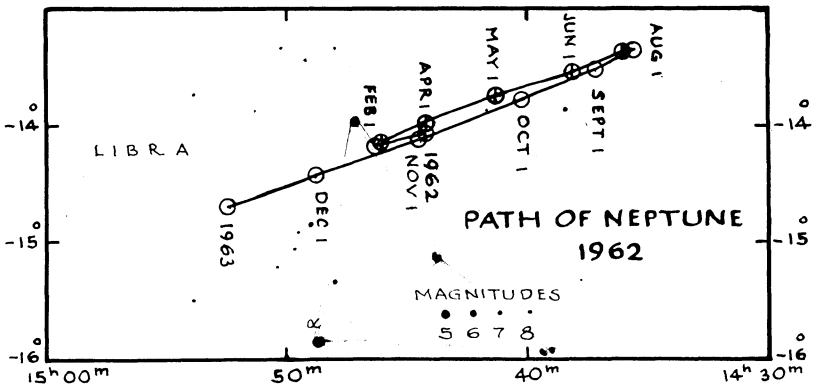


URANUS

Uranus was discovered in 1781 by Sir William Herschel by means of a 6½-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.

During 1962 Uranus is in Leo (see map). At the beginning of the year it is in the morning sky and is retrograding, direct motion being resumed on May 4.

This brings it close to Regulus in early February and again in late July. On Feb. 17 it is in opposition with the sun and is above the horizon all night; its apparent diameter is 4.0″ and its stellar magnitude is +5.7. By the time of conjunction on Aug. 24 its magnitude has faded to +5.9. It is in the morning sky the rest of the year. Venus passes close to the planet during the night of July 10–11.



NEPTUNE

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

During 1962 Neptune is in Libra (see map). It is in opposition to the sun on May 2, when it is above the horizon all night. Its stellar magnitude is then +7.7 and during the year fades slightly to +7.8. 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. 5 and moves into the morning sky for the rest of the year.

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. 27, at which time its astrometric position is R.A. $11^h\ 03^m$, Dec. +20° 48′.

THE SKY MONTH BY MONTH

By J. F. Heard

THE SKY FOR JANUARY 1962

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

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

The Sun—During January the sun's R.A. increases from 18h 44m to 20h 56m and its Decl. changes from 23° 04′ S. to 17° 18′ S. The equation of time changes from −3m 14s to −13m 33s. On the 2nd the earth is in perihelion, or closest to the sun. 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. Regulus and Uranus will be occulted by the moon on the night of the 22nd. See p. 61.

Mercury on the 15th is in R.A. 20h 57m, Decl. 18° 38′ S. and transits at 13h 23m. It is at greatest eastern elongation on the 20th, and at that time for a few evenings it may be seen low in the south-west just after sunset. This is a fairly favourable elongation, Mercury's altitude being about 14° at sunset.

Venus on the 15th is in R.A. 19h 33m, Decl. 22° 29′ S., mag. −3.5, and transits at 11h 58m. It is too close to the sun for observation, superior conjunction being on the 27th.

Mars on the 15th is in R.A. 19h 10m, Decl. 23° 19′ S. and transits at 11h 34m. It is too close to the sun for observation.

Jupiter on the 15th is in R.A. 21h 05m, Decl. 17° 22′ S. and transits at 13h 27m. It is low in the south-west at sunset and sets about an hour later. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 20h 15m, Decl. 20° 12′ S. and transits at 12h 36m. It is too close to the sun for observation, conjunction being on the 22nd.

Uranus on the 15th is in R.A. 10h 09m, Decl. 12° 15′ N. and transits at 2h 32m. It rises about three hours after sunset.

Neptune on the 15th is in R.A. 14h 45m, Decl. 14° 08′ S. and transits at 7h 07m. It rises about two hours after midnight.

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

JANUARY E.S.T.				Min. of Algol	Config. of Jupiter's Sat. 17h 30m	Sun's Selen. Colong. 0h U.T.
	d	h	m	h m		°
Mon.	1	16	☌♆☾ ♆ 4° S.		4320I	206.29
Tue.	2		⊕ at perihelion. Dist. from ☉, 91,346,000 mi.	19 04	4210З	218.46[b]
			☿ greatest hel. lat. S.			
Wed.	3		Quadrantid meteors		d4023	230.64[l]
		22	Ceres stationary in R.A.			
Thu.	4				40123	242.82
Fri.	5			15 53	2140З	255.01
Sat.	6	7	36 ☍ New Moon			267.20
Sun.	7	8	☌☿☾ ☿ 4° S.			279.39
		8	☌♄☾ ♄ 2° S.			
		11	☌☿♄ ☿ 1.7° S.			
Mon.	8	3	☌♃☾ ♃ 1° S.	12 43		291.58
		6	Vesta stationary in R.A.			
		9	☾ at perigee. Dist. from ⊕, 225,400 mi.			
Tue.	9					303.76
Wed.	10					315.95
Thu.	11			9 32		328.12
Fri.	12					340.29
Sat.	13	0	02 ☽ First Quarter			352.46
Sun.	14			6 21		4.62
Mon.	15					16.77[b]
Tue.	16	12	☌☿♃ ☿ 0.4° S.			28.91[l]
Wed.	17			3 11		41.05
Thu.	18					53.18
Fri.	19					65.32
Sat.	20	13	17 ☺ Full Moon	0 00		77.45
		19	☿ greatest elongation E., 19°			
Sun.	21		☿ at ♌			89.58
Mon.	22	13	☌♄☉	20 50		101.71
Tue.	23	0	☌♁☾ ♁ 0.3° S.			113.84
Wed.	24	8	☾ at apogee. Dist. from ⊕, 252,100 mi.			125.98
Thu.	25			17 39		138.11
Fri.	26		☿ at perihelion			150.26
		21	☿ stationary in R.A.			
Sat.	27	5	☌♀☉ superior			162.41
Sun.	28	18	37 ☾ Last Quarter	14 29		174.56
Mon.	29		♀ at aphelion			186.72
		2	☌♆☾ ♆ 4° S.			
Tue.	30					198.89[b]
Wed.	31			11 18		211.06[l]

[l]Jan. 3, −6.42°; Jan. 16, +6.03°; Jan. 31, −7.40°.
[b]Jan. 2, −6.71°; Jan. 15, +6.77°; Jan. 30, −6.84°.

THE SKY FOR FEBRUARY 1962

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

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

The Sun—During February the sun's R.A. increases from 20h 56m to 22h 46m and its Decl. changes from 17° 18′ S. to 7° 51′ S. The equation of time changes from −13m 33s to a minimum of −14m 19s on the 12th to −12m 35s at the end of the month. There is an eclipse of 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. Times of moonrise and moonset are given on p. 20. There is a penumbral eclipse of the moon on the 19th. Aldebaran will be occulted by the moon on the evening of the 12th and Regulus on the morning of the 19th. See p. 61.

Mercury on the 15th is in R.A. 20h 38m, Decl. 15° 31′ S., and transits at 10h 56m. It is poorly placed for observation during this month (inferior conjunction being on the 5th).

Venus on the 15th is in R.A. 22h 12m, Decl. 12° 42′ S., mag. −3.5, 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. 20h 52m, Decl. 18° 43′ S., and transits at 11h 13m. It is a morning star but too close to the sun for easy observation.

Jupiter on the 15th is in R.A. 21h 35m, Decl. 15° 10′ S., and transits at 11h 54m. It is too close to the sun for observation, conjunction being on the 8th.

Saturn on the 15th is in R.A. 20h 30m, Decl. 19° 24′ S., and transits at 10h 49m. It is a morning star but too close to the sun for easy observation.

Uranus on the 15th is in R.A. 10h 04m, Decl. 12° 42′ N., and transits at 0h 25m. It rises about at sunset. Opposition is on the 17th. During the first few days of the month it is very close to Regulus.

Neptune on the 15th is in R.A. 14h 46m, Decl. 14° 11′ S., and transits at 5h 07m. It rises about at midnight.

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

				FEBRUARY E.S.T.	Min. of Algol		Sun's Selen. Colong. 0h U.T.
	d	h	m		h m		°
Thu.	1			.....			223.24
Fri.	2			□♆☉ west.....			235.42
Sat.	3			.....	8 07		247.61
Sun.	4	19	10	● New Moon. Eclipse, see p. 60....			259.81
Mon.	5			☿ greatest hel. lat. N.....			272.00
		8		☌☿☉ inferior.....			
		17		☾ at perigee. Dist. from ⊕, 222,700 mi.			
Tue.	6	18		☌☌♄ ☌ 0.7° S.....	4 57		284.20
Wed.	7			.....			296.40
Thu.	8	13		☌♃☉.....			308.59
Fri.	9			.....	1 46		320.77
Sat.	10			.....			332.95
Sun.	11	10	43	☽ First Quarter.....	22 36		345.13[b]
Mon.	12	2		☌☿☌ ☿ 5° N.....			357.30[l]
Tue.	13			.....			9.46[l]
Wed.	14	4		♆ stationary in R.A.....	19 25		21.61
Thu.	15			.....			33.77
Fri.	16			.....			45.91
Sat.	17	6		☿ stationary in R.A.....	16 15		58.06
		11		☍☊☉ Dist. from ⊕, 1,612,000,000 mi.			
Sun.	18			.....			70.20
Mon.	19	4		☌☊☾ ☊ 0.2° S.....			82.34
		8	18	♋ Full Moon. Penumbral eclipse, see p. 60			
Tue.	20	16		☾ at apogee. Dist. from ⊕, 252,500 mi.	13 04		94.48
Wed.	21			♀ greatest hel. lat. S.....			106.62
Thu.	22			.....			118.76
Fri.	23			.....	9 53		130.91
Sat.	24			.....			143.06
Sun.	25	9		☌♆☾ ♆ 4° S.....			155.21
Mon.	26			.....	6 43		167.38[b]
Tue.	27	10	50	☾ Last Quarter.....			179.54
		17		☍♇☉ Dist. from ⊕, 3,006,000,000 mi.			
Wed.	28			.....			191.72[l]

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

[l]Feb. 12, 13, +7.15°; Feb. 28, −7.71°. [b]Feb. 11, +6.80°; Feb. 26, −6.82°.

Jupiter being near the sun, configurations of the satellites are not given between Jan. 6 and Apr. 18.

THE SKY FOR MARCH 1962

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

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

The Sun—During March the sun's R.A. increases from 22h 46m to 0h 40m and its Decl. changes from 7° 51′ S. to 4° 16′ N. The equation of time changes from −12m 35s to −4m 10s. On the 20th at 21h 30m E.S.T. the sun crosses the equator on its way north, enters the sign of Aries, and spring commences. This is the vernal equinox.

For changes in the length of the day, see p. 14.

The Moon—For its phases, 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. There will be a daytime occultation of Mercury on the 4th, one of Aldebaran on the night of the 11th, and one of Saturn on the morning of the 31st. See p. 61.

Mercury on the 15th is in R.A. 22h 08m, Decl. 13° 25′ S., and transits at 10h 41m. Greatest western elongation is on the 3rd, so that it might be glimpsed low in the south-east just before sunrise. However, this is a very unfavourable elongation, Mercury being only at 9° altitude at sunrise.

Venus on the 15th is in R.A. 0h 21m, Decl. 0° 59′ N., mag. −3.4, and transits at 12h 53m. It is an evening star and may be seen briefly low in the west just after sunset.

Mars on the 15th is in R.A. 22h 18m, Decl. 11° 47′ S., and transits at 10h 49m. It is a morning star but too close to the sun for easy observation.

Jupiter on the 15th is in R.A. 22h 00m, Decl. 13° 01′ S., mag. −1.6, and transits at 10h 30m. It is a morning star but too close to the sun for easy observation.

Saturn on the 15th is in R.A. 20h 42m, Decl. 18° 42′ S., mag. +0.9, and transits at 9h 11m. It is in Capricornus, visible in the south-east for about two hours before sunrise. Saturn is occulted by the moon on the morning of the 31st. See p. 60.

Uranus on the 15th is in R.A. 10h 00m, Decl. 13° 06′ N., and transits at 22h 26m. It is well up in the east at sunset.

Neptune on the 15th is in R.A. 14h 45m, Decl. 14° 06′ S., and transits at 3h 16m. It rises in the late evening.

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

MARCH E.S.T.				Min. of Algol	Sun's Selen. Colong. 0h U.T.
d	h	m		h m	°
Thu. 1			☿ at ♉	3 32	203.90
Fri. 2					216.08
Sat. 3	0		☿ greatest elongation W., 27°		228.28
	17		☌ ♄ ☾ ♄ 1° S.		
Sun. 4	8		☌ ☿ ☾ ☿ 0.7° S.	0 22	240.48
	21		☌ ♂ ☾ ♂ 0.5° S.		
	22		☌ ♃ ☾ ♃ 0.1° S.		
Mon. 5					252.68
Tue. 6	5		☾ at perigee. Dist. from ⊕, 221,800 mi.	21 11	264.89
	5	31	● New Moon		
	9		☌ ♂ ♃ ♂ 0.4° S.		
Wed. 7					277.10
Thu. 8					289.30
Fri. 9				18 01	301.51
Sat. 10					313.71
Sun. 11			☿ in aphelion		325.91[b]
Mon. 12	23		☌ ☿ ♃ ☿ 1.0° S.	14 50	338.10
	23	39	☽ First Quarter		
Tue. 13					350.29[l]
Wed. 14					2.47
Thu. 15				11 39	14.64
Fri. 16					26.81
Sat. 17					38.97
Sun. 18	8		☌ ♁ ☾ ♁ 0.1° S.	8 29	51.13
	12		☌ ☿ ♂ ☿ 1.0° S.		
Mon. 19			♂ greatest hel. lat. S.		63.29
	16		☾ at apogee. Dist. from ⊕, 252,500 mi.		
Tue. 20	21	30	☉ enters ♈. Spring commences		75.45
Wed. 21	2	56	♍ Full Moon	5 18	87.60
Thu. 22					99.76
Fri. 23					111.91
Sat. 24	14		☌ ♆ ☾ ♆ 3° S.	2 07	124.07
Sun. 25					136.24[b]
Mon. 26				22 57	148.40
Tue. 27					160.57
Wed. 28	23	11	☾ Last Quarter		172.75[l]
Thu. 29				19 46	184.94
Fri. 30					197.13
Sat. 31			☿ greatest hel. lat. S.		209.33
	6		☌ ♄ ☾ ♄ 1° S.		

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

[l]Mar. 13, +7.64°; Mar. 28, −7.15°. [b]Mar. 11, +6.71°; Mar. 25, −6.68°.

Jupiter being near the sun, configurations of the satellites are not given between Jan. 6 and Apr. 18.

THE SKY FOR APRIL 1962

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

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

The Sun—During April the sun's R.A. increases from 0h 40m to 2h 31m and its Decl. changes from 4° 16′ N. to +14° 52′ N. The equation of time changes from −4m 10s to +2m 50s, 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. 1h 28m, Decl. 8° 17′ N., and transits at 12h 00m. It is too close to the sun for observation all month. Superior conjunction is on the 15th.

Venus on the 15th is in R.A. 2h 45m, Decl. 15° 47′ N., mag. −3.3, and transits at 13h 15m. It is an evening star visible low in the west for an hour or more after sunset.

Mars on the 15th is in R.A. 23h 48m, Decl. 2° 29′ S., mag. +1.4, and transits at 10h 17m. In Pisces, it rises about an hour before the sun.

Jupiter on the 15th is in R.A. 22h 25m, Decl. 10° 46′ S., mag. −1.7, and transits at 8h 53m. In Aquarius, it rises about two hours before the sun. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 20h 52m, Decl. 18° 07′ S., mag. +0.9, and transits at 7h 19m. In Capricornus, it rises about three hours before the sun.

Uranus on the 15th is in R.A. 9h 56m, Decl. 13° 23′ N., and transits at 20h 21m. It is approaching the meridian at sunset.

Neptune on the 15th is in R.A. 14h 43m, Decl. 13° 53′ S., and transits at 1h 11m. It rises soon after sunset.

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

APRIL E.S.T.				Min. of Algol	Config. of Jupiter's Sat. 4h 15m	Sun's Selen. Colong. 0h U.T.
	d	h	m	h m		°
Sun.	1	18		☌☿☾ ☿ 0.5° N.	16 36		221.53
Mon.	2	18		☌♂☾ ♂ 2° N.			233.74
Tue.	3	16		☾ at perigee. Dist. from ⊕, 222,800 mi.			245.96
Wed.	4	14	45	● New Moon	13 25		258.18
Thu.	5	17		☌♀☾ ♀ 5° N.			270.41
Fri.	6						282.63
Sat.	7				10 14		294.86[b]
Sun.	8						307.07
Mon.	9	20		☌ Pallas ☉			319.29
Tue.	10				7 03		331.50[l]
Wed.	11	14	51	◑ First Quarter			343.71
Thu.	12						355.90
Fri.	13			♂ at perihelion	3 53		8.10
Sat.	14	13		☌♁☾ ♁ 0.2° S.			20.29
Sun.	15	21		☌☿☉ superior			32.47
Mon.	16	2		☾ at apogee. Dist. from ⊕, 252,100 mi.	0 42		44.65
Tue.	17						56.83
Wed.	18			♀ at ☊	21 31		69.00
Thu.	19			☿ at ☊		32O4*	81.17
		19	34	○ Full Moon			
Fri.	20	19		☌♆☾ ♆ 3° S.		1O24*	93.34
Sat.	21				18 20	O1234	105.51[b]
Sun.	22			Lyrid meteors		12O34	117.69
Mon.	23					2O134	129.86
Tue.	24			☿ at perihelion	15 10	31O24	142.04
Wed.	25					3O142	154.22[l]
Thu.	26					324O*	166.41
Fri.	27	8	00	☾ Last Quarter	11 59	431O*	178.61
		16		☌♄☾ ♄ 0.8° S.			
Sat.	28					4O132	190.82
Sun.	29	10		☌☿☾ ☿ 1° N.		412O3	203.03
Mon.	30				8 48	42O13	215.25

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

[l]Apr. 10, +7.35°; Apr. 25, −6.01°. [b]Apr. 7, +6.59°; Apr. 21, −6.57°.

Jupiter being near the sun, configurations of the satellites are not given between Jan. and Apr. 18.

THE SKY FOR MAY 1962

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

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

The Sun—During May the sun's R.A. increases from 2h 31m to 4h 34m and its Decl. changes from 14° 52′ N. to 21° 57′ N. The equation of time changes from +2m 50s to a maximum of +3m 44s on the 15th and then to +2m 25s 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. There will be an occultation of Regulus on the night of the 11th–12th. See p. 61.

Mercury on the 15th is in R.A. 4h 55m, Decl. 24° 58′ N., and transits at 13h 26m. Greatest eastern elongation is on the 13th. This is a favourable elongation, Mercury's altitude being about 19° at sunset, so that the planet should be easily seen in the west after sunset for a week or so at this time.

Venus on the 15th is in R.A. 5h 17m, Decl. 24° 13′ N., mag. −3.4, and transist at 13h 49m. It is an evening star seen low in the west for about two hours after sunset.

Mars on the 15th is in R.A. 1h 13m, Decl. 6° 42′ N., mag. +1.4, and transits at 9h 44m. In Pisces, moving into Aries, it rises an hour or more before sunrise.

Jupiter on the 15th is in R.A. 22h 44m, Decl. 9° 00′ S., mag. −1.8, and transits at 7h 14m. In Aquarius, it rises about three hours before the sun. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 20h 56m, Decl. 17° 54′ S., mag. +0.8, and transits at 5h 25m. In Capricornus, it rises shortly after midnight. On the 22nd it is stationary in right ascension and begins to move westward among the stars.

Uranus on the 15th is in R.A. 9h 56m, Decl. 13° 25′ N., and transits at 18h 23m. It is a little past the meridian at sunset.

Neptune on the 15th is in R.A. 14h 40m, Decl. 13° 38′ S., and transits at 23h 06m. It is low in the south-east at sunset. Opposition is on the 2nd.

