THE OBSERVER'S HANDBOOK FOR 1954

PUBLISHED BY

The Royal Astronomical Society of Canada

C. A. CHANT, Editor
RUTH J. NORTHCOTT, Assistant Editor
DAVID DUNLAP OBSERVATORY

FORTY-SIXTH YEAR OF PUBLICATION

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1953

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.

For many years the Toronto organization existed alone, but now the Society is national in extent, having active Centres in Montreal and Quebec, P.Q.; Ottawa, Toronto, Hamilton, London, and Windsor, Ontario; Winnipeg, Man.; Saskatoon, Sask.; Edmonton, Alta.; Vancouver and Victoria, B.C. As well as nearly 1000 members of these Canadian Centres, there are nearly 400 members not attached to any Centre, mostly resident in other nations, while some 200 additional institutions or persons are on the regular mailing list of our publications. The Society publishes a bi-monthly JOURNAL and a yearly OBSERVER'S HANDBOOK. Single copies of the JOURNAL are 50 cents, and of the HANDBOOK, 50 cents.

Membership is open to anyone interested in astronomy. Annual dues, $3.00; life membership, $40.00. Publications are sent free to all members or may be subscribed for separately. Applications for membership or publications may be made to the National Secretary, 15 Ross St., Toronto 2B.

CALENDAR 1954

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	....

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TABLES IN RECENT OBSERVER'S HANDBOOKS

PRINTED IN CANADA

PREFACE

The HANDBOOK for 1954 is the 46th issue and its circulation is 5000. The Officers of the Society appreciate the increase in advertisements which will help to meet our mounting expense.

In this issue the distances of the extra-galactic nebulae have been increased in accordance with Dr. Walter Baade's recent investigation of the Andromeda Nebula. Four circular star maps 9 inches in diameter at a price of two cents each and a set of four maps plotted on equatorial co-ordinates at a price of twenty cents are obtainable from the Director of University Extension, University of Toronto, Toronto 5.

Celestial distances given herein are based on the standard value of 8″.80 for the sun's parallax, not on the more recent value 8″.790 determined by Sir Harold Jones; and the calculations for Algol are based on Olin J. Eggen's epoch 2432520.6303 and period 2.86731525 d., as published in the *Astrophysical Journal*, 1948.

Cordial thanks are tendered to those who assisted in preparing this volume, especially to the staff of the David Dunlap Observatory, and also Miss Carol Henderson, Malcolm Lennox and Donald Morton. Our deep indebtedness to the British *Nautical Almanac* and the *American Ephemeris* is thankfully acknowledged.

C. A. CHANT

David Dunlap Observatory,
Richmond Hill, Ont., October 1953.

ANNIVERSARIES AND FESTIVALS, 1954

New Year's Day	Fri.	Jan. 1	Trinity Sunday		June 13
Epiphany	Wed.	Jan. 6	Corpus Christi	Thu.	June 17
Accession of Queen Elizabeth (1952)	Sat.	Feb. 6	St. John Baptist (Mid-summer Day)	Thu.	June 24
Septuagesima Sunday		Feb. 14	Dominion Day	Thu.	July 1
Quinquagesima (Shrove Sunday)		Feb. 28	Birthday of Queen Mother Elizabeth (1900)	Wed.	Aug. 4
St. David	Mon.	Mar. 1	Labour Day	Mon.	Sept. 6
Ash Wednesday		Mar. 3	Hebrew New Year (Rosh Hashanah)	Tue.	Sept. 28
St. Patrick	Wed.	Mar. 17	St. Michael (Michaelmas Day)	Wed.	Sept. 29
Palm Sunday		Apr. 11	All Saints' Day	Mon.	Nov. 1
Good Friday		Apr. 16	Remembrance Day	Thu.	Nov. 11
Easter Sunday		Apr. 18	First Sunday in Advent		Nov. 28
Birthday of Queen Elizabeth (1926)	Wed.	Apr. 21	St. Andrew	Tue.	Nov. 30
St. George	Fri.	Apr. 23	Christmas Day	Sat.	Dec. 25
Rogation Sunday		May 23			
Empire Day (Victoria Day)	Mon.	May 24			
Ascension Day	Thu.	May 27			
Pentecost (Whit Sunday)		June 6			

Thanksgiving Day, date set by Proclamation

SYMBOLS AND ABBREVIATIONS

SIGNS OF THE ZODIAC

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

SUN, MOON AND PLANETS

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

ASPECTS AND ABBREVIATIONS

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

THE GREEK ALPHABET

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

THE CONFIGURATIONS OF JUPITER'S SATELLITES

In the Configurations of Jupiter's Satellites (pages 31, 33, etc.), O represents the disc of the planet, d signifies that the satellite is on the disc, * signifies that the satellite is behind the disc or in the shadow. Configurations are for an inverting telescope.

