THE OBSERVER'S HANDBOOK 1957

Forty-Ninth Year of Publication

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

Price 75 cents

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

The Society was incorporated in 1890 as The Astronomical and Physical Society of Toronto, assuming its present name in 1903.

The Society is national in extent, having active centres in Halifax, Quebec, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Winnipeg, Edmonton, Vancouver and Victoria. In addition to 1500 members of these Canadian Centres there are nearly 500 members not attached to any centre, mostly resident in other nations, while some 300 additional institutions or persons receive our publications. The Society publishes a bi-monthly JOURNAL and the annual OBSERVER'S HANDBOOK.

Membership, which includes the publications, is open to anyone interested in astronomy. Annual dues $3.00; life membership $50.00. Applications for membership or publications should be made to The Royal Astronomical Society of Canada, 252 College Street, Toronto 2B, Ontario.

Editorial Office—David Dunlap Observatory, Richmond Hill, Ontario.
Editors—C. A. Chant, Ruth J. Northcott.

CALENDAR 1957

Jan.

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

Feb.

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

Mar.

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

April

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

May

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

June

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

July

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

Aug.

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

Sept.

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

Oct.

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

Nov.

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

Dec.

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

THE OBSERVER'S HANDBOOK 1957

EDITED BY

C. A. CHANT AND RUTH NORTHCOTT

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252 COLLEGE STREET, TORONTO 2B, ONTARIO

GEORGE VARCOE, TORONTO

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PREFACE

The OBSERVER'S HANDBOOK for 1957 is the 49th and largest yet published. Interest in astronomy has increased steadily in the last ten years: the current impetus of the International Geophysical Year is coupled with that of rapid and incredible developments in many fields related to astronomy. The advances being made daily in radio astronomy, missiles research and the proposed launching of man-made satellites have led the intelligent layman to feel the need for a greater knowledge of the fundamentals of astronomy. To meet this need, the Royal Astronomical Society of Canada, despite limited funds and staff, is expanding its programme of activities, increasing the size of its library, and broadening the scope of its publications to include articles and data applicable to these new fields.

Those now using the OBSERVER'S HANDBOOK for the first time will find here the most basic astronomical data in a highly usable form. Those readers already experienced in the use of the OBSERVER'S HANDBOOK can accommodate readily to certain new arrangement of the material. Lunar observers will welcome the addition of the ephemeris for the physical observation of the moon.

Cordial thanks are tendered to all those who assisted in preparing this volume, especially to the following: Gustav Bakos, Barbara Gaizauskas, Charles M. Good, James Hogg, Ross Lemire, Isabel K. Williamson and Dorothy Yane. Special thanks are due Margaret W. Mayall, A.A.V.S.O. Recorder, for the predictions of times of maxima of the long-period variables.

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

RUTH J. NORTHCOTT

David Dunlap Observatory,
Richmond Hill, Ont., Sept. 1956.

ANNIVERSARIES AND FESTIVALS, 1957

New Year's Day	Tue.	Jan. 1
Epiphany	Sun.	Jan. 6
Accession of Queen Elizabeth (1952)	Wed.	Feb. 6
Septuagesima Sunday		Feb. 17
St. David	Fri.	Mar. 1
Quinquagesima (Shrove Sunday)		Mar. 3
Ash Wednesday		Mar. 6
St. Patrick	Sun.	Mar. 17
Palm Sunday		Apr. 14
Good Friday		Apr. 19
Easter Sunday		Apr. 21
Birthday of Queen Elizabeth (1926)	Sun.	Apr. 21
St. George	Tue.	Apr. 23
Empire Day (Victoria Day)	Mon.	May 20
Rogation Sunday		May 26
Ascension Day	Thu.	May 30
Pentecost (Whit Sunday)		June 9
Trinity Sunday		June 16
Corpus Christi	Thu.	June 20
St. John Baptist (Midsummer Day)	Mon.	June 24
Dominion Day	Mon.	July 1
Birthday of Queen Mother Elizabeth (1900)	Sun.	Aug. 4
Labour Day	Mon.	Sept. 2
Hebrew New Year (Rosh Hashanah)	Thu.	Sept. 26
St. Michael (Michaelmas Day)	Sun.	Sept. 29
All Saints' Day	Fri.	Nov. 1
Remembrance Day	Mon.	Nov. 11
St. Andrew	Sat.	Nov. 30
First Sunday in Advent		Dec. 1
Christmas Day	Wed.	Dec. 25

Thanksgiving Day, date set by Proclamation

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°	♐ Saggittarius ..240°
♉ Taurus........30°	♍ Virgo........150°	♑ Capricornus ..270°
♊ Gemini........60°	♎ Libra........180°	♒ Aquarius.....300°
♋ Cancer........90°	♏ Scorpius.....210°	♓ Pisces........330°

THE GREEK ALPHABET

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

THE CONFIGURATIONS OF JUPITER'S SATELLITES

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

CALCULATIONS FOR ALGOL

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

CELESTIAL DISTANCES

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

THE CONSTELLATIONS

Latin and English Names with Abbreviations

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

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

MISCELLANEOUS ASTRONOMICAL DATA

UNITS OF LENGTH

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

UNITS OF TIME

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

THE EARTH

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

EARTH'S ORBITAL MOTION

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

SOLAR MOTION

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

THE GALACTIC SYSTEM

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

EXTRA-GALACTIC NEBULAE

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

RADIATION CONSTANTS

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

MISCELLANEOUS

Constant of gravitation, $G = 6.670 \times 10^{-8}$ c.g.s. units
Mass of the electron, $m = 9.1055 \times 10^{-28}$ gm.; mass of the proton $= 1.6725 \times 10^{-24}$ gm.
Planck's constant, $h = 6.6234 \times 10^{-27}$ erg. sec.
Loschmidt's number = 2.6873×10^{19} molecules/cu. cm. of gas at N.T.P
Absolute temperature = $T°$ K = $T°$C + 273° = 5/9 ($T°$ F + 459°)

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

$\pi = 3.141{,}592{,}653{,}6$

No. of square degrees in the sky = 41,253

1957 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

Date 1957	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
	h m s	m s	° ′
Jan. 1	18 44 54	+ 3 23	−23 02.5
4	18 58 08	+ 4 47	−22 46.2
7	19 11 18	+ 6 08	−22 25.9
10	19 24 24	+ 7 24	−22 01.6
13	19 37 24	+ 8 34	−21 33.4
16	19 50 19	+ 9 40	−21 01.5
19	20 03 08	+10 39	−20 26.0
22	20 15 50	+11 31	−19 47.0
25	20 28 25	+12 17	−19 04.6
28	20 40 54	+12 56	−18 19.1
31	20 53 15	+13 27	−17 30.7
Feb. 3	21 05 29	+13 52	−16 39.4
6	21 17 36	+14 09	−15 45.6
9	21 29 35	+14 18	−14 49.3
12	21 41 27	+14 20	−13 50.8
15	21 53 11	+14 15	−12 50.2
18	22 04 50	+14 04	−11 47.8
21	22 16 22	+13 46	−10 43.7
24	22 27 48	+13 23	− 9 38.1
27	22 39 10	+12 55	− 8 31.2
Mar. 2	22 50 26	+12 22	− 7 23.1
5	23 01 38	+11 44	− 6 14.1
8	23 12 46	+11 02	− 5 04.3
11	23 23 50	+10 16	− 3 54.0
14	23 34 51	+ 9 28	− 2 43.2
17	23 45 49	+ 8 37	− 1 32.1
20	23 56 46	+ 7 44	− 0 21.0
23	0 07 42	+ 6 50	+ 0 50.1
26	0 18 37	+ 5 55	+ 2 00.9
29	0 29 32	+ 5 00	+ 3 11.4
Apr. 1	0 40 27	+ 4 06	+ 4 21.3
4	0 51 24	+ 3 13	+ 5 30.5
7	1 02 21	+ 2 21	+ 6 38.8
10	1 13 21	+ 1 31	+ 7 46.1
13	1 24 22	+ 0 42	+ 8 52.2
16	1 35 26	− 0 03	+ 9 56.9
19	1 46 34	− 0 45	+11 00.2
22	1 57 45	− 1 23	+12 01.9
25	2 09 01	− 1 57	+13 01.8
28	2 20 21	− 2 27	+13 59.8
May 1	2 31 45	− 2 52	+14 55.7
4	2 43 15	− 3 13	+15 49.4
7	2 54 49	− 3 28	+16 40.7
10	3 06 28	− 3 39	+17 29.5
13	3 18 12	− 3 44	+18 15.7
16	3 30 01	− 3 45	+18 59.1
19	3 41 55	− 3 40	+19 39.7
22	3 53 55	− 3 30	+20 17.2
25	4 05 59	− 3 16	+20 51.6
28	4 18 08	− 2 56	+21 22.8
31	4 30 21	− 2 33	+21 50.7
June 3	4 42 38	− 2 06	+22 15.1
6	4 54 59	− 1 35	+22 36.1
9	5 07 21	− 1 02	+22 53.5
12	5 19 46	− 0 26	+23 07.3
15	5 32 13	+ 0 11	+23 17.4
18	5 44 41	+ 0 49	+23 23.8
21	5 57 10	+ 1 28	+23 26.5
24	6 09 39	+ 2 07	+23 25.5
27	6 22 07	+ 2 46	+23 20.7
30	6 34 34	+ 3 23	+23 12.3

Date 1957	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
	h m s	m s	° ′
July 3	6 46 58	+ 3 58	+23 00.2
6	6 59 20	+ 4 30	+22 44.5
9	7 11 39	+ 4 59	+22 25.3
12	7 23 54	+ 5 24	+22 02.6
15	7 36 04	+ 5 45	+21 36.5
18	7 48 11	+ 6 02	+21 07.0
21	8 00 13	+ 6 14	+20 34.4
24	8 12 10	+ 6 21	+19 58.6
27	8 24 02	+ 6 24	+19 19.8
30	8 35 48	+ 6 20	+18 38.1
Aug. 2	8 47 29	+ 6 12	+17 53.7
5	8 59 04	+ 5 57	+17 06.7
8	9 10 34	+ 5 37	+16 17.2
11	9 21 59	+ 5 12	+15 25.3
14	9 33 18	+ 4 42	+14 31.2
17	9 44 32	+ 4 07	+13 35.1
20	9 55 42	+ 3 27	+12 36.9
23	10 06 48	+ 2 43	+11 37.0
26	10 17 50	+ 1 56	+10 35.4
29	10 28 48	+ 1 04	+ 9 32.3
Sept. 1	10 39 43	+ 0 10	+ 8 27.8
4	10 50 36	− 0 48	+ 7 22.1
7	11 01 25	− 1 48	+ 6 15.4
10	11 12 13	− 2 50	+ 5 07.7
13	11 23 00	− 3 53	+ 3 59.3
16	11 33 45	− 4 57	+ 2 50.2
19	11 44 31	− 6 01	+ 1 40.6
22	11 55 17	− 7 04	+ 0 30.6
25	12 06 05	− 8 07	− 0 39.5
28	12 16 53	− 9 08	− 1 49.7
Oct. 1	12 27 43	−10 07	− 2 59.7
4	12 38 36	−11 04	− 4 09.5
7	12 49 32	−11 58	− 5 18.7
10	13 00 31	−12 49	− 6 27.4
13	13 11 34	−13 35	− 7 35.3
16	13 22 42	−14 17	− 8 42.3
19	13 33 56	−14 53	− 9 48.2
22	13 45 15	−15 24	−10 52.8
25	13 56 40	−15 48	−11 55.9
28	14 08 11	−16 06	−12 57.4
31	14 19 49	−16 18	−13 57.1
Nov. 3	14 31 34	−16 23	−14 54.8
6	14 43 26	−16 20	−15 50.2
9	14 55 26	−16 10	−16 43.4
12	15 07 33	−15 53	−17 33.9
15	15 19 48	−15 28	−18 21.8
18	15 32 11	−14 55	−19 06.7
21	15 44 41	−14 14	−19 48.6
24	15 57 19	−13 26	−20 27.2
27	16 10 03	−12 31	−21 02.4
30	16 22 54	−11 30	−21 34.1
Dec. 3	16 35 51	−10 23	−22 02.0
6	16 48 53	− 9 10	−22 26.2
9	17 02 00	− 7 53	−22 46.4
12	17 15 11	− 6 31	−23 02.6
15	17 28 26	− 5 06	−23 14.7
18	17 41 43	− 3 39	−23 22.6
21	17 55 02	− 2 09	−23 26.3
24	18 08 22	− 0 39	−23 25.7
27	18 21 41	+ 0 50	−23 20.9
30	18 34 59	+ 2 18	−23 11.9

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

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

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

PHYSICAL ELEMENTS

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

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

SATELLITES OF THE SOLAR SYSTEM

Name	Stellar Mag.	Mean Dist. from Planet " *	Mean Dist. from Planet Miles	Revolution Period d	h	m	Diameter Miles	Discoverer
SATELLITE OF THE EARTH								
Moon	−12.6	530	238,857	27	07	43	2160	
SATTELITES 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	—	—		—		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
SATELLITE OF NEPTUNE								
Triton	13	16	220,000	5	21	03	3000?	Lassell, 1846
Nereid	19	260	3,460,000	359			200?	Kuiper, 1949

*As seen from the sun.

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

SOLAR AND SIDEREAL TIME

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

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

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

3. *Sidereal Time*—This is time as determined from the stars. It is sidereal noon when the Vernal Equinox or First of Aries is on the meridian. In accurate time-keeping the moment when a star is on the meridian is observed and the corresponding mean time is then computed with the assistance of the Nautical Almanac. When a telescope is mounted equatorially the position of a body in the sky is located by means of the sidereal time. At 0h. G.C.T. the Greenwich Sidereal Time = R.A. apparent sun + 12h. — correction to sun-dial (p. 7). Sidereal time gains with respect to mean time at the rate of 3m. 56s. a day or about 2 hours a month.

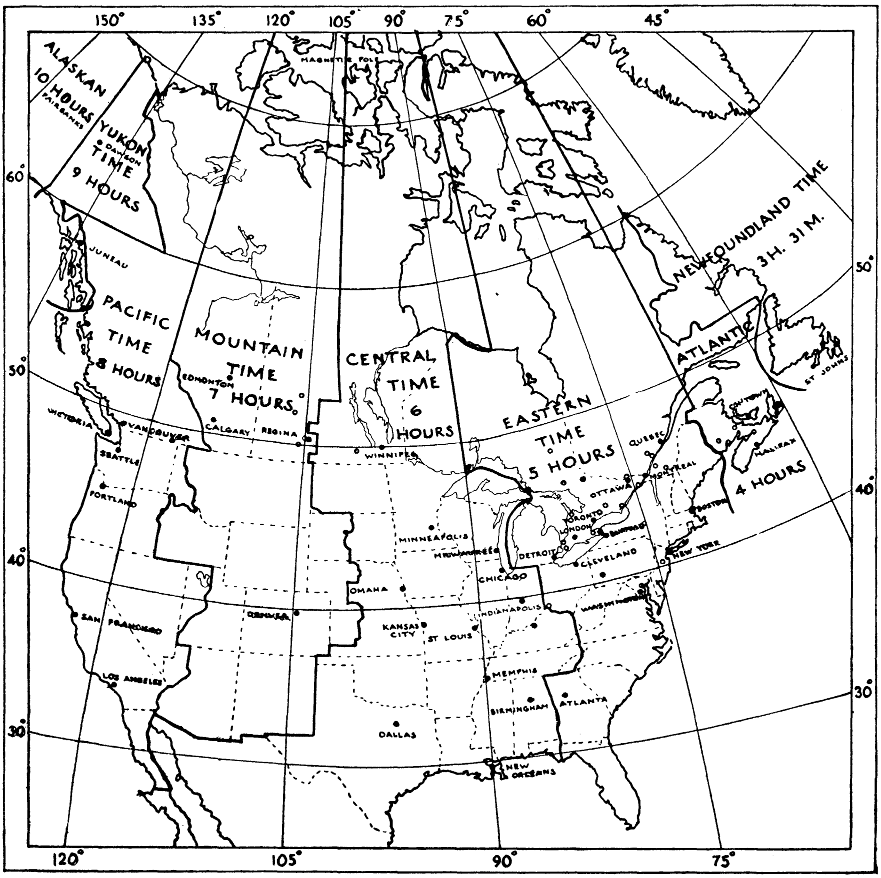
4. *Standard Time*—In everyday life we use still another kind of time. A moment's thought will show that in general two places will not have the same mean time; indeed, difference in longitude between two places is determined from their difference in time. But in travelling it is very inconvenient to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

In Canada we have seven standard time belts, as follows;—Newfoundland Time, 3h. 30m. slower than Greenwich; 60th meridian or Atlantic Time, 4h.; 75th meridian or Eastern Time, 5h.; 90th meridian or Central Time, 6h.; 105th meridian or Mountain Time, 7h.; 120th meridian or Pacific Time, 8h.; and 135th meridian or Yukon Time, 9h. slower than Greenwich.

The boundaries of the time belts are shown on the map on page 11.

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

MAP OF STANDARD TIME ZONES



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

JULIAN DAY CALENDAR, 1957

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

Jan. 1	5,840	May 1	5,960	Sept. 1	6,083
Feb. 1	5,871	June 1	5,991	Oct. 1	6,113
Mar. 1	5,899	July 1	6,021	Nov. 1	6,144
Apr. 1	5,930	Aug. 1	6,052	Dec. 1	6,174

The Julian Day commences at noon. Thus J.D. 2,435,840.0 = Jan. 1.5 G.C.T.

TIMES OF SUNRISE AND SUNSET

In the tables on pages 11 to 16 are given the times of sunrise and sunset for places in latitudes 32°, 36°, 40°, 44°, 46°, 48°, 50°, and 54°. The times are given in Local Mean Time, and in the table below are given corrections to change from Local Mean to Standard Time for the cities and towns named.