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

			MAY E.S.T.	Min. of Algol	Config. of Jupiter's Sat. 3h 15m	Sun's Selen. Colong. 0h U.T.
	d	h	m	h m		°
Tue.	1		☐ ♄ ☉ west		41302	227.47
		14	☌ ♂ ☾ ♂ 3° N			
		21	☾ at perigee. Dist. from ⊕, 225,400 mi.			
Wed.	2	20	☍ ♆ ☉ Dist. from ⊕, 2,723,000,000 mi.		43012	239.70
Thu.	3	23	25 ● New Moon	5 37	32410	251.94
Fri.	4		☿ greatest hel. lat. N		3014*	264.17[b]
		10	♁ stationary in R.A.			
Sat.	5		η Aquarid meteors		01324	276.41
		7	☌ ☿ ☾ ☿ 7° N			
		18	☌ ♀ ☾ ♀ 5° N			
Sun.	6			2 26	12034	288.65
Mon.	7				20134	300.89
Tue.	8			23 15	13024	313.12[l]
Wed.	9				30124	325.35
Thu.	10				32104	337.57
Fri.	11	7	45 ◑ First Quarter	20 05	32014	349.79
		20	☌ ♁ ☾ ♁ 0.5° S			
Sat.	12				0432*	2.00
Sun.	13	17	☿ greatest elongation E., 22°		d4103	14.21
		18	☾ at apogee. Dist. from ⊕, 251,500 mi.			
Mon.	14			16 54	42013	26.41
Tue.	15				41032	38.60
Wed.	16				43012	50.80
Thu.	17		☐ ♁ ☉ east	13 43	43210	62.99
Fri.	18	0	☌ ♆ ☾ ♆ 3° S		43201	75.17[b]
Sat.	19	9	32 ○ Full Moon		41032	87.36
Sun.	20			10 32	d4023	99.54
Mon.	21				20143	111.72[l]
Tue.	22		♀ at perihelion		10234	123.91
		4	♄ stationary in R.A.			
Wed.	23			7 21	30124	136.10
Thu.	24	2	♇ stationary in R.A.		31204	148.29
		22	☌ ♄ ☾ ♄ 0.6° S			
Fri.	25				32014	160.49
Sat.	26	10	☿ stationary in R.A.	4 10	10324	172.70
		14	06 ☾ Last Quarter			
		23	☌ ♃ ☾ ♃ 2° N			
Sun.	27				01234	184.91
Mon.	28		☿ at ♉		2043*	197.13
Tue.	29	8	☾ at perigee. Dist. from ⊕, 228,500 mi.	0 59	d103*	209.36
Wed.	30	10	☌ ♂ ☾ ♂ 4° N		43012	221.60
Thu.	31			21 48	43120	233.84[b]

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

[l]May 8, +6.49°; May 21, −4.98°. [b]May 4, +6.51°; May 18, −6.56°; May 31, +6.54°.

THE SKY FOR JUNE 1962

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

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

The Sun—During June the sun's R.A. increases from 4h 34m to 6h 38m and its Decl. changes from 21° 57′ N. to 23° 09 ′N. The equation of time changes from +2m 25s to −3m 33s, being zero on the 14th. The solstice is on the 21st at 16h 24m E.S.T. For changes in the length of the day, see p. 15.

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

Mercury on the 15th is in R.A. 4h 46m, Decl. 18° 09′ N., and transits at 11h 12m. Inferior conjunction is on the 7th, and until the last few days of the month the planet is too close to the sun for observation. (See July.)

Venus on the 15th is in R.A. 7h 59m, Decl. 22° 33′ N., mag. −3.4, and transits at 14h 29m. It is an evening star seen low in the west for two hours or more after sunset.

Mars on the 15th is in R.A. 2h 42m, Decl. 14° 55′ N., mag. +1.4, and transits at 9h 10m. In Aries, it rises about two hours before the sun.

Jupiter on the 15th is in R.A. 22h 56m, Decl. 7° 59′ S., mag. −2.1, and transits at 5h 23m. In Aquarius, it rises about midnight.

For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 20h 54m, Decl. 18° 05′ S., mag. +0.7, and transits at 3h 22m. In Capricornus, it rises in the late evening. Saturn is occulted by the moon on the night of the 20th–21st. See p. 61.

Uranus on the 15th is in R.A. 9h 58m, Decl. 13° 09′ N., and transits at 16h 24m. It is well past the meridian at sunset.

Neptune on the 15th is in R.A. 14h 37m, Decl. 13° 26′ S., and transits at 21h 01m. It is approaching the meridian at sunset.

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

JUNE E.S.T.				Min. of Algol	Config. of Jupiter's Sat. 2h 45m	Sun's Selen. Colong. 0h U.T.
	d	h	m	h m		°
Fri.	1		.....		43201	246.08
Sat.	2		☐♃☉ west.....		4102*	258.33
		8	27	● New Moon.....		
Sun.	3		.....	18 37	40123	270.58
Mon.	4	22	☌♀☾ ♀ 4° N.....		4203*	282.83[l]
Tue.	5		.....		4103*	295.08[l]
Wed.	6		.....	15 26	34012	307.32
Thu.	7		☿ at aphelion.....		d3104	319.56
		3	☌♀☉ inferior.....			
Fri.	8	5	☌♁☾ ♁ 0.8° S.....		32014	331.80
Sat.	9		.....	12 14	1024*	344.03
Sun.	10	1	22 ◑ First Quarter.....		01234	356.25
		13	☾ at apogee. Dist. from ⊕, 251,100 mi.			
Mon.	11		.....		21034	8.47
Tue.	12		.....	9 03	d2034	20.69
Wed.	13		☿ greatest hel. lat. N.....		30124	32.89
Thu.	14	7	☌♆☾ ♆ 3° S.....		d3104	45.10
Fri.	15		.....	5 52	32401	57.30[b]
Sat.	16		.....		41302	69.49
Sun.	17	21	03 ♋ Full Moon.....		40123	81.69[l]
Mon.	18		.....	2 41	42103	93.88
Tue.	19	3	☿ stationary in R.A.....		42013	106.07
Wed.	20		.....	23 30	d402*	118.26
Thu.	21	2	☌♄☾ ♄ 0.5° S.....		43102	130.45
		16	24 ☉ enters ♋. Summer commences..			
Fri.	22		.....		34201	142.65
Sat.	23	7	☌♃☾ ♃ 2° N.....	20 19	3102*	154.86
		15	☾ at perigee. Dist. from ⊕, 229,600 mi.			
Sun.	24	18	43 ☾ Last Quarter.....		03142	167.07
Mon.	25		.....		12034	179.29
Tue.	26		.....	17 08	20134	191.51
Wed.	27		☿ greatest hel. lat. S.....		0324*	203.74
Thu.	28	5	☌♂☾ ♂ 5° N.....		31024	215.98[b]
Fri.	29		.....	13 57	32014	228.23
Sat.	30	1	☌☿☾ ☿ 0.8° N.....		3104*	240.48

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

[l]June 4, 5, +5.54°; June 17, −5.00°. [b]June 15, −6.66°; June 28, +6.67°.

THE SKY FOR JULY 1962

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

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

The Sun—During July the sun's R.A. increases from 6h 38m to 8h 43m and its Decl. changes from 23° 09′ N. to 18° 12′ N. The equation of time changes from −3m 33s to a minimum of −6m 25s on the 27th and then to −6m 17s at the end of the month. On the 4th the earth is in aphelion, or farthest from the sun. There is an eclipse of the sun on the 31st. 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. There is a penumbral eclipse of the moon on the 17th.

Mercury on the 15th is in R.A. 6h 27m, Decl. 22° 54′ N., and transits at 11h 00m. It is at greatest western elongation on the 1st. This elongation is not particularly favourable, Mercury having an altitude of about 11° at sunrise; however, it may be seen (just east of Aldebaran) low in the east just before sunrise for a few mornings at this time. By the 29th it is in superior conjunction.

Venus on the 15th is in R.A. 10h 19m, Decl. 11° 58′ N., mag. −3.6, and transits at 14h 50m. It is an evening star seen low in the west for about two hours after sunset.

Mars on the 15th is in R.A. 4h 09m, Decl. 20° 34′ N., mag. +1.4, and transits at 8h 39m. In Taurus to the north of Aldebaran, it rises about three hours before the sun.

Jupiter on the 15th is in R.A. 22h 57m, Decl. 8° 02′ S., mag. −2.3, and transits at 3h 26m. In Aquarius, it rises in the late evening and has passed the meridian by dawn. On the 2nd it is stationary in right ascension and begins to move westward among the stars. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 20h 48m, Decl. 18° 35′ S., mag. +0.5, and transits at 1h 17m. In Capricornus, it rises shortly after sunset. Opposition is on the 31st.

Uranus on the 15th is in R.A. 10h 04m, Decl. 12° 40′ N., and transits at 14h 31m. It is low in the west at sunset. During the night of the 10th–11th Venus will pass close to the north of Uranus, and during the last week of the month Uranus will be very close to Regulus.

Neptune on the 15th is in R.A. 14h 36m, Decl. 13° 21′ S., and transits at 19h 02m. It is past the meridian at sunset.

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

	d	h	m	JULY E.S.T.	Min. of Algol	Config. of Jupiter's Sat. 2h 15m	Sun's Selen. Colong. 0h U.T.
					h m		°
Sun.	1	7		☿ greatest elongation W., 22°.....		03412	252.73
		18	53	● New Moon.....			
Mon.	2	19		♃ stationary in R.A.....	10 45	14203	264.98[l]
Tue.	3	9		☌ Ceres ☉.....		42013	277.23
Wed.	4			⊕ at aphelion. Dist. from ☉, 94,453,000 mi.		41032	289.48
		11		☌ Juno ☉.....			
Thu.	5	2		☌ ♀ ☾ ♀ 0.6° N.....	7 34	d4302	301.74
		15		☌ ♁ ☾ ♁ 1° S.....			
Fri.	6			.....		43201	313.98
Sat.	7			.....		4310*	326.22
Sun.	8	7		☾ at apogee. Dist. from ⊕, 251,300 mi.	4 23	40312	338.46
Mon.	9	18	40	☽ First Quarter.....		41203	350.69
Tue.	10	23		☌ ♀ ♁ ♀ 0.9° N.....		20413	2.92
Wed.	11	15		☌ ♆ ☾ ♆ 4° S.....	1 12	10234	15.14
Thu.	12			.....		30124	27.35[b]
Fri.	13	10		☌ Vesta ☉.....	22 00	3204*	39.56
Sat.	14			.....		32104	51.76[l]
Sun.	15			.....		0124*	63.96
Mon.	16			☿ at ♌.....	18 49	d1034	76.15
Tue.	17	6	41	○ Full Moon. Penumbral eclipse, see p. 60		20143	88.34
Wed.	18	8		☌ ♄ ☾ ♄ 0.7° S.....		10423	100.53
Thu.	19			.....	15 38	43012	112.72
Fri.	20	5		☾ at perigee. Dist. from ⊕, 227,000 mi.		4320*	124.92
		13		☌ ♃ ☾ ♃ 2° N.....			
Sat.	21			☿ at perihelion.....		d4320	137.12
Sun.	22			.....	12 27	4012*	149.32
Mon.	23	17		♆ stationary in R.A.....		41023	161.52
		23	19	☾ Last Quarter.....			
Tue.	24			.....		42013	173.74
Wed.	25			.....	9 15	41023	185.96[b]
Thu.	26	23		☌ ♂ ☾ ♂ 4° N.....		43012	198.19
Fri.	27			.....		31204	210.43
Sat.	28			.....	6 04	d3204	222.67[l]
Sun.	29			δ Aquarid meteors.....		30124	234.91
		10		☌ ☿ ☉ superior.....			
Mon.	30			.....		10234	247.16
Tue.	31			☿ greatest hel. lat. N.....	2 53	20134	259.41
		7	24	● New Moon. Eclipse, see p. 60...			
		14		☍ ♄ ☉. Dist. from ⊕, 830,700,000 mi.			

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56
[l]July 2, +5.15°; July 14, −5.70°; July 28, +5.78°. [b]July 12, −6.82°; July 25, +6.78°.

THE SKY FOR AUGUST 1962

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

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

The Sun—During August the sun's R.A. increases from 8h 43m to 10h 39m and its Decl. changes from 18° 12′ N. to 8° 32′ N. The equation of time changes from −6m 17s to −0m 15s. 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. There is a penumbral eclipse of the moon on the 15th.

Mercury on the 15th is in R.A. 10h 38m, Decl. 9° 49′ N., and transits at 13h 08m. It is too close to the sun all month for observation.

Venus on the 15th is in R.A. 12h 24m, Decl. 3° 12′ S., mag. −3.8, and transits at 14h 52m. It is an evening star seen low in the west for about two hours after sunset.

Mars on the 15th is in R.A. 5h 39m, Decl. 23° 23′ N., mag. +1.3, and transits at 8h 06m. Moving from Taurus into Gemini, it rises at about midnight and is well up in the eastern sky at dawn.

Jupiter on the 15th is in R.A. 22h 48m, Decl. 9° 08′ S., mag. −2.4, and transits at 1h 15m. In Aquarius, it rises about an hour after sunset and is visible all night. Opposition is on the 31st. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 20h 38m, Decl. 19° 13′ S., mag. +0.4, and transits at 23h 02m. In Capricornus, it is risen at sunset and is visible most of the night.

Uranus on the 15th is in R.A. 10h 11m, Decl. 12° 02′ N., and transits at 12h 36m. It is too close to the sun for observation, conjunction being on the 24th.

Neptune on the 15th is in R.A. 14h 36m, Decl. 13° 25′ S., and transits at 17h 01m. 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.					Min. of Algol	Config. of Jupiter's Sat. 1h 00m	Sun's Selen. Colong. 0h U.T.
	d	h	m		h m		°
Wed.	1			.....		1034*	271.66
Thu.	2	1		☌♃☾ ♃ 1° S.....	23 41	3O124	283.90
Fri.	3			□♆☉ east.....		3120 4	296.15
Sat.	4	3		☌♀☾ ♀ 4° S.....		3240 1	308.40
Sun.	5	1		☾ at apogee. Dist. from ⊕, 251,900 mi.	20 30	4302*	320.64
Mon.	6			.....		4102 3	332.87
Tue.	7	23		☌♆☾ ♆ 4° S.....		4201 3	345.10
Wed.	8			☿ at ♉.....	17 19	4120 3	357.33[b]
		10	55	◑ First Quarter.....			
Thu.	9			.....		d4012	9.54
Fri.	10	11		☌☿♃ ☿ 0.8° N.....		4312O	21.76
Sat.	11			.....	14 07	3420 1	33.96[l]
Sun.	12			Perseid meteors.....		3140 2	46.16[l]
Mon.	13			☌ at ♌.....		d0342	58.35
Tue.	14	14		☌♄☾ ♄ 0.9° S.....	10 56	2O134	70.54
Wed.	15	15	10	☽ Full Moon. Penumbral eclipse, see p. 60		2103 4	82.72
Thu.	16	18		☌♃☾ ♃ 1° N.....		O3124	94.91
Fri.	17	3		☾ at perigee. Dist. from ⊕, 224,000 mi.	7 45	d3104	107.09
Sat.	18			.....		3201 4	119.27
Sun.	19			.....		3102 4	131.46
Mon.	20			.....	4 34	O1342	143.65
Tue.	21			.....		4203*	155.85[b]
Wed.	22	5	27	☾ Last Quarter.....		4210 3	168.06
Thu.	23			.....	1 22	4O312	180.27
Fri.	24			☿ at ♉.....		4310 2	192.48[l]
		9		☌♃☉			
		17		☌♂☾ ♂ 3° N.....			
Sat.	25			.....	22 11	4320 1	204.71
Sun.	26			.....		4310 2	216.94
Mon.	27			.....		4O312	229.17
Tue.	28			.....	19 00	4203*	241.40
Wed.	29	22	09	● New Moon.....		2104 3	253.64
Thu.	30			.....		O1324	265.88
Fri.	31	10		☍♃☉. Dist. from ⊕, 370,200,000 mi.	15 48	3102 4	278.12

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

[l]Aug. 11, 12, −6.61°; Aug. 24, +7.02°. [b]Aug. 8, −6.85°; Aug. 21, +6.76°.

THE SKY FOR SEPTEMBER 1962

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

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

The Sun—During September the sun's R.A. increases from 10h 39m to 12h 27m and its Decl. changes from 8° 32′ N. to 2° 55′ S. The equation of time changes from −0m 15s to +10m 02s. On the 23rd at 7h 35m E.S.T. the sun crosses the equator moving southward, enters the sign of Libra and autumn commences. For changes in the length of the day, see p. 17.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 24. There will be an occultation of Saturn on the night of the 10th. See p. 61.

Mercury on the 15th is in R.A. 13h 02m, Decl. 9° 54′ S., and transits at 13h 27m. On the 10th it is at greatest eastern elongation, but this is an unfavourable elongation, the planet being only 9° above the western horizon at sunset.

Venus on the 15th is in R.A. 14h 15m, Decl. 17° 22′ S., mag. −4.1, and transits at 14h 40m. It is an evening star of great brilliance seen low in the west for about two hours after sunset. Greatest eastern elongation is on the 3rd.

Mars on the 15th is in R.A. 7h 04m, Decl. 23° 10′ N., mag. +1.2, and transits at 7h 29m. In Gemini, to the south of Castor and Pollux, it rises about midnight and is nearly at the meridian at dawn.

Jupiter on the 15th is in R.A. 22h 33m, Decl. 10° 39′ S., mag. −2.4, and transits at 22h 54m. In Aquarius, it is just risen at sunset and is visible all night. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 20h 31m, Decl. 19° 41′ S., mag. +0.6, and transits at 20h 53m. In Capricornus, it is well up in the south-east at sunset and sets soon after midnight. Saturn is occulted by the moon on the night of the 10th. See p. 60.

Uranus on the 15th is in R.A. 10h 18m, Decl. 11° 21′ N., and transits at 10h 42m. It rises an hour or two before the sun.

Neptune on the 15th is in R.A. 14h 38m, Decl. 13° 37′ S., and transits at 15h 01m. It is low in the south-west at sunset.

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

SEPTEMBER E.S.T.					Min. of Algol	Config. of Jupiter's Sat. 23h 15m	Sun's Selen. Colong. 0h U.T.
	d	h	m		h m		°
Sat.	1	0		☌☿☾ ☿ 6° S.		3104*	290.36
		14		☾ at apogee. Dist. from ⊕, 252,500 mi.			
Sun.	2	15		☌P☉		30124	302.59
		21		☌♀☾ ♀ 8° S.			
Mon.	3			☿ at aphelion	12 37	12034	314.83
		14		♀ greatest elongation E., 46°			
Tue.	4	7		☌♆☾ ♆ 4° S.		20143	327.05[b]
Wed.	5					d0123	339.27
Thu.	6				9 26	43102	351.49
Fri.	7	1	45	☽ First Quarter		43201	3.70
Sat.	8					43120	15.90
Sun.	9				6 14	43012	28.10[l]
Mon.	10	18		☿ greatest elongation E., 27°		41203	40.29
		22		☌♄☾ ♄ 1° S.			
Tue.	11			♀ at aphelion		42013	52.47
Wed.	12	23		☌♃☾ ♃ 1° N.	3 03	4023*	64.64
Thu.	13	23	12	☍ Full Moon. Harvest Moon		43102	76.82
Fri.	14	11		☾ at perigee. Dist. from ⊕, 222,000 mi.	23 52	32014	88.99
Sat.	15					31204	101.15
Sun.	16					30124	113.32
Mon.	17				20 41	d1034	125.49[b]
Tue.	18					20134	137.67
Wed.	19					10234	149.85
Thu.	20	14	36	☾ Last Quarter	17 29	dd024	162.04
Fri.	21					32014	174.23[l]
Sat.	22	8		☌♂☾ ♂ 2° N.		31240	186.44
		13		☌♀♆ ♀ 6° S.			
Sun.	23			☿ greatest hel. lat. S.	14 18	43012	198.64
		7	35	☉ enters ♎. Autumn commences			
		19		☿ stationary in R.A.			
Mon.	24					41023	210.85
Tue.	25	20		☌♎☾ ♎ 2° S.		42013	223.07
Wed.	26				11 07	41023	235.29
Thu.	27					d4032	247.51
Fri.	28	14	40	● New Moon		4320*	259.73
		20		☾ at apogee. Dist. from ⊕, 252, 700 mi.			
Sat.	29				7 56	34210	271.96
Sun.	30					3012*	284.18

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

[l]Sept. 9, −7.31°; Sept. 21, +7.95°. [b]Sept. 4, −6.75°; Sept. 17, +6.63°.