THE CONSTELLATIONS

Latin and English Names with Abbreviations

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

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

MISCELLANEOUS ASTRONOMICAL DATA

UNITS OF LENGTH

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

UNITS OF TIME

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

THE EARTH

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

EARTH'S ORBITAL MOTION

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

SOLAR MOTION

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

THE GALACTIC SYSTEM

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

EXTRA-GALACTIC NEBULAE

Red shift = +265 km./sec./megaparsec = +50 miles /sec./million l.y.

RADIATION CONSTANTS

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

MISCELLANEOUS

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

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

Date 1954	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
	h m s	m s	° ′
Jan. 1	18 43 41	+ 3 15	− 23 04.0
4	18 56 55	+ 4 39	− 22 48.1
7	19 10 06	+ 6 00	− 22 28.1
10	19 23 12	+ 7 17	− 22 04.1
13	19 36 14	+ 8 28	− 21 36.3
16	19 49 09	+ 9 34	− 21 04.7
19	20 01 58	+ 10 34	− 20 29.5
22	20 14 41	+ 11 27	− 19 50.8
25	20 27 17	+ 12 13	− 19 08.8
28	20 39 46	+ 12 52	− 18 23.6
31	20 52 08	+ 13 25	− 17 35.4
Feb. 3	21 04 22	+ 13 49	− 16 44.4
6	21 16 30	+ 14 07	− 15 50.7
9	21 28 29	+ 14 17	− 14 54.6
12	21 40 22	+ 14 20	− 13 56.3
15	21 52 08	+ 14 16	− 12 55.9
18	22 03 46	+ 14 05	− 11 53.7
21	22 15 19	+ 13 48	− 10 49.7
24	22 26 46	+ 13 25	− 9 44.3
27	22 38 07	+ 12 57	− 8 37.5
Mar. 2	22 49 24	+ 12 24	− 7 29.5
5	23 00 36	+ 11 47	− 6 20.5
8	23 11 44	+ 11 05	− 5 10.8
11	23 22 49	+ 10 20	− 4 00.5
14	23 33 50	+ 9 32	− 2 49.7
17	23 44 49	+ 8 41	− 1 38.7
20	23 55 46	+ 7 48	− 0 27.6
23	0 06 41	+ 6 54	+ 0 43.5
26	0 17 36	+ 5 59	+ 1 54.4
29	0 28 31	+ 5 04	+ 3 04.9
Apr. 1	0 39 26	+ 4 10	+ 4 14.9
4	0 50 23	+ 3 16	+ 5 24.1
7	1 01 20	+ 2 24	+ 6 32.6
10	1 12 19	+ 1 34	+ 7 40.0
13	1 23 21	+ 0 46	+ 8 46.2
16	1 34 25	+ 0 00	+ 9 51.1
19	1 45 32	− 0 42	+ 10 54.5
22	1 56 43	− 1 21	+ 11 56.3
25	2 07 58	− 1 56	+ 12 56.4
28	2 19 17	− 2 26	+ 13 54.6
May 1	2 30 41	− 2 52	+ 14 50.7
4	2 42 10	− 3 12	+ 15 44.6
7	2 53 44	− 3 28	+ 16 36.2
10	3 05 23	− 3 39	+ 17 25.3
13	3 17 07	− 3 45	+ 18 11.7
16	3 28 56	− 3 46	+ 18 55.4
19	3 40 49	− 3 42	+ 19 36.2
22	3 52 48	− 3 32	+ 20 14.0
25	4 04 52	− 3 18	+ 20 48.7
28	4 17 01	− 2 59	+ 21 20.2
31	4 29 14	− 2 36	+ 21 48.4
June 3	4 41 30	− 2 09	+ 22 13.2
6	4 53 50	− 1 39	+ 22 34.5
9	5 06 13	− 1 05	+ 22 52.2
12	5 18 38	− 0 30	+ 23 06.3
15	5 31 05	+ 0 07	+ 23 16.8
18	5 43 33	+ 0 45	+ 23 23.5
21	5 56 02	+ 1 24	+ 23 26.6
24	6 08 30	+ 2 03	+ 23 25.9
27	6 20 59	+ 2 42	+ 23 21.5
30	6 33 26	+ 3 19	+ 23 13.4