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

The Standard Times for Any Station

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

CANADIAN CITIES AND TOWNS

	Lat.	Cor.		Lat.	Cor.
Belleville	44	+ 09	Peterborough	44	+ 13
Brandon	50	+ 40	Port Arthur	48	+ 57
Brantford	43	+ 21	Prince Albert	53	+ 03
Calgary	51	+ 36	Prince Rupert	54	+ 41
Charlottetown	46	+ 13	Quebec	47	− 15
Chatham	42	+ 29	Regina	50	− 02
Cornwall	45	− 01	St. Catharines	43	+ 17
Dawson	64	+ 18	St. Hyacinthe	46	− 09
Edmonton	54	+ 34	Saint John, N.B.	45	+ 24
Fort William	48	+ 57	St. John's, Nfld.	48	+ 01
Fredericton	46	+ 26	St. Thomas	43	+ 25
Galt	43	+ 21	Sarnia	43	+ 30
Glace Bay	46	00	Saskatoon	52	+ 07
Granby	45	− 09	Sault Ste. Marie	47	+ 37
Guelph	44	+ 21	Shawinigan Falls	47	− 09
Halifax	45	+ 15	Sherbrooke	45	− 13
Hamilton	43	+ 19	Stratford	43	+ 24
Hull	45	+ 03	Sudbury	47	+ 24
Kingston	44	+ 06	Sydney	46	+ 01
Kitchener	43	+ 22	Timmins	48	+ 26
London	43	+ 25	Toronto	44	+ 18
Medicine Hat	50	+ 23	Three Rivers	46	− 10
Moncton	46	+ 19	Trail	49	− 09
Montreal	45	− 06	Truro	45	+ 13
Moose Jaw	50	+ 02	Vancouver	49	+ 12
Niagara Falls	43	+ 16	Victoria	48	+ 14
North Bay	46	+ 18	Windsor	42	+ 32
Oshawa	44	+ 15	Winnipeg	50	+ 29
Ottawa	45	+ 03	Woodstock	43	+ 23
Owen Sound	45	+ 24	Yellowknife	63	+ 37

AMERICAN CITIES

	Lat.	Cor.
Atlanta	34	+ 37
Baltimore	39	+ 06
Birmingham	34	− 13
Boston	42	− 16
Buffalo	43	+ 15
Chicago	42	− 10
Cincinnati	39	+ 38
Cleveland	42	+ 26
Dallas	33	+ 27
Denver	40	00
Detroit	42	+ 32
Fairbanks	65	− 10
Indianapolis	40	− 15
Juneau	58	+ 58
Kansas City	39	+ 18
Los Angeles	34	− 07
Louisville	38	− 17
Memphis	35	00
Milwaukee	43	− 09
Minneapolis	45	+ 13
New Orleans	30	00
New York	41	− 04
Omaha	41	+ 24
Philadelphia	40	+ 01
Pittsburgh	40	+ 20
Portland	46	+ 11
St. Louis	39	+ 01
San Francisco	38	+ 10
Seattle	48	+ 09
Washington	39	+ 08

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

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

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

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

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

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

DATE		Latitude 32° Sunrise	Latitude 32° Sunset	Latitude 36° Sunrise	Latitude 36° Sunset	Latitude 40° Sunrise	Latitude 40° Sunset	Latitude 44° Sunrise	Latitude 44° Sunset	Latitude 46° Sunrise	Latitude 46° Sunset	Latitude 48° Sunrise	Latitude 48° Sunset	Latitude 50° Sunrise	Latitude 50° Sunset	Latitude 54° Sunrise	Latitude 54° Sunset
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
November	**1**	6 16	5 10	6 22	5 05	6 28	4 58	6 35	4 52	6 39	4 47	6 44	4 43	6 48	4 39	6 59	4 28
	3	6 18	5 09	6 24	5 03	6 31	4 55	6 38	4 49	6 42	4 44	6 47	4 40	6 52	4 35	7 03	4 24
	5	6 20	5 07	6 26	5 01	6 33	4 53	6 41	4 46	6 45	4 41	6 50	4 37	6 55	4 32	7 07	4 20
	7	6 22	5 06	6 27	4 59	6 35	4 51	6 43	4 43	6 48	4 38	6 53	4 34	6 58	4 28	7 11	4 16
	9	6 23	5 04	6 29	4 57	6 37	4 49	6 46	4 41	6 51	4 36	6 56	4 31	7 01	4 25	7 14	4 12
	11	6 25	5 03	6 31	4 56	6 39	4 47	6 48	4 39	6 53	4 33	6 59	4 29	7 04	4 22	7 18	4 09
	13	6 27	5 02	6 33	4 54	6 42	4 45	6 51	4 37	6 56	4 31	7 02	4 26	7 08	4 20	7 22	4 06
	15	6 29	5 01	6 35	4 52	6 44	4 44	6 54	4 35	6 59	4 29	7 05	4 24	7 11	4 17	7 26	4 02
	17	6 30	4 59	6 37	4 51	6 47	4 42	6 57	4 32	7 02	4 27	7 08	4 21	7 15	4 14	7 30	3 59
	19	6 32	4 59	6 39	4 50	6 49	4 41	6 59	4 31	7 04	4 25	7 10	4 19	7 18	4 12	7 34	3 56
	21	6 34	4 58	6 41	4 49	6 51	4 39	7 01	4 29	7 07	4 23	7 13	4 17	7 21	4 10	7 37	3 54
	23	6 36	4 57	6 43	4 48	6 54	4 38	7 04	4 28	7 10	4 21	7 16	4 15	7 24	4 08	7 41	3 51
	25	6 37	4 57	6 45	4 48	6 56	4 37	7 06	4 27	7 12	4 20	7 19	4 14	7 27	4 06	7 44	3 49
	27	6 39	4 56	6 47	4 47	6 58	4 36	7 09	4 25	7 15	4 19	7 22	4 12	7 30	4 04	7 48	3 47
	29	6 41	4 56	6 48	4 47	6 59	4 36	7 11	4 24	7 18	4 18	7 25	4 11	7 33	4 03	7 51	3 45
December	**1**	6 43	4 55	6 50	4 47	7 01	4 35	7 13	4 23	7 20	4 17	7 27	4 10	7 36	4 02	7 54	3 43
	3	6 44	4 55	6 52	4 46	7 03	4 35	7 15	4 23	7 22	4 16	7 30	4 09	7 38	4 01	7 57	3 41
	5	6 46	4 55	6 54	4 46	7 05	4 35	7 18	4 23	7 25	4 15	7 32	4 08	7 41	4 00	8 00	3 40
	7	6 47	4 56	6 56	4 46	7 07	4 35	7 20	4 22	7 27	4 15	7 35	4 07	7 43	3 59	8 03	3 39
	9	6 49	4 56	6 57	4 46	7 09	4 35	7 22	4 22	7 29	4 15	7 37	4 07	7 45	3 59	8 06	3 38
	11	6 50	4 56	6 59	4 46	7 10	4 35	7 24	4 22	7 31	4 15	7 39	4 07	7 48	3 58	8 08	3 38
	13	6 52	4 57	7 01	4 47	7 12	4 35	7 25	4 22	7 32	4 15	7 40	4 07	7 50	3 58	8 10	3 38
	15	6 53	4 57	7 02	4 47	7 14	4 36	7 27	4 23	7 34	4 16	7 42	4 07	7 51	3 59	8 12	3 38
	17	6 54	4 58	7 04	4 48	7 16	4 36	7 29	4 23	7 36	4 16	7 44	4 08	7 53	3 59	8 14	3 38
	19	6 55	4 59	7 05	4 49	7 17	4 37	7 30	4 24	7 37	4 17	7 45	4 08	7 54	4 00	8 15	3 38
	21	6 56	4 59	7 06	4 50	7 18	4 38	7 31	4 25	7 38	4 18	7 46	4 09	7 55	4 01	8 17	3 39
	23	6 57	5 01	7 07	4 51	7 19	4 39	7 32	4 26	7 39	4 19	7 47	4 10	7 56	4 02	8 18	3 40
	25	6 58	5 02	7 08	4 52	7 20	4 40	7 33	4 27	7 40	4 20	7 48	4 11	7 57	4 03	8 19	3 41
	27	6 59	5 03	7 09	4 53	7 21	4 41	7 34	4 28	7 41	4 21	7 49	4 13	7 58	4 04	8 19	3 43
	29	7 00	5 04	7 09	4 54	7 21	4 42	7 34	4 30	7 41	4 22	7 50	4 14	7 58	4 06	8 20	3 44
	31	7 00	5 06	7 10	4 56	7 22	4 44	7 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, 1957. (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	07 17	17 49	07 29	17 39	07 42	17 25	07 59	17 10	08 15	16 54
2	07 55	18 44	08 05	18 36	08 16	18 25	08 31	18 12	08 44	17 59
3	08 31	19 39	08 38	19 33	08 47	19 25	08 58	19 15	09 08	19 06
4	09 02	20 34	09 08	20 30	09 14	20 25	09 22	20 18	09 29	20 12
5	09 32	21 28	09 35	21 26	09 39	21 24	09 43	21 21	09 47	21 19
6	10 01	22 22	10 02	22 23	10 03	22 24	10 03	22 25	10 05	22 26
7	10 31	23 18	10 29	23 21	10 27	23 25	10 24	23 30	10 22	23 34
8	11 02	.. ..	10 57	.. ..	10 52	.. ..	10 46	.. ..	10 40	.. ..
9 ☽	11 34	00 15	11 28	00 21	11 20	00 27	11 11	00 36	11 01	00 44
10	12 12	01 14	12 03	01 22	11 52	01 32	11 39	01 43	11 26	01 55
11	12 55	02 15	12 44	02 25	12 30	02 38	12 15	02 53	11 58	03 08
12	13 44	03 17	13 31	03 29	13 16	03 44	12 58	04 02	12 40	04 19
13	14 41	04 19	14 28	04 32	14 12	04 48	13 53	05 07	13 34	05 26
14	15 45	05 19	15 33	05 32	15 18	05 47	14 59	06 06	14 41	06 25
15	16 55	06 15	16 44	06 26	16 31	06 40	16 15	06 56	16 00	07 13
16 ○	18 07	07 05	17 59	07 14	17 48	07 25	17 37	07 38	17 25	07 52
17	19 19	07 50	19 14	07 57	19 07	08 04	19 00	08 13	18 53	08 22
18	20 30	08 31	20 28	08 34	20 25	08 39	20 22	08 44	20 20	08 48
19	21 39	09 09	21 40	09 10	21 41	09 10	21 42	09 11	21 44	09 12
20	22 46	09 46	22 49	09 43	22 54	09 40	23 00	09 37	23 06	09 34
21	23 50	10 23	23 57	10 17	.. ..	10 11	.. ..	10 04	.. ..	09 56
22 ☾	.. ..	11 00	.. ..	10 52	00 05	10 43	00 15	10 31	00 25	10 21
23	00 53	11 40	01 02	11 30	01 14	11 18	01 26	11 03	01 40	10 49
24	01 53	12 23	02 04	12 11	02 18	11 57	02 34	11 40	02 51	11 23
25	02 49	13 09	03 02	12 56	03 18	12 41	03 36	12 22	03 55	12 03
26	03 43	13 58	03 56	13 45	04 12	13 29	04 31	13 10	04 50	12 50
27	04 31	14 50	04 45	14 37	05 00	14 23	05 19	14 04	05 38	13 45
28	05 16	15 43	05 28	15 33	05 42	15 19	05 59	15 03	06 17	14 45
29	05 56	16 38	06 06	16 29	06 19	16 17	06 33	16 03	06 48	15 50
30 ●	06 32	17 33	06 40	17 26	06 50	17 17	07 01	17 06	07 14	16 56
31	07 04	18 28	07 11	18 23	07 18	18 17	07 27	18 09	07 35	18 02
Feb.										
1	07 35	19 22	07 40	19 20	07 44	19 16	07 49	19 12	07 55	19 08
2	08 05	20 16	08 07	20 16	08 08	20 16	08 10	20 15	08 13	20 15
3	08 34	21 11	08 34	21 14	08 32	21 17	08 30	21 20	08 30	21 22
4	09 04	22 07	09 01	22 12	08 56	22 18	08 52	22 25	08 48	22 30
5	09 36	23 04	09 30	23 12	09 23	23 19	09 15	23 30	09 08	23 40
6	10 11	.. ..	10 02	.. ..	09 53	.. ..	09 41	.. ..	09 31	.. ..
7 ☽	10 50	00 03	10 40	00 12	10 27	00 23	10 13	00 37	09 59	00 50
8	11 34	01 03	11 22	01 14	11 09	01 27	10 51	01 44	10 34	02 00
9	12 26	02 02	12 13	02 15	11 58	02 30	11 39	02 48	11 20	03 07
10	13 24	03 01	13 12	03 14	12 56	03 30	12 37	03 48	12 18	04 07
11	14 29	03 57	14 18	04 10	14 03	04 24	13 46	04 42	13 29	04 59
12	15 39	04 49	15 29	05 00	15 17	05 13	15 03	05 27	14 50	05 42
13	16 51	05 37	16 44	05 46	16 35	05 55	16 26	06 06	16 16	06 17
14 ○	18 04	06 21	18 00	06 26	17 55	06 32	17 50	06 39	17 44	06 46
15	19 15	07 01	19 14	07 03	19 14	07 06	19 13	07 09	19 12	07 12
16	20 25	07 40	20 28	07 39	20 31	07 38	20 34	07 37	20 38	07 36
17	21 33	08 18	21 39	08 14	21 45	08 10	21 53	08 04	22 01	07 59
18	22 39	08 57	22 48	08 50	22 57	08 42	23 09	08 33	23 21	08 24
19	23 43	09 38	23 53	09 28	.. ..	09 18	.. ..	09 04	.. ..	08 52
20	.. ..	10 20	.. ..	10 09	00 06	09 56	00 21	09 40	00 36	09 25
21 ☾	00 42	11 06	00 54	10 54	01 09	10 39	01 27	10 21	01 44	10 03
22	01 38	11 55	01 51	11 43	02 06	11 27	02 25	11 08	02 44	10 49
23	02 29	12 46	02 42	12 34	02 57	12 18	03 15	12 00	03 35	11 41
24	03 14	13 39	03 27	13 28	03 41	13 14	03 59	12 57	04 16	12 40
25	03 55	14 33	04 06	14 24	04 19	14 11	04 34	13 57	04 50	13 42
26	04 32	15 28	04 42	15 20	04 52	15 10	05 05	14 58	05 17	14 47
27	05 07	16 22	05 13	16 17	05 22	16 10	05 31	16 01	05 40	15 53
28	05 38	17 17	05 43	17 13	05 48	17 09	05 55	17 04	06 01	16 59

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

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

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

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

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

THE PLANETS FOR 1957

THE SUN

Mr. Frank J. DeKinder reports that in June 1956 solar activity, which was a very low minimum a little more than two years before, had increased in intensity more rapidly than in most cycles. The last full month under observation (May 1956) had the greatest sun-spot number since the new cycle began. That, and an extraordinary outburst of activity in February 1956, seem to indicate that the next maximum may be an early and a high one.

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 1957

Elong. East—Evening Star			Elong. West—Morning Star		
Date	Distance	Mag.	Date	Distance	Mag.
Apr. 15	20°	+0.3	Feb. 2	25°	+0.1
Aug. 13	27°	+0.6	June 1	24°	+0.8
Dec. 7	21°	−0.2	Sept. 25	18°	−0.2

The most favourable elongations to observe are: in the evening, Apr. 15, and in the morning, Sept. 25. At these times Mercury is about 80 million miles from the earth and in a telescope looks like a half-moon about 7″ in diameter. On May 5 Mercury transits the sun's disk (see p. 59).

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, 1957, Venus crosses the meridian about two hours before the sun. It is in declination -22^{c} and appears rather low in the south-eastern sky for observers in Canada. Its stellar magnitude is -3.4. It reaches greatest elongation east, 47° 14′ on Nov. 18. Its stellar magnitude is now -4.0 and its declination is $-26°$ and it transits the meridian $3\frac{1}{2}$ hours after the sun. It attains greatest brilliancy on Dec. 23, with stellar magnitude -4.4. On Dec. 31 it is in declination $-16°$ and transits the meridian $2\frac{1}{2}$ hours after the sun.

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

MARS

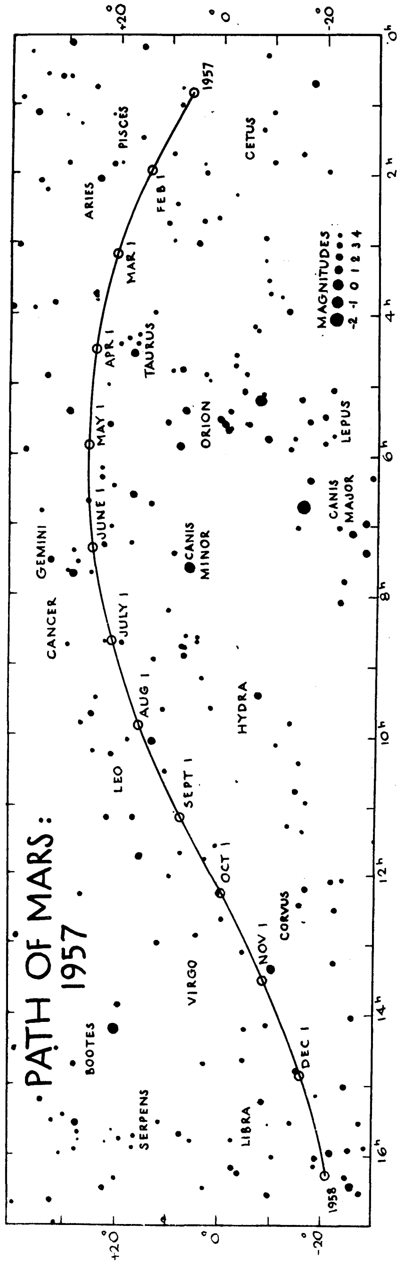
The orbit of Mars is outside that of the earth and consequently its planetary phenomena are quite different from those of the two inferior planets discussed above. Its mean distance from the sun is 141 million miles and the eccentricity of its orbit is 0.093, and a simple computation shows that its distance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

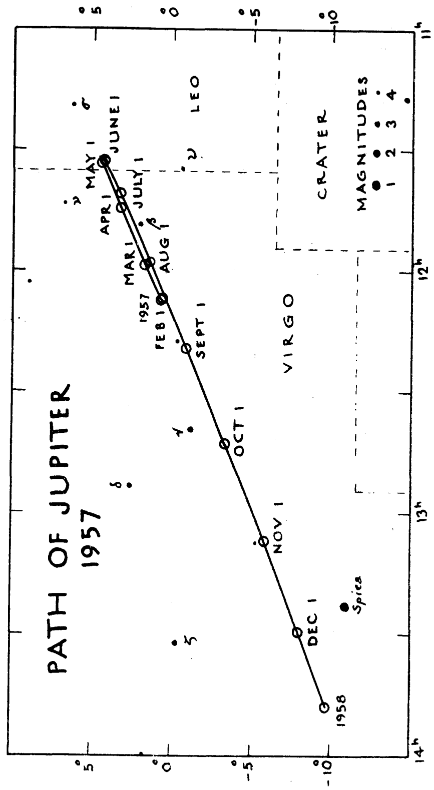
The sidereal, or true mechanical, period of revolution of Mars is 687 days; and the synodic period (for example, the interval from one opposition to the next one) is 780 days. This is the average value; it may vary from 764 to 810 days. The planet was in opposition on June 24, 1954; then on Sept. 10, 1956. There will not be an opposition in 1957.

On Jan. 1, 1957, Mars is in Pisces and is near the meridian at sunset; its stellar magnitude is $+0.3$. It is in the evening sky until it comes into conjunction with the sun on Sept. 21. On Dec. 31 it is in Scorpius. 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


PATH OF MARS:
1957
PISCES
ARIES
CETUS
TAURUS
ORION
LEPUS
GEMINI
CANIS MINOR
CANIS MAJOR
CANCER
HYDRA
LEO
VIRGO
CORVUS
BOOTES
SERPENS
LIBRA
MAGNITUDES
-2 -1 0 1 2 3 4
1957
FEB 1
MAR 1
APR 1
MAY 1
JUNE 1
JULY 1
AUG 1
SEPT 1
OCT 1
NOV 1
DEC 1
1958
+20°
0°
-20°
0h
2h
4h
6h
8h
10h
12h
14h
16h


PATH OF JUPITER
1957
LEO
CRATER
VIRGO
MAGNITUDES
1 2 3 4
Spica
1957
FEB 1
MAR 1
APR 1
MAY 1
JUNE 1
JULY 1
AUG 1
SEPT 1
OCT 1
NOV 1
DEC 1
1958
5°
0°
-5°
-10°
11h
12h
13h
14h

its original high temperature, but from actual measurements of the radiation from it to the earth it has been deduced that the surface is at about $-200°F$. The spectroscope shows that its atmosphere is largely ammonia and methane.