THE SKY FOR OCTOBER 1962

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

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

The Sun—During October the sun's R.A. increases from 12h 27m to 14h 23m and its Decl. changes from 2° 55′ S. to 14° 12′ S. The equation of time changes from +10m 02s to +16m 20s. For changes in the length of the day, see p. 17.

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

Mercury on the 15th is in R.A. 12h 25m, Decl. 2° 02′ S., and transits at 10h 50m. Early in the month it is too close to the sun for observation, inferior conjunction being on the 6th. By the 21st it is at greatest western elongation and stands at 16° altitude above the eastern horizon at sunrise. This, therefore, is a favourable elongation, and Mercury may be seen easily for about a week at this time.

Venus on the 15th is in R.A. 15h 30m, Decl. 25° 27′ S., mag. −4.3, and transits at 13h 55m. It is an evening star of great brilliance (greatest on the 8th) seen low in the south-west for about two hours after sunset early in the month, but then approaching conjunction rapidly.

Mars on the 15th is in R.A. 8h 16m, Decl. 20° 55′ N., mag. +1.0, and transits at 6h 43m. Moving from Gemini into Cancer, it rises before midnight.

Jupiter on the 15th is in R.A. 22h 22m, Decl. 11° 36′ S., mag. −2.3, and transits at 20h 46m. In Aquarius, it is well up in the south-east at sunset and sets about two hours after midnight. On the 29th it is stationary in right ascension and resumes eastward motion among the stars. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 20h 29m, Decl. 19° 48′ S., mag. +0.8, and transits at 18h 53m. In Capricornus, it is near the meridian at sunset and sets about midnight. On the 9th it is stationary in right ascension and resumes eastward motion among the stars.

Uranus on the 15th is in R.A. 10h 24m, Decl. 10° 46′ N., and transits at 8h 50m. It is well up in the east at sunrise.

Neptune on the 15th is in R.A. 14h 42m, Decl. 13° 55′ S., and transits at 13h 07m. It is too close to the sun for easy observation.

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

				OCTOBER E.S.T.	Min. of Algol	Config. of Jupiter's Sat. 21h 15m	Sun's Selen. Colong. 0h U.T.
	d	h	m		h m		°
Mon.	1	15		☌♆☾ ♆ 3° S.		1O234	296.40[b]
Tue.	2	4		☌♀☾ ♀ 11° S.	4 44	2O134	308.62
Wed.	3			♀ greatest hel. lat. S.		1O34*	320.84
Thu.	4					O1324	333.05
Fri.	5				1 33	3210̄4	345.25
Sat.	6	11		☌♀☉ inferior		d32O4	357.45
		14	55	☽ First Quarter			
Sun.	7				22 22	3O124	9.64[l]
Mon.	8	6		☌♄☾ ♄ 0.9° S.		1O42*	21.82
		17		♀ greatest brilliancy, mag. −4.3.			
Tue.	9	11		♄ stationary in R.A.		24O13	33.99
Wed.	10	6		☌♃☾ ♃ 1° N.	19 11	412O3	46.16
Thu.	11					4O132	58.32
Fri.	12			☿ at ☊		4312O	70.48
		22		☾ at perigee. Dist. from ⊕, 221,800 mi.			
Sat.	13	7	33	♍ Full Moon. Hunter's Moon	16 00	d432O	82.63
Sun.	14	19		☿ stationary in R.A.		43O2*	94.78
Mon.	15					41O2*	106.93[b]
Tue.	16				12 48	24O13	119.09
Wed.	17			☿ at perihelion		12O3*	131.25
Thu.	18					O1324	143.41
Fri.	19				9 37	d13O4	155.58[l]
Sat.	20			Orionid meteors		32O14	167.75
		3	48	☾ Last Quarter			
		20		☌♂☾ ♂ 1° N.			
Sun.	21	23		☿ greatest elongation W., 18°		3O24*	179.93
Mon.	22				6 26	31O24	192.12
Tue.	23	0		♀ stationary in R.A.		2O134	204.31
		5		☌♁☾ ♁ 2° S.			
Wed.	24					21O43	216.51
Thu.	25	23		☾ at apogee. Dist. from ⊕, 252,500 mi.	3 15	dO123	228.71
Fri.	26	16		☌☿☾ ☿ 3° S.		d41O2	240.91
Sat.	27			☿ greatest hel. lat. N.		432O1	253.12
Sun.	28			□♄☉ east	0 04	431O*	265.33
		8	05	● New Moon			
Mon.	29	14		♃ stationary in R.A.		d43O2	277.54[b]
		22		☌♀☾ ♀ 11° S.			
Tue.	30				20 53	42O13	289.74
Wed.	31					412O3	301.95

Explanation of symbols and abbreviations on p. 4, of time on p. 10, of colongitude on p. 56
[l]Oct. 7, −7.36°; Oct. 19, +8.09°. [b]Oct. 1, −6.60°; Oct. 15, +6.48°; Oct. 29, −6.53°.

THE SKY FOR NOVEMBER 1962

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

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

The Sun—During November the sun's R.A. increases from 14h 23m to 16h 26m and its Decl. changes from 14° 12′ S. to 21° 42′ S. The equation of time changes from +16m 20s to a maximum of +16m 23s on the 4th and then to +11m 14s 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 55m, Decl. 16° 05′ S., and transits at 11h 22m. It is too close to the sun for observation, superior conjunction being on the 25th.

Venus on the 15th is in R.A. 15h 01m, Decl. 20° 48′ S., mag. −3.1, and transits at 11h 22m. Still visible briefly as an evening star early in the month, it reaches inferior conjunction on the 12th. During the latter part of the month it is visible just before sunrise as a morning star low in the south-east.

Mars on the 15th is in R.A. 9h 16m, Decl. 17° 56′ N., mag. +0.5, and transits at 5h 40m. Moving through Cancer into Leo, and brightening noticeably, it rises before midnight.

Jupiter on the 15th is in R.A. 22h 23m, Decl. 11° 28′ S., mag. −2.1, and transits at 18h 45m. In Aquarius it is well up in the south-eastern sky at sunset and sets about midnight. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 20h 34m, Decl. 19° 32′ S., mag. +0.9, and transits at 16h 56m. In Capricornus, it is about on the meridian at sunset and sets well before midnight.

Uranus on the 15th is in R.A. 10h 28m, Decl. 10° 23′ N., and transits at 6h 52m. It rises soon after midnight.

Neptune on the 15th is in R.A. 14h 47m, Decl. 14° 16′ S., and transits at 11h 10m. It is too close to the sun for observation; conjunction being on the 5th.

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

NOVEMBER E.S.T.					Min. of Algol	Config. of Jupiter's Sat. 19h 00m	Sun's Selen. Colong. 0h U.T.
	d	h	m		h m		°
Thu.	1			.....		4O123	314.15
Fri.	2			.....	17 42	d14O2	326.34
Sat.	3			□☌☉ west.....		32O1*	338.54
Sun.	4	14		☌♄☾ ♄ 0.6° S.....		312O4	350.72[l]
Mon.	5			Taurid meteors.....	14 31	3O124	2.90
		2	15	☽ First Quarter.....			
		22		☌♆☉.....			
Tue.	6	13		☌♃☾ ♃ 1° N.....		2O34*	15.07
Wed.	7			.....		21O34	27.23
Thu.	8			.....	11 20	O1234	39.38
Fri.	9			.....		1O324	51.53
Sat.	10	9		☾ at perigee. Dist. from ⊕, 223,500 mi.		32O14	63.67
Sun.	11	17	04	♋ Full Moon.....	8 09	3124O	75.81[b]
Mon.	12	15		☌♀☉ inferior.....		43O12	87.95
Tue.	13			.....		d41O*	100.08
Wed.	14			.....	4 58	d42O3	112.22
Thu.	15			.....		4O123	124.36
Fri.	16			Leonid meteors.....		41O32	136.51[l]
Sat.	17			.....	1 47	432O1	148.66
Sun.	18	4		☌☌☾ ☌ 0.7° N.....		3412O	160.82
		21	10	☾ Last Quarter.....			
Mon.	19	13		☌♁☾ ♁ 2° S.....	22 36	34O12	172.98
Tue.	20			☿ at ♉.....		1O324	185.15
Wed.	21	18		☌♀♆ ♀ 4° S.....		2O134	197.32
		21		Pallas stationary in R.A.....			
Thu.	22	11		☾ at apogee. Dist. from ⊕, 252,000 mi.	19 25	O34**	209.50
Fri.	23			.....		1O324	221.69
Sat.	24			.....		32O14	233.88
Sun.	25	5		☌☿☉ superior.....	16 14	321O4	246.07[b]
		5		☌♀☾ ♀ 6° S.....			
		7		☌♆☾ ♆ 3° S.....			
Mon.	26			□♃☉ east.....		3O124	258.26
Tue.	27			□♁☉ west.....		13O24	270.46
		1	30	● New Moon.....			
Wed.	28			.....	13 03	24O13	282.65
Thu.	29			♀ at ♌.....		4O3**	294.84
Fri.	30			☿ at aphelion.....		41O32	307.04

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

[l]Nov. 4, −6.61°; Nov. 16, +7.37°. [b]Nov. 11, +6.51°; Nov. 25, −6.61°.

THE SKY FOR DECEMBER 1962

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

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

The Sun—During December the sun's R.A. increases from 16h 26m to 18h 43m and its Decl. changes from 21° 42′ S. to 23° 05′ S. The equation of time changes from +11m 14s to −3m 08s, being zero on the 25th. The solstice is on the 22nd at 3h 15m E.S.T. For changes in the length of the day, see p. 18.

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

Mercury on the 15th is in R.A. 18h 15m, Decl. 25° 31′ S., and transits at 12h 44m. It is too close to the sun all month for observation.

Venus on the 15th is in R.A. 14h 52m, Decl. 13° 40′ S., mag. −4.4, and transits at 9h 18m. It is a morning star of great brilliance (greatest on the 18th) visible in the south-east for several hours before sunrise.

Mars on the 15th is in R.A. 9h 49m, Decl. 16° 18′ N., mag. −0.1, and transits at 4h 15m. In Leo, now quite bright, it rises about two hours before midnight. On the 27th it is stationary in right ascension and begins to move westward among the stars.

Jupiter on the 15th is in R.A. 22h 34m, Decl. 10° 17′ S., mag. −1.9, and transits at 16h 58m. In Aquarius, it is about on 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. 20h 43m, Decl. 18° 57′ S., mag. +0.9, and transits at 15h 08m. In Capricornus, it is well past the meridian at sunset and sets about three hours later.

Uranus on the 15th is in R.A. 10h 30m, Decl. 10° 17′ N., and transits at 4h 55m. It rises before midnight.

Neptune on the 15th is in R.A. 14h 51m, Decl. 14° 34′ S., and transits at 9h 16m. It rises several hours before the sun.

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

DECEMBER E.S.T.				Min. of Algol	Config. of Jupiter's Sat. 17h 15m	Sun's Selen. Colong. 0h U.T.
	d	h	m	h m		°
Sat.	1	15		♀ stationary in R.A.	9 52	43201	319.22
		22		☌ ♄ ☾ ♄ 0.2° S.			
Sun.	2					43210	331.40[l]
Mon.	3	22		☌ ♃ ☾ ♃ 2° N.		43012	343.58
Tue.	4	11	48	☽ First Quarter	6 42	41302	355.75
Wed.	5					42013	7.91
Thu.	6					1203*	20.06
Fri.	7				3 31	01423	32.21
Sat.	8	12		☾ at perigee. Dist. from ⊕, 226,800 mi.		3204*	44.35[b]
Sun.	9					32104	56.48
Mon.	10				0 20	30124	68.61
Tue.	11	4	28	☍ Full Moon		31024	80.74
		8		♁ stationary in R.A.			
Wed.	12				21 09	20314	92.87
Thu.	13			Geminid meteors		12043	105.00
		18		☌ ♀ ♆ ♀ 0.9° N.			
Fri.	14					01423	117.13[l]
Sat.	15				17 58	d403*	129.26
Sun.	16	2		☌ ♂ ☾ ♂ 0.9° N.		43210	141.40
		22		☌ ♁ ☾ ♁ 2° S.			
Mon.	17					43021	153.54
Tue.	18	17	43	☾ Last Quarter	14 48	43102	165.70
		19		♀ greatest brilliancy, mag. −4.4			
Wed.	19					42031	177.85
Thu.	20			☿ greatest hel. lat. S.		42103	190.01
		6		☾ at apogee. Dist. from ⊕, 251,500 mi.			
Fri.	21	6		♇ stationary in R.A.	11 37	40123	202.18
Sat.	22			Ursid meteors		41032	214.35[b]
		3	15	☉ enters ♑. Winter commences			
		17		☌ ♆ ☾ ♆ 3° S.			
Sun.	23	2		☌ ♀ ☾ ♀ 2° S.		d3204	226.53
Mon.	24				8 26	3014*	238.72
Tue.	25					31024	250.90
Wed.	26	17	59	● New Moon		20314	263.09
Thu.	27	4		♂ stationary in R.A.	5 16	21034	275.28
Fri.	28	6		☌ ☿ ☾ ☿ 2° S.		01234	287.47[l]
Sat.	29	9		☌ ♄ ☾ ♄ 0.2° N.		10324	299.65
Sun.	30				2 04	23014	311.84
Mon.	31	10		☌ ♃ ☾ ♃ 2° N.		3204*	324.02

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

[l]Dec. 2, −5.34°; Dec. 14, +6.15°; Dec. 28, −4.73°. [b]Dec. 8, +6.63°; Dec. 22, −6.78°.

Jupiter being near the sun, phenomena of the satellites are not given between Jan. 6 and Apr. 18.

APRIL

d	h	m	Sat.	Phen.
27	3	50	I	Te
	3	54	III	ER

MAY

d	h	m	Sat.	Phen.
4	3	32	I	TI
13	2	53	II	TI
	3	04	II	Se
15	3	38	III	TI
19	3	20	I	ED
20	2	50	I	Se
	2	50	II	SI
22	2	46	II	OR
27	2	28	I	SI
28	3	24	I	OR

JUNE

d	h	m	Sat.	Phen.
2	1	57	III	OD
4	1	37	I	ED
5	2	25	I	Te
	2	25	II	ED
7	2	56	II	Te
12	2	03	I	TI
	2	59	I	Se
13	1	39	I	OR
14	2	45	II	TI
	2	48	II	Se
19	2	37	I	SI
20	3	03	III	Te
21	0	38	I	Te
	2	36	II	SI
23	2	02	IV	OD
	2	14	II	OR
27	1	48	I	ED
	1	48	III	Se
28	0	13	I	TI
	1	14	I	Se
	2	28	I	Te

JULY

d	h	m	Sat.	Phen.
1	3	21	IV	Se
4	2	17	III	SI
5	0	52	I	SI
	2	03	I	TI
	3	08	I	Se
6	1	39	I	OR
7	2	01	II	ED
8	0	30	III	OR
	23	56	II	Se
9	2	10	II	Te
12	2	46	I	SI
13	0	05	I	ED
	3	27	I	OR
	23	30	I	Se
14	0	33	I	Te
	23	53	III	ER
15	0	43	III	OD
	23	43	II	SI
16	1	51	II	TI
	2	32	II	Se
18	3	06	IV	TI
20	1	59	I	ED
	23	08	I	SI
21	0	05	I	TI
	1	24	I	Se
	2	20	I	Te
	23	41	I	OR
22	0	21	III	ED
23	2	20	II	SI
25	1	01	II	OR
26	1	55	IV	ED
28	1	02	I	SI
	1	51	I	TI
	3	18	I	Se
	22	22	I	ED
29	1	27	I	OR
	22	33	I	Te
31	23	04	II	ED

AUGUST

d	h	m	Sat.	Phen.
1	3	19	II	OR
	21	47	III	Se
2	0	37	III	Te
	22	23	II	Te
3	21	52	IV	Te
4	2	56	I	SI
	3	36	I	TI
5	0	16	I	ED
	3	13	I	OR
	22	03	I	TI
	23	41	I	Se
6	0	18	I	Te
	21	39	I	OR
8	1	40	II	ED
	22	17	III	SI
9	0	38	III	TI
	1	47	III	Se
	3	59	III	Te
	21	57	II	TI
	23	38	II	Se
10	0	40	II	Te
12	0	27	IV	ER
	1	02	IV	OD
	2	11	I	ED
	23	19	I	SI
	23	47	I	TI
13	1	35	I	Se
	2	03	I	Te
	23	23	I	OR
16	2	19	III	SI
	3	58	III	TI
	23	26	II	SI
17	0	12	II	TI
	2	13	II	Se
	2	55	II	Te
18	21	00	II	OR
19	4	05	I	ED
	21	04	III	OR
20	1	13	I	SI
	1	31	I	TI
	3	30	I	Se
	3	47	I	Te
	22	34	I	ED
21	1	07	I	OR
	21	59	I	Se
	22	13	I	Te
24	2	02	II	SI
	2	26	II	TI
25	20	11	II	ED
	23	15	II	OR
26	20	26	III	ED
27	0	20	III	OR
	3	08	I	SI
	3	15	I	TI
28	0	28	I	ED
	2	50	I	OR
	21	36	I	SI
	21	40	I	TI
	23	53	I	Se
	23	57	I	Te
29	21	16	I	OR

SEPTEMBER

d	h	m	Sat.	Phen.
1	22	44	II	OD
2	1	36	II	ER
3	0	13	III	OD
	3	56	III	ER
	20	31	II	Te
	20	43	II	Se
4	2	18	I	OD
	23	24	I	TI
	23	31	I	SI
5	1	40	I	Te
	1	48	I	Se
	20	43	I	OD
	22	39	IV	TI
	23	09	I	ER
	23	51	IV	SI
6	2	25	IV	Te
	20	07	I	Te
	20	17	I	Se
9	0	59	II	OD
10	3	29	III	OD
	20	01	II	TI
	20	33	II	SI
	22	45	II	Te
	23	19	II	Se
12	1	08	I	TI
	1	26	I	SI
	3	25	I	Te
	22	27	I	OD
13	1	03	I	ER
	19	34	I	TI
	19	55	I	SI
	20	25	III	Te
	21	51	I	Te
	21	51	III	Se
	22	12	I	Se
14	19	32	I	ER
17	22	16	II	TI
	23	09	II	SI
18	1	00	II	Te
	1	54	II	Se
19	20	09	II	ER
20	0	12	I	OD
	20	20	III	TI
	21	19	I	TI
	21	50	I	SI
	22	25	III	SI
	23	36	I	Te
	23	44	III	Te
21	0	07	I	Se
	1	52	III	Se
	21	27	I	ER
22	22	15	IV	Se
25	0	32	II	TI
	1	45	II	SI
26	22	46	II	ER
27	1	57	I	OD
	23	05	I	TI
	23	43	III	TI
	23	46	I	SI
28	1	21	I	Te
	2	02	I	Se
	20	23	I	OD
	23	22	I	ER
29	19	48	I	Te
	20	31	I	Se
30	19	55	IV	OD
	23	54	IV	OR