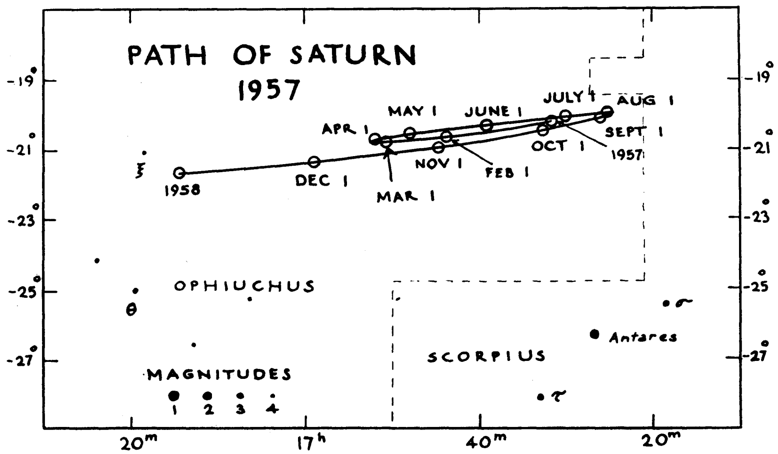
Jupiter is a fine object for the telescope. Many details of the surface as well as the flattening of the planet, due to its short rotation period, are visible, and the phenomena of its satellites provide a continual interest.

On Jan. 1, 1957, Jupiter is a morning star in the constellation Virgo, crossing the meridian about 5 a.m. It is close to the equator. It comes into opposition with the sun on Mar. 17, when it is on the meridian at midnight. Its stellar magnitude will then be -2.0. It will be retrograding from Jan. 16 to May 19 when it will begin to move eastward among the stars again (see map). It will come into conjunction with the sun on Oct. 5.

SATURN

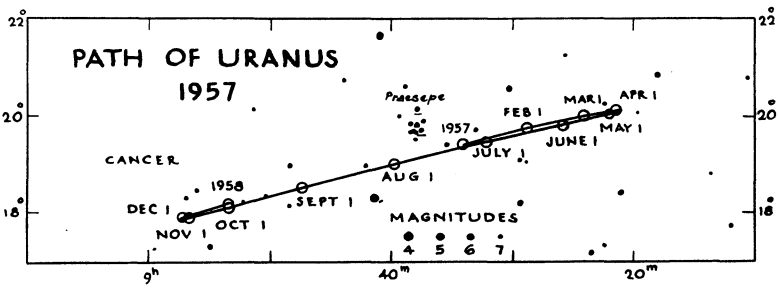
Saturn was the outermost planet known until modern times. In size it is a good second to Jupiter. In addition to its family of nine satellites, this planet has a unique system of rings, and it is one of the finest of celestial objects in a good telescope. The plane of the rings makes an angle of 27°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

On Jan. 1, 1957, Saturn is in the morning sky in the constellation Ophiuchus (see map). On Mar. 23 it reaches a stationary point and begins to move westward, or retrograde. Opposition to the sun occurs on June 1, and although its declination is $-20°$ it is visible most of the night. Its magnitude is then $+0.2$. It continues to move westward until Aug. 12, when it again begins to move eastward. On Dec. 8 it comes into conjunction with the sun.



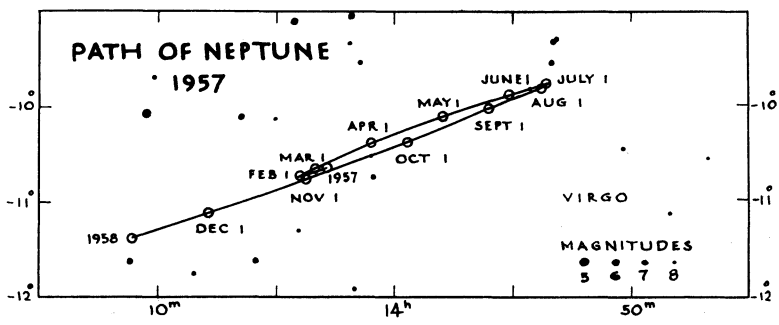
Uranus was discovered in 1781 by Sir William Herschel by means of a $6\frac{1}{4}$-in. mirror-telescope made by himself. The object did not look just like a star and he observed it again four days later. It had moved amongst the stars, and he assumed it to be a comet. He could not believe that it was 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. The fifth satellite was discovered by G P. Kuiper in 1948 at the McDonald Observatory (see p. 9).

As shown by the map, Uranus in 1957 is in the constellation Cancer where it will remain for some years. On Jan. 24 it is in opposition to the sun. Its magnitude is then about +5.7, and its apparent diameter is 3.9″. On July 30 it is in conjunction with the sun.



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 1957 Neptune is still in the constellation Virgo. It is in opposition to the sun on Apr. 21. Its stellar magnitude is about +7.6 and hence it is too faint for the naked eye. In the telescope it shows a greenish tint and a diameter of 2.5″. It is in conjunction with the sun on Oct. 25.

PLUTO

Pluto, the most distant known planet, was discovered at the Lowell Observa. tory in 1930. 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. 17, at which its astrometric position is R.A. $10^h\ 22^m$, Dec. $+22^\circ\ 26'$.

THE SKY MONTH BY MONTH

By J. F. Heard

THE SKY FOR JANUARY, 1957

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

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

The Sun—During January the sun's R.A. increases from 18h 45m to 20h 57m and its Decl. changes from 23° 03′ S. to 17° 14′ S. The equation of time changes from −3m 23 s to −13 m 36 s. The earth is in perihelion or nearest the sun on the 3rd. For changes in the length of the day, see p. 13.

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

Mercury on the 15th is in R.A. 19h 02m, Decl. 19° 14′ S. and transits at 11h 20m. It is in inferior conjunction on the 10th, but by the end of the month it may be seen as a morning star low in the south-east just before sunrise.

Venus on the 15th is in R.A. 18h 12m, Decl. 23° 02′ S. and transits at 10h 36m. It is a morning star visible very low in the south-east just before sunrise.

Mars on the 15th is in R.A. 1h 20m, Decl. 9° 01′ N. and transits at 17h 42m. It is in Pisces and is nearly to the meridian at sunset and sets at about midnight. It has declined greatly in brightness and will continue to do so during the coming months.

Jupiter on the 15th is in R.A. 12h 09m, Decl. 0° 32′ N. and transits at 4h 31m. It is in Virgo and rises just before midnight. On the 16th it is stationary in R.A. and begins to retrograde, i.e. 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. 16h 38m, Decl. 20° 23′ S. and transits at 8h 59m. It is in Scorpius and rises in the south-east about two hours before the sun.

Uranus on the 15th is in R.A. 8h 32m, Decl. 19° 32′ N. and transits at 0h 54m.

Neptune on the 15th is in R.A. 14h 04m. Decl. 10° 43′ S. and transits at 6h 25m.

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

ASTRONOMICAL PHENOMENA MONTH BY MONTH

By Ruth J. Northcott

			JANUARY 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 4h 15m
d	h	m		h m	
Tue. 1	1		☿ Stationary in R.A.		4201*
Wed. 2	8	35	☌ ☿ ☾ ☿ 3° 56′ S.	6 47	42103
Thu. 3			Quadrantid meteors		40123
	1		⊕ in Perihelion. Dist. from ☉, 91,347,000 mi.		
Fri. 4	3		Moon in Apogee. Dist. from ⊕, 252,400 mi.		4023*
Sat. 5	1		☿ in Perihelion	3 36	d4230
Sun. 6					3401*
Mon. 7					31042
Tue. 8	9		□ ♂ ☉ East	0 26	32014
Wed. 9	2	06	☽ First Quarter		21034
	3	45	☌ ♂ ☾ ♂ 2° 56′ S.		
Thu. 10	10		☌ ☿ ☉ Inferior	21 15	01234
Fri. 11					10234
Sat. 12					d2304
Sun. 13				18 04	32014
Mon. 14					31042
Tue. 15	7		☿ Greatest Hel. Lat. N.		32401
Wed. 16	1	21	○ Full Moon	14 53	42103
	17		Moon in Perigee. Dist. from ⊕, 222,000 mi.		
	18	17	☌ ♅ ☾ ♅ 5° 33′ N.		
	19		♃ Stationary in R.A.		
Thu. 17					40213
Fri. 18					41023
Sat. 19				11 43	d4201
Sun. 20	14	51	☌ ♃ ☾ ♃ 5° 54′ N.		4320*
Mon. 21	11		☌ ☿ ♀ ☿ 2° 49′ N.		43102
	13		☿ Stationary in R.A.		
Tue. 22	15		□ ♆ ☉ West	8 32	d4301
	16	48	☾ Last Quarter		
	19	07	☌ ♆ ☾ ♆ 3° 57′ N.		
Wed. 23	14		♀ in ☋		21403
Thu. 24	23		☍ ♅ ☉ Dist. from ⊕, 1,630,000,000 mi.		02143
Fri. 25	18	38	☌ ♄ ☾ ♄ 0° 23′ N.	5 21	10234
Sat. 26					20314
Sun. 27					3204*
Mon. 28	10	44	☌ ☿ ☾ ☿ 2° 01′ S.	2 10	d3024
Tue. 29	0	53	☌ ♀ ☾ ♀ 4° 23′ S.		30214
Wed. 30	16	24	● New Moon	23 00	21034
Thu. 31	9		Moon in Apogee. Dist. from ⊕ 252,700 mi.		02413

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

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

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

The Sun—During February the sun's R.A. increases from 20h 57m to 22h 47m and its Decl. changes from 17° 14′ S. to 7° 46′ S. The equation of time changes from −13m 36s to a minimum of −14m 20s on the 11th and then to −12m 33s at the end of the month. For changes in the length of the day, see p. 13.

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

Mercury on the 15th is in R.A. 20h 23m, Decl. 20° 22′ S. and transits at 10h 45m. Greatest western elongation is on the 2nd, and at about this time for a few days it may be glimpsed very low in the south-east just before sunrise.

Venus on the 15th is in R.A. 20h 57m, Decl. 18° 11′ S. and transits at 11h 18m. It is a morning star but too close to the sun for easy observation.

Mars on the 15th is in R.A. 2h 32m, Decl. 15° 56′ N. and transits at 16h 52m. It is now in Aries, past the meridian at sunset and visible until about midnight.

Jupiter on the 15th is in R.A. 12h 04m, Decl. 1° 12′ N. and transits at 2h 24m. It rises late in the evening and is visible for the rest of the night. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 56.

Saturn on the 15th is in R.A. 16h 48m, Decl. 20° 40′ S. and transits at 7h 07m. It rises in the south-east several hours before the sun.

Uranus on the 15th is in R.A. 8h 26m, Decl. 19° 52′ N. and transits at 22h 43m.

Neptune on the 15th is in R.A. 14h 04m, Decl. 10° 42′ S. and transits at 4h 23m.

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

				FEBRUARY 75th Meridian Civil Time		Min. of Algol	Config. of Jupiter's Sat. 2h 45m
	d	h	m			h m	
Fri.	1			....			14023
Sat.	2	14		☿	Greatest elongation W., 25° 19′......	19 49	42031
Sun.	3	3		♆	Stationary in R.A..................		42310
Mon.	4			....			43012
Tue.	5			....		16 38	4302*
Wed.	6	18	05	☌ ♂ ☾	♂ 0° 48′ S..................		4210*
Thu.	7	18		☿	in ☋...........................		4013*
		18	23	☽	First Quarter.....................		
Fri.	8			....		13 28	41023
Sat.	9			Aurigid meteors..........................			20413
Sun.	10			....			23104
Mon.	11			....		10 17	30124
Tue.	12			....			3024*
Wed.	13	3	54	☌ ♅ ☾	♅ 5° 32′ N.................		2104*
Thu.	14	6		Moon in Perigee.	Dist. from ⊕, 221,500 mi...	7 06	20134
		11	38	○	Full Moon.......................		
Fri.	15			....			10234
Sat.	16	22	02	☌ ♃ ☾	♃ 5° 54′ N.................		20134
Sun.	17	22		☍ ♇ ☉	Dist. from ⊕, 3,118,000,000 mi.	3 56	21304
Mon.	18	0		☿	in Aphelion.......................		34021
Tue.	19	2	43	☌ ♆ ☾	♆ 3° 42′ N.................		43102
Wed.	20			....		0 45	d4230
Thu.	21	7	18	☾	Last Quarter......................		42013
Fri.	22	4	16	☌ ♄ ☾	♄ 0° 01′ N.........................	21 34	41023
Sat.	23			....			d4013
Sun.	24			....			42130
Mon.	25			....		18 23	34021
Tue.	26			....			31042
Wed.	27	6		♀	in Aphelion.......................		23014
		10		Moon in Apogee.	Dist. from ⊕, 252,600 mi ..		
Thu.	28	4	52	☌ ☿ ☾	☿ 7° 28′ S..................	15 13	2034*
		15	33	☌ ♀ ☾	♀ 6° 37′ S..................		

Explanations of symbols and abbreviations on p. 4, of time on p. 10.

THE SKY FOR MARCH, 1957

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

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

The Sun—During March the sun's R.A. increases from 22h 47m to 0h 40m and its Decl. changes from 7° 46′ S. to 4° 21′ N. The equation of time changes from −12m 33s to −4m 06s. On the 20th at 16h 17m 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.

Mercury on the 15th is in R.A. 23h 22m, Decl. 6° 13′ S. and transits at 11h 54m. It is too close to the sun for observation, superior conjunction being on the 20th.

Venus on the 15th is in R.A. 23h 12m, Decl. 6° 42′ S. and transits at 11h 43m. It is a morning star but too close to the sun for observation.

Mars on the 15th is in R.A. 3h 43m, Decl. 20° 53′ N. and transits at 16h 12m. It has moved into Taurus, is well past the meridian at sunset and sets about four hours later.

Jupiter on the 15th is in R.A. 11h 52m, Decl. 2° 31′ N. and transits at 0h 22m. It rises just about at sunset and is visible all night. Opposition is on the 17th. 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. 16h 53m, Decl. 20° 44′ S. and transits at 5h 22m. It rises in the south-east at about midnight and is past the meridian by sunrise. On the 23rd it is stationary in R.A. and begins to retrograde, i.e. move westward among the stars.

Uranus on the 15th is in R.A. 8h 22m, Decl. 20° 04′ N. and transits at 20h 49m.

Neptune on the 15th is in R.A. 14h 02m. Decl. 10° 33′ S. and transits at 2h 32m.

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

MARCH

75th Meridian Civil Time

	d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 1h 15m
Fri.	1	11	12	● New Moon		10234
Sat.	2					02134
Sun.	3				12 02	d2104
Mon.	4	15		□ ♄ ☉ West		3014*
Tue.	5					31024
Wed.	6				8 51	32401
Thu.	7	8	25	☌ ♂ ☾ ♂ 1° 17′ N.		42103
Fri.	8					d4023
Sat.	9	6	50	☽ First Quarter	5 41	40123
Sun.	10	8		☌ ☿ ♀ ☿ 0° 47′ S.		42103
		8		☿ Greatest Hel. Lat. S.		
Mon.	11					43201
Tue.	12	12	35	☌ ♅ ☾ ♅ 5° 38′ N.	2 30	43102
Wed.	13					43201
Thu.	14	17		Moon in Perigee. Dist. from ⊕, 223,100 mi.	23 19	21403
Fri.	15	21	22	○ Full Moon		01243
Sat.	16	4	07	☌ ♃ ☾ ♃ 6° 03′ N.		01234
Sun.	17	13		☍ ♃ ☉ Dist. from ⊕, 413,400,000 mi.	20 08	21034
Mon.	18	11	52	☌ ♆ ☾ ♆ 3° 33′ N.		32014
Tue.	19					31024
Wed.	20	13		☌ ☿ ☉ Superior	16 58	32014
		16	17	☉ enters ♈. Spring commences. Long. of ☉, 0°.		
Thu.	21	11		♀ Greatest Hel. Lat. S.		21034
		13	23	☌ ♄ ☾ ♄ 0° 15′ S.		
Fri.	22					01243
Sat.	23	0	04	☾ Last Quarter	13 47	4023*
		23		♄ Stationary in R.A.		
Sun.	24					42103
Mon.	25					43201
Tue.	26	23		Moon in Apogee. Dist. from ⊕, 252,100 mi.	10 36	43102
Wed.	27					d4301
Thu.	28					4210*
Fri.	29	9		☿ in ☊	7 25	40213
Sat.	30					41023
Sun.	31	0	54	☌ ♀ ☾ ♀ 5° 14′ S.		d203*
		4	19	● New Moon		

Explanations of symbols and abbreviations on p. 4, of time on p. 10.

THE SKY FOR APRIL, 1957

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

The times of transit at the 75th meridian are given in local mean time, 0h at midnight; to change to Standard Time, see p. 12. 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 32m and its Decl. changes from 4° 21′ N. to 14° 56′ N. The equation of time changes from −4m 06s to +2m 52s, being zero on the 15th; that is, the apparent sun moves from east to west of the mean sun on that date. There is an annular eclipse of the sun on the 29th. 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. 2h 44m, Decl. 18°44′ N. and transits at 13h 12m. Greatest eastern elongation is on the 15th and for some days at this time Mercury will be easily seen as an evening star due west just after sunset.

Venus on the 15th is in R.A. 1h 34m, Decl. 8° 36′ N. and transits at 12h 03m. It is too close to the sun for observation, superior conjunction being on the 14th.

Mars on the 15th is in R.A. 5h 06m, Decl. 24° 08′ N. and transits at 15h 33m. It is in Taurus, well past the meridian at sunset and it sets about four hours later.

Jupiter on the 15th is in R.A. 11h 39m, Decl. 3° 58′ N. and transits at 22h 02m. It has already risen at sunset and remains 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. 16h 51m, Decl. 20° 38′ S. and transits at 3h 18m. It rises in the south-east late in the evening and is visible for the rest of the night.

Uranus on the 15th is in R.A. 8h 21m, Decl. 20° 07′ N. and transits at 18h 46m.

Neptune on the 15th is in R.A. 14h 00m, Decl. 10° 17′ S. and transits at 0h 27m.