OCTOBER

d	h	m	Sat.	Phen.
1	20	00	III	ER
3	20	58	II	OD
4	1	24	II	ER
5	0	51	I	TI
5	1	41	I	SI
	18	44	II	Te
	20	23	II	Se
	22	10	I	OD
6	1	17	I	ER
	19	18	I	TI
	20	10	I	SI
	21	34	I	Te
	22	26	I	Se
7	19	45	I	ER
8	20	22	III	OR
	20	35	III	ED
9	0	01	III	ER
10	23	20	II	OD
11	18	20	II	TI
12	20	16	II	SI
	21	04	II	Te
	22	59	II	Se
	23	57	I	OD
13	21	06	I	TI
	22	06	I	SI
	23	23	I	Te
14	0	22	I	Se
	18	24	I	OD
	21	41	I	ER
15	18	51	I	Se
	20	26	III	OD
	23	54	III	OR
16	0	37	III	ED
17	21	09	IV	ED
19	20	43	II	TI
	22	52	II	SI
	23	27	II	Te
20	22	56	I	TI
21	0	01	I	SI
	20	00	II	ER
	20	13	I	OD
	23	36	I	ER
22	18	30	I	SI
	19	39	I	Te
	20	46	I	Se
23	0	02	III	OD
	18	05	I	ER
25	19	29	IV	TI
	23	37	IV	Te
26	21	59	III	Se
	23	08	II	TI
28	22	03	I	OD
	22	39	II	ER
29	19	14	I	TI
	20	26	I	SI
	21	30	I	Te
	22	42	I	Se
30	20	00	I	ER

NOVEMBER

d	h	m	Sat.	Phen.
2	21	01	III	Te
	22	38	III	SI
3	19	13	IV	ER
4	19	55	II	OD
5	21	06	I	TI
	22	22	I	SI
	23	22	I	Te
6	18	23	I	OD
	20	03	II	Se
	21	55	I	ER
7	17	50	I	Te
	19	07	I	Se
9	21	23	III	TI
11	22	28	II	OD
12	23	00	I	TI
13	19	58	II	SI
	20	06	II	Te
	20	09	III	ER

d	h	m	Sat.	Phen.
13	20	15	I	OD
	22	39	II	Se
14	18	47	I	SI
	19	44	I	Te
	21	03	I	Se
15	18	19	I	ER
19	20	55	IV	OD
20	18	48	III	OR
	19	56	II	TI
	20	48	III	ED
	22	09	I	OD
	22	34	II	SI
	22	39	II	Te
21	19	23	I	TI
	20	43	I	SI
21	21	39	I	Te
22	19	54	II	ER
	20	14	I	ER
23	17	28	I	Se
27	19	18	III	OD
28	19	32	IV	SI
	21	19	I	TI
29	18	34	I	OD
30	18	04	I	Te
	19	24	I	Se

DECEMBER

d	h	m	Sat.	Phen.
1	18	08	III	Se
6	19	32	IV	OR
6	19	42	II	OD
	20	30	I	OD
7	17	45	I	TI
	19	04	I	SI
	20	01	I	Te
	21	20	I	Se
8	18	34	I	ER
	18	52	III	SI
	19	44	II	Se
14	19	43	I	TI
	21	00	I	SI
15	17	15	IV	Se
	17	39	III	TI
	19	41	II	SI
	19	52	II	Te
15	20	29	I	ER
	21	06	III	Te
16	17	45	I	Se
22	18	55	I	OD
	19	50	II	TI
23	17	25	I	SI
	18	28	I	Te
	19	41	I	Se
24	19	50	II	ER
26	20	18	III	ER
30	18	11	I	TI
	19	21	I	SI
	20	28	I	Te
31	18	49	I	ER

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 at least one hour above the horizon, and the sun at least one hour below the horizon.

THE OBSERVATION OF THE MOON

During 1962 the ascending node of the moon's orbit moves from the constellation Leo into Cancer (☊ from 140° to 121°). See p. 61 for occultations of the planets and of the bright stars Aldebaran and Regulus.

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 $+1\frac{1}{2}°$ and $-1\frac{1}{2}°$ during the year.

By the moon's libration is meant the shifting, or rather apparent shifting, of the visible disk. Sometimes the observer sees features farther around the eastern or the western limb (libration in longitude), or the northern or southern limb (libration in latitude). The quantities called the earth's selenographic longitude and latitude are a convenient way of indicating the two librations. When the libration in longitude, that is the selenographic longitude of the earth, is positive, the mean central point of the disk of the moon is displaced eastward on the celestial sphere, exposing to view a region on the west limb. When the libration in latitude, or the selenographic latitude of the earth, is positive, the mean central point of the disk of the moon is displaced towards the south, and a region on the north limb is exposed to view.

In the Astronomical Phenomena Month by Month the dates of the greatest positive and negative values of the libration in longitude are indicated by [l] in the column headed "Sun's Selenographic Colongitude," and their values are given in the footnotes. Similarly the extreme values of the libration in latitude are indicated by [b].

LONGITUDE OF JUPITER'S CENTRAL MERIDIAN

By Geoffrey Gaherty, Jr.

The table gives the longitude of the central meridian of the illuminated disk of Jupiter for given times daily during the period when the planet is favourably placed. System I applies to the regions between the middle of the North Equatorial Belt and the middle of the South Equatorial Belt; System II to the rest of the planet. Longitude increases hourly by 36.58° in System I and 36.26° in System II. Detailed ancillary tables may be found in "The Planet Jupiter" by B. M. Peek (Faber & Faber, 1958) on pages 274 and 275.

	SYSTEM I						SYSTEM II					
Month U.T. E.S.T.	June 29h 24h	July 27h 22h	Aug. 24h 19h	Sept. 24h 19h	Oct. 24h 19h	Nov. 22h 17h	June 29h 24h	July 27h 22h	Aug. 24h 19h	Sept. 24h 19h	Oct. 24h 19h	Nov. 22h 17h
Day	°	°	°	°	°	°	°	°	°	°	°	°
1	70.3	34.8	143.0	2.0	61.6	202.3	8.7	122.3	354.8	337.3	168.0	72.9
2	208.2	192.8	301.0	160.1	219.5	0.2	156.2	272.6	145.2	127.7	318.3	223.1
3	6.1	350.7	99.0	318.1	17.5	158.0	306.5	63.0	295.6	278.1	108.6	13.3
4	156.0	148.7	257.1	116.1	175.4	315.8	96.8	213.3	86.0	68.5	258.9	163.4
5	321.9	306.7	55.1	274.1	333.3	113.5	247.0	3.6	236.4	218.9	49.2	313.6
6	119.8	104.7	213.1	72.2	131.2	271.3	37.3	154.0	26.8	9.3	199.5	103.8
7	277.7	262.6	11.1	230.2	289.1	69.1	187.6	304.3	177.2	159.7	349.7	253.9
8	75.6	60.6	169.2	28.2	87.0	226.9	337.8	94.7	327.6	310.1	140.0	44.1
9	233.5	218.6	327.2	186.2	244.9	24.7	128.1	245.0	118.0	100.4	290.3	194.2
10	31.4	16.6	125.2	344.2	42.8	182.5	278.4	35.4	268.4	250.8	80.6	344.4
11	189.3	174.6	283.3	142.2	200.7	340.2	68.7	185.7	58.8	41.2	230.8	134.5
12	347.2	332.5	81.3	300.2	358.6	138.0	218.9	336.1	209.2	191.6	21.1	284.7
13	145.1	130.5	239.4	98.2	156.5	295.8	9.2	126.4	359.6	341.9	171.3	74.8
14	303.0	288.5	37.4	256.2	314.4	93.5	159.5	276.8	150.0	132.3	321.6	224.9
15	101.0	86.5	195.4	54.2	112.3	251.3	309.8	67.2	300.4	282.7	111.8	15.1
16	258.9	244.5	353.5	212.2	270.1	49.1	100.1	217.5	90.8	73.0	262.1	165.2
17	56.8	42.5	151.5	10.2	68.0	206.8	250.4	7.9	241.2	223.4	52.3	315.3
18	214.7	200.5	309.5	168.2	225.9	4.6	40.7	158.2	31.7	13.7	202.6	105.5
19	12.7	358.5	107.6	326.1	23.7	162.3	191.0	308.6	182.1	164.1	352.8	255.6
20	170.6	156.5	265.6	124.1	181.6	320.1	341.3	99.0	332.5	314.4	143.0	45.7
21	328.5	314.5	63.7	282.1	339.4	117.8	131.6	249.4	122.9	104.8	293.2	195.8
22	126.5	112.5	221.7	80.1	137.3	275.6	281.9	39.7	273.3	255.1	83.5	345.9
23	284.4	270.5	19.7	238.0	295.1	73.3	72.2	190.1	63.7	45.5	233.7	136.0
24	82.3	68.5	177.8	36.0	93.0	231.0	222.5	340.5	214.1	195.8	23.9	286.1
25	240.3	226.5	335.8	193.9	250.8	28.8	12.8	130.9	4.5	346.1	174.1	76.2
26	38.2	24.6	133.8	351.9	48.6	186.5	163.2	281.3	154.9	136.4	324.3	226.3
27	196.2	182.6	291.9	149.8	206.5	344.2	313.5	71.7	305.3	286.8	114.5	16.4
28	354.1	340.6	89.9	307.8	4.3	141.9	103.8	222.0	95.7	77.1	264.7	166.5
29	152.1	138.6	247.9	105.7	162.1	299.7	254.1	12.4	246.1	227.4	54.9	316.6
30	310.1	296.6	46.0	263.7	319.9	97.4	144.5	162.8	36.5	17.7	205.1	106.7
31		94.7	204.0		117.7			313.2	186.9		355.2	

EPHEMERIS FOR THE PHYSICAL OBSERVATIONS OF THE SUN, 1962
For 0h U.T.

Date	P	B_0	L_0	Date	P	B_0	L_0
	°	°	°		°	°	°
Jan. 1	+ 2.24	−3.04	314.04	July 5	− 1.09	+3.31	32.32
6	− 0.19	−3.61	248.20	10	+ 1.18	+3.84	326.15
11	− 2.60	−4.16	182.35	15	+ 3.42	+4.34	259.98
16	− 4.97	−4.67	116.51	20	+ 5.63	+4.80	193.82
21	− 7.28	−5.14	50.68	25	+ 7.77	+5.24	127.67
26	− 9.51	−5.57	344.84	30	+ 9.85	+5.64	61.53
31	−11.64	−5.96	279.01	Aug. 4	+11.85	+6.00	355.41
Feb. 5	−13.66	−6.30	213.18	9	+13.74	+6.32	289.29
10	−15.55	−6.60	147.35	14	+15.54	+6.59	223.19
15	−17.32	−6.84	81.51	19	+17.22	+6.82	157.10
20	−18.94	−7.02	15.67	24	+18.78	+7.01	91.03
25	−20.41	−7.15	309.82	29	+20.21	+7.14	24.97
Mar. 2	−21.74	−7.23	243.96	Sept. 3	+21.51	+7.22	318.92
7	−22.90	−7.25	178.09	8	+22.67	+7.25	252.89
12	−23.91	−7.21	112.20	13	+23.68	+7.23	186.86
17	−24.74	−7.12	46.30	18	+24.54	+7.15	120.85
22	−25.41	−6.98	340.38	23	+25.24	+7.03	54.85
27	−25.90	−6.78	274.45	28	+25.77	+6.85	348.86
Apr. 1	−26.21	−6.54	208.50	Oct. 3	+26.14	+6.62	282.89
6	−26.35	−6.24	142.52	8	+26.33	+6.34	216.92
11	−26.30	−5.90	76.53	13	+26.34	+6.01	150.95
16	−26.07	−5.52	10.52	18	+26.16	+5.64	85.00
21	−25.66	−5.10	304.48	23	+25.79	+5.22	19.05
26	−25.06	−4.65	238.43	28	+25.23	+4.76	313.11
May 1	−24.28	−4.16	172.36	Nov. 2	+24.47	+4.27	247.18
6	−23.32	−3.64	106.27	7	+23.51	+3.74	181.26
11	−22.18	−3.10	40.16	12	+22.36	+3.18	115.33
16	−20.87	−2.54	334.04	17	+21.02	+2.60	49.42
21	−19.40	−1.96	267.90	22	+19.49	+2.00	343.51
26	−17.78	−1.37	201.74	27	+17.79	+1.38	277.61
31	−16.01	−0.78	135.58	Dec. 2	+15.92	+0.75	211.71
June 5	−14.12	−0.17	69.42	7	+13.90	+0.11	145.82
10	−12.12	+0.43	3.24	12	+11.76	−0.53	79.94
15	−10.02	+1.03	297.06	17	+ 9.51	−1.17	14.06
20	− 7.85	+1.62	230.87	22	+ 7.18	−1.80	308.19
25	− 5.62	+2.20	164.68	27	+ 4.78	−2.41	242.33
30	− 3.36	+2.77	98.50				

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, 1962

No.	Commences	No.	Commences	No.	Commences
1450	Jan. 24.85	1455	June 10.24	1460	Oct. 24.44
1451	Feb. 21.19	1456	July 7.44	1461	Nov. 20.75
1452	Mar. 20.51	1457	Aug. 3.65	1462	Dec. 18.07
1453	Apr. 16.80	1458	Aug. 30.89		
1454	May 14.04	1459	Sept. 27.16		

ECLIPSES, 1962

In 1962 there will be five eclipses, two of the sun and three of the moon.

All three eclipses of the moon are penumbral, that is to say the moon does not enter the umbra of the earth's shadow at all. The "magnitude" of each of these eclipses (by which is meant the ratio of the least distance from the moon's edge to the umbra relative to the moon's diameter) is such that the eclipse will not be apparent to the eye, but may be detected on photographs.

I. *A Total Eclipse of the Sun* on February 4, visible as a partial eclipse at sunset along the western edge of North America. The path of totality begins in Borneo, crosses New Guinea and ends in the Pacific Ocean off the California coast.

II. *A Penumbral Eclipse of the Moon* on February 19, the beginning "visible" in North America just before dawn.

Moon enters penumbra.....6h 05m E.S.T.
Middle of eclipse.....8h 04m E.S.T.
Moon leaves penumbra.....10h 02m E.S.T.
Penumbral magnitude of eclipse . . . 0.639

III. *A Penumbral Eclipse of the Moon* on July 17, the beginning "visible" before dawn in North America except the north-eastern part.

Moon enters penumbra.....5h 28m E.S.T.
Middle of eclipse.....6h 55m E.S.T.
Moon leaves penumbra.....8h 22m E.S.T.
Penumbral magnitude of the eclipse 0.418

IV. *An Annular Eclipse of the Sun* on July 31, visible as a partial eclipse at sunrise in the Florida peninsula, but not elsewhere in North America. The path of the annular eclipse begins in northern South America, crosses the Atlantic and central Africa, and ends in the Indian Ocean.

V. *A Penumbral Eclipse of the Moon* on August 15, not "visible" in North America.

PLANETARY OCCULTATIONS

The close approach of a planet to a star is of interest to observers. A rare phenomenon, the occultation of a star by a planet, is visible from Canada in 1962.

On the night of July 22–23 Saturn occults the 8.6th magnitude star, B.D.—19° 5925. Since Saturn is a slow-moving planet the predicted times are approximate, and may be in error by two or three minutes. The following data, supplied by Mr. Gordon E. Taylor and the British Astronomical Association, include the standard time and *P* the position angle of the point of contact on Saturn, reckoned from the north point towards the east.

	Montreal, Toronto E.S.T.			P	Edmonton M.S.T.			P	Vancouver P.S.T.			P
			h	m			h	m			h	m
BALL OF PLANET				°				°				°
Disappearance	July	23	0	56	234	July	22	22 58	234	July	22	22 00	234
Reappearance	July	23	2	28	91	July	23	0 27	92	July	22	23 27	93
RINGS													
Disappearance	July	23	0	47	236	July	22	22 49	235	July	22	21 51	235
Reappearance	July	23	3	14	83	July	23	1 16	84	July	23	0 18	84

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 7.5 or brighter are included as well as daytime occultations of very bright stars and planets. Since an occultation at the bright limb of the moon is difficult to observe the predictions are limited to phenomena occurring at the dark limb.

The terms a and b are for determining corrections to the times of the phenomena for stations within 300 miles of the standard stations. Thus if λ_0, ϕ_0, be the longitude and latitude of the standard station and λ, ϕ, the longitude and latitude of the neighbouring station then for the neighbouring station we have:

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

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

The co-ordinates of the standard stations are: Toronto, λ_0 79° 23.9′, ϕ_0+43° 39.8′; Montreal, λ_0 73° 34.7′, ϕ_0+45° 30.3′; Edmonton, λ_0 113° 05′, ϕ_0+53° 32′; Vancouver, λ_0 123° 06′, ϕ_0+49° 30′.

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1962

Date	Star	Mag.	I or E	Age of Moon	Toronto				Montreal			
					E.S.T.	a	b	P	E.S.T.	a	b	P
				d	h m	m	m	°	h m	m	m	°
Jan. 12	117G. Psc	6.6	I	6.6	22 07.1	−0.9	−1.6	96	22 08.8	−0.7	−1.5	92
Jan. 14	+11° 434	7.3	I	8.5	18 34.0	−0.8	+3.0	23	18 44.1	−0.9	+2.7	25
Jan. 14	+11° 445	5.9	I	8.6	21 06.2	−1.8	0.0	76	21 15.7	−1.6	−0.2	74
Jan. 15	179B. Tau	6.0	I	9.6	23 38.5	−1.2	−3.2	127	23 39.7	−1.0	−2.5	118
Jan. 22	α Leo	1.3	I	16.6	21 34.7	−0.9	−1.7	158	21 37.1	−0.9	−1.2	151
Jan. 22	α Leo	1.3	E	16.6	22 15.8	−0.8	+3.9	229	22 27.8	−1.1	+3.2	238
Jan. 22	Uranus	5.7	E	16.7	23 13.9	−1.3	−0.2	306	23 20.8	−1.3	−0.7	314
Jan. 29	13 Lib	5.8	E	22.9	4 44.2	−2.0	+1.3	261	4 57.1	−1.8	+0.6	274
Jan. 30	190B. Lib	6.4	E	23.9	3 41.4	−1.1	+1.5	264	3 50.1	−1.1	+1.1	276
Jan. 31	24 Sco	5.0	E	25.0	5 38.5	—	—	356	No occ.	...	...	...
Feb. 7	25B. Cet	6.8	I	3.0	20 05.1	−0.5	−1.6	98	Low	...	...	...
Feb. 8	26 Cet	6.2	I	4.0	18 33.7	−1.5	−1.1	91	18 39.4	−1.2	−1.2	90
Feb. 8	29 Cet	6.7	I	4.0	20 55.3	−0.4	−0.3	56	Low	...	...	...
Feb. 12	α Tau	1.1	I	7.9	15 57.0	−0.8	+1.9	66	16 05.5	−1.0	+1.8	68
Feb. 12	α Tau	1.1	E	7.9	17 10.4	−1.4	+1.4	258	17 21.5	−1.5	+1.2	256
Feb. 13	+16° 657	7.2	I	8.2	0 42.4	−0.4	−0.9	73	0 43.3	−0.4	−0.7	63
Feb. 13	119 Tau	4.7	I	9.0	Sun	...	...	...	17 44.5	−1.1	+2.4	49
Feb. 13	120 Tau	5.5	I	9.0	18 13.7	−1.5	+1.4	76	18 25.3	−1.6	+1.2	76
Feb. 14	+18° 950	6.9	I	9.2	1 22.6	−0.4	−1.3	89	1 22.4	−0.3	−1.1	80
Feb. 14	22 Gem	6.9	I	10.2	23 16.1	−1.8	−0.2	72	23 25.8	−1.6	0.0	62
Feb. 15	+19° 1734	7.2	I	11.2	23 34.5	−1.9	−0.3	80	23 45.0	−1.8	−0.1	69
Feb. 16	+18° 1882	6.4	I	12.1	20 26.9	—	—	164	20 30.7	—	—	153
Feb. 17	25 Cnc	6.2	I	12.3	3 56.3	+0.3	−2.9	152	3 50.2	+0.2	−2.4	141
Feb. 19	α Leo	1.3	I	14.4	6 34.3	−0.3	−0.4	53	6 35.2	−0.2	+0.1	42
Mar. 4	Mercury	0.3	I	27.5	6 29.3	−1.1	+2.9	29	6 42.1	—	—	19
Mar. 4	Mercury	0.3	E	27.5	7 13.3	−0.8	+0.1	311	7 18.4	—	—	319
Mar. 11	75 Tau	5.3	I	5.6	21 36.1	−0.8	−1.2	85	21 38.1	−0.6	−1.0	76
Mar. 11	+15° 633m.	6.6	I	5.7	22 05.6	0.0	−4.0	142	22 00.1	−0.1	−2.8	127
Mar. 11	264B. Tau	4.8	I	5.7	22 51.6	+0.4	−3.9	145	22 44.3	+0.2	−2.6	129
Mar. 11	269B. Tau	6.7	I	5.7	No occ.	...	...	...	22 57.6	+0.6	−4.1	148
Mar. 13	+18° 862	6.6	I	6.8	0 34.2	+0.1	−1.3	92	Low	...	...	...
Mar. 13	71 Ori	5.2	I	7.6	20 04.1	−1.8	−3.2	136	20 08.9	−1.6	−2.4	126
Mar. 14	+19° 1623	7.3	I	8.6	20 42.9	—	—	35	No occ.	...	...	...