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

APRIL 75th Meridian Civil Time					Min. of Algol	Config. of Jupiter's Sat. 0h 15m
	d	h	m		h m	
Mon.	1	6	58	☌ ☿ ☾ ☿ 1° 50′ S.	4 15	23O14
Tue.	2			. . . .		31O24
Wed.	3	0		☿ in Perihelion		3O214
Thu.	4	22	41	☌ ♂ ☾ ♂ 3° 09′ N.	1 04	213O4
Fri.	5			. . . .		O134*
Sat.	6			. . . .	21 53	1O234
Sun.	7	15	32	☽ First Quarter		2O134
Mon.	8	19	28	☌ ♅ ☾ ♅ 5° 47′ N.		23O4*
Tue.	9			. . . .	18 42	341O2
Wed.	10	6		♅ Stationary in R.A.		43O21
Thu.	11	20		Moon in Perigee. Dist. from ⊕, 226,100 mi.		4213O
Fri.	12	9	02	☌ ♃ ☾ ♃ 6° 15′ N.	15 31	4O13*
Sat.	13	6		☿ Greatest Hel. Lat. N.		41O23
Sun.	14	7	09	○ Full Moon		42O13
		8		☌ ♀ ☉ Superior		
		21	13	☌ ♆ ☾ ♆ 3° 34′ N.		
Mon.	15	4		☿ Greatest elongation E., 19° 45′	12 20	423O*
Tue.	16			. . . .		341O2
Wed.	17	21	41	☌ ♄ ☾ ♄ 0° 18′ S.		3O142
Thu.	18			. . . .	9 09	231O4
Fri.	19			. . . .		2O134
Sat.	20			. . . .		1O234
Sun.	21			Lyrid meteors	5 59	2O134
		10		☍ ♆ ☉ Dist. from ⊕, 2,724,000,000 mi.		
		18	00	☾ Last Quarter		
Mon.	22			. . . .		d21O4
Tue.	23	4		□ ♅ ☉ East		d3O24
		16		Moon in Apogee. Dist. from ⊕, 251,500 mi.		
Wed.	24			. . . .	2 48	3O124
Thu.	25	10		☿ Stationary in R.A.		2314O
Fri.	26			. . . .	23 37	42O31
Sat.	27			. . . .		41O23
Sun.	28			. . . .		d4O13
Mon.	29			Annular eclipse of ☉. See p. 59	20 26	421O3
		18	54	● New Moon		
Tue.	30	3	53	☌ ♀ ☾ ♀ 1° 12′ S.		43O12
		10	25	☌ ☿ ☾ ☿ 1° 34′ N.		

Explanations of symbols and abbreviations on p. 4, of time on p. 10.

THE SKY FOR MAY, 1957

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

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

The Sun—During May the sun's R.A. increases from 2h 32m to 4h 34m and its Decl. changes from 14° 56′ N. to 21° 59′ N. The equation of time changes from +2m 52s to a maximum of +3m 45s on the 15th and then to +2m 24s 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 is a total eclipse of the moon on the evening of the 13th partly visible on the east coast of North America.

Mercury on the 15th is in R.A. 2h 36m, Decl. 12° 56′ N. and transits at 11h 03m. Inferior conjunction is on the 5th (at which time it transits the sun's disk), but by the end of the month it may be seen as a morning star low in the east just before sunrise. The transit on May 5th will be visible in part, at least, over all of North America except the extreme east; it will start at about 18h 56m E.S.T.

Venus on the 15th is in R.A. 3h 59m, Decl. 20° 28′ N. and transits at 12h 30m. It is an evening star, but rather close to the sun for easy observation until the latter part of the month.

Mars on the 15th is in R.A. 6h 29m, Decl. 24° 34′ N. and transits at 14h 58m. It has now moved into Gemini and is well down in the west at sunset, setting a few hours later.

Jupiter on the 15th is in R.A. 11h 32m, Decl. 4° 33′ N. and transits at 19h 58m. It is nearly to the meridian at sunset and remains visible until nearly dawn. On the 19th it is stationary in R.A. and resumes direct, i.e. eastward, motion among the stars. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 57.

Saturn on the 15th is in R.A. 16h 44m, Decl. 20° 25′ S. and transits at 1h 13m. It rises an hour or two after sunset and is visible all the rest of the night.

Uranus on the 15th is in R.A. 8h 23m, Decl. 19° 59′ N. and transits at 16h 50m.

Neptune on the 15th is in R.A. 13h 57m, Decl. 10° 00′ S. and transits at 22h 22m.

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

MAY

75th Meridian Civil Time

	d	h	m			Min. of Algol h m	Config. of Jupiter's Sat. 23h 30m
Wed.	1			....			43210
Thu.	2	11		☌ ☿ ♀	☿ 1° 49′ N.	17 15	2401*
Fri.	3	13	07	☌ ♂ ☾	♂ 4° 40′ N.		10243
Sat.	4			η Aquarid meteors.			02134
Sun.	5			Transit of ☿.	See p. 59.	14 04	21034
		19		☌ ☿ ☉	Inferior.		
Mon.	6	1	36	☌ ♅ ☾	♅ 5° 52′ N.		3014*
		17		☿	in ☋		
		21	29	☽	First Quarter.		
Tue.	7			....			31024
Wed.	8	22		Moon in Perigee.	Dist. from ⊕, 229,200 mi.	10 53	d3204
Thu.	9	13	39	☌ ♃ ☾	♃ 6° 19′ N		20314
Fri.	10			....			10423
Sat.	11			....		7 42	40213
Sun.	12	5	09	☌ ♆ ☾	♆ 3° 39′ N.		42103
Mon.	13			Total eclipse of ☾.	See p. 59.		4301*
		17	34	○	Full Moon.		
Tue.	14			....		4 31	43102
Wed.	15	4	20	☌ ♄ ☾	♄ 0° 10′ S.		d4320
Thu.	16	18		♀	in ☊		4230*
Fri.	17	0		☿	in Aphelion.	1 20	41023
Sat.	18	2		☿	Stationary in R.A.		40213
Sun.	19	11		♃	Stationary in R.A.	22 09	21043
Mon.	20			....			32014
Tue.	21	11		Moon in Apogee.	Dist. from ⊕, 251,200 mi.		31024
		12	03	☾	Last Quarter.		
Wed.	22			....		18 58	32014
Thu.	23			....			2304*
Fri.	24			....			10234
Sat.	25			....		15 46	01234
Sun.	26			....			21034
Mon.	27	11	58	☌ ☿ ☾	☿ 4° 24′ S.		23041
Tue.	28			....		12 35	34102
Wed.	29	6	39	●	New Moon.		d4301
Thu.	30	4	56	☌ ♀ ☾	♀ 3° 15′ N.		42310
Fri.	31			....		9 24	41023

Explanations of symbols and abbreviations on p. 4, of time on p. 10.

THE SKY FOR JUNE, 1957

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

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

The Sun—During June the Sun's R.A. increases from 4h 34m to 6h 39m and its Decl. changes from 21° 59′ N. to 23° 26′ N. at the solstice on the 21st at 11h 21m E.S.T. and then to 23° 09′ N. at the end of the month. The equation of time changes from +2m 24s to zero on the 14th to −3m 35s 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 and moonrise and moonset are given on p. 22.

Mercury on the 15th is in R.A. 4h 09m, Decl. 18° 58′ N. and transits at 10h 38m. Greatest western elongation is on the 1st, so for the first few days of the month Mercury may be seen as a morning star low in the east just before sunrise.

Venus on the 15th is in R.A. 6h 44m, Decl. 24° 10′ N. and transits at 13h 12m. It is a brilliant object low in the western sky for an hour or more after sunset.

Mars on the 15th is in R.A. 7h 53m, Decl. 22° 12′ N. and transits at 14h 20m. It is moving through Gemini into Cancer and is to be seen only for an hour or two after sunset low in the west.

Jupiter on the 15th is in R.A. 11h 36m, Decl. 4° 02′ N. and transits at 18h 00m. It is just past the meridian at sunset and sets at about 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. 16h 35m, Decl. 20° 08′ S. and transits at 22h 58m. Being in opposition on the 1st, it rises at about sunset and is visible until nearly dawn.

Uranus on the 15th is in R.A. 8h 29m, Decl. 19° 41′ N. and transits at 14h 53m.

Neptune on the 15th is in R.A. 13h 54m, Decl. 9° 48′ S. and transits at 20h 18m.

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

JUNE

75th Meridian Civil Time

	d	h	m		Min. of Algol	Config. of Jupiter's Sat. 22h 45m
	d	h	m		h m	
Sat.	1	3	50	☌ ♂ ☾ ♂ 5° 48′ N..................		4O123
		14		☍ ♄ ☉ Dist. from ⊕, 837,100,000 mi. .		
		18		☿ Greatest elongation W., 24° 28′......		
Sun.	2	8	53	☌ ♅ ☾ ♅ 5° 51′ N..................		421O3
		23		Moon in Perigee. Dist. from ⊕, 229,100 mi. . .		
Mon.	3			....	6 13	d42O1
Tue.	4			....		314O2
Wed.	5	2	10	☽ First Quarter......................		3O241
		19	47	☌ ♃ ☾ ♃ 6° 08′ N................		
Thu.	6	7		☿ Greatest Hel. Lat. S.................	3 02	231O4
Fri.	7			....		O134*
Sat.	8	11	06	☌ ♆ ☾ ♆ 3° 39′ N..................	23 51	O234*
Sun.	9			....		21O34
Mon.	10			....		2O314
Tue.	11	8	57	☌ ♄ ☾ ♄ 0° 00′........................	20 39	31O24
Wed.	12	5	02	○ Full Moon........................		3O214
Thu.	13	23		□ ♃ ☉ East........................		2314O
Fri.	14			....	17 28	4O1**
Sat.	15			....		4O23*
Sun.	16			....		421O3
Mon.	17			....	14 17	42O13
Tue.	18	6		Moon in Apogee. Dist. from ⊕, 251,400 mi. . .		431O2
Wed.	19	15		♀ in Perihelion......................		43O21
Thu.	20	5	22	☾ Last Quarter..	11 06	4321O
Fri.	21	11	21	☉ enters ♋, Summer commences. Long. of ☉, 90°		42O31
Sat.	22			....		1O423
Sun.	23			....	7 54	d2O34
Mon.	24	5		♂ Greatest Hel. Lat. N................		2O134
Tue.	25	8		☿ in ☊..............................		31O24
Wed.	26			....	4 43	3O124
Thu.	27	0	33	☌ ☿ ☾ ☿ 3° 28′ N................		321O4
		15	53	● New Moon........................		
Fri.	28			Draconid meteors		23O14
Sat.	29	5	36	☌ ♀ ☾ ♀ 6° 24′ N..................	1 32	1O423
		18		☌ ♂ ♅ ♂ 0° 40′ N..................		
		18	41	☌ ♅ ☾ ♅ 5° 46′ N..................		
		18	44	☌ ♂ ☾ ♂ 6° 26′ N..................		
		23		☿ in Perihelion......................		
Sun.	30	3		Moon in Perigee. Dist. from ⊕, 226,200 mi. . .		d4O13

Explanations of symbols and abbreviations on p. 4, of time on p. 10.

THE SKY FOR JULY, 1957

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

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

The Sun—During July the sun's R.A. increases from 6h 39m to 8h 44m and its Decl. changes from 23° 09′ N. to 18° 09′ N. The equation of time changes from −3m 35s to a minimum of −6m 24s on the 27th and then to −6m 15s at the end of the month. On the 2nd the earth is in aphelion, or farthest from the sun. For changes in the length of the day, see p. 16.

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

Mercury on the 15th is in R.A. 8h 28m, Decl. 20° 58′ N. and transits at 13h 01m. It is in superior conjunction on the 4th and is poorly placed all month for observation.

Venus on the 15th is in R.A. 9h 18m, Decl. 17° 26′ N. and transits at 13h 48m. It is a brilliant object low in the western sky for about an hour after sunset. On the evening of the 11th Venus and Mars are very close together.

Mars on the 15th is in R.A. 9h 10m, Decl. 17° 33′ N. and transits at 13h 39m. It is moving through Cancer into Leo and may still be seen low in the west after sunset, although by now it has declined to 2nd magnitude. (See Venus.)

Jupiter on the 15th is in R.A. 11h 48m, Decl. 2° 37′ N. and transits at 16h 15m. It is well down in the west at sunset and sets a few hours later. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 57.

Saturn on the 15th is in R.A. 16h 27m, Decl. 19° 57′ S. and transits at 20h 53m. Near Antares, it is well up in the south-east at sunset and is visible until after midnight.

Uranus on the 15th is in R.A. 8h 35m, Decl. 19° 16′ N. and transits at 13h 02m.

Neptune on the 15th is in R.A. 13h 54m, Decl. 9° 46′ S. and transits at 18h 19m.

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

d		h	m	JULY 75th Meridian Civil Time		Min. of Algol h m	Config. of Jupiter's Sat. 21h 45m
Mon.	1					22 20	4203*
Tue.	2	20		⊕ in Aphelion. Dist. from ☉, 94,452,000 mi.			43102
Wed.	3	5	12	☌ ♃ ☾	♃ 5° 43′ N.		43012
Thu.	4	0		☌ ☿ ☉	Superior	19 09	43210
		7	09	☽	First Quarter		
Fri.	5	16	03	☌ ♆ ☾	♆ 3° 30′ N.		42301
		19		☌ ♀ ♅	♀ 1° 00′ N.		
Sat.	6						41023
Sun.	7					15 58	40213
Mon.	8	12	14	☌ ♄ ☾	♄ 0° 01′ N.		21403
Tue.	9						d304*
Wed.	10	6		☿	Greatest Hel. Lat. N.	12 46	30124
Thu.	11	6		♀	Greatest Hel. Lat. N.		31204
		14		☌ ♀ ♂	♀ 0° 25′ N.		
		17	50	○	Full Moon		
Fri.	12	5		♆	Stationary in R.A.		23014
Sat.	13					9 35	10324
Sun.	14						02134
Mon.	15	17		☌ ☿ ♅	☿ 1° 15′ N.		21034
		22		Moon in Apogee. Dist. from ⊕, 251,900 mi.			
Tue.	16					6 24	20314
Wed.	17						3402*
Thu.	18						34120
Fri.	19	21	17	☾	Last Quarter	3 12	42301
Sat.	20						41032
Sun.	21						40123
Mon.	22	19		□ ♆ ☉	East	0 01	42103
Tue.	23	17		☌ ☿ ♂	☿ 0° 07′ N.		42013
Wed.	24					20 49	3402*
Thu.	25						d3104
Fri.	26	23	28	●	New Moon		32014
Sat.	27	6	56	☌ ♅ ☾	♅ 5° 45′ N.	17 38	1024*
Sun.	28	5		Moon in Perigee. Dist. from ⊕, 223,400 mi.			01234
		9	44	☌ ♂ ☾	♂ 6° 27′ N.		
		17	34	☌ ☿ ☾	☿ 5° 56′ N.		
Mon.	29	3	02	☌ ♀ ☾	♀ 6° 39′ N.		21034
				δ Aquarid meteors			
Tue.	30	13		☌ ♅ ☉		14 26	20134
		18	41	☌ ♃ ☾	♃ 5° 10′ N.		
		21		♂	in Aphelion		
Wed.	31						31024

Explanations of symbols and abbreviations on p. 4, of time on p. 10.

THE SKY FOR AUGUST, 1957

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

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

The Sun—During August the sun's R.A. increases from 8h 44m to 10h 40m and its Decl. changes from 18° 09′ N. to 8° 28′ N. The equation of time changes from −6m 15s to −0m 10s. For changes in the length of the day, see p. 16.

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

Mercury on the 15th is in R.A. 11h 17m, Decl. 2° 22′ N. and transits at 13h 44m. Greatest eastern elongation is on the 13th at about which time the planet may be seen low in the west just after sunset. However, this is a poor elongation.

Venus on the 15th is in R.A. 11h 39m, Decl. 3° 21′ N. and transits at 14h 07m. It is a brilliant object low in the western sky for about an hour after sunset.

Mars on the 15th is in R.A. 10h 26m, Decl. 10° 57′ N. and transits at 12h 53m. It is in Leo but now too low in the west at sunset for easy observation.

Jupiter on the 15th is in R.A. 12h 07m, Decl. 0° 29′ N. and transits at 14h 32m. It is quite low in the 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. 57.

Saturn on the 15th is in R.A. 16h 25m, Decl. 19° 58′ S. and transits at 18h 48m. It is about at the meridian at sunset and is visible in the south-west until late in the evening. On the 12th it is stationary in R.A. and resumes direct, or eastward, motion among the stars.

Uranus on the 15th is in R.A. 8h 43m, Decl. 18° 47′ N. and transits at 11h 08m.

Neptune on the 15th is in R.A. 13h 55m, Decl. 9° 54′ S. and transits at 16h 19m.

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

AUGUST

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 20h 30m
Thu. 1	21	53	☌ ♆ ☾ ♆ 3° 13′ N.		d3024
Fri. 2	13	55	☽ First Quarter	11 15	3204*
	16		☿ in ☋		
Sat. 3					4130*
Sun. 4	16	03	☌ ♄ ☾ ♄ 0° 12′ S.		40123
Mon. 5				8 04	41203
Tue. 6					42013
Wed. 7					41302
Thu. 8				4 52	43012
Fri. 9					4320*
Sat. 10	8	08	🌕 Full Moon		4310*
Sun. 11				1 41	04132
Mon. 12			Perseid meteors		12043
	3		♄ Stationary in R.A.		
	9		Moon in Apogee. Dist. from ⊕, 252,400 mi.		
	23		☿ in Aphelion		
Tue. 13	10		☿ Greatest elongation E., 27° 26′	22 29	20134
Wed. 14					13024
Thu. 15					30124
Fri. 16				19 18	32104
Sat. 17					d3204
Sun. 18	11	16	☾ Last Quarter		01324
Mon. 19				16 06	12043
Tue. 20					24013
Wed. 21					d4102
Thu. 22	10		☌ ♀ ♃ ♀ 0° 28′ S.	12 15	43012
Fri. 23	9		☌ ♇ ☉		43210
	20	21	☌ ♅ ☾ ♅ 5° 49′ N.		
Sat. 24					
Sun. 25	6	32	● New Moon	9 44	
	13		Moon in Perigee. Dist. from ⊕, 222,000 mi.		
Mon. 26	0	50	☌ ♂ ☾ ♂ 5° 49′ N.		
	14		☿ Stationary in R.A.		
	18	57	☌ ☿ ☾ ☿ 0° 17′ S.		
Tue. 27	11	52	☌ ♃ ☾ ♃ 4° 34′ N.		
	20	16	☌ ♀ ☾ ♀ 3° 25′ N.		
Wed. 28				6 32	
Thu. 29	6	13	☌ ♆ ☾ ♆ 2° 55′ N.		
Fri. 30					
Sat. 31	12		□ ♄ ☉ East	3 21	
	22	33	☌ ♄ ☾ ♄ 0° 34′ S.		
	23	34	☽ First Quarter		

Jupiter being near the sun, configurations of the satellites are not given from August 24 to October 21.

THE SKY FOR SEPTEMBER, 1957

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

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

The Sun—During September the sun's R.A. increases from 10h 40m to 12h 28m and its Decl. changes from 8° 28′ N. to 3° 00′ S. The equation of time changes from −0m 10s to +10m 07s, the apparent sun passing to the west of the mean sun on the 1st. On the 23rd at 2h 27m 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 and moonrise and moonset are given on p. 24.

Mercury on the 15th is in R.A. 10h 52m, Decl. 4° 58′ N. and transits at 11h 14m. Inferior conjunction is on the 9th, but by the 25th Mercury has reached greatest western elongation, and for some days it will be easily seen in the east just before sunrise.

Venus on the 15th is in R.A. 13h 54m, Decl. 12° 18′ S. and transits at 14h 20m. It is an evening star low in the south-west near Spica just after sunset.

Mars on the 15th is in R.A. 11h 40m, Decl. 3° 12′ N. and transits at 12h 04m. It is too close to the sun for observation; conjunction is on the 21st.

Jupiter on the 15th is in R.A. 12h 30m, Decl. 2° 02′ S. and transits at 12h 53m. It is too close to the sun for easy observation.