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1962

Date	Star	Mag.	I or E	Age of Moon	Toronto				Montreal			
					E.S.T.	a	b	P	E.S.T.	a	b	P
				d	h m	m	m	°	h m	m	m	°
Mar. 15	+18° 1816	7.1	I	9.6	20 10.6	−1.9	−1.6	128	20 19.0	−1.8	−1.3	119
Mar. 16	ζ Cnc m.	5.1	I	9.9	3 05.8	+0.2	−1.7	115	Low	...	...	...
Mar. 17	11 Leo	6.6	I	11.6	Sun	...	...	...	19 09.3	—	—	30
Mar. 18	23 Leo	6.7	I	11.9	3 40.2	−0.4	−1.3	83	3 39.7	−0.2	−1.2	75
Mar. 20	σ Leo	4.1	I	13.8	No occ.	...	...	...	2 43.8	+0.1	−3.8	176
Mar. 31	Saturn	0.9	I	25.0	4 43.7	−0.4	−0.3	141	4 47.1	−0.7	+0.2	131
Mar. 31	Saturn	0.9	E	25.0	5 19.5	−1.5	+3.0	204	5 32.9	−1.4	+2.3	212
Apr. 6	+11° 434	7.3	I	2.2	19 59.9	−0.1	−1.3	92	Low	...	...	...
Apr. 8	α Tau	1.1	E	3.8	Low	...	...	...	8 27.4	+0.3	+1.3	262
Apr. 10	+19° 1559	7.4	I	6.3	23 56.4	+0.4	−2.2	133	23 50.6	+0.3	−1.9	123
Apr. 14	+12° 2177	7.3	I	10.3	21 07.5	−1.6	−1.7	130	21 14.4	−1.7	−1.4	118
Apr. 21	190B. Lib	6.4	E	17.4	22 38.0	—	—	7	No occ.	...	...	...
Apr. 21	η Lib	5.6	E	17.4	No occ.	...	...	...	23 49.4	—	—	230
May 8	+19° 1734	7.2	I	4.9	No occ.	...	...	...	21 42.3	—	—	170
May 21	μ Sgr	4.0	I	18.1	23 42.5	−1.2	+0.8	101	23 51.6	−1.4	+0.9	92
May 22	μ Sgr	4.0	E	18.1	0 59.1	−1.7	+0.6	276	1 09.6	−1.7	+0.2	283
May 23	π Sgr	3.0	E	19.0	Low	...	...	...	0 03.8	−1.0	+0.8	287
June 5	+19° 1896	6.9	I	3.5	20 52.4	−0.3	−1.1	79	20 51.9	−0.2	−0.9	70
June 7	ψ Leo	5.6	I	5.5	21 27.9	−0.3	−2.1	127	21 25.5	−0.2	−2.0	119
June 9	+7° 2440	6.6	I	7.6	23 47.8	−0.1	−2.0	128	Low	...	...	...
June 12	80 Vir	5.8	I	10.6	22 52.3	−1.7	−1.1	88	22 59.5	−1.5	−1.1	80
June 15	49 Lib	5.5	I	13.6	21 29.4	−1.5	−0.2	120	21 38.3	−1.7	−0.1	110
June 19	ξ Sgr	3.6	I	16.7	2 24.8	−1.4	+1.1	33	2 33.7	−1.1	−0.8	33
June 19	ξ Sgr	3.6	E	16.7	3 12.9	−2.1	−2.2	318	3 20.7	−1.9	−2.3	316
June 27	ξ² Cet	4.3	I	24.8	3 16.2	0.0	+2.2	35	3 20.7	−0.1	+2.2	36
July 13	η Lib	5.6	I	11.2	0 25.2	−1.1	−2.6	145	Low	...	...	...
July 20	182B. Agr	6.2	E	18.3	0 43.7	−1.3	+1.7	226	0 54.2	−1.3	+1.5	225
Aug. 11	24B. Sgr	6.8	I	11.6	22 50.9	—	—	25	22 58.4	—	—	24
Aug. 12	ξ Sgr	3.6	I	12.6	20 27.4	−2.2	+2.3	36	20 44.1	—	—	26
Aug. 27	20 Cnc	5.9	E	26.9	Low	...	...	...	3 46.6	−0.1	+0.9	288
Sept. 3	652B. Vir	6.6	I	4.9	20 00.6	−0.8	−0.8	62	Low	...	...	...
Sept. 8	115B. Sgr	5.8	I	10.0	23 00.0	−1.2	−1.5	104	Low	...	...	...
Sept. 9	253B. Sgr	6.0	I	10.9	20 00.1	−1.9	−1.3	142	20 09.4	−2.0	−1.3	139
Sept. 9	203G. Sgr	6.7	I	11.0	22 39.9	−1.1	+0.1	48	22 45.4	−0.9	−0.1	50
Sept. 10	Saturn	0.6	I	12.0	21 40.2	−2.1	−0.6	112	21 50.7	−2.0	−0.9	114
Sept. 10	Saturn	0.6	E	12.0	22 42.2	−1.1	+0.7	219	22 49.1	−0.9	+0.5	216
Sept. 16	ξ² Cet	4.3	I	18.1	23 09.8	−0.5	+1.8	56	23 16.8	−0.7	+1.8	58
Sept. 17	ξ² Cet	4.3	E	18.1	0 13.9	−1.1	+1.5	253	0 23.2	−1.2	+1.4	250
Sept. 17	8B. Tau	6.2	E	19.1	23 38.3	−0.4	+1.8	241	23 44.5	−0.5	+1.9	238
Sept. 18	+12° 477	6.2	E	19.1	0 51.6	+0.1	+3.5	190	0 57.4	+0.3	+4.0	184
Oct. 9	−15° 6143	6.6	I	11.3	21 51.1	−1.9	−0.4	93	22 00.9	−1.8	−0.8	97
Oct. 17	104 Tau m.	5.0	E	18.6	5 25.5	−1.6	+0.3	243	Sun	...	...	...
Oct. 17	+19° 1110	6.0	E	19.3	Low	...	...	...	22 05.6	−0.7	−0.2	320
Oct. 17	57 Ori	5.9	E	19.4	23 18.3	−0.2	+1.5	260	23 22.9	−0.4	+1.6	259
Oct. 18	χ² Ori	4.7	E	19.5	4 05.6	−1.9	+0.6	261	4 17.1	−1.8	+0.2	265
Oct. 19	ζ Gem	4.1	I	20.6	4 28.0	−1.8	+1.8	63	4 41.9	−1.9	+1.8	57
Oct. 19	ζ Gem	4.1	E	20.6	5 42.9	−1.9	−1.5	299	Sun	...	...	...
Oct. 24	308B. Leo	5.9	E	25.6	4 08.5	−0.3	+1.2	278	4 13.2	−0.5	+1.0	284
Nov. 2	31 Sgr	6.7	I	5.4	18 23.8	−1.8	−1.3	107	18 30.8	−1.5	−1.5	108
Nov. 3	292B. Sgr	6.8	I	6.4	18 31.1	−1.0	+1.1	29	18 38.1	−0.8	+0.7	31
Nov. 4	−19° 5905	7.3	I	7.4	17 44.4	−1.8	+0.7	65	17 55.4	−1.7	+0.3	66
Nov. 4	−19° 5928	6.8	I	7.5	20 23.9	−2.0	−1.8	114	20 31.2	−1.8	−2.1	118
Nov. 5	γ Cap	3.8	I	8.4	17 26.3	−1.8	+0.4	103	17 37.9	−1.9	+0.2	104
Nov. 6	−12° 6327	6.8	I	9.5	20 41.4	−2.2	−0.8	102	20 51.9	−2.1	−1.3	107
Nov. 7	351B. Agr	6.5	I	10.5	19 40.8	−1.4	+1.4	50	19 51.0	−1.4	+1.1	53
Nov. 14	16 Gem	6.1	E	17.6	22 34.4	−0.5	+1.3	269	22 40.4	−0.7	+1.4	268
Nov. 19	34 Leo m.	6.4	E	21.8	2 45.7	−1.0	+0.3	299	2 52.3	−1.1	0.0	305
Dec. 3	50 Agr	5.9	I	6.8	19 39.8	−1.3	−1.0	63	19 46.4	−1.1	−0.3	66
Dec. 4	ψ² Agr	4.6	I	7.7	19 07.3	−1.4	+0.8	50	19 16.3	−1.3	+0.5	54
Dec. 4	−9° 6173	7.4	I	7.8	21 21.1	−0.7	+0.6	37	21 25.6	−0.6	+0.4	38
Dec. 4	−9° 6183f.	7.2	I	7.9	22 39.6	−0.6	−0.3	58	22 41.7	−0.4	−0.4	57
Dec. 5	−4° 12	7.5	I	8.8	20 32.8	−1.2	+0.8	46	20 41.0	−1.1	+0.5	49
Dec. 7	311B. Psc	7.1	I	10.8	18 22.1	−0.9	+1.8	53	18 30.9	−1.0	+1.7	56
Dec. 7	+6° 324	6.9	I	10.9	22 28.3	−0.5	+3.2	8	22 36.9	−0.5	+3.0	8
Dec. 12	ζ Gem	3.8	I	16.0	23 21.6	—	—	148	23 29.6	−2.0	−2.3	144
Dec. 12/13	ζ Gem	3.8	E	16.0	23 57.7	—	—	205	0 12.3	−1.3	+4.1	211
Dec. 13	85 Gem	5.4	E	16.8	21 03.6	−0.1	+1.3	268	21 07.2	−0.3	+1.4	268
Dec. 13	217B. Gem	6.3	E	16.9	23 32.1	−1.0	+1.7	255	23 41.7	−1.2	+1.6	258
Dec. 21	566B. Vir	6.5	E	24.1	Low	...	...	...	3 12.8	−0.3	−0.4	323
Dec. 30	−15° 6139	7.1	I	4.0	Sun	...	...	...	17 6.8	−0.8	+0.7	33

Date	Star	Mag.	I or E	Age of Moon	Edmonton				Vancouver			
					M.S.T.	a	b	P	P.S.T.	a	b	P
				d	h m	m	m	°	h m	m	m	°
Jan. 9	45 Cap	5.9	I	2.5	Low	...	...	...	17 50.4	−0.7	−0.5	61
Jan. 11	−2° 69	6.8	I	5.5	18 01.5	−1.8	−0.8	107	Sun	...	...	...
Jan. 12	117G. Psc	6.6	I	6.6	19 26.5	−1.0	+0.9	41	18 11.4	−1.1	+1.4	41
Jan. 13/4	ξ^2 Cet	4.3	I	7.8	00 13.8	−0.3	−2.5	115	23 22.2	−0.6	−4.6	136
Jan. 14	+11° 445	5.9	I	8.6	18 41.3	−0.2	+3.4	10	17 25.9	+0.1	+3.8	7
Jan. 15	8B. Tau	6.2	I	8.8	01 55.3	−0.2	−1.2	78	00 58.6	−0.3	−1.6	93
Jan. 15	179B. Tau	6.0	I	9.6	20 32.6	−1.4	+0.6	77	19 14.6	−1.5	+1.0	79
Jan. 16	48 Tau	6.4	I	9.8	01 22.2	−0.3	−3.1	130	No Occ.	...	...	...
Jan. 16	γ Tau	3.9	I	9.9	03 11.8	+0.1	−1.8	105	02 21.3	+0.1	−2.5	124
Jan. 16	318B. Tau	5.7	I	10.6	18 14.0	−0.9	+1.1	102	Sun	...	...	...
Jan. 22	α Leo	1.3	E	16.6	20 26.6	0.0	+1.4	278	Low	...	...	...
Feb. 8	35 Cet	6.8	I	4.1	No Occ.	...	...	...	20 00.6	−0.3	+2.2	9
Feb. 9	+6° 324	6.9	I	5.1	20 36.8	—	—	3	19 21.6	−0.7	+1.9	18
Feb. 10	+10° 401	6.2	I	6.1	20 42.4	−1.2	−1.8	104	19 36.0	−1.7	−2.1	114
Feb. 10	+11° 434	7.3	I	6.2	No Occ.	...	...	...	22 55.8	−0.6	+0.9	26
Feb. 12	α Tau	1.1	I	7.9	14 22.2	—	—	359	13 17.7	—	—	353
Feb. 12	α Tau	1.1	E	7.9	14 36.9	—	—	330	13 26.1	—	—	336
Feb. 12	+16° 657	7.2	I	8.2	22 06.0	−1.2	+0.1	58	20 51.9	−1.5	+0.1	70
Feb. 13	318B. Tau	5.7	I	8.3	01 39.3	0.0	−1.9	108	00 48.5	0.0	−2.6	127
Feb. 13	+18° 950	6.9	I	9.2	22 40.2	−1.3	−0.7	81	21 28.5	−1.6	−0.8	95
Feb. 14	+18° 987	7.0	I	9.3	01 54.1	0.0	−2.3	121	01 05.0	+0.1	−3.4	144
Feb. 14	22 Gem	6.9	I	10.2	20 29.4	−1.3	+2.9	40	19 06.6	−1.1	+2.6	50
Feb. 15	+18° 1338	6.8	I	10.4	03 19.8	...	...	163	No Occ.	...	...	...
Feb. 15	+19° 1734	7.2	I	11.2	20 43.6	−1.3	+2.4	53	19 22.3	−1.1	+2.2	63
Feb. 17	25 Cnc	6.2	I	12.3	01 24.4	...	...	170	No Occ.	...	...	...
Feb. 19	α Leo	1.3	I	14.4	03 59.5	−1.3	−0.9	68	02 50.3	−1.4	−1.1	88
Feb. 19	α Leo	1.3	E	14.4	04 49.3	−0.1	−2.7	335	03 57.0	−0.5	−2.4	318
Feb. 26	γ Lib	4.0	I	21.5	05 37.8	−1.5	−0.2	106	04 24.2	−1.3	−0.2	121
Feb. 26	γ Lib	4.0	E	21.5	Sun	...	...	...	05 44.6	−1.7	−0.4	281
Mar. 10	+13° 579	6.9	I	4.7	No Occ.	...	...	...	21 18.5	−0.7	+0.8	28
Mar. 11	75 Tau	5.3	I	5.6	18 51.9	−1.3	+0.6	57	Sun	...	...	...
Mar. 11	+15° 633m	6.6	I	5.7	19 07.0	−1.4	−1.4	107	Sun	...	...	...
Mar. 11	264B. Tau	4.8	I	5.7	20 03.6	−1.2	−2.3	118	19 01.1	−1.7	−3.8	136
Mar. 11	269B. Tau	6.7	I	5.7	20 17.6	−1.0	−3.6	136	No Occ.	...	...	...
Mar. 11	275B. Tau	6.5	I	5.7	21 41.7	−0.6	−2.3	116	20 46.9	−0.7	−3.8	137
Mar. 11	α Tau	1.1	I	5.8	22 45.7	−0.3	−1.5	88	21 48.4	−0.5	−1.9	105
Mar. 11	α Tau	1.1	E	5.8	23 45.1	−0.1	−1.3	259	22 47.0	−0.4	−0.7	242
Mar. 12	+18° 862	6.6	I	6.8	22 07.4	−0.8	−1.4	90	21 04.4	−1.1	−1.8	107
Mar. 12	+18° 873	7.0	I	6.8	23 24.1	−0.2	−2.5	124	22 35.3	0.0	−4.2	149
Mar. 12	119 Tau	4.7	I	6.8	23 46.8	−0.7	0.0	38	22 40.7	−0.8	−0.6	60
Mar. 12/3	120 Tau	5.5	I	6.8	00 17.1	−0.4	−0.7	56	23 16.6	−0.5	−1.1	74
Mar. 15/6	ζ Cnc m.	5.1	I	9.9	00 41.3	−0.5	−2.3	125	23 46.5	−0.5	−3.0	145
Mar. 16	+18° 1882	6.4	I	9.9	01 40.6	−0.5	−1.6	93	00 42.4	−0.6	−1.9	109
Mar. 17/8	23 Leo	6.7	I	11.9	00 58.0	−1.2	−1.3	97	23 51.0	−1.4	−1.6	115
Mar. 18	ν Leo	5.2	I	12.0	Low	...	...	...	04 13.6	0.0	−1.7	103
Mar. 27	29 Oph	6.4	E	21.0	04 10.2	−0.6	−1.1	342	03 05.0	−0.9	−0.3	321
Mar. 28	16G. Sgr	6.5	E	22.1	Sun	...	...	...	04 44.5	−1.1	−0.7	326
Mar. 29	36 Sgr	5.1	E	23.1	Sun	...	...	...	04 51.9	−1.2	+0.2	304
Apr. 10	+19° 1559	7.4	I	6.3	21 30.1	−0.4	−3.0	141	No Occ.	...	...	...
Apr. 13	7 Leo	6.2	I	9.4	No Occ.	...	...	...	22 53.8	—	—	44
Apr. 14	α Leo	1.3	I	10.1	14 37.6	−0.2	−0.4	152	Low	...	...	...
Apr. 14	α Leo	1.3	E	10.1	15 15.8	+0.2	+3.1	232	14 06.8	+0.7	+3.5	221
Apr. 15	+11° 2217	6.8	I	10.5	01 04.7	+0.2	−3.3	172	No Occ.	...	...	...
Apr. 25	121B. Sgr	5.9	E	20.6	Sun	...	...	...	02 58.4	−1.4	+0.7	277
May 6	+18° 920	7.5	I	3.0	21 39.5	+0.1	−1.2	81	20 45.4	0.0	−1.5	97
May 6	127 Tau	6.7	I	3.0	21 49.6	+0.1	−1.3	83	20 56.0	+0.1	−1.5	98
May 7	+19° 1430	7.4	I	4.0	22 11.9	−0.1	−1.2	73	21 15.7	−0.2	−1.4	89
May 8	+19° 1784	6.8	I	5.1	23 28.3	+0.2	−1.7	111	22 38.0	+0.2	−2.0	125
May 10	227B. Cnc	6.5	I	7.1	No Occ.	...	...	...	23 23.4	—	—	32
May 11	α Leo	1.3	I	8.1	23 54.8	+0.1	−2.7	157	23 10.8	—	—	183
May 11/2	α Leo	1.3	E	8.1	00 37.9	−0.4	−1.2	243	23 32.4	—	—	220
June 9	358B. Leo	7.0	I	7.6	22 11.0	−0.8	−1.8	105	21 09.6	−1.0	−1.9	119
June 13/4	8G. Lib	6.7	I	11.7	00 12.3	−1.3	−0.9	66	23 00.5	−1.7	−0.7	79
June 18	ξ Sgr	3.6	E	16.7	No Occ.	...	...	...	22 56.1	−0.6	−0.4	330
July 9	−3° 3462	7.1	I	8.2	Low	...	...	...	22 18.6	−0.8	−1.5	87
July 13	120B. (Sco)	6.7	I	12.2	No Occ.	...	...	...	21 11.8	—	—	46
July 18	Saturn	0.5	I	16.5	Low	...	...	...	05 02.5	−0.5	−0.8	69
July 21	351B. Aqr	6.5	E	19.4	Sun	...	...	...	02 01.9	−1.3	+1.2	249
July 26	179B. Tau	6.0	E	24.5	Sun	...	...	...	02 38.5	−0.1	+1.7	253
Aug. 9	−17° 4534	7.2	I	9.7	Low	...	...	...	21 46.3	−1.3	−1.0	82
Aug. 12/3	π Sgr	3.0	I	12.8	00 26.2	—	—	15	23 17.0	—	—	14