Saturn on the 15th is in R.A. 16h 29m, Decl. 20° 13′ S. and transits at 16h 50m. It is past the meridian at sunset and is visible for a few hours thereafter in the south-west.

Uranus on the 15th is in R.A. 8h 50m, Decl. 18° 20′ N. and transits at 9h 13m.

Neptune on the 15th is in R.A. 13h 58m, Decl. 10° 11′ S. and transits at 14h 20m.

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

	SEPTEMBER 75th Meridian Civil Time			Min. of Algol
d	h	m		h m
Sun. 1			....	
Mon. 2	7		☿ Greatest Hel. Lat. S................	
Tue. 3			....	0 09
Wed. 4			....	
Thu. 5	7		♀ in ☋............................	20 58
	21		☌ ☿ ♂ ☿ 5° 39′ S................	
Fri. 6			....	
Sat. 7	9		♃ Greatest Hel. Lat. N...............	
Sun. 8	12		Moon in Apogee. Dist. from ⊕, 252,500 mi...	17 46
	23	55	🌕 Full Moon. Harvest Moon.........	
Mon. 9	15		☌ ☿ ☉ Inferior....................	
Tue. 10			....	
Wed. 11			....	14 35
Thu. 12			....	
Fri. 13			....	
Sat. 14			....	11 23
Sun. 15	14		☌ ♀ ♆ ♀ 2° 28′ S..................	
Mon. 16	23	02	☾ Last Quarter......................	
Tue. 17			....	8 12
Wed. 18	3		☿ Stationary in R.A.................	
Thu. 19			....	
Fri. 20	9	01	☌ ♅ ☾ ♅ 5° 59′ N.................	5 01
Sat. 21	7		☿ in ☊............................	
	10		☌ ♂ ☉	
Sun. 22	12	30	☌ ☿ ☾ ☿ 5° 02′ N.................	
Mon. 23	0		Moon in Perigee. Dist. from ⊕, 222,300 mi...	1 49
	2	27	☉ enters ♎, Autumn commences. Long. of ☉, 180°	
	14	18	🌑 New Moon........................	
	16	05	☌ ♂ ☾ ♂ 4° 33′ N..................	
Tue. 24	7	29	☌ ♃ ☾ ♃ 4° 00′ N.................	
Wed. 25	14		☿ Greatest elongation W., 17° 52′......	22 38
	17	14	☌ ♆ ☾ ♆ 2° 40′ N.................	
	23		☿ in Perihelion.....................	
Thu. 26	13	12	☌ ♀ ☾ ♀ 1° 39′ S..................	
Fri. 27			....	
Sat. 28	8	56	☌ ♄ ☾ ♄ 0° 59′ S..................	19 27
Sun. 29			....	
Mon. 30	12	49	☽ First Quarter.....................	

Jupiter being near the sun, configurations of the satellites are not given from August 24 to October 21.

THE SKY FOR OCTOBER, 1957

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

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

The Sun—During October the sun's R.A. increases from 12h 28m to 14h 24m and its Decl. changes from 3° 00′ S. to 14° 17′ S. The equation of time changes from +10m 07s to +16m 20s. There is a total eclipse of the sun on the 23rd. 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 57m, Decl. 4° 27′ S. and transits at 11h 26m. At the very beginning of the month it may still be seen as a morning star, but by the 23rd it has reached superior conjunction.

Venus on the 15th is in R.A. 16h 13m, Decl. 23° 35′ S. and transits at 14h 41m. It is an evening star low in the south-west for about two hours after sunset.

Mars on the 15th is in R.A. 12h 51m, Decl. 4° 39′ S. and transits at 11h 17m. It is too close to the sun for observation.

Jupiter on the 15th is in R.A. 12h 54m, Decl. 4° 34′ S. and transits at 11h 19m. It is too close to the sun for observation until late in the month, conjunction being on the 5th. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 57.

Saturn on the 15th is in R.A. 16h 38m, Decl. 20° 38′ S. and transits at 15h 20m. Still near Antares, it is well down in the south-west at sunset and sets about two hours later.

Uranus on the 15th is in R.A. 8h 55m, Decl. 18° 01′ N. and transits at 7h 20m.

Neptune on the 15th is in R.A. 14h 01m, Decl. 10° 33′ S. and transits at 12h 26m.

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

				OCTOBER 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 7h 00m
	d	h	m		h m	
Tue.	1			....	16 15	
Wed.	2			....		
Thu.	3			....		
Fri.	4			....	13 04	
Sat.	5	11		☌♃☉		
		17		Moon in Apogee. Dist. from ⊕, 252,200 mi. . .		
Sun.	6	5		☿ Greatest Hel. Lat. N................		
Mon.	7			....	9 52	
Tue.	8	16	42	○ Full Moon. Hunter's Moon.........		
Wed.	9	22		♀ in Aphelion.......................		
Thu.	10			....	6 41	
Fri.	11			....		
Sat.	12			....		
Sun.	13	6		☌☿♂ ☿ 0° 57′ N..................	3 30	
Mon.	14	5		☌☿♃ ☿ 0° 30′ N..................		
Tue.	15			....		
Wed.	16	8	44	☾ Last Quarter......................	0 19	
		13		☌♂♃ ♂ 0° 24′ S..................		
Thu.	17	19	01	☌⛢☾ ⛢ 6° 07′ N..................		
Fri.	18			....	21 07	
Sat.	19			....		
Sun.	20			Orionid meteors..............................		
		7		☌♀♄ ♀ 4° 07′ S..................		
Mon.	21	8		Moon in Perigee. Dist. from ⊕, 224,400 mi. . .	17 56	31O24
Tue.	22	3	33	☌♃☾ ♃ 3° 29′ N..................		O1324
		7	33	☌♂☾ ♂ 2° 48′ N..................		
		23	43	● New Moon..........................		
		23	46	☌☿☾ ☿ 1° 52′ N..................		
Wed.	23	0		♃ in Aphelion........................		2O34*
				Total eclipse of ☉. See p. 59................		
		5	36	☌♆☾ ♆ 2° 32′ N..................		
		22		☌☿☉ Superior.....................		
Thu.	24			....	14 45	21O34
Fri.	25	8		☌☿♆ ☿ 1° 17′ S..................		O3124
		20		☌♆☉		
		22	47	☌♄☾ ♄ 1° 20′ S..................		
Sat.	26	10	17	☌♀☾ ♀ 6° 10′ S..................		31O24
Sun.	27			....	11 34	324O1
Mon.	28			....		431O2
Tue.	29	15		☿ in ☋..............................		4O312
Wed.	30	5	48	☽ First Quarter......................	8 22	42O3*
Thu.	31			Taurid meteors..............................		421O3

Jupiter being near the sun, configurations of the satellites are not given from August 24th to October 21.

THE SKY FOR NOVEMBER, 1957

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

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

The Sun—During November the sun's R.A. increases from 14h 24m to 16h 27m and its Decl. changes from 14° 17′ S. to 21° 44′ S. The equation of time changes from +16m 20s to a maximum of +16m 23s on the 3rd and then to +11m 08s 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. There is a total eclipse of the moon on the 7th which is partly visible in North America except in the eastern part.

Mercury on the 15th is in R.A. 16h 11m, Decl. 22° 46′ S. and transits at 12h 37m. The planet is poorly placed all month for observation.

Venus on the 15th is in R.A. 18h 42m, Decl. 26° 24′ S. and transits at 15h 08m. It is an evening star dominating the southern and south-western sky for several hours after sunset. Greatest eastern elongation is on the 18th.

Mars on the 15th is in R.A. 14h 08m, Decl. 12° 24′ S. and transits at 10h 32m. It is moving from Virgo into Libra and may now be seen low in the south-east just before sunrise.

Jupiter on the 15th is in R.A. 13h 18m, Decl. 7° 01′ S. and transits at 9h 41m. It is very close to Spica and is seen in the south-east, rising an hour or two before the sun. 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. 16h 51m, Decl. 21° 06′ S. and transits at 13h 13m. It is too low in the south-west at sunset to be easily seen.

Uranus on the 15th is in R.A. 8h 57m, Decl. 17° 54′ N. and transits at 5h 20m.

Neptune on the 15th is in R.A. 14h 06m, Decl. 10° 56′ S. and transits at 10h 28m.

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

NOVEMBER

75th Meridian Civil Time

d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 6h 45m
Fri. 1	4		♀ Greatest Hel. Lat. S.		40132
Sat. 2	7		Moon in Apogee. Dist. from ⊕, 251,700 mi.	5 11	43102
Sun. 3					32401
Mon. 4	2		□♅☽ West		3104*
Tue. 5				2 00	0124*
Wed. 6					21034
Thu. 7			Total eclipse of ☾. See p. 59	22 49	d2034
	9	32	🌕 Full Moon		
Fri. 8	22		☿ in Aphelion		01234
Sat. 9					31024
Sun. 10				19 38	32014
Mon. 11					3104*
Tue. 12			Northern Arietid meteors		30412
Wed. 13	20		☌♂♆ ♂ 1° 15′ S.	16 27	41203
Thu. 14	1	45	☌♅☾ ♅ 6° 09′ N.		42013
	16	59	☾ Last Quarter		
Fri. 15					4023*
Sat. 16			Leonid meteors	13 16	41302
Sun. 17	7		♅ Stationary in R.A.		43201
Mon. 18	2		♀ Greatest elongation E., 47° 14′		43120
	6		Moon in Perigee. Dist. from ⊕, 227,700 mi.		
	21	57	☌♃☾ ♃ 2° 59′ N.		
Tue. 19	17	05	☌♆☾ ♆ 2° 27′ N.	10 05	43012
	23	22	☌♂☾ ♂ 0° 46′ N.		
Wed. 20					d1403
Thu. 21	11	19	● New Moon		20143
	16		☌☿♄ ☿ 3° 34′ S.		
Fri. 22	14	16	☌♄☾ ♄ 1° 36′ S.	6 53	0234*
	16	51	☌☿☾ ☿ 5° 19′ S.		
Sat. 23					d1024
Sun. 24					32014
Mon. 25	8	35	☌♀☾ ♀ 8° 11′ S.	3 42	32104
Tue. 26					30124
Wed. 27					10234
Thu. 28				0 31	20143
Fri. 29	1	57	☽ First Quarter		14023
	6		☿ Greatest Hel. Lat. S.		
Sat. 30	2		Moon in Apogee. Dist. from ⊕, 251,300 mi.	21 20	d4032

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

THE SKY FOR DECEMBER, 1957

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

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

The Sun—During December the sun's R.A. increases from 16h 27m to 18h 44m and its Decl. changes from 21° 44′ S. to 23° 27′ S. at the solstice on the 21st at 21h 49m E.S.T. and then to 23° 04′ S. at the end of the month. The equation of time changes from +11m 08s to zero on the 25th and then to −3m 16s at the end of the month. For changes in the length of 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 50m, Decl. 23° 54′ S. and transits at 13h 14m. Greatest eastern elongation is on the 7th and at about this time the planet may be seen as an evening star low in the south-west just after sunset. However, this is a poor elongation.

Venus on the 15th is in R.A. 20h 38m, Decl. 20° 24′ S. and transits at 15h 03m. It dominates the evening sky, being visible in the south-west for several hours after sunset. It has become appreciably brighter (greatest brilliancy is on the 23rd) and in a telescope it now has a crescent shape.

Mars on the 15th is in R.A. 15h 29m, Decl. 18° 38′ S. and transits at 9h 54m. It is in Libra and may be seen in the south-east for a few hours before sunrise.

Jupiter on the 15th is in R.A. 13h 39m, Decl. 8° 59′ S. and transits at 8h 03m. It rises several hours after midnight and is visible in the south-east until dawn. 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. 17h 06m, Decl. 21° 31′ S. and transits at 11h 30m. It is too close to the sun for observation, conjunction being on the 8th.

Uranus on the 15th is in R.A. 8h 56m, Decl. 18° 01′ N. and transits at 3h 21m.

Neptune on the 15th is in R.A. 14h 10m, Decl. 11° 15′ S. and transits at 8h 34m.

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

				DECEMBER 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 6h 30m
	d	h	m		h m	
Sun.	1					43201
Mon.	2					43210
Tue.	3				18 10	43012
Wed.	4					41032
Thu.	5					42013
Fri.	6				14 59	4103*
Sat.	7	1	16	🌕 Full Moon		40132
		19		☿ Greatest elongation E., 20° 58′		
Sun.	8	22		☌ ♄ ☉		3204*
Mon.	9				11 48	32104
Tue.	10					30124
Wed.	11	6	44	☌ ♅ ☾ ♅ 6° 03′ N.		1024*
Thu.	12				8 37	20134
Fri.	13			Geminid meteors		1034*
Sat.	14	0		Moon in Perigee. Dist. from ⊕, 230,100 mi.		01324
		0	45	☾ Last Quarter		
Sun.	15				5 26	31204
Mon.	16	3		☿ Stationary in R.A.		d3240
		12	57	☌ ♃ ☾ ♃ 2° 29′ N.		
Tue.	17	1	57	☌ ♆ ☾ ♆ 2° 18′ N.		34012
Wed.	18	7		☿ in ☊	2 15	4102*
		15	56	☌ ♂ ☾ ♂ 1° 20′ S.		
Thu.	19					42013
Fri.	20	5	09	☌ ♄ ☾ ♄ 1° 51′ S.	23 04	41203
Sat.	21	1	12	🌑 New Moon		40132
		18	52	☌ ☿ ☾ ☿ 3° 16′ S.		
		21	49	☉ enters ♑. Winter commences. Long. of ☉, 270°		
Sun.	22			Ursid meteors		d4310
		22		☿ in Perihelion		
Mon.	23	23		♀ Greatest brilliancy	19 53	34201
Tue.	24	13	27	☌ ♀ ☾ ♀ 5° 48′ S.		34012
Wed.	25	15		☌ ☿ ☉ Inferior		31024
Thu.	26				16 42	20134
Fri.	27	11		♀ in ☊		12034
		23		Moon in Apogee. Dist. from ⊕, 251,300 mi.		
Sat.	28	23	52	☽ First Quarter		01234
Sun.	29				13 32	13024
Mon.	30					32014
Tue.	31					3024*

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

JANUARY

d	h	m	Sat.	Phen.
1	1	09	III	ED
	4	22	III	ER
	6	11	III	OD
3	6	44	I	SI
4	3	54	I	ED
5	1	12	I	SI
	2	24	I	TI
	3	27	I	Se
	4	37	I	Te
6	1	48	I	OR
	2	20	II	ED
	5	19	IV	ED
8	1	41	II	Te
	5	07	III	ED
11	5	47	I	ED
12	0	02	III	TI
	2	55	III	Te
	3	06	I	SI
	4	15	I	TI
	5	20	I	Se
	6	28	I	Te
13	0	15	I	ED
	3	38	I	OR
	4	56	II	ED
	23	49	I	Se
14	0	56	I	Te
	23	18	II	SI
15	1	34	II	TI
	1	58	II	Se
	4	08	II	Te
16	23	10	II	OR
18	23	12	III	SI
19	2	21	III	Se
	3	45	III	TI
	4	59	I	SI
	6	05	I	TI
	6	36	III	Te
20	2	08	I	ED
	5	27	I	OR
	23	27	I	SI
21	0	32	I	TI
	1	42	I	Se
	2	45	I	Te
	23	54	I	OR
22	1	51	II	SI
	3	59	II	TI
	4	31	II	Se
	6	33	II	Te
	23	21	IV	ED
23	2	06	IV	ER
24	1	35	II	OR
26	3	10	III	SI
	6	18	III	Se
27	4	01	I	ED
28	1	21	I	SI
	2	20	I	TI
	3	36	I	Se
	4	33	I	Te
	22	29	I	ED
29	1	42	I	OR
	4	24	II	SI
	6	22	II	TI
	23	00	I	Te
	23	51	III	OR
30	23	24	II	ED
31	3	59	II	OR

FEBRUARY

d	h	m	Sat.	Phen.
1	22	06	II	Te
3	5	54	I	ED
4	3	14	I	SI
4	4	08	I	TI
4	5	29	I	Se
	6	21	I	Te
5	0	22	I	ED
	3	28	I	OR
	21	43	I	SI
	22	34	I	TI
	23	57	I	Se
6	0	05	III	ER
	0	32	III	OD
	0	47	I	Te
	3	22	III	OR
	21	55	I	OR
7	2	00	II	ED
	6	20	II	OR
8	21	53	II	TI
	22	54	II	Se
9	0	26	II	Te
11	5	08	I	SI
	5	54	I	TI
12	2	16	I	ED
	5	14	I	OR
	23	36	I	SI
13	0	20	I	TI
	0	54	III	ED
	1	51	I	Se
	2	33	I	Te
	23	41	I	OR
14	4	35	II	ED
	21	00	I	Te
15	22	48	II	SI
16	0	11	II	TI
	1	28	II	Se
	2	44	II	Te
17	1	24	IV	SI
	3	51	IV	Se
	21	48	II	OR
19	4	09	I	ED
20	1	30	I	SI
	2	05	I	TI
	3	45	I	Se
	4	19	I	Te
	4	52	III	ED
	22	37	I	ED
21	1	26	I	OR
	20	32	I	TI
	22	13	I	Se
	22	45	I	Te
23	1	22	II	SI
	2	27	II	TI
	4	02	II	Se
	5	01	II	Te
	21	12	III	TI
	22	06	III	Se
24	0	00	III	Te
	20	28	II	ED
25	0	05	II	OR
26	6	03	I	ED
27	3	23	I	SI
	3	50	I	TI
	5	38	I	Se
	6	03	I	Te
28	0	31	I	ED
	3	10	I	OR
	21	52	I	SI
	22	16	I	TI

MARCH

d	h	m	Sat.	Phen.
1	0	07	I	Se
	0	29	I	Te
	21	36	I	OR
2	3	56	II	SI
	4	42	II	TI
2	22	59	III	SI
3	0	31	III	TI
3	2	04	III	Se
	3	19	III	Te
	23	03	II	ED
4	2	20	II	OR
5	19	53	II	Se
	20	24	II	Te
	21	39	IV	Se
6	5	17	I	SI
	5	34	I	TI
7	2	25	I	ED
	4	54	I	OR
	23	46	I	SI
8	0	00	I	TI
	2	00	I	Se
	2	13	I	Te
	20	53	I	ED
	23	20	I	OR
9	20	29	I	Se
	20	39	I	Te
10	2	57	III	SI
	3	47	III	TI
11	1	39	II	ED
	4	35	II	OR
12	19	48	II	SI
	20	04	II	TI
	22	28	II	Se
	22	39	II	Te
13	20	06	III	OR
14	4	19	I	ED
	5	32	IV	ED
15	1	40	I	SI
	1	44	I	TI
	3	54	I	Se
	3	57	I	Te
	22	47	I	ED
16	1	04	I	OR
	20	08	I	SI
	20	10	I	TI
	22	23	I	Se
	22	23	I	Te
17	19	30	I	ER
18	4	14	II	OD
19	22	18	II	TI
	22	23	II	SI
20	0	53	II	Te
	1	03	II	Se
	20	30	III	OD
	23	48	III	ER
21	20	11	II	ER
22	3	27	I	TI
	3	34	I	SI
23	0	34	I	OD
	2	56	I	ER
	21	53	I	TI
	22	02	I	SI
24	0	07	I	Te
	0	17	I	Se
	19	00	I	OD
	21	25	I	ER
27	0	32	II	TI
	0	58	II	SI
	3	08	II	Te
	3	38	II	Se
	23	46	III	OD
28	3	46	III	ER
	19	35	II	OD
	22	46	II	ER
30	2	18	I	OD
	4	50	I	ER
	23	37	I	TI
	23	38	IV	ED
	23	56	I	SI
31	1	26	IV	ER
31	1	51	I	Te
31	2	11	I	Se
	20	44	I	OD
	23	19	I	ER