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					M.S.T.	a	b	P	P.S.T.	a	b	P
				d	h m	m	m	°	h m	m	m	°
Aug. 12	π Sgr	3.0	E	12.8	Low	...	...	...	23 42.5	—	—	334
Aug. 17	ψ^1 Aqr	4.5	I	16.9	02 56.3	−1.3	−0.2	77	01 42.2	−1.4	+0.4	74
Aug. 17	ψ^1 Aqr	4.5	E	16.9	04 02.2	−0.8	0.0	232	02 52.1	−1.1	+0.3	234
Aug. 21	+10° 401	6.2	E	21.0	Sun	...	...	...	03 27.4	−1.1	+1.6	238
Sept. 8	115B. Sgr	5.8	I	10.0	20 05.7	−1.5	+0.1	74	Sun	...	...	...
Sept. 10	Saturn	0.6	I	12.0	18 54.5	−0.9	+1.1	94	17 41.6	−0.7	+1.1	104
Sept. 10	Saturn	0.6	E	12.0	20 02.2	−1.2	+1.0	250	18 44.9	−1.2	+1.5	244
Sept. 16	ξ^2 Cet	4.3	E	18.1	22 00.6	−0.4	+1.1	301	Low	...	...	...
Sept. 17	μ Cet	4.4	I	18.4	Sun	...	...	...	04 49.2	−1.2	+0.5	53
Sept. 17	+12° 477	6.2	E	19.1	23 06.4	−0.1	+1.8	244	21 59.1	+0.1	+1.7	245
Sept. 17	5 Tau	4.3	I	19.2	23 46.7	−0.6	+1.4	100	22 37.0	−0.3	+1.3	98
Sept. 17/8	5 Tau	4.3	E	19.2	00 39.1	−0.3	+2.2	218	23 28.0	−0.2	+2.1	221
Sept. 18/9	75 Tau	5.3	E	20.2	01 00.1	−0.3	+2.1	232	23 50.2	−0.1	+2.0	234
Sept. 21	ν Gem	4.1	I	22.4	03 58.6	−0.3	+3.5	31	02 43.2	−0.1	+3.2	34
Sept. 21	ν Gem	4.1	E	22.4	04 42.4	−1.6	−1.0	316	03 28.9	−1.5	−0.3	311
Oct. 8	31 Cap	6.3	I	10.5	Low	...	...	...	22 48.0	−1.2	−1.0	88
Oct. 9	−15° 6143	6.6	I	11.3	19 08.5	−1.0	+1.4	55	Sun	...	...	...
Oct. 9	39 Aqr	6.2	I	11.4	21 42.9	−1.4	+0.1	79	20 27.3	−1.5	+0.6	77
Oct. 10	45 Aqr	6.1	I	11.5	Low	...	...	...	00 24.5	−0.4	+0.2	35
Oct. 10/1	ψ^1Aqr	4.5	I	12.5	00 44.1	−1.1	−0.9	84	23 34.4	−1.4	−0.5	82
Oct. 17	104 Tau m.	5.0	E	18.6	02 32.5	−1.5	0.0	290	01 16.5	−1.5	+0.4	288
Oct. 17/8	64 Ori	5.2	E	19.5	01 01.1	−0.2	+2.8	217	23 49.6	+0.1	+2.6	217
Oct. 18	χ^2 Ori	4.7	E	19.5	01 13.5	—	—	325	00 01.3	—	—	325
Oct. 21	X Cnc	var	E	22.7	05 06.5	−1.2	+1.9	251	03 46.4	−0.8	+2.8	238
Oct. 21	+17° 1979	6.3	E	22.7	Sun	...	...	...	04 48.7	−1.3	+3.1	233
Nov. 4	59G. Cap	7.1	I	7.6	20 29.5	−1.5	−1.5	114	19 17.7	−1.8	−1.0	110
Nov. 4	90B. Cap	6.7	I	7.6	Low	...	...	...	20 04.1	−1.1	−0.3	60
Nov. 5	δ Cap	3.0	I	8.6	18 47.2	−1.4	+0.5	73	17 30.2	−1.4	+1.0	72
Nov. 5	δ Cap	3.0	E	8.6	20 01.1	−1.2	0.0	248	18 46.4	−1.5	+0.4	251
Nov. 5	156B. Cap	7.0	I	8.7	Low	...	...	...	22 19.4	−0.5	−0.2	47
Nov. 6	−12° 6327	6.8	I	9.5	17 55.2	−1.0	+1.4	57	Sun	...	...	...
Nov. 7	351B. Aqr	6.5	I	10.5	17 32.9	—	—	3	Sun	...	...	...
Nov. 7/8	376B. Aqr	6.3	I	10.7	00 21.3	−1.1	−1.9	105	23 15.7	−1.6	−1.8	107
Nov. 14	ν Gem	4.1	E	17.6	21 06.0	+0.2	+1.7	250	Low	...	...	...
Dec. 4	ψ^3 Aqr	5.2	I	7.8	16 49.3	−1.5	+0.6	116	Sun	...	...	...
Dec. 8	+10° 401	6.2	I	11.8	18 17.3	−0.7	+1.2	106	17 06.2	−0.5	+1.2	103
Dec. 8	+11° 445	5.9	I	12.0	23 42.8	−1.7	−2.1	119	22 31.5	−2.4	−2.3	126
Dec. 12	ζ Gem	3.8	I	16.0	20 54.7	−0.2	+1.6	84	19 47.9	0.0	+1.4	84
Dec. 12	ζ Gem	3.8	E	16.0	21 55.3	−0.5	+1.5	267	20 45.3	−0.3	+1.5	266
Dec. 13	56 Gem	5.2	E	16.3	07 06.7	−0.3	−1.8	288	06 08.8	−0.7	−1.4	270
Dec. 13	217B(Gem)	6.3	E	16.9	21 21.6	−0.4	+0.6	309	20 16.4	−0.2	+0.5	308
Dec. 17	53 Leo	5.3	E	20.2	04 45.3	−1.2	−0.8	309	03 32.8	−1.5	+0.2	289
Dec. 29	30 Cap	5.4	I	3.1	Low	...	...	...	17 15.5	−0.9	−0.4	60

THE BRIGHTEST ASTEROIDS, 1962

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 half the diameter of Ceres, is brighter. The next brightest asteroids, Juno and Pallas, are 120 and 300 miles in diameter, respectively. Unlike the planets the asteroids move in orbits which are appreciably elongated. Thus the distance of an asteroid from the earth (and consequently its magnitude) varies greatly at different oppositions.

None of the four bright asteroids comes to opposition in 1962; therefore no ephemeris is included.

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 1962.

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 other organization concerned with the collection of such information. Where no local organization exists, reports should be sent to Meteor Centre, National Research Council, Ottawa 2, Ontario. 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 1962

Shower	Shower Maximum			Radiant				Single Observer Hourly Rate	Normal Duration to ¼ strength of Max.
	Date	E.S.T.	Moon	Position at Max. α	Position at Max. δ	Daily Motion α	Daily Motion δ		
				°	°	°	°		(days)
Quadrantids	Jan. 3	12h	N.M.	232	+50			40	0.6
Lyrids	Apr. 22	07	F.M.	274	+34	+1.1	0.0	15	2.3
η Aquarids	May 5	06	N.M.	336	00	+0.9	+0.4	20	18
δ Aquarids	July 29	14	N.M.	339	−17	+0.85	+0.17	20	20
Perseids	Aug. 12	09	F.M.	046	+58	+1.35	+0.12	50	5.0
Orionids	Oct. 20	20	L.Q.	095	+15	+1.23	+0.13	25	8
Taurids	Nov. 5	21	F.Q.	053	+14	+0.67	+0.13	15	(30)
Leonids	Nov. 16	19	L.Q.	152	+22	+0.70	−0.42	15	4
Geminids	Dec. 13	14	F.M.	113	+32	+1.05	−0.07	50	6.0
Ursids	Dec. 22	19	N.M.	217	+76			15	2.2

TABLE OF PRECESSION FOR 50 YEARS

R.A.	Prec. in Dec.	Precession in Right Ascension														Prec. in Dec.	R.A.
		$\delta = +85°$	$+80°$	$+75°$	$+70°$	$+60°$	$+50°$	$+40°$	$+30°$	$+20°$	$+10°$	$0°$	$-10°$	$-20°$	$-30°$		
h m	′	m	m	m	m	m	m	m	m	m	m	m	m	m	m	′	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

FINDING LIST OF NAMED STARS

Name		R.A.	Name		R.A.
Acamar	θ Eri	02	Fomalhaut	α PsA	22
Achernar	α Eri	01	Gacrux	γ Cru	12
Acrux	α Cru	12	Gienah	γ Crv	12
Adhara	ε CMa	06	Hadar	β Cen	14
Al Na'ir	α Gru	22	Hamal	α Ari	02
Albireo	β Cyg	19	Kaus Australis	ε Sgr	18
Alcyone	η Tau	03	Kochab	β UMi	14
Aldebaran	α Tau	04	Markab	α Peg	23
Alderamin	α Cep	21	Megrez	δ UMa	12
Algenib	γ Peg	00	Menkar	α Cet	03
Algol	β Per	03	Menkent	θ Cen	14
Alioth	ε UMa	12	Merak	β UMa	10
Alkaid	η UMa	13	Miaplacidus	β Car	09
Almach	γ And	02	Mira	ο Cet	02
Alnilam	ε Ori	05	Mirach	β And	01
Alphard	α Hya	09	Mirfak	α Per	03
Alphecca	α CrB	15	Mizar	ζ UMa	13
Alpheratz	α And	00	Nunki	σ Sgr	18
Altair	α Aql	19	Peacock	α Pav	20
Ankaa	α Phe	00	Phecda	γ UMa	11
Antares	α Sco	16	Polaris	α UMi	01
Arcturus	α Boo	14	Pollux	β Gem	07
Atria	α TrA	16	Procyon	α CMi	07
Avior	ε Car	08	Ras-Algethi	α Her	17
Bellatrix	γ Ori	05	Rasalhague	α Oph	17
Betelgeuse	α Ori	05	Regulus	α Leo	10
Canopus	α Car	06	Rigel	β Ori	05
Capella	α Aur	05	Rigil Kentaurus	α Cen	14
Caph	β Cas	00	Sabik	η Oph	17
Castor	α Gem	07	Scheat	β Peg	23
Deneb	α Cyg	20	Schedar	α Cas	00
Denebola	β Leo	11	Shaula	λ Sco	17
Diphda	β Cet	00	Sirius	α CMa	06
Dubhe	α UMa	11	Spica	α Vir	13
Elnath	β Tau	05	Suhail	λ Vel	09
Eltanin	γ Dra	17	Vega	α Lyr	18
Enif	ε Peg	21	Zubenelgenubi	α Lib	14

THE BRIGHTEST STARS

By Donald A. MacRae

The 286 stars brighter than apparent magnitude 3.55.

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

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

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

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

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

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

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

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

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

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

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

[a] UMi, *Polaris:* R.A. 1 h 57.2 m; Dec. +89° 05′ (1962).

Star	R.A. 1960 h m	Dec. ° ′	V	$B-V$	Type	π	M_V	D	μ	R	
						″		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 h m	Dec. ° ′	V	$B-V$	Type	π	M_V	D	μ	R	
						″		l.y.	″	km./sec.	
γ UMa	11 51.7	+53 55	2.44	0.00	A0 V	0.020	+0.2	90	0.094	−12.9	*Phecda*
δ Cen	12 06.3	−50 30	2.59v	−0.15:	*B2 Ve*		−2.7	370	0.042	+09	Var. *R* 2.56–2.62
ϵ Crv	08.1	−22 24	3.04	+1.33	K3 III		−0.2	140	0.069	+04.9	
δ Cru	13.0	−58 32	2.81v	−0.23	*B2 IV*		−3.4	570	0.041	+26.4	Var. *R* 2.78–2.84
δ UMa	13.5	+57 15	3.30	+0.07	A3 V	0.052	+1.9	63	0.106	−12.9	*Megrez*
γ Crv	13.7	−17 19	2.59	−0.10	B8 III		−3.1	450	0.163	−04.2	*Gienah*
α Cru *A*	24.4	−62 53	1.39	−0.25	*B1 IV*		−3.9	370	0.042	*−11.2*	} 5″, *C* 4.90^m 89″ ***Acrux***
α Cru *B*	24.4	−62 53	1.86	−0.25	(B3)		−3.4	370	0.042	*−00.6*	
δ Crv *A*	27.8	−16 18	2.97	−0.04	B9.5 V: n	0.018	+0.1	124	0.255	+09	*B* 8.26^m 24″
γ Cru	28.9	−56 53	1.69	+1.55	*M3 II*		−2.5	220	0.274	+21.3	*Gacrux*
β Crv	32.3	−23 11	2.66	+0.89	G5 III	0.027	+0.1	108	0.059	−07.7	
α Mus	34.8	−68 55	2.70v	−0.20	*B3 IV*		−2.9	430	0.037	+18	Var. *R* 2.66–2.73
γ Cen *AB*	39.3	−48 44	2.17	+0.00	*A0 IV:*	0.006	−0.5	160	0.197	−07.5	*A* 2.9^m *B* 2.9^m 1″
γ Vir *AB*	39.6	−01 14	2.76	+0.34	F0 V	0.101	+3.5	32	0.567	−19.7	*A* 3.50^m *B* 3.52^m 4″
β Mus *AB*	43.8	−67 53	3.06	−0.17:	*B3 V*		−2.1	470	0.041	+42	*A* 3.7^m *B* 4.0^m 1″
β Cru	45.4	−59 28	1.28	−0.25	*B0 III*		−4.6	490	0.049	+20.0	***Beta Crucis***
ϵ UMa	52.3	+56 11	1.79	−0.03	A0pv	0.008	+0.2	68	0.113	−09.3	Chromium-europium star *Alioth*
α CVn *A*	54.2	+38 32	2.90	−0.10	B9.5pv	0.023	+0.1	118	0.238	*−03.3*	Silicon-europium star. *B* 5.61^m 20″
ϵ Vir	13 00.2	+11 10	2.86	+0.93	G9 II–III	0.036	+0.6	90	0.274	−14.0	
γ Hya	16.7	−22 58	2.98	+0.92	G8 III	0.021	+0.3	113	0.086	−05.4	
ι Cen	18.3	−36 30	2.76	+0.05	*A2 V*	0.046	+1.1	71	0.351	+00.1	
ζ UMa *A*	22.3	+55 08	2.26	+0.02	A2 V	0.037	+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 h m	Dec. ° ′	V	$B-V$	Type	π	M_V	D	μ	R	
						″		l.y.	″	km./sec.	
β Cen AB	14 01.0	−60 11	0.63	−0.23:	*B1 II:*	0.016	−5.2	490	0.035	*−12*	A 0.7^m B 3.9^m 1″ **Hadar**
π Hya	04.1	−26 29	3.25	+1.13	K2 III	0.039	+1.2	84	0.156	+27.2	
θ Cen	04.3	−36 10	2.04	+1.03	K0 III–IV	0.059	+0.9	55	0.738	+01.3	*Menkent*
α Boo	13.8	+19 23	−0.06	+1.23	K2 IIIp	0.090	−0.3	36	2.284	−05.2	**Arcturus**
γ Boo	30.5	+38 29	3.05	+0.19	A7 III	0.016	+0.2	118	0.186	−35.5	
η Cen	33.0	−41 59	2.39v	−0.21	B1.5 V:ne		−3.0	390	0.049	−00.2	Var. R 2.33–2.45
α Cen A	36.9	−60 40	0.01	+0.68	*G2 V*	.751	+4.39	4.3	3.676	−24.6	18″ **Rigil Kentaurus**
α Cen B	36.9	−60 40	1.40:	+0.73:	(dK1)		+5.8	4.3		−20.7	
α Cir AB	39.2	−64 48	3.18	+0.25	*F0 Vp*	0.049	+1.6	66	0.308	+07.4	Strontium star. A 3.19^m B 8.61^m 16″
α Lup	39.3	−47 13	2.32	−0.22	B1 V		−3.3	430	0.033	+07.3	
ϵ Boo AB	43.2	+27 14	2.37	+0.96	K1: III: + A	0.013	+0.0	103	0.051	−16.5	A 2.47^m B 5.04^m 3″
α Lib A	48.5	−15 50	2.76	+0.15	A3m	0.049	+1.2	66	0.130	−10	B 5.15^m 231″ *Zubenelgenubi*
β UMi	50.8	+74 19	2.04	+1.47	K4 III	0.031	−0.5	105	0.033	+16.9	*Kochab*
β Lup	55.9	−42 58	2.69	−0.23	B2 IV		−3.4	540	0.066	−00.3	
κ Cen	56.5	−41 57	3.15	−0.21	B2 V		−2.7	470	0.033	+09.1	
β Boo	15 00.4	+40 33	3.48	+0.95	G8 III	0.022	+0.3	140	0.059	−19.9	
σ Lib	01.7	−25 08	3.31	+1.65	M4 III	0.056	+2.0:	58:	0.089	−04.3	
ζ Lup A	09.4	−51 57	3.42	+0.90:	*K0 III*	0.036	+1.2	90	0.135	−09.7	B 7.8^m 71″
δ Boo A	13.9	+33 28	3.47	+0.95	G8 III	0.028	+0.3	140	0.148	−12.2	B 7.84^m 105″
β Lib	14.8	−09 14	2.61	−0.11	B8 V	−.012	−0.6	140	0.101	−35.2	
γ TrA	15.1	−68 32	2.94	−0.01	*A0 Vp*	0.005	+0.2	113	0.067	00	Europium star
δ Lup	18.7	−40 30	3.24	−0.23	B2 IV		−3.4	680	0.032	+02	
γ UMi	20.8	+71 59	3.08	+0.06	A3 II-III	−.005	−1.5	270	0.026	*−03.9*	
ι Dra	24.0	+59 06	3.28	+1.18	K2 III	0.032	+0.8	102	0.012	−11.0	
γ Lup AB	32.5	−41 02	2.80	−0.22	B2 Vn		−2.7	570	0.037	+06	A 3.5^m B 3.7^m 1″
α CrB	33.0	+26 51	2.23v	−0.02	A0 V	0.043	+0.4	76	0.154	*+01.7*	Ecl. R 0.11^m, 17.4^d *Alphecca*
α Ser	42.3	+06 33	2.65	+1.17	K2 III	0.046	+1.0	71	0.139	+02.9	
β TrA	51.6	−63 19	2.87	+0.28:	*F2 V*	0.078	+2.3	42	0.448	−00.3	
π Sco	56.4	−26 00	2.92	−0.19	B1 V	0.005	−3.3	570	0.034	*−03*	
η Lup AB	57.5	−38 17	3.45	−0.23	B2 V		−2.7	570	0.042	+07	A 3.47^m B 7.70^m 15″
δ Sco	58.0	−22 51	2.34	−0.13	B0 V		−4.0	590	0.032	−14	

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

Star	R.A. 1960	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 h m	Dec. ° ′	V	$B-V$	Type	π ″	M_V	D l.y.	μ ″	R km./sec.	
θ Aql	20 09.2	−00 56	3.31	−0.07	B9.5 III	0.008	−1.7	330	0.034	*−27.3*	
β Cap *A*	18.8	−14 55	3.06	+0.76	comp.	0.005	+0.1	130	0.039	−18.9	Type gK0: + late B; *B* 5.97^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	1 19	+0.10	A3 V	0.144	+2.0	22.6	0.367	+06.5	***Fomalhaut***
β Peg	23 01.8	+27 52	2.5 v	+1.67	M2 II–III	0.015	−1.5	210	0.234	+08.7	Var. *R* 2.4–2.7 *Scheat*
α Peg	02.8	+14 59	2.50	−0.03	B9.5 III	0.030	−0.1	109	0.071	−03.5	*Markab*
γ Cep	37.7	+77 25	3.20	+1.02	K1 IV	0.064	+2.2	51	0.168	−42.4	

DOUBLE AND MULTIPLE STARS

By Frank Holden

Many stars may be separated into two or more components by the use of a telescope. The greater the aperture of the telescope, the closer the stars which can be separated *in good seeing conditions*. With telescopes of medium size, and for stars which are not unduly bright or faint, the minimum angle of separation—in seconds of arc—is given by $4.6/D$. The symbol D indicates the diameter of the telescope's objective in inches.