APRIL

d	h	m	Sat.	Phen.
1	20	17	I	Te
	20	39	I	Se
3	2	47	II	TI
	3	34	II	SI
4	3	04	III	OD
	21	50	II	OD
5	1	20	II	ER
6	4	02	I	OD
	19	31	II	Se
7	1	22	I	TI
	1	51	I	SI
	3	36	I	Te
	4	05	I	Se
	19	48	III	Te
	21	52	III	Se
	22	28	I	OD
8	1	13	I	ER
	3	19	IV	TI
	3	59	IV	Te
	19	48	I	TI
	20	19	I	SI
	22	02	I	Te
	22	33	I	Se
9	19	42	I	ER
12	0	06	II	OD
	3	55	II	ER
13	19	28	II	SI
	20	51	II	Te
	22	07	II	Se
14	3	08	I	TI
	3	45	I	SI
	20	14	III	TI
	22	50	III	SI
	23	11	III	Te
15	0	14	I	OD
	1	50	III	Se
	3	08	I	ER
	21	34	I	TI
	22	14	I	SI
	23	48	I	Te
16	0	28	I	Se
	21	36	I	ER
19	2	24	II	OD
20	20	32	II	TI
	22	04	II	SI
	23	11	II	Te
21	0	43	II	Se
	23	39	III	TI
22	2	00	I	OD
	2	37	III	Te
	2	49	III	SI
	19	47	II	ER
	23	21	I	TI
23	0	08	I	SI
	1	34	I	Te
	2	22	I	Se
	20	27	I	OD
	23	31	I	ER
24	20	01	I	Te
	20	50	I	Se
25	1	40	IV	SI
	3	01	IV	Se
	19	40	III	ER
27	22	53	II	TI
28	0	41	II	SI
	1	32	II	Te

d	h	m	Sat.	Phen.
29	22	22	II	ER
30	1	08	I	TI
	2	03	I	SI
	22	15	I	OD

MAY

d	h	m	Sat.	Phen.
1	1	26	I	ER
	19	35	I	TI
	20	31	I	SI
	21	49	I	Te
	22	45	I	Se
2	19	45	III	OR
	19	55	I	ER
	20	38	III	ED
	23	38	III	ER
3	2	20	IV	OD
5	1	16	II	TI
6	20	17	II	OD
7	0	56	II	ER
8	0	04	I	OD
	21	24	I	TI
	22	26	I	SI
	23	37	I	Te
9	0	39	I	Se
	20	18	III	OD
	21	50	I	ER
	23	21	III	OR
10	0	37	III	ED
11	19	53	IV	SI
	20	43	IV	Se
13	22	41	II	OD
15	1	54	I	OD
	21	50	II	Se
	23	14	I	TI
16	0	21	I	SI
	1	27	I	Te
	20	21	I	OD
	23	45	I	ER
	23	58	III	OD
17	19	55	I	Te
	21	02	I	Se
19	20	29	IV	OR
20	21	41	III	Se
21	1	08	II	OD
22	21	50	II	SI
	22	05	II	Te
23	0	27	II	Se
23	1	05	I	TI
	22	13	I	OD
24	20	44	I	SI
	21	46	I	Te
	22	56	I	Se
25	20	09	I	ER
27	20	49	III	Te
	22	44	III	SI
29	21	56	II	TI
30	0	28	II	SI
	0	37	II	Te
31	0	06	I	OD
	21	25	I	TI
	21	57	II	ER
	22	39	I	SI
	23	39	I	Te

JUNE

d	h	m	Sat.	Phen.
1	22	04	I	ER
3	21	36	III	TI
6	0	30	II	TI
7	23	19	I	TI
8	20	28	I	OD
	23	59	I	ER
9	21	14	I	Se
13	21	38	IV	Te
14	20	36	III	ED
	21	58	II	OD
	23	30	III	ER
15	22	23	I	OD
16	20	57	I	SI
	21	37	II	Se
	21	55	I	Te
	23	09	I	Se
17	20	23	I	ER
21	22	30	III	OR
23	21	37	I	TI
	21	40	II	SI
	21	45	II	Te
	22	51	I	SI
24	22	18	I	ER
30	21	45	II	TI

JULY

d	h	m	Sat.	Phen.
1	20	45	I	OD
2	20	16	I	Te
	21	26	I	Se
	21	31	III	Se
	21	31	II	ER
9	20	53	III	Te
	21	09	I	SI
	22	13	I	Te
10	20	38	I	ER
16	21	51	II	OD
	21	57	I	TI
18	21	25	II	Se
24	21	10	I	OD
25	20	39	I	Te
27	20	33	III	ED

AUGUST

d	h	m	Sat.	Phen.
1	20	24	I	TI
2	20	52	I	ER
3	20	36	III	OD
10	19	56	I	Se
17	19	38	I	SI
19	19	46	II	Te
21	19	35	III	TI

Jupiter being near the sun, phenomena of the satellites are not given from Aug. 25 to Oct. 21.

OCTOBER

d	h	m	Sat.	Phen.
31	5	48	I	Se

NOVEMBER

d	h	m	Sat.	Phen.
7	5	30	I	SI
	6	01	I	TI
8	5	35	I	OR
13	5	30	II	Te
15	4	44	I	ED
16	4	44	I	Te
20	5	49	II	TI
23	4	31	I	TI
	4	48	III	Se
	5	21	III	TI
	5	57	I	Se
29	5	17	II	OR
30	5	39	I	SI
	6	11	III	SI
	6	30	I	TI

DECEMBER

d	h	m	Sat.	Phen.
1	6	02	I	OR
6	3	42	II	ED
8	4	52	I	ED
9	4	13	I	Se
	5	10	I	Te
11	4	06	III	OD
	6	34	III	OR
13	6	18	II	ED
15	3	25	II	TI
	3	46	II	Se
	5	45	II	Te
	6	45	I	ED
16	3	55	I	SI
	4	57	I	TI
	6	06	I	Se
17	4	27	I	OR
18	4	02	III	ED
	6	35	III	ER
22	3	55	II	SI
	6	06	II	TI
	6	19	II	Se
23	5	48	I	SI
	6	54	I	TI
24	2	52	II	OR
	3	06	I	ED
	6	23	I	OR
25	3	34	I	Te
29	2	46	III	TI
	5	04	III	Te
	6	28	II	SI
31	4	59	I	ED
	5	33	II	OR

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

EPHEMERIS FOR PHYSICAL OBSERVATION OF THE MOON, 1957

The Sun's Selenographic Co-ordinates for 0h Greenwich Civil Time

	Colong. °	Lat. °		Colong. °	Lat. °		Colong. °	Lat. °
Jan. 1	266.1	+1.1	May 1	287.3	+0.3	Sept. 1	350.1	−1.4
Feb. 1	283.1	+1.5	June 1	305.9	−0.5	Oct. 1	356.2	−0.9
Mar. 1	263.7	+1.5	July 1	312.6	−1.2	Nov. 1	13.9	−0.1
Apr. 1	281.3	+1.0	Aug. 1	331.5	−1.5	Dec. 1	19.0	+0.7

The average *daily* change in the sun's selenographic colongitude is +12°.2.

EPHEMERIS FOR THE PHYSICAL OBSERVATION OF THE SUN, 1957

For 0h Greenwich Civil Time

Date	P	B_0	L_0	Date	P	B_0	L_0
	°	°	°		°	°	°
Jan. 1	+ 2.13	−3.08	295.05	July 5	− 0.99	+3.34	13.31
6	− 0.30	−3.65	229.21	10	+ 1.28	+3.87	307.13
11	− 2.71	−4.19	163.36	15	+ 3.52	+4.36	240.96
16	− 5.08	−4.70	97.52	20	+ 5.73	+4.83	174.80
21	− 7.39	−5.17	31.69	25	+ 7.87	+5.26	108.65
26	− 9.61	−5.60	325.85	30	+ 9.94	+5.66	42.52
31	−11.74	−5.98	260.02	Aug. 4	+11.93	+6.02	336.39
Feb. 5	−13.75	−6.32	194.19	9	+13.83	+6.33	270.28
10	−15.64	−6.61	128.36	14	+15.62	+6.61	204.18
15	−17.40	−6.85	62.52	19	+17.29	+6.83	138.09
20	−19.02	−7.03	356.67	24	+18.85	+7.01	72.01
25	−20.49	−7.16	290.82	29	+20.28	+7.14	5.96
Mar. 2	−21.80	−7.23	224.96	Sept. 3	+21.57	+7.22	299.91
7	−22.96	−7.25	159.09	8	+22.72	+7.25	233.87
12	−23.96	−7.21	93.21	13	+23.73	+7.22	167.85
17	−24.78	−7.12	27.30	18	+24.58	+7.15	101.84
22	−25.44	−6.97	321.38	23	+25.27	+7.02	35.84
27	−25.92	−6.77	255.45	28	+25.80	+6.84	329.85
Apr. 1	−26.23	−6.52	189.50	Oct. 3	+26.16	+6.60	263.88
6	−26.36	−6.23	123.52	8	+26.34	+6.32	197.91
11	−26.30	−5.88	57.53	13	+26.34	+5.99	131.95
16	−26.07	−5.50	351.51	18	+26.15	+5.61	66.00
21	−25.64	−5.08	285.48	23	+25.78	+5.20	0.05
26	−25.04	−4.62	219.42	28	+25.20	+4.74	294.12
May 1	−24.25	−4.13	153.35	Nov. 2	+24.43	+4.24	228.18
6	−23.28	−3.61	87.26	7	+23.47	+3.71	162.26
11	−22.14	−3.07	21.15	12	+22.31	+3.15	96.33
16	−20.82	−2.51	315.02	17	+20.96	+2.57	30.42
21	−19.34	−1.93	248.88	22	+19.42	+1.96	324.52
26	−17.71	−1.34	182.73	27	+17.71	+1.34	258.62
31	−15.94	−0.74	116.57	Dec. 2	+15.83	+0.71	192.72
June 5	−14.04	−0.14	50.40	7	+13.81	+0.07	126.83
10	−12.03	+0.46	344.22	12	+11.66	−0.57	60.95
15	− 9.93	+1.06	278.04	17	+ 9.40	−1.21	355.07
20	− 7.75	+1.66	211.85	22	+ 7.07	−1.84	289.21
25	− 5.53	+2.24	145.67	27	+ 4.67	−2.45	223.35
30	− 3.26	+2.80	79.48				

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, 1957

No.	Commences	No.	Commences	No.	Commences
1383	Jan. 23.41	1388	June 8.81	1393	Oct. 23.00
1384	Feb. 19.75	1389	July 6.01	1394	Nov. 19.31
1385	Mar. 19.07	1390	Aug. 2.21	1395	Dec. 16.63
1386	Apr. 15.36	1391	Aug. 29.45		
1387	May 12.60	1392	Sept. 25.72		

ECLIPSES, 1957

In 1957 there will be four eclipses, two of the sun and two of the moon.

I. *An Annular Eclipse of the Sun*, April 29, 1957, visible as a partial eclipse at or just before sunset in the north-western part of North America. The path of the annular eclipse is confined to the Arctic.

II. *A Total Eclipse of the Moon*, May 13, 1957, its ending visible just at or after moonrise on the east coast of North America. This eclipse is visible generally in Asia, Africa, Europe and the Atlantic Ocean.

Circumstances of the Lunar Eclipse, May 13, 1957 (E.S.T.)

☾ enters penumbra	14h 41.9m	Total eclipse ends	18h 10.2m
☾ enters umbra	15 44.8	☾ leaves umbra	19 17.0
Total eclipse begins	16 51.6	☾ leaves penumbra	20 20.0
Middle of eclipse	17 30.9	Magnitude of eclipse	1.304

III. *A Total Eclipse of the Sun*, October 23, 1957, invisible in North America. The path of totality is confined to the Antarctic, but a partial eclipse is visible in South Africa as well.

IV. *A Total Eclipse of the Moon*, November 7, 1957, the beginning visible in the western part of North America just before moonset on the morning of November 7. This eclipse is visible generally in the Arctic, the Pacific Ocean, Australia and Asia.

Circumstances of the Lunar Eclipse, November 7, 1957 (E.S.T.)

☾ enters penumbra	6h 30.5m	Total eclipse ends	9h 41.9m
☾ enters umbra	7 43.4	☾ leaves umbra	11 10.5
Total eclipse begins	9 11.9	☾ leaves penumbra	12 23.2
Middle of eclipse	9 26.9	Magnitude of eclipse	1.035

TRANSIT OF MERCURY, 1957

A transit of Mercury over the sun's disk will occur on May 5, 1957. The ingress will be visible generally over North America except in the extreme east, exterior contact being at about 18h 56m E.S.T.; the egress will be visible in the far west, exterior contact being at about 21h 29m E.S.T. The transit will be visible generally in the Arctic, the Pacific Ocean, Australia and Asia.

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 appearance from behind the west limb the emersion. As in the case of eclipses, the times of immersion and emersion and the duration of the occultation are different for different places on the earth's surface. The tables given below, adapted from the 1957 Nautical Almanac, give the times of immersion or emersion or both for occultations of stars of magnitude 5.0 or brighter visible at Toronto and at Montreal at night. 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 in the table is the position angle of the point of contact on the moon's disk reckoned from the north point towards the east. The table of occultations visible at Vancouver is adapted from the American Ephemeris for 1957.

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1957

Date	Star	Mag.	I or E	Age of Moon	Toronto E.S.T.	Toronto a	Toronto b	Toronto P	Montreal E.S.T.	Montreal a	Montreal b	Montreal P
				d	h m	m	m	°	h m	m	m	°
Feb. 10	χ^2 Ori	4.7	I	11.1	17 52.7	−1.1	+1.3	82	18 01.9	−1.2	+1.4	80
Apr. 17	ω^1 Sco	4.1	I	16.9	1 04.1	−1.1	−0.5	139	1 10.7	−1.4	−0.3	130
Apr. 17	ω^1 Sco	4.1	E	16.9	2 07.8	−2.1	+0.9	243	2 21.0	−2.0	+0.4	250
Aug. 3	κ Lib	5.0	I	7.9	20 09.1	−1.8	−1.5	135	20 16.4	−1.7	−1.5	131
Aug. 6	21 Sgr	5.0	I	10.9	20 02.2	—	—	151	20 09.5	—	—	144
Oct. 7	λ Psc	4.6	I	13.5	3 01.0	−0.6	+0.4	40	3 04.8	−0.4	+0.5	35
Oct. 15	λ Gem	3.6	E	22.4	Low	.....	.....	.....	23 22.1	+0.5	+2.8	223
Oct. 29	ρ Sgr	4.0	I	5.8	19 27.4	−1.4	−0.7	77	19 33.4	−1.2	−0.9	80
Nov. 12	λ Gem	3.6	I	20.2	6 13.0	−0.4	−3.9	162	6 10.3	−0.6	−2.8	146
Dec. 16	α Vir	1.2	I	24.8	4 08.5	−0.6	+0.4	118	4 13.7	−0.8	+0.7	107
Dec. 16	α Vir	1.2	E	24.8	5 14.9	−1.1	+0.5	290	5 21.6	−1.0	+0.1	302
Dec. 23	β Cap	3.2	I	2.7	17 43.0	−0.7	−0.1	51	17 46.1	−0.5	−0.3	52

LUNAR OCCULTATIONS VISIBLE AT VANCOUVER, 1957

Date	Star	Mag.	I or E	Age of Moon	P.S.T.	a	b	P
				d	h m	m	m	°
Jan. 6	κ Psc	4.9	I	6.0	20 18.0	—	—	359
Jan. 14	χ^1 Ori	4.6	I	13.3	2 29.0	−0.8	−1.0	79
Feb. 6	Mars*	0.9	I	7.1	13 30.9	−0.9	+1.5	91
Feb. 6	Mars*	0.9	E	7.1	14 39.7	−0.8	+2.4	225
Feb. 21	ω^1 Sco	4.1	I	21.6	3 57.4	−2.1	+2.5	47
Feb. 21	ω^1 Sco	4.1	E	21.6	4 41.8	−0.7	−1.0	337
Feb. 21	ω^2 Sco	4.6	E	21.7	5 26.1	−1.5	0.0	291
Mar. 20	κ Lib	5.0	E	18.8	2 04.4	—	—	345
July 7	ω^1 Sco	4.1	I	10.4	22 49.3	−1.6	−1.8	143
Oct. 29	β Cap	3.2	I	7.0	20 58.7	−1.0	−1.0	77
Oct. 30	ν Aqr	4.5	I	8.0	21 33.1	−0.7	0.0	46

*Daytime Occultation.

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 1957. It has been adapted from a list published in the JOURNAL of the R.A.S.C., vol. 48, p. 194, 1954.

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

METEOR SHOWERS FOR 1957

Shower	Shower Maximum			Radiant				Single Observer Hourly Rate	Normal Duration (days)
	Date	E. ST.	Moon	Position at Max. α	δ	Daily Motion α	δ		
Quadrantids	Jan. 3	5^h	N.M.	231°	+50°			35	1
Aurigids	Feb. 9		F.Q.	75	+42			12	
Lyrids	Apr. 21	19	L.Q.	273	+34			12	2
η Aquarids	May 4	23	F.Q.	336	0	+53′	+22′	12	10
Draconids	June 28		N.M.	220	+58			12	
δ Aquarids	July 29		N.M.	340	−15	+52	+12	20	15
Perseids	Aug. 12	2	F.M.	46	+57	+81	+ 8	50	20
Orionids	Oct. 20	14	N.M.	95	+15	+74	+ 8	20	10
Taurids	Oct. 31		F.Q.	54	+17	+35	+ 8	12	30
N. Arietids	Nov. 12		L.Q.	50	+22			12	
Leonids	Nov. 16	13	L.Q.	152	+22	+42	−25	20	5
Geminids	Dec. 13	7	L.Q.	113	+32	+63	− 4	40	5
Ursids	Dec. 22	12	N.M.	207	+80			15	1

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, ρ Sco and ζ Oph, which are significantly reddened and would therefore be about a magnitude brighter if they were in the clear.

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

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

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

	Right Ascension	Declination	Visual Magnitude	Colour Index	Spectral Classification		Parallax	Absolute Magnitude	Distance light-years	Proper Motion	Radial Velocity		
Star	R.A. 1960	Dec.	V	$B-V$	Type		π	M_V	D	μ	R		
	h m	° ′					″		l.y.	″	km./sec.		
SUN			-26.89	+0.63	G2	V		+4.68					***Sun***
α And	00 06.3	+28 52	2.06	−0.08	B9p		0.024	−0.1	90	0.209	*−11.7*	Manganese star	*Alpheratz*
β Cas	07.0	+58 56	2.26	+0.34	F2	IV	0.072	+1.6	45	0.555	+11.8		*Caph*
γ Peg	11.2	+14 58	2.84v	−0.23	B2	IV	−.004	−3.4	570	0.010	+04.1	β CMa type, *R* in *V* 2.83–2.85, 0.15ᵈ	γ Peg = *Algenib*
β Hyi	23.7	−77 29	2.78	+0.62	*G1*	*IV*	0.153	+3.7	21	2.255	+22.8		
α Phe	24.3	−42 31	2.39	+1.08	*K0*	*III*	0.035	+0.1	93	0.442	*+74.6*		*Ankaa*
δ And *A*	37.2	+30 39	3.25:	+1.26	K3	III	0.024	−0.2	160	0.161	−07.3	*B* 12ᵐ 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* 7.26ᵐ 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* 8.18ᵐ 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* 4.1ᵐ *B* 4.1ᵐ 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 759ᵈ	
γ Phe	26.6	−43 31	3.44	+1.56	*K5*	*Ib*	−.003	−4.6	1300	0.209	*+25.7*		
α Eri	36.2	−57 26	0.51	−0.16	*B5*	*IV:*	0.023	−2.3	118	0.098	+19		***Achernar***
τ Cet	42.2	−16 09	3.50	+0.72	G8	Vp	0.275	+5.70	12	1.921	−16.2		

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

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

Star	R.A. 1960	Dec.	V	$B-V$	Type	π	M_V	D	μ	R	
	h m	° ′				″		l.y.	″	km./sec.	
ϵ Aur	04 59.1	+43 46	3.0v	+0.50:	F0 Iap	0.004	−7.1	3400	0.008	*−02.5*	Ecl. R 0.81^{m} 9886^{d}
η Aur	05 03.7	+41 11	3.17	−0.18	B3 V	0.013	−2.1	370	0.077	+07.4	
ϵ Lep	03.8	−22 25	3.21	+1.46	*K5 III*	0.006	−0.4	170	0.077	+01.0	
β Eri	05.9	−05 08	2.79	+0.13	A3 III	0.042	+0.9	78	0.122	−08	
μ Lep	11.1	−16 15	3.29	−0.09	*B9 IIIp*	0.018	−2.1	390	0.049	+27.7	Manganese star
β Ori *A*	12.6	−08 15	0.14v	−0.04	B8 Ia	−.003	−7.1	900	0.001	*+20.7*	Irr.? R 0.08–0.20, B 6.65^{m} 9″ **Rigel**
α Aur	13.7	+45 58	0.05	+0.80	G8III: +F	0.073	−0.6	45	0.435	*+30.2*	**Capella**
η Ori *AB*	22.5	−02 26	3.32v	−0.18	B0.5 V	0.004	−3.7	940	0.008	*+19.8*	Ecl. R 3.32–3.50, 8.0^{d}, A3.59^{m} B4.98^{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″, $\theta = 90°$	**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^m0.2″15^y, *C*6.8^m3″*D*12^m20″	
ζ Hya	53.3	+06 06	3.11	+1.00	K0 II–III	0.029	−1.1	220	0.101	+22.8		
ι UMa *A*	56.5	+48 12	3.12	+0.19	A7 V	0.066	+2.2	49	0.505	+12.2	*BC* 10.8^m 7″	

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

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

Star	R.A. 1960	Dec.	V	$B-V$	Type	π	M_V	D	μ	R		
	h m	° ′				″		l.y.	″	km./sec.		
β Cen *AB*	14 01.0	−60 11	0.63	−0.23:	*B1 II:*	0.016	−5.2	490	0.035	−*12*	*A* 0.7^m *B* 3.9^m 1″	***Hadar***
π Hya	04.1	−26 29	3.25	+1.13	K2 III	0.039	+1.2	84	0.156	+27.2		
θ Cen	04.3	−36 10	2.04	+1.03	K0 III–IV	0.059	+0.9	55	0.738	+01.3		*Menkent*
α Boo	13.8	+19 23	−0.06	+1.23	K2 IIIp	0.090	−0.3	36	2.284	−05.2		**Arcturus**
γ Boo	30.5	+38 29	3.05	+0.19	A7 III	0.016	+0.2	118	0.186	−35.5		
η Cen	33.0	−41 59	2.39v	−0.21	B1.5 V:ne		−3.0	390	0.049	−00.2	Var. *R* 2.33–2.45	
α Cen *A*	36.9	−60 40	0.01	+0.68	*G2 V*	.751	+4.39	4.3	3.676	−24.6	18″	***Rigil Kentaurus***
α Cen *B*	36.9	−60 40	1.40:	+0.73:	(dK1)		+5.8	4.3		−20.7		
α Cir *AB*	39.2	−64 48	3.18	+0.25	*F0 Vp*	0.049	+1.6	66	0.308	+07.4	Strontium star. *A* 3.19^m *B* 8.61^m 16″	
α Lup	39.3	−47 13	2.32	−0.22	B1 V		−3.3	430	0.033	+07.3		
ϵ Boo *AB*	43.2	+27 14	2.37	+0.96	K1: III: + A	0.013	+0.0	103	0.051	−16.5	*A* 2.47^m *B* 5.04^m 3″	
α Lib *A*	48.5	−15 50	2.76	+0.15	A3m	0.049	+1.2	66	0.130	−10	*B* 5.15^m 231″	*Zubenelgenubi*
β UMi	50.8	+74 19	2.04	+1.47	K4 III	0.031	−0.5	105	0.033	+16.9		*Kochab*
β Lup	55.9	−42 58	2.69	−0.23	B2 IV		−3.4	540	0.066	−00.3		
κ Cen	56.5	−41 57	3.15	−0.21	B2 V		−2.7	470	0.033	+09.1		
β Boo	15 00.4	+40 33	3.48	+0.95	G8 III	0.022	+0.3	140	0.059	−19.9		
σ Lib	01.7	−25 08	3.31	+1.65	M4 III	0.056	+2.0:	58:	0.089	−04.3		
ζ Lup *A*	09.4	−51 57	3.42	+0.90:	*K0 III*	0.036	+1.2	90	0.135	−09.7	*B* 7.8^m 71″	
δ Boo *A*	13.9	+33 28	3.47	+0.95	G8 III	0.028	+0.3	140	0.148	−12.2	*B* 7.84^m 105″	
β Lib	14.8	−09 14	2.61	−0.11	B8 V	−.012	−0.6	140	0.101	−35.2		
γ TrA	15.1	−68 32	2.94	−0.01	*A0 Vp*	0.005	+0.2	113	0.067	00	Europium star	
δ Lup	18.7	−40 30	3.24	−0.23	B2 IV		−3.4	680	0.032	+02		
γ UMi	20.8	+71 59	3.08	+0.06	A3 II-III	−.005	−1.5	270	0.026	−*03.9*		
ι Dra	24.0	+59 06	3.28	+1.18	K2 III	0.032	+0.8	102	0.012	−11.0		
γ Lup *AB*	32.5	−41 02	2.80	−0.22	B2 Vn		−2.7	570	0.037	+06	*A* 3.5^m *B* 3.7^m 1″	
α CrB	33.0	+26 51	2.23v	−0.02	A0 V	0.043	+0.4	76	0.154	+*01.7*	Ecl. *R* 0.11^m, 17.4^d	*Alphecca*
α Ser	42.3	+06 33	2.65	+1.17	K2 III	0.046	+1.0	71	0.139	+02.9		
β TrA	51.6	−63 19	2.87	+0.28:	*F2 V*	0.078	+2.3	42	0.448	−00.3		
π Sco	56.4	−26 00	2.92	−0.19	B1 V	0.005	−3.3	570	0.034	−*03*		
η Lup *AB*	57.5	−38 17	3.45	−0.23	B2 V		−2.7	570	0.042	+07	*A* 3.47^m *B* 7.70^m 15″	
δ Sco	58.0	−22 31	2.34	−0.13	B0 V		−4.0	590	0.032	−14		

Star	R.A. 1960	Dec.	*V*	*B–V*	Type	π	M_V	D	μ	R	
	h m	° ′				″		l.y.	″	km./sec.	
β Sco *AB*	16 03.1	−19 42	2.65	−0.09	B0.5 V	0.004	−3.7	650	0.027	*−06.6*	*A* 2.78^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	
μ¹ Sco	49.2	−37 59	2.99v	−0.20	B1.5 V		−3.0	520	0.033	*−25*	Ecl. *R* 2.99–3.09, 1.4^d
ζ Ara	55.3	−55 56	3.16	+1.61	(gK5)	0.036	+0.9	90	0.042	−06.0	
κ Oph	55.8	+09 26	3.18	+1.15	K2 III	0.026	−0.1	150	0.293	−55.6	
η Oph *AB*	17 08.1	−15 41	2.46	+0.06	A2.5 V	0.047	+1.4	69	0.097	−00.9	*A* 3.0^m *B* 3.4^m 1″ *Sabik*
ζ Dra	08.7	+65 46	3.20	−0.12	B6 III	0.017	−3.2	620	0.026	−14.1	
η Sco	09.3	−43 11	3.33	+0.38	*F2 III*	0.063	+2.3	52	0.293	−28.4	
α Her *AB*	12.8	+14 26	3.10v	+1.41	M5 II	−.007	−2.3	410	0.032	−33.1	*A* 3.2^m ± 0.3 *B* 5.4^m 5″ *Ras-Algethi*
δ Her	13.4	+24 53	3.14	+0.09	A3 IV	0.034	+0.8	96	0.164	−41	
π Her	13.7	+36 51	3.13	+1.43	K3 II	0.020	−2.4	410	0.029	−25.7	
θ Oph	19.6	−24 58	3.29	−0.22	B2 IV		−3.4	710	0.025	−03.6	
β Ara	22.0	−55 30	2.90	+1.45:	*K3 Ib*	0.026	−4.6	1030	0.035	−00.4	
γ Ara *A*	22.0	−56 21	3.32	−0.16	*B1 V*		−3.3	680	0.017	−04	*B* 10^m 18″
υ Sco	28.0	−37 16	2.71	−0.22	*B2 IV*		−3.4	540	0.039	*+18*	
α Ara	28.7	−49 51	2.95	−0.18:	B2.5 V		−2.4	390	0.083	*−02*	
β Dra *A*	29.5	+52 20	2.77	+0.96	G2 II	0.009	−2.1	310	0.019	−20.0	*B* 11.49^m 4″
λ Sco	30.9	−37 05	1.60	−0.24	B1 V		−3.3	310	0.031	00	*Shaula*
α Oph	33.1	+12 35	2.09	+0.16	A5 III	0.056	+0.8	58	0.260	+12.7	*Rasalhague*
θ Sco	34.4	−42 58	1.86	+0.39	*F0 Ib*	0.020	−4.6	650	0.012	+01.4	

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

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

TABLE OF PRECESSION FOR 50 YEARS

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

DOUBLE AND MULTIPLE STARS

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

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

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

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

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

The accompanying table provides a list of double stars, selected on account of their brightness, suitability for small telescopes, or particular astrophysical interest. The data are taken chiefly from Aitken's *New General Catalogue of Double Stars*, and from the Yale *Catalogue of Bright Stars*. Successive columns give the star, its 1950 equatorial coordinates, the magnitudes and spectral classes of its components, their separation, in seconds of arc, and the approximate distance of the double star in light years. The last column gives, for binary stars of well determined orbits, the period in years, and the mean separation of the components in astronomical units. For stars sufficiently bright to show colour differences in the telescope used, the spectral classes furnish an indication of the colour. Thus O and B stars are bluish white, A and F white, G yellow, K orange and M stars reddish.

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

REPRESENTATIVE DOUBLE STARS

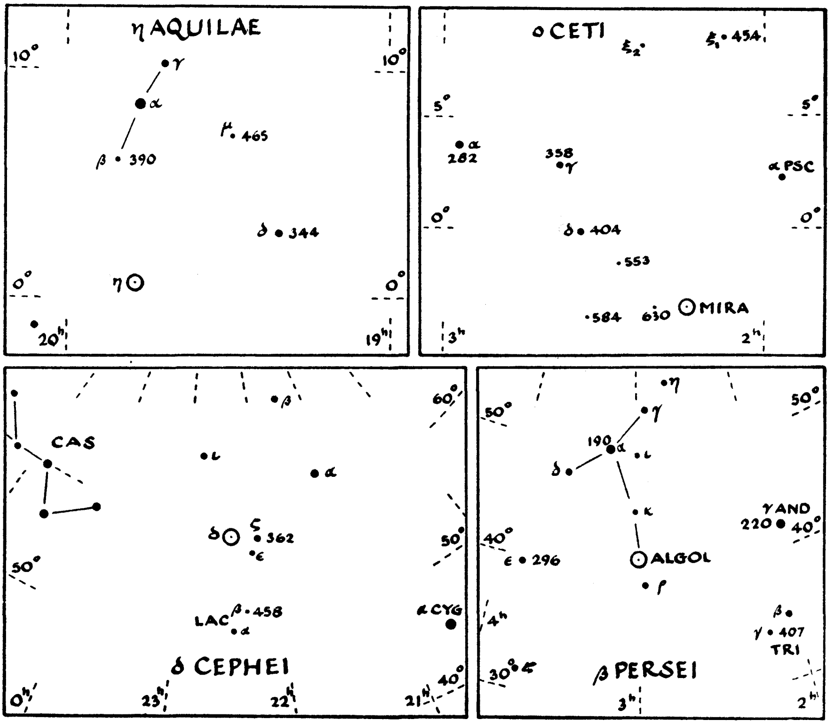
Star		α 1950	δ	Mag. and Spect.	d	D	Remarks
		h m	° ′		″	L.Y.	
π	And	00 34.2	+33 27	4.4B3; 8.5	36	470	†
η	Cas	00 46.0	+57 33	3.6F8; 7.2M0	8	18	526y; 66AU
α	UMi	01 48.8	+89 02	var. F8; 8.8	19	407	Polaris
γ	Ari	01 50.8	+19 03	4.8A0; 4.8A0	8.3	150	
α	Pis	01 59.4	+02 31	5.2A2; 4.3A2	2.4	130	††
γ	And	02 00.8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

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

VARIABLE STARS

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

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



LONG-PERIOD VARIABLE STARS

Variable	Max. m	Per. d	Epoch 1957	Variable	Max. m	Per. d	Epoch 1957
001755 T Cas	7.8	445	Sept. 3	142539 V Boo	7.9	260	July 15
001838 R And	7.0	410	Dec. 17	143227 R Boo	7.3	224	July 18
021143 W And	7.5	397	July 24	151731 S CrB	7.5	361	June 12
0214*03* o Cet	3.7	332	Nov. 3	154639 V CrB	7.4	358	Mar. 15
0228*13* U Cet	7.5	235	July 10	154615 R Ser	6.8	357	Apr. 12
023133 R Tri	6.3	266	Feb. 12	162119 U Her	7.6	405	July 5
0455*14* R Lep	6.7	428	Aug. 24	1621*12* V Oph	7.5	298	Jan. 30
050953 R Aur	7.8	458	Jan. 31	163266 R Dra	7.6	245	Apr. 3
054920a U Ori	6.6	372	Apr. 16	164715 S Her	7.6	307	Jan. 17
0617*02* V Mon	7.1	334	Mar. 22	1702*15* R Oph	7.6	302	Sept. 30
065355 R Lyn	7.9	378	Sept. 4	171723 RS Her	8.0	219	Mar. 28
070122a R Gem	7.1	370	Apr. 6	180531 T Her	8.0	165	Feb. 28
072708 S CMi	7.5	335	Jan. 7	181136 W Lyr	8.0	197	June 5
0728*20*b Z Pup	7.9	512	Apr. 18	183308 X Oph	6.9	335	Oct. 26
081112 R Cnc	6.8	361	Apr. 10	190108 R Aql	6.3	300	May 1
084803 S Hya	7.9	258	Aug. 24	1910*19* R Sgr	7.2	269	Aug. 28
0850*08* T Hya	7.7	289	Aug. 31	193449 R Cyg	7.3	425	July 23
093934 R LMi	7.2	372	Nov. 29	194048 RT Cyg	7.4	190	Jan. 3
094211 R Leo	5.9	313	Sept. 13	194632 χ Cyg	5.3	406	July 1
103769 R UMa	7.6	301	Mar. 8	200938 RS Cyg	7.4	420	July 29
115158 Z UMa	6.6	198	Feb. 25	201647 U Cyg	7.6	463	Dec. 29
1214*18* R Crv	7.6	317	Sept. 14	2044*05* T Aqr	7.9	202	Feb. 17
122001 SS Vir	6.9	358	Aug. 19	210868 T Cep	5.8	390	Oct. 10
123160 T UMa	7.9	257	Mar. 19	230110 R Peg	7.9	377	May 26
123307 R Vir	6.9	145	Apr. 6	230759 V Cas	7.9	228	Aug. 2
123961 S UMa	7.9	226	Jan. 1	231508 S Peg	8.0	320	June 20
1327*06* S Vir	7.1	377	July 29	233815 R Aqr	7.3	386	Dec. 19
134440 R CVn	7.7	326	July 3	235350 R Cas	6.5	430	Mar. 17

OTHER TYPES OF VARIABLE STARS

Variable	Max. m	Min. m	Type	Sp. Cl.	Period d	Epoch 1957 E.S.T.
005381 U Cep	6.8	9.8	Ecl	B8	2.4929005	Jan. 5.979*
025838 ρ Per	3.2	3.8	SemiR	M4	50	
035512 λ Tau	3.5	4.0	Ecl	B3	3.952952	Jan. 1.546*
051133 ARAur	5.8	6.5	Ecl	A0+A0	4.134606	Jan. 4.114*
060822 η Gem	3.1	3.9	SemiR	M3	234	Apr. 2*
061907 T Mon	5.8	6.8	δ Cep	F7–K1	27.018	Jan. 27.48
065820 ζ Gem	3.7	4.1	δ Cep	F7–G3	10.153527	Jan. 2.147
154428 R CrB	5.8	14	R CrB	cG0ep		
171014 α Her	3.0	4.0	SemiR	M5	100	
1842*05* R Sct	5.0	8.4	RVTau	G0–M5	144	
184633 β Lyr	3.4	4.3	Ecl	B8	12.9308	Jan. 4.37*
192242 RRLyr	7.3	8.1	RRLyr	A2–F0	0.56683500	Jan. 1.486
194700 η Aql	3.7	4.4	δ Cep	F6–G4	7.176678	Jan. 8.042
201437a P Cyg	3.5	6.0	Nova	B1 eq		
222557 δ Cep	3.8	4.6	δ Cep	F5–G2	5.366306	Jan. 5.979

*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 1950 h m	δ ° ′	Cl.	Diam. ′	Mag. B.S.	No.	Int. mag.	Dist l.y.
869		h Per	02 15.5	+56 55	Op	30	7			4,300
884		χPer	02 18.9	+56 53	Op	30	7			4,300
1039	34	Per	02 38.3	+42 35	Op	30	9	80		1,500
Pleiades	45	Tau	03 44.5	+23 58	Op	120	4.2	250		490
Hyades		Tau	04 17	+15 30	Op	400	4.0	100		120
1912	38	Aur	05 25.3	+35 48	Op	18	9.7	100		2,800
2099	37	Aur	05 49.0	+32 33	Op	24	9.7	150		2,700
2168	35	Gem	06 05.7	+24 21	Op	29	9.0	120		2,700
2287	41	C Ma	06 44.9	−20 42	Op	32	9	50		1,300
2632	44	Cnc	08 37.2	+20 10	Op	90	6.5	350		490
5139		ωCen	13 23.7	−47 03	Gl	23	12.9		3	22,000
5272	3	C Vn	13 39.9	+28 38	Gl	10	14.2		4.5	40,000
5904	5	Ser	15 15.9	+02 16	Gl	13	14.0		3.6	35,000
6121	4	Scr	16 20.5	−26 24	Gl	14	13.9		5.2	24,000
6205	13	Her	16 39.9	+36 33	Gl	10	13.8		4.0	34,000
6218	12	Oph	16 44.6	−01 51	Gl	9	14.0		6.0	36,000
6254	10	Oph	16 54.5	−04 02	Gl	8	14.1		5.4	36,000
6341	92	Her	17 15.6	+43 12	Gl	8	13.9		5.1	36,000
6494	23	Sgr	17 54.0	−19 01	Op	27	10.2	120		2,200
6611	16	Ser	18 16.0	−13 48	Op	8	10.6	55		6,700
6656	22	Sgr	18 33.3	−23 57	Gl	17	12.9		3 6	22,000
7078	15	Peg	21 27.6	+11 57	Gl	7	14.3		5.2	43,000
7089	2	Aqr	21 30.9	−01 04	Gl	8	14.6		5.0	45,000
7092	39	Cyg	21 30.5	+48 13	Op	32	6.5	25		1,000
7654	52	Cas	23 22.0	+61 19	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.