The following lists give some interesting examples of double stars. In the first list are pairs suitable for testing the performance of telescopes because the stellar components are relatively fixed over many years; in the second list are pairs of more general interest, including several binaries of shorter period for which the apparent separation or position-angle alters relatively quickly.

In both lists the columns give, successively, the star's designation in two forms; its right ascension and declination for 1960; the visual magnitudes of the combined pair and of each component; the apparent separation in 1962; the approximate position-angle in 1962; and the period, if known.

Star	A.D.S.	R.A.Dec. 1960 h	m	°	′	Magnitudes comb.	a	b	Sep. (1962) ″	P.A. °	P (app.) years
λ Cas	434	00	29.6	+54	18	4.9	5.5	5.8	0.6	180	900
α Psc	1615	01	59.9	+02	34	4.0	4.3	5.3	2.0	294	720
33 Ori	4123	05	29.1	+03	15	5.7	6.0	7.3	1.9	27	—
OΣ 156	5447	06	45.1	+18	14	6.1	6.8	7.0	0.5	258	1,060
Σ 1338	7307	09	18.5	+38	21	5.8	6.5	6.7	1.2	226	390
35 Com	8695	12	51.3	+21	28	5.1	5.3	7.3	0.9	146	675
Σ 2054	10052	16	23.3	+61	48	5.6	6.0	7.2	1.2	353	—
ϵ^1 Lyr	11635	18	43.0	+39	38	4.4	4.6	6.3	2.8	1	—
ϵ^2 Lyr	11635	18	43.0	+39	35	4.2	4.9	5.2	2.4	99	—
π Aql	12962	19	46.9	+11	42	5.6	6.0	6.8	1.4	108	—
Σ 2924	16057	22	31.9	+69	42	6.3	6.8	7.3	0.7	73	790
σ Cas	17140	23	56.9	+55	32	4.9	5.4	7.5	3.0	326	—
η Cas	671	00	46.7	+57	36	3.4*	3.5	7.3	11.1	297	530
Σ 186	1538	01	53.8	+01	39	6.2	6.9	7.0	1.5	53	160
λ And AB	1630	02	01.4	+42	08	2.1*	2.1	5.4	9.9	63	—
α C Ma	5423	06	43.4	−16	40	−1.4	−1.4	8.7	9.6	85	50
α Gem	6175	07	32.0	+31	59	1.6	2.0	2.9	2.0	158	380
ξ Cnc AB	6650	08	09.9	+17	46	5.0	5.6	5.9	1.2	358	60
10 U Ma	Kpr	08	58.1	+41	57	4.1	4.3	6.3	0.6	339	20
γ Leo	7724	10	17.8	+20	03	2.0	2.3	3.5	4.3	122	620
ξ U Ma AB	8119	11	16.1	+31	46	3.9	4.4	4.9	2.3	144	60
λ Vir	8630	12	39.6	−01	14	2.8	3.5	3.5	5.0	307	170
Σ 1785	9031	13	47.3	+27	11	6.6	7.2	7.5	3.0	146	155
ζ Boo	9413	14	39.3	+13	54	3.9	4.6	4.6	1.2	309	125
ξ Boo	9413	14	49.6	+19	17	4.7	4.8	6.9	6.9	346	150
ζ Her	10157	16	39.8	+31	40	2.8	2.9	5.5	1.3	51	35
α Her AB	10418	17	12.8	+14	26	3.1*	3.2	5.4	5.0	109	—
Σ 2173	10598	17	28.3	−01	01	5.4	6.1	6.1	0.7	159	45
70 Oph	11046	18	03.4	+02	31	4.1	4.3	6.0	4.1	87	90
β 648	11871	18	55.6	+32	51	5.2	5.3	7.7	1.1	222	60
4 Aqr	14360	20	49.3	−05	47	6.0	6.4	7.2	1.0	4	155
τ Cyg	14787	21	13.2	+37	52	3.8	3.9	6.3	0.8	224	50
Σ 3050	17149	23	57.4	+33	30	5.8	6.5	6.5	1.5	280	—

*The two components have dissimilar colours.

Many of the components themselves are very close visual doubles or spectroscopic binaries. (Other double stars appear in the table of The Brightest Stars, p. 68.)

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., W; apparent visual magnitude, m; and finally, luminosity in terms of the sun, L. In column four, *wd* indicates a white dwarf, and *e* indicates an emission-line star.

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

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

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

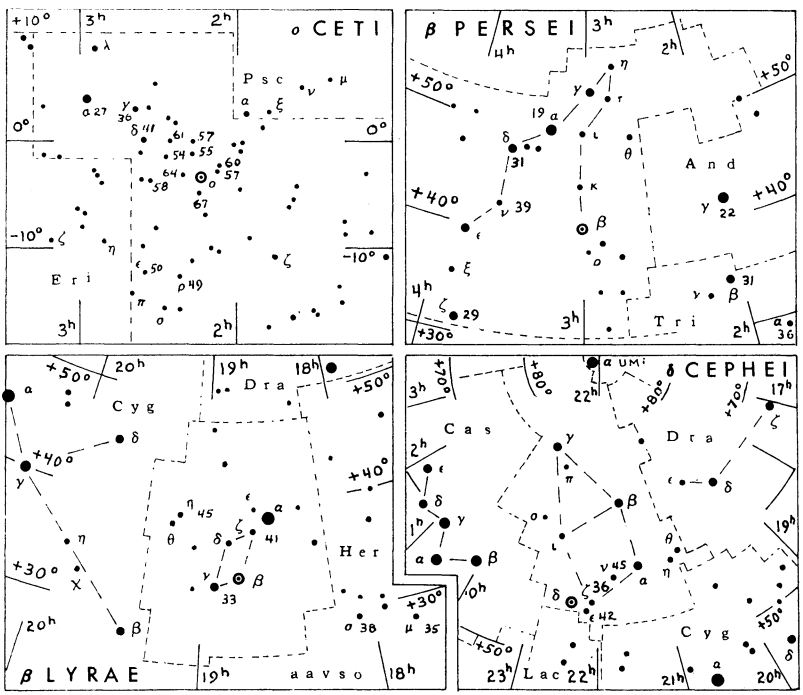
Star	1950 α h	1950 α m	1950 δ °	1950 δ ′	Sp.	π ″	D l.y.	μ ″	W km./sec.	m	L
Sun					G2					−26.9	1.0
α Cen A	14	36	−60	38	G2	0.751	4.3	3.68	34	0.0	1.0
B					K1					1.4	0.28
C	14	26	−62	28	M5*e*					11	0.000052
Barnard's *	17	55	+ 4	33	M5	.545	6.0	10.30	141	9.5	0.00040
Wolf 359	10	54	+ 7	20	M6*e*	.421	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	A1	.375	8.7	1.32	18	−1.4	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	0.4	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	G8	.275	11.8	1.92	37	3.5	0.36
Lac. 9352	23	03	−36	09	M2	.273	11.9	6.87	118	7.2	0.013
BD +5°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 A	6	27	− 2	47	M5*e*	.248	13.1	0.97	30	10.9	0.00052
B					?					14.8	0.000016
BD −12°4523	16	28	−12	32	M5	.244	13.4	1.24	27	10.0	0.0013
van Maanen's	0	46	+ 5	10	*wd*F	.236	13.8	2.98	64	12.3	0.00016
Wolf 424 A	12	31	+ 9	18	M6*e*	.223	14.6	1.87	40	12.6	0.00014
B					M6*e*					12.6	0.00014
Groom. 1618	10	08	+49	42	K5	.222	14.7	1.45	41	6.8	0.030
CD −37°15492	0	02	−37	36	M3	.219	14.9	6.09	134	8.6	0.0058
CD −46°11540	17	25	−46	51	M4	.213	15.3	1.15		9.7	0.0023
BD +20°2465*	10	17	+20	07	M4*e*	.211	15.4	0.49	15	9.5	0.0028
CD −44°11909	17	34	−44	16	M5	.209	15.6	1.14		11.2	0.00058
CD −49°13515	21	30	−49	13	M3	.209	15.6	0.78		9	0.0044
AOe 17415-6	17	37	+68	23	M3	.206	15.8	1.31	34	9.1	0.0040
Ross 780	22	50	−14	31	M5	.206	15.8	1.12	28	10.2	0.0014
Lal. 25372	13	43	+15	10	M2	.205	15.9	2.30	55	8.6	0.0063
CC 658	11	43	−64	33	*wd*	.203	16.0	2.69		11	0.0008
o^2 Eri A	4	13	− 7	44	K0	.200	16.3	4.08	105	4.5	0.30
B					*wd*A					9.2	0.0040
C					M5*e*					11.0	0.0008
70 Oph A	18	03	+ 2	31	K1	.199	16.4	1.13	28	4.2	0.40
B					K5					5.9	0.083
Altair	19	48	+ 8	44	A7	.198	16.5	0.66	31	0.8	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 36 is of mag. 3.6. 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 1962	Variable		Max. m	Per. d	Epoch 1962
001755	T Cas	7.8	445	Aug. 13	143227	R Boo	7.2	223	May 25
001838	R And	7.0	409	May 6	151731	S CrB	7.3	361	Apr. 24
021143	W And	7.4	397	Nov. 27	154639	V CrB	7.5	358	Feb. 2
0214*03*	o Cet	3.4	332	May 11	154615	R Ser	6.9	357	Mar. 4
0228*13*	U Cet	7.5	235	Jan. 14	160625	Ru Her	8.0	484	...
023133	R Tri	6.2	266	Feb. 27	162119	U Her	7.5	406	Dec. 27
043065	T Cam	8.0	374	Sept. 24	1621*12*	V Oph	7.5	298	Oct. 2
0455*14*	R Lep	6.8	432	May 10	163266	R Dra	7.6	245	Aug. 13
050953	R Aur	7.7	459	Jan. 6	164715	S Her	7.6	307	Feb. 7
054920a	U Ori	6.3	372	May 20	1702*15*	R Oph	7.9	302	Sept. 5
0617*02*	V Mon	7.0	335	Aug. 18	171723	RS Her	7.9	219	Jan. 16
065355	R Lyn	7.9	379	Nov. 4	180531	T Her	8.0	165	Mar. 1
070122a	R Gem	7.1	370	Apr. 11	181136	W Lyr	7.9	196	Apr. 22
070310	R CMi	8.0	338	Oct. 20	183308	X Oph	6.8	344	June 7
072708	S CMi	7.5	332	July 14	190108	R Aql	6.1	300	Feb. 24
081112	R Cnc	6.8	362	Mar. 8	1910*17*	T Sgr	8.0	392	Apr. 7
081617	V Cnc	7.9	272	Apr. 10	1910*19*	R Sgr	7.3	269	Feb. 11
084803	S Hya	7.8	257	July 4	193449	R Cyg	7.5	426	Mar. 23
085*008*	T Hya	7.8	288	Apr. 25	194048	RT Cyg	7.3	190	Mar. 6
093934	R LMi	7.1	372	Jan. 1	194632	χ Cyg	5.2	407	...
094211	R Leo	5.8	313	Oct. 21	200938	RS Cyg	7.2	418	Feb. 12
103769	R UMa	7.5	302	Apr. 12	201647	U Cyg	7.2	465	...
1214*18*	R Crv	7.5	317	Jan. 22	2044*05*	T Aqr	7.7	202	Feb. 10
122001	SS Vir	6.8	355	June 13	210868	T Cep	6.0	390	Dec. 21
123160	T UMa	7.7	257	Feb. 14	213753	RU Cyg	8.0	234	Feb. 20
123307	R Vir	6.9	146	Jan. 7	230110	R Peg	7.8	378	Aug. 5
123961	S UMa	7.8	226	July 8	230759	V Cas	7.9	228	July 27
131546	V CVn	6.8	192	May 10	231508	S Peg	8.0	319	Sept. 30
1327*06*	S Vir	7.0	378	Sept. 12	2338*15*	R Aqr	6.5	387	Mar. 11
134440	R CVn	7.7	328	Nov. 14	235350	R Cas	7.0	431	...
142584	R Cam	7.9	270	Mar. 23	2357*15*	W Cet	7.6	351	July 17
142539	V Boo	7.9	258	July 12					

OTHER TYPES OF VARIABLE STARS

Variable		Max. m	Min. m	Type	Sp. Cl.	Period d	Epoch 1962 E.S.T.
005381	U Cep	6.7	9.8	Ecl	B8+gG2	2.49295	Jan. 3.48*
025838	ρ Per	3.3	4.0	Semi R	M4	33–55	
030140	β Per	2.1	3.3	Ecl	B8+G	2.8674	Jan. 2.80*
035512	λ Tau	3.5	4.0	Ecl	B3	3.952952	Jan. 1.81*
060822	η Gem	3.1	3.9	Semi R	M3	233.4	Apr. 15.9*
061907	T Mon	6.4	8.0	δ Cep	F7–K1	27.0205	Jan. 11.77
065820	ζ Gem	4.4	5.2	δ Cep	F7–G3	10.15172	Jan. 10.49
154428	R Cr B	5.8	14.8	R Cr B	cFpep		
171014	α Her	3.0	4.0	Semi R	M5		
1842*05*	R Set	6.3	8.6	RVTau	G0e-K0p	144	
184633	β Lyr	3.4	4.3	Ecl	B8	12.931163	Jan. 7.94*
192242	RR Lyr	6.9	8.0	RR Lyr	A2–F1	0.5668223	Jan. 1.26
194700	η Aql	4.1	5.2	δ Cep	F6–G4	7.176641	Jan. 5.80
222557	δ Cep	4.1	5.2	δ Cep	F5–G2	5.366341	Jan. 4.58

*Minima

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

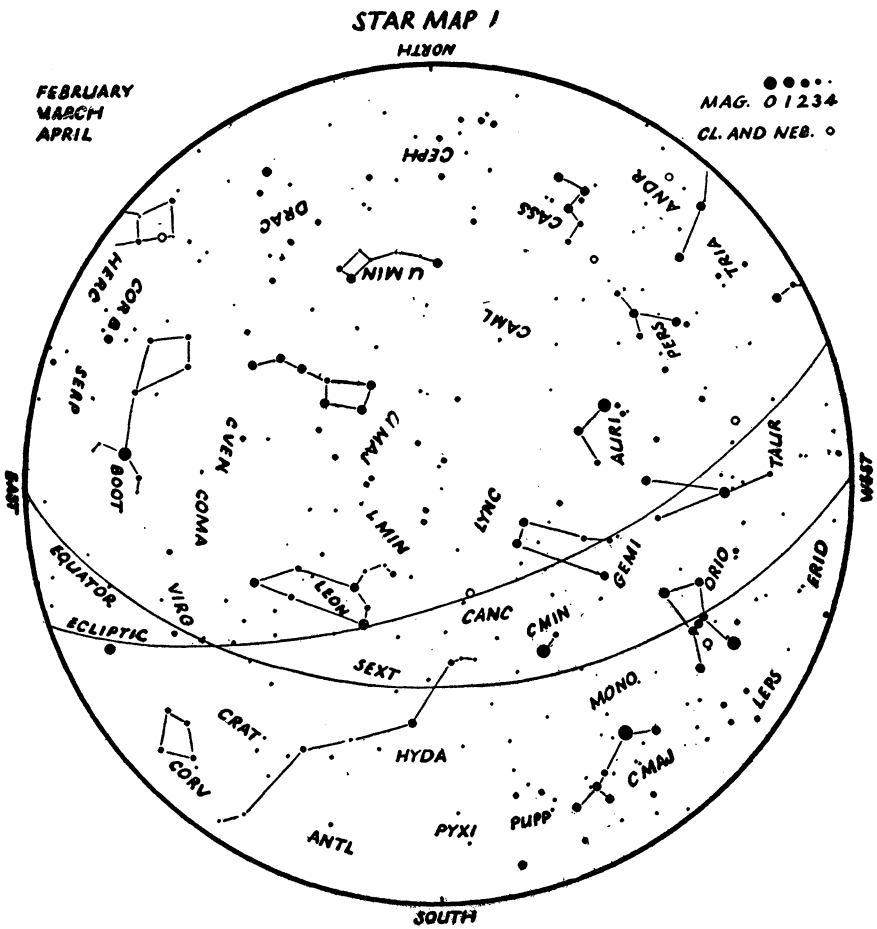
The galactic nebulae here listed have been selected to include the most readily observable representatives of planetary nebulae such as the Ring Nebula in Lyra, diffuse bright nebulae like the Orion nebula and dark absorbing nebulosities such as the Coal Sack. These objects are all located in our own 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