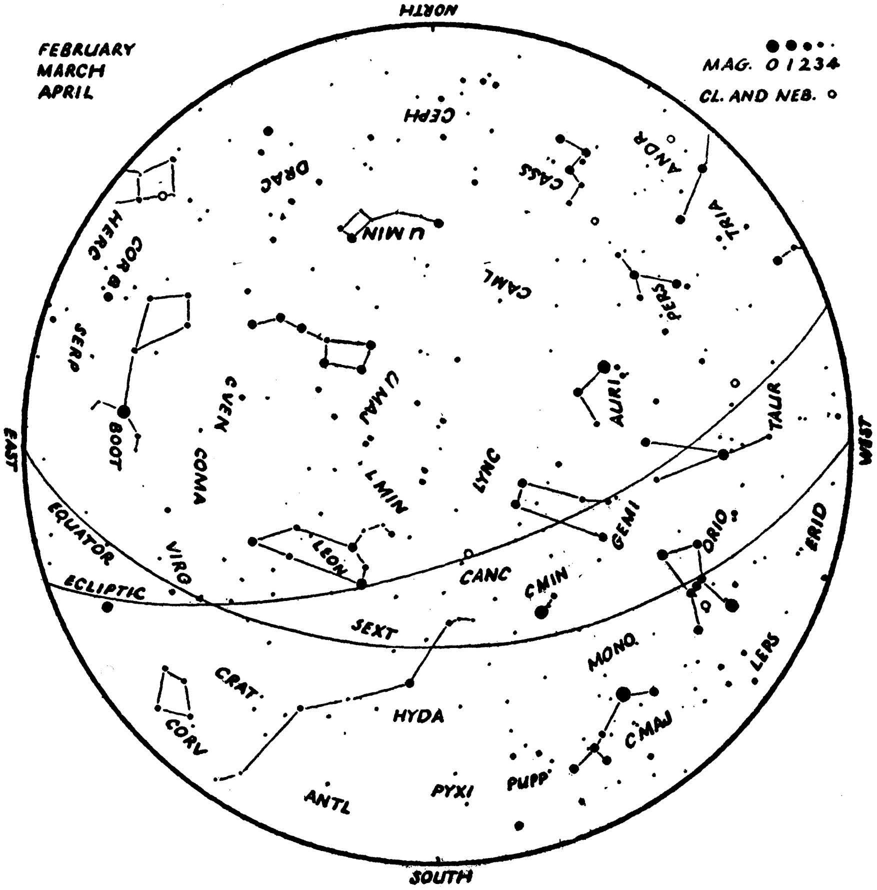
N.G.C.	M	Con	α 1950 h m	δ ° ′	Cl	Size ′	m n	m *	Dist. l.y.	Name
650	76	Per	01 38.3	+51 20	Pl	1.5	11	17	15,000	
1952	1	Tau	05 31.5	+21 59	Pl	6	11	16	4,100	Crab
1976	42	Ori	05 32.5	−05 25	Dif	30			1,800	Orion
B33		Ori	05 38.0	−02 29	Drk	4			300	Horsehead
2261		Mon	06 36.4	+08 47	Dif	2				Hubble's var.
2392		Gem	07 26.2	+21 02	Pl	0.3	8	10	2,800	
2440		Pup	07 39.6	−18 05	Pl	0.9	11	16	8,600	
3587	97	UMa	11 11.8	+55 17	Pl	3.3	11	14	12,000	Owl
		Cru	12 48	−63	Drk	300			300	Coalsack
6210		Her	16 42.4	+23 54	Pl	0.3	10	12	5,600	
B72		Oph	17 20.5	−23 36	Drk	20			400	S nebula
6514	20	Sgr	17 59.3	−23 02	Dif	24			3,200	Trifid
B86		Sgr	17 59.9	−27 52	Drk	5				
6523	8	Sgr	18 00.6	−24 23	Dif	50			3,600	Lagoon
6543		Dra	17 58.6	+66 38	Pl	0.4	9	11	3,500	
6572		Oph	18 10.2	+06 50	Pl	0.2	9	12	4,000	
B92		Sgr	18 12.7	−18 15	Drk	15				
6618	17	Sgr	18 18.0	−16 12	Dif	26			3,000	Horseshoe
6720	57	Lyr	18 52.0	+32 58	Pl	1.4	9	14	5,400	Ring
6826		Cyg	19 43.5	+50 24	Pl	0.4	9	11	3,400	
6853	27	Vul	19 57.4	+22 35	Pl	8	8	13	3,400	Dumb-bell
6960		Cyg	20 43.6	+30 32	Dif	60				Network
7000		Cyg	20 57.0	+44 07	Dif	100				N. America
7009		Aqr	21 01.4	−11 34	Pl	0.5	8	12	3,000	
7662		And	23 23.4	+42 12	Pl	0.3	9	13	3,900	

EXTRA-GALACTIC NEBULAE

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 1950 h m	δ ° ′	Cl	Dimens. ′ ′	Mag.	Distance millions of l.y.	Vel. km / sec
221	32	And	00 39.9	+40 36	E	3×3	8.8	1.6	− 185
224	31	And	00 40.0	+41 00	Sb	160×40	5.0	1.6	− 220
SMC		Tuc	00 53	−72 38	I	220×220	1.5	0.17	+ 170
598	33	Tri	01 31.0	+30 24	Sc	60×40	7.0	1.4	− 70
LMC		Dor	05 21	−69 27	I	430×530	0.5	0.17	+ 280
3031	81	UMa	09 51.5	+69 18	Sb	16×10	8.3	4.8	− 30
3034	82	UMa	09 51.8	+69 58	I	7× 2	9.0	5.2	+ 290
3368	96	Leo	10 44.1	+12 05	Sa	7× 4	10.0	11.4	+ 940
3623	65	Leo	11 16.3	+13 22	Sb	8× 2	9.9	10.0	+ 800
3627	66	Leo	11 17.6	+13 16	Sb	8× 2	9.1	8.6	+ 650
4258		CVn	12 16.5	+47 34	Sb	20× 6	8.7	9.2	+ 500
4374	84	Vir	12 22.5	+13 09	E	3× 2	9.9	12.0	+1050
4382	85	Com	12 22.9	+18 28	E	4× 2	10.0	7.4	+ 500
4472	49	Vir	12 27.2	+08 16	E	5× 4	10.1	11.4	+ 850
4565		Com	12 33.9	+26 16	Sb	15× 1	11.0	15.2	+1100
4594		Vir	12 37.4	−11 20	Sa	7× 2	9.2	14.4	+1140
4649	60	Vir	12 41.1	+11 50	E	4× 3	9.5	15.0	+1090
4736	94	CVn	12 48.6	+41 24	Sb	5× 4	8.4	6.0	+ 290
4826	64	Com	12 54.3	+21 57	Sb	8× 4	9.2	2.6	+ 150
5005		CVn	13 08.6	+37 20	Sc	5× 2	11.1	13.2	+ 900
5055	63	CVn	13 13.6	+42 18	Sb	8× 3	9.6	7.2	+ 450
5194	51	CVn	13 27.8	+47 27	Sc	12× 6	7.4	6.0	+ 250
5236	83	Hya	13 34.2	−29 36	Sc	10× 8	8	5.8	+ 500
6822		Sgr	19 42.4	−14 53	I	20×10	11	2.0	− 150
7331		Peg	22 34.8	+33 59	Sb	9× 2	10.4	10.4	+ 500

STAR MAP I

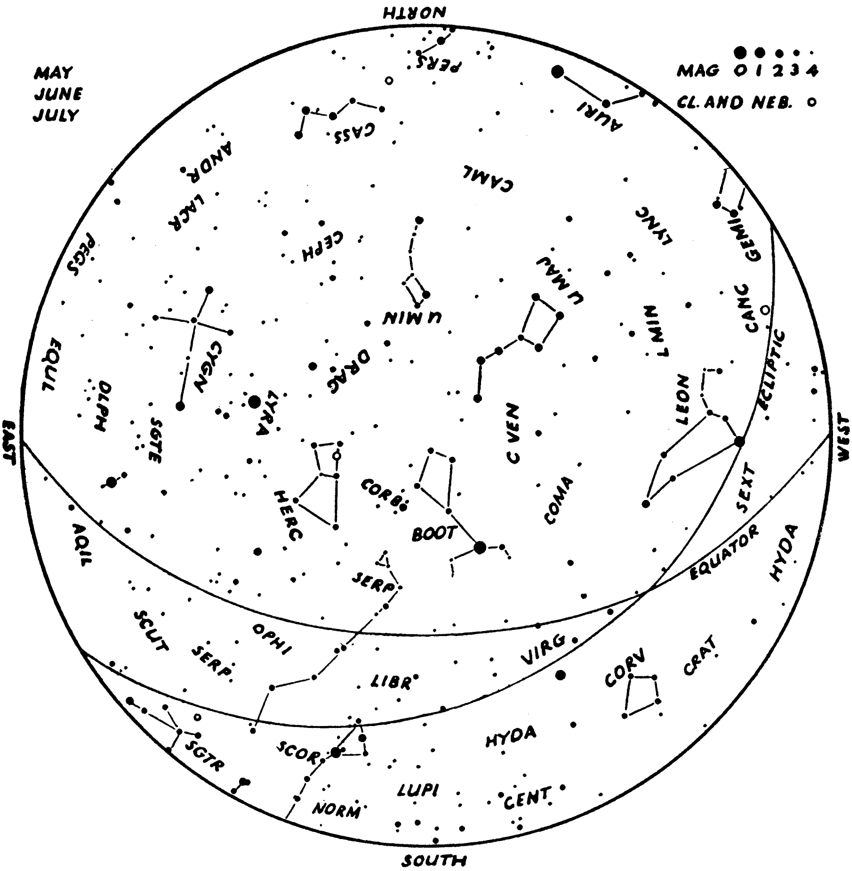


The above map represents the evening sky at

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

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

STAR MAP 2

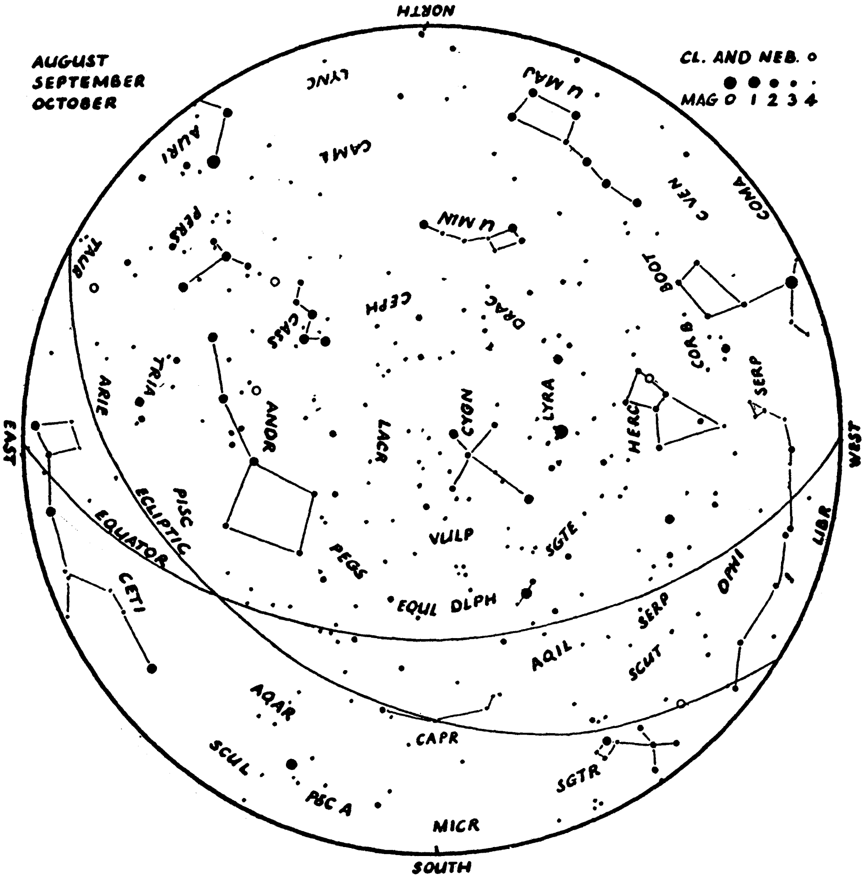


The above map represents the evening sky at

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

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

STAR MAP 3

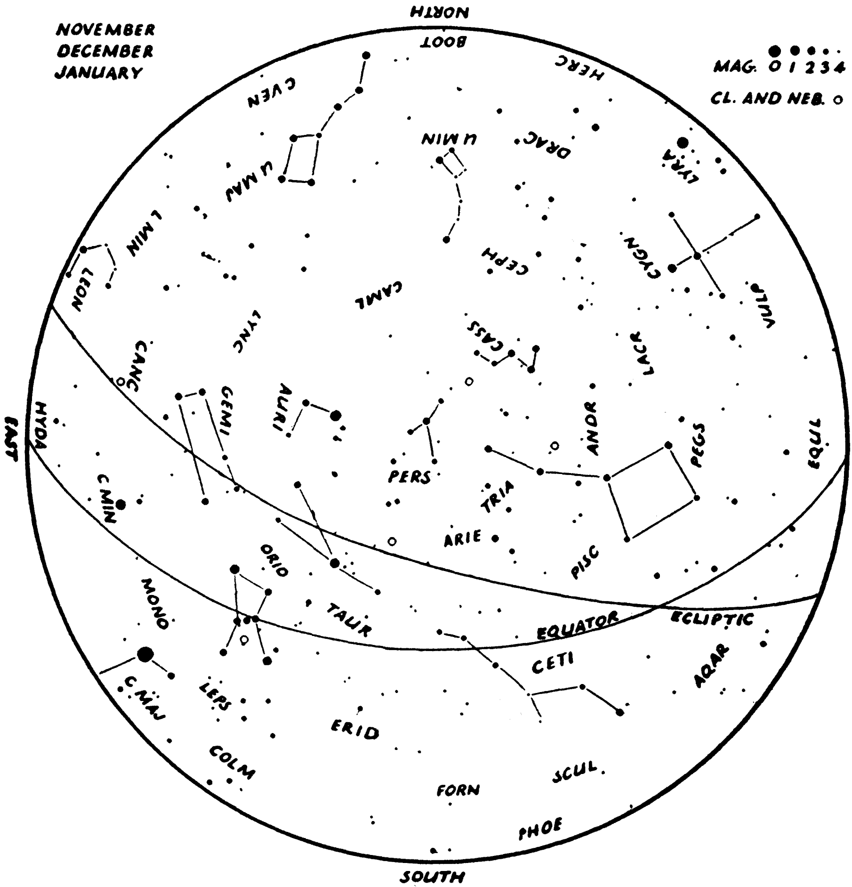


The above map represents the evening sky at

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

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

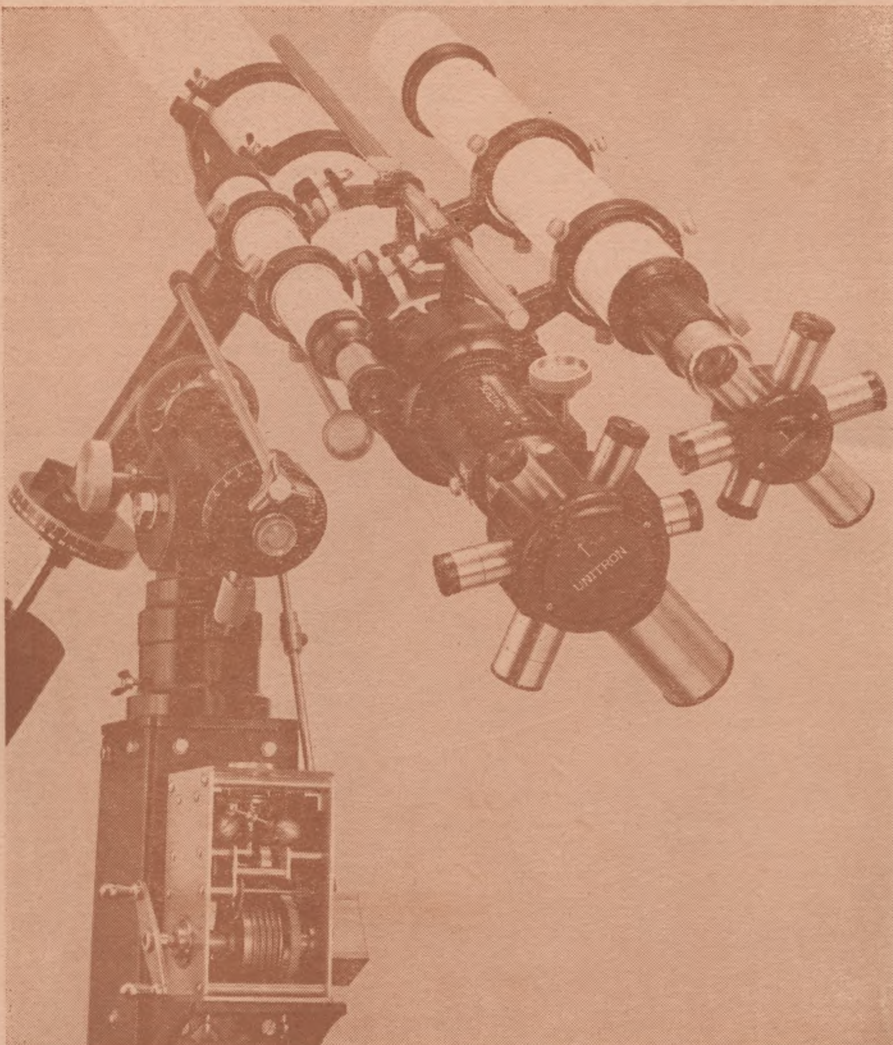
STAR MAP 4



The above map represents the evening sky at

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

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


UNITRON