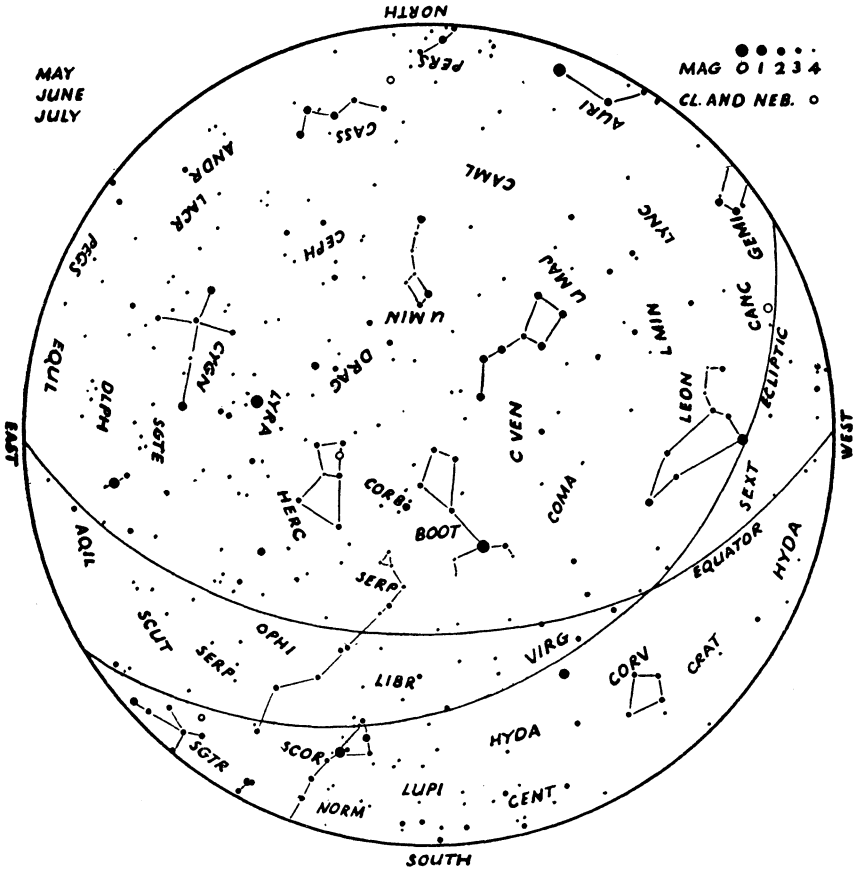


The above map represents the evening sky at

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

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

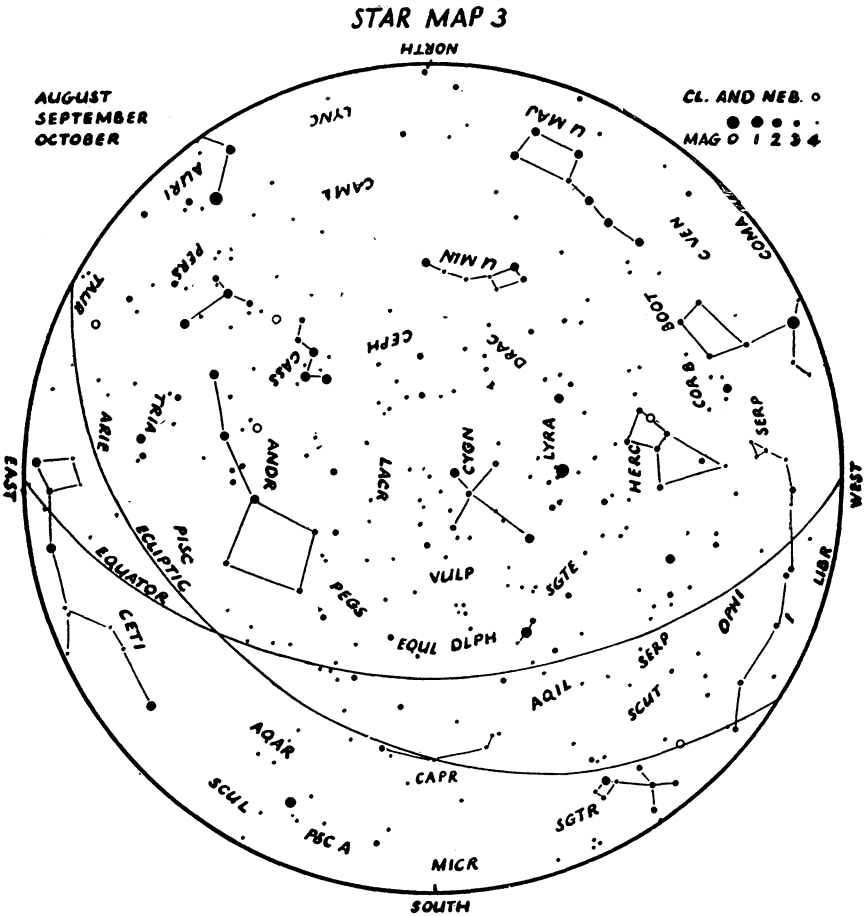
STAR MAP 2



The above map represents the evening sky at

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

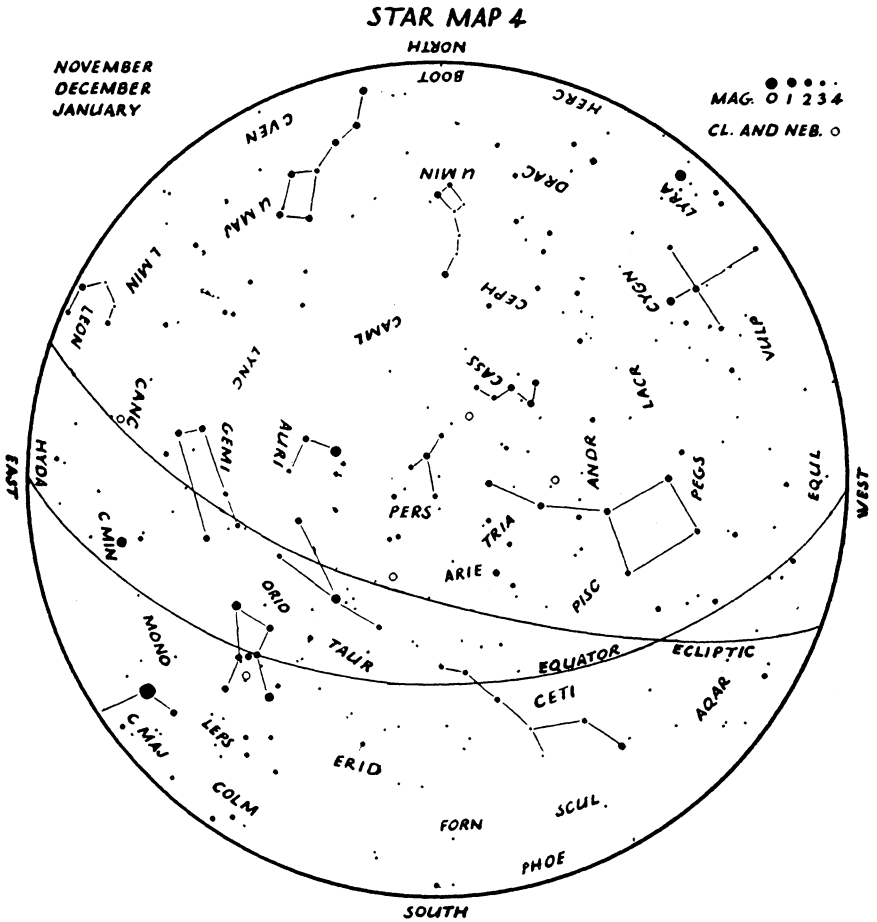
The centre of the map is the zenith, the circumference the horizon. To identify the stars hold the map so that the part of the horizon you are facing is down.



The above map represents the evening sky at

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

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



The above map represents the evening sky at

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

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

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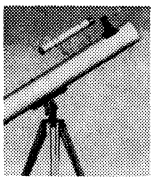

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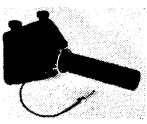
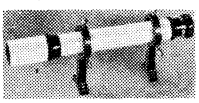
TELESCOPE ROLL-FILM CAMERA



This model uses rolls of No. 127 film. Picture area will be a circle 1-9/16" in diameter. The advantage of this model is the ease of using roll film. With each camera you get a piece of ground glass. Before loading film in camera, you focus the telescope. Then lock it in this position. For positions other than infinity, you can scribe a mark on your tube.

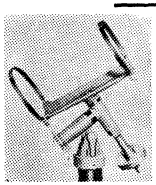
Stock No. 70,182-V $29.50 postpaid

6X FINDER TELESCOPE



Has crosshairs for exact locating. You focus by sliding objective mount in and out. Base fits any diameter tube—an important advantage. Has 3 centering screws for aligning with main telescope. 20-mm. diam. objective. Weighs less than ½ lb.

Stock No. 50,121-V ..... $8.00 postpaid

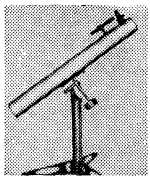


SUPER-STURDY MOUNT FOR LARGER TELESCOPES

Finest new heavy duty mount available. Specifically designed for 8" telescopes, either commercial or amateur—also ideal for 6" scope. Can handle 10" reflector and up to 5" refractor. Massive design, with 1½" diameter polar and declination axis. Cast iron construction. Weighs 75 lb. including counter-weights. Provides mass where most needed. Perfect balance. Fine adjustment for latitude setting. Positive shaft clamping. Large bearing surfaces. Specially designed tube handle for better tube rotation. Can be permanently mounted on standard 4" pipe. For professionals, serious amateurs, educational institutions. Aluminum setting circles available at extra cost. State mirror diameter when ordering.

Stock No. 85,134-V ..... $79.50 F.O.B. Barrington, N.J.
Shipping wt. 85 lb.

4¼" ASTRONOMICAL TELESCOPE
UP TO 255 POWER
New Vibration-Free Metal Pedestal Mount



With this scope you can see everything described at left but with greater power. Also, it will split closer double stars. Mirror has twice the light-gathering power. Rack-and-pinion focusing, real equatorial mounting—only one motion needed to follow the stars! Aluminum tube. 6-power finder telescope. 2 standard-size eyepieces and mounted Barlow lens give you powers of 45x—90x—135x—180x and 225x. Low-cost accessory eyepiece available for higher powers. FREE with Scope: Valuable STAR CHART plus 272-page "HANDBOOK OF THE HEAVENS" plus the book "HOW TO USE YOUR TELESCOPE" Shpg. wt. 25 lb.

Stock #85,105-V.....$79.50 f.o.b Barrington, N.J

Same telescope as described above but equipped with Electric Clock Drive.

Stock #85,107-V.....$109.00 f.o.b. Barrington, N.J.

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Real rack-and-pinion focusing with variable tension adjustment; tube accommodates standard 1¼" eyepieces and accessory equipment; lightweight aluminum body casting (not cast iron); focusing tube and rack of chrome-plated brass; body finished in black wrinkle paint.

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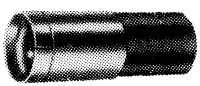
For Refractors
Stock # 50,103-V (for 2 7/8" I.D. tubing) 12.95 ppd.
Stock # 50,108-V (for 3 7/8" I.D. tubing) 13.95 ppd.

MOUNTED BARLOW LENS



Double and triple your Telescope's power with a Barlow Lens. Ours is mounted in chrome-plated brass tubing with variable spacers—just slide this mounted negative lens into your 1¼" I.D. eyepiece holder, and use your regular eyepiece in it. Fully guaranteed to please you.

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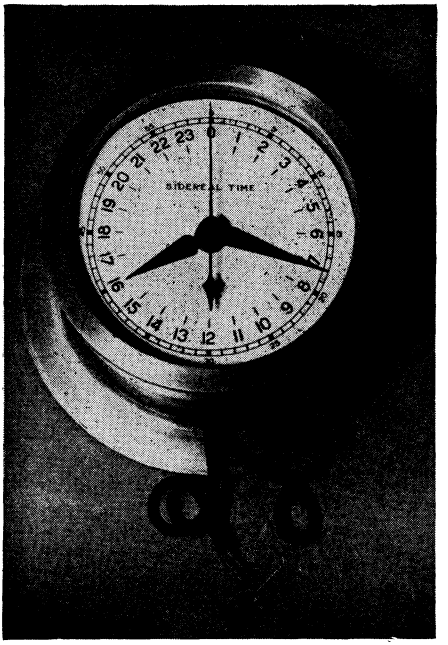

WHAT IS SIDEREAL TIME?

By definition it is the hour angle of the March equinox, which is at right ascension 0 hours. At your observing station the right ascension of the celestial meridian is always your local sidereal time.

Knowing the sidereal time is an astronomical necessity, for it tells you quickly the hour angle of any celestial body to which you wish to point your telescope. Our clocks can be equipped for broadcasting time signals at some extra cost.

Sidereal time for any time and place will be computed free of charge to anyone sending their Longitude as exact as possible and computation formula sheets will be provided also. Write for instructions.

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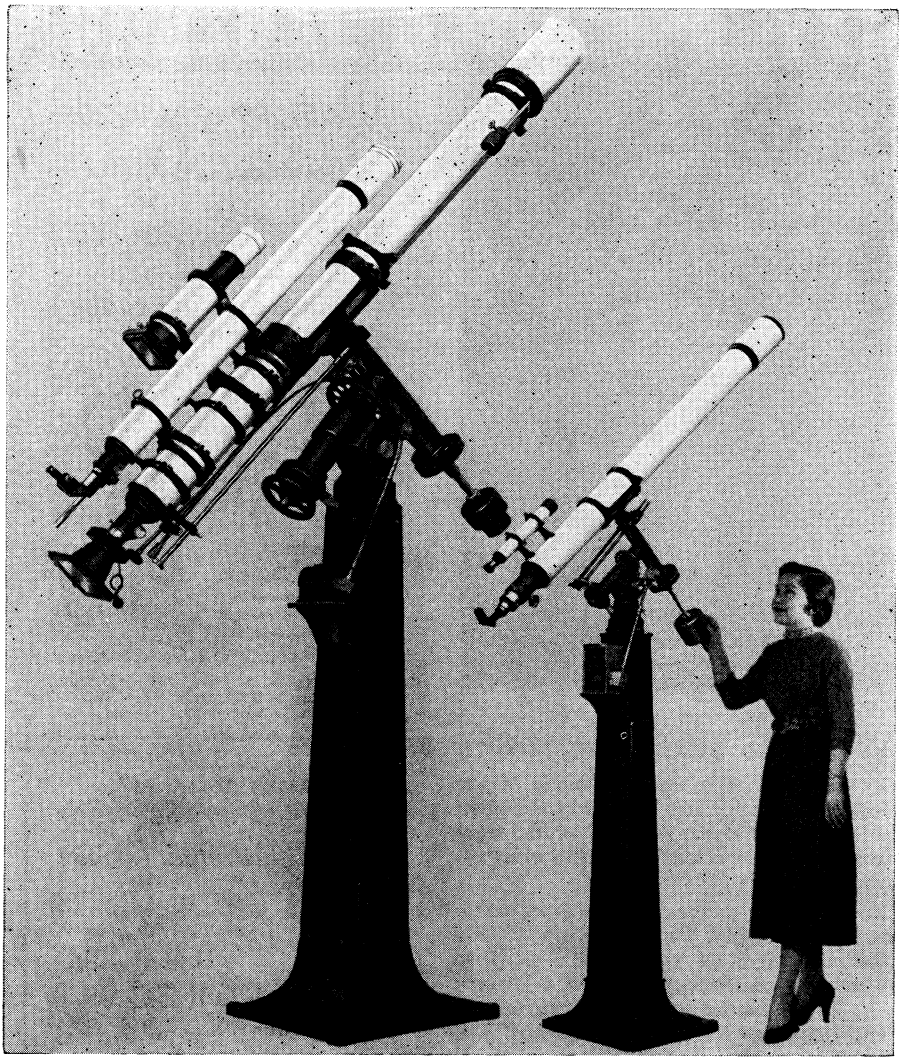

UNITRON'S 6" Refractor on left, 4" on right

Amateur and professional astronomers alike continue to proclaim their enthusiasm and high praise for UNITRON's new 6-inch Refractor. And little wonder—for this latest and largest UNITRON offers features, precision, and performance usually associated only with custom-built observatory telescopes of much larger aperture. Here, indeed, is the ideal telescope for the serious observer and for the school and college observatory.

Imagine yourself at the controls of this 6" UNITRON—searching the skies, seeing more than you have ever seen before, photographically recording your observations—truly, the intellectual adventure of a lifetime.

Full specifications are given in the UNITRON Telescope Catalog available on request. There are three massive 6" models from which to choose with prices starting at $5125.

SEE OUR ADVERTISEMENTS ON THE BACK COVER

NEW UNITRON CLOCK DRIVE MODELS

Synchronous motor clock drives are now available for all UNITRON Equatorial Models. The new drive, pictured on the back cover of this issue, is priced at $50 for the 2.4" and at $60 for the 3" and 4" models. The 4" refractors are also available with our popular weight-driven clock drive which operates independently of a source of electricity.

Each UNITRON comes complete with an assortment of eyepieces and accessories as standard equipment. In addition, our barlow-type Achromatic Amplifier is now included at no extra cost. A proven reputation for optical and mechanical quality plus unique features and extra value make a UNITRON Refractor the logical telescope for you to choose.

1.6" ALTAZIMUTH **$75**
with eyepieces for 78x, 56x, 39x

2.4" ALTAZIMUTH **$125**
with eyepieces for 100x, 72x, 50x, 35x

2.4" EQUATORIAL **$225**
with eyepieces for 129x, 100x, 72x, 50x, 35x

3" ALTAZIMUTH **$265**
with eyepieces for 171x, 131x, 96x, 67x, 48x

3" EQUATORIAL **$435**
with eyepieces for 200x, 131x, 96x, 67x, 48x

3" PHOTO-EQUATORIAL **$550**
with eyepieces for 200x, 171x, 131x, 96x, 67x, 48x

4" ALTAZIMUTH **$465**
with eyepieces for 250x, 214x, 167x, 120x, 83x, 60x

4" EQUATORIAL **$785**
with eyepieces for 250x, 214x, 167x, 120x, 83x, 60x, 38x

4" PHOTO-EQUATORIAL **$890**
with eyepieces for 250x, 214x, 167x, 120x, 83x, 60x, 38x

4" EQUITORIAL with weight-driven clock drive, eyepieces as above **$985**

4" EQUATORIAL with weight-driven clock drive, metal pier, eyepieces as above **$1075**

4" PHOTO-EQUATORIAL with weight-driven clock drive and ASTRO-CAMERA, with eyepieces for 250x, 214x, 167x, 120x, 83x, 60x, 38x, 25x **$1175**

4" PHOTO-EQUATORIAL with weight-driven clock drive, pier, ASTRO-CAMERA, eyepieces for 375x, 300x, 250x, 214x, 167x, 120x, 83x, 60x, 38x, 25x **$1280**

5" PHOTO-EQUATORIAL with clock drive and ASTRO-CAMERA with eyepieces for 500x, 400x, 333x, 286x, 222x, 160x, 111x, 80x, 50x, 33x **$2275**

6" EQUATORIAL with clock drive, pier, 2.4" view finder, with 10 eyepieces **$5125**

6" PHOTO-EQUATORIAL as above but with 4" guide telescope, illuminated diagonal, UNIBALANCE, ASTRO-CAMERA Model 330 **$5660**

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Get UNITRON's FREE Observer's Guide and Catalog on ASTRONOMICAL TELESCOPES

This valuable 38-page book is yours for the asking!

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Contents include—

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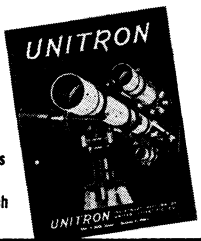
- **Constellation map**
- **Hints for observers**
- **Glossary of telescope terms**
- **How to choose a telescope**
- **Amateur clubs and research programs**



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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
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Feb.

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Mar.

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April

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May

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June

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July

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Aug.

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Sept.

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Oct.

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Nov.

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Dec.

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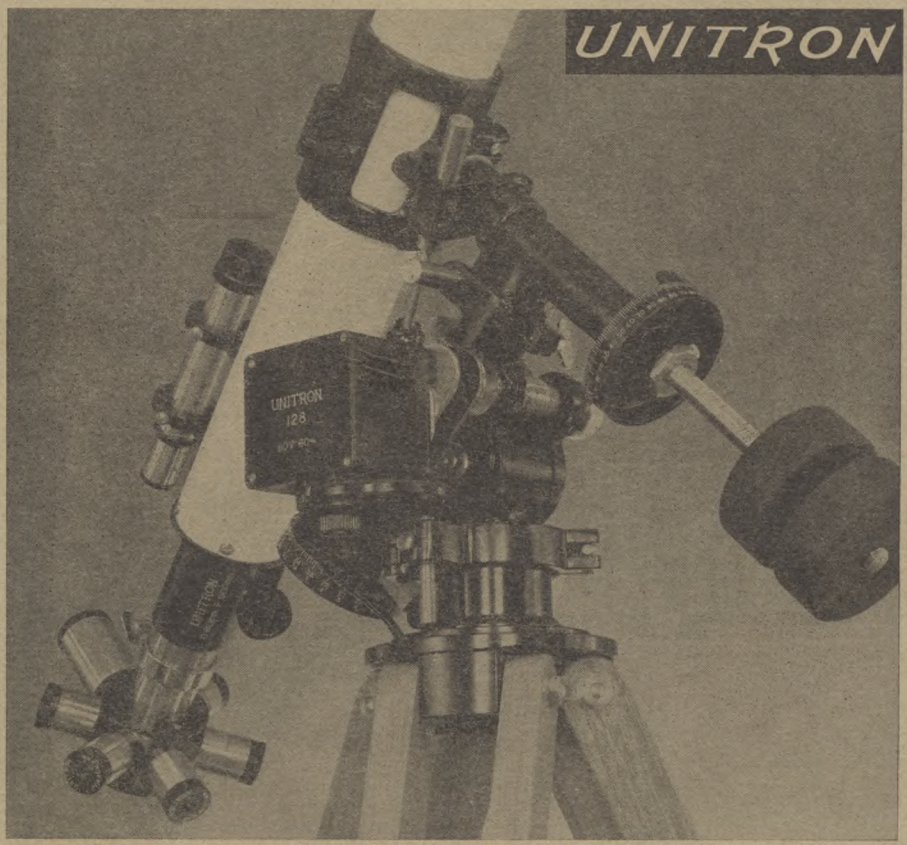

Presenting—UNITRON'S New 2.4" Equatorial with Setting Circles and Optional Motor Drive

New features have been added to UNITRON'S popular, portable 2.4" Equatorial. Setting circles are now standard equipment. An optional synchronous motor clock drive may be obtained with the telescope or added later. In addition to the hand drive, a supplementary R.A. slow motion has been included to facilitate changes in this coordinate without the need to stop or disengage the motor.

If this sounds like what you have been waiting for in a telescope, we have some good news indeed. These new features—the circles and supplementary slow motion—are included at no extra charge. The price of $225 includes viewfinder, 5 eyepieces, UNIHEX Rotary Eyepiece Selector, Achromatic Amplifier, sunglass, cabinets, etc. The accessory drive is priced at $50 extra. Write for complete details.

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