Date 1954	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
	h m s	m s	° ′
July 3	6 45 51	+ 3 54	+ 23 01.6
6	6 58 13	+ 4 27	+ 22 46.3
9	7 10 32	+ 4 57	+ 22 27.3
12	7 22 48	+ 5 22	+ 22 04.9
15	7 34 59	+ 5 44	+ 21 39.1
18	7 47 06	+ 6 01	+ 21 10.0
21	7 59 08	+ 6 14	+ 20 37.6
24	8 11 05	+ 6 21	+ 20 02.1
27	8 22 58	+ 6 24	+ 19 23.6
30	8 34 45	+ 6 21	+ 18 42.1
Aug. 2	8 46 26	+ 6 13	+ 17 58.0
5	8 58 02	+ 6 00	+ 17 11.1
8	9 09 33	+ 5 41	+ 16 21.8
11	9 20 58	+ 5 16	+ 15 30.1
14	9 32 18	+ 4 46	+ 14 36.3
17	9 43 32	+ 4 11	+ 13 40.3
20	9 54 43	+ 3 32	+ 12 42.3
23	10 05 49	+ 2 48	+ 11 42.5
26	10 16 51	+ 2 01	+ 10 41.1
29	10 27 49	+ 1 10	+ 9 38.1
Sept. 1	10 38 45	+ 0 15	+ 8 33.7
4	10 49 37	− 0 42	+ 7 28.1
7	11 00 27	− 1 42	+ 6 21.4
10	11 11 15	− 2 43	+ 5 13.8
13	11 22 02	− 3 46	+ 4 05.4
16	11 32 48	− 4 50	+ 2 56.4
19	11 43 33	− 5 54	+ 1 46.9
22	11 54 19	− 6 58	+ 0 36.9
25	12 05 06	− 8 01	− 0 33.2
28	12 15 55	− 9 02	− 1 43.4
Oct. 1	12 26 45	− 10 01	− 2 53.5
4	12 37 37	− 10 58	− 4 03.2
7	12 48 33	− 11 53	− 5 12.6
10	12 59 32	− 12 44	− 6 21.3
13	13 10 34	− 13 30	− 7 29.3
16	13 21 42	− 14 13	− 8 36.4
19	13 32 54	− 14 50	− 9 42.3
22	13 44 13	− 15 21	− 10 47.1
25	13 55 37	− 15 46	− 11 50.4
28	14 07 08	− 16 05	− 12 52.0
31	14 18 45	− 16 17	− 13 51.9
Nov. 3	14 30 30	− 16 23	− 14 49.7
6	14 42 21	− 16 21	− 15 45.4
9	14 54 20	− 16 12	− 16 38.8
12	15 06 27	− 15 55	− 17 29.6
15	15 18 41	− 15 30	− 18 17.6
18	15 31 02	− 14 58	− 19 02.9
21	15 43 32	− 14 19	− 19 45.0
24	15 56 09	− 13 31	− 20 24.0
27	16 08 53	− 12 37	− 20 59.5
30	16 21 43	− 11 36	− 21 31.5
Dec. 3	16 34 40	− 10 29	− 21 59.8
6	16 47 42	− 9 17	− 22 24.3
9	17 00 48	− 8 00	− 22 44.9
12	17 13 59	− 6 39	− 23 01.4
15	17 27 13	− 5 15	− 23 13.9
18	17 40 30	− 3 47	− 23 22.2
21	17 53 49	− 2 18	− 23 26.3
24	18 07 09	− 0 48	− 23 26.1
27	18 20 28	+ 0 41	− 23 21.7
30	18 33 46	+ 2 10	− 23 13.1

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 9.

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, 1954

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

Jan. 1	4744	May 1	4864	Sept. 1	4987
Feb. 1	4775	June 1	4895	Oct. 1	5017
Mar. 1	4803	July 1	4925	Nov. 1	5048
Apr. 1	4834	Aug. 1	4956	Dec. 1	5078

The Julian Day commences at noon. Thus J.D. 2,434,744.0 = 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 52°. The times are given in Local Mean Time, and in the table below are given corrections to change from Local Mean to Standard Time for the cities and towns named.

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 11 the time of sunrise on February 12 for latitude 45° is 7.07; add 24 min. and we get 7.31 (Eastern Standard Time).

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

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

DATE		Latitude **32°** 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

Month	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 10. The entry —— in the above table indicates that at such dates and latitudes, twilight lasts all night. This table, taken from the American Ephemeris, is computed for *astronomical* twilight, i.e. for the time at which the sun is 108° from the zenith (or 18° below the horizon).

TIME OF MOONRISE AND MOONSET, 1954. (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	04 00	13 55	04 16	13 28	04 34	13 19	04 57	12 56	05 21	12 32
2	04 59	14 43	05 16	14 25	05 37	14 05	06 02	13 39	06 30	13 12
3	05 56	15 39	06 14	15 22	06 35	15 01	07 01	14 35	07 28	14 08
4 ●	06 49	16 42	07 06	16 25	07 25	16 07	07 49	15 43	08 14	15 19
5	07 36	17 48	07 50	17 35	08 06	17 20	08 27	17 00	08 48	16 40
6	08 17	18 57	08 28	18 47	08 41	18 35	08 57	18 21	09 13	18 06
7	08 53	20 06	09 00	20 00	09 09	19 52	09 20	19 43	09 31	19 34
8	09 25	21 14	09 30	21 11	09 35	21 08	09 41	21 05	09 46	21 01
9	09 56	22 21	09 57	22 23	09 58	22 24	09 59	22 26	10 00	22 27
10	10 26	23 29	10 24	23 34	10 20	23 40	10 17	23 47	10 13	23 54
11 ☽	10 58	.. ..	10 52	.. ..	10 44	.. ..	10 36	.. ..	10 27	.. ..
12	11 33	00 38	11 23	00 47	11 12	00 57	10 58	01 09	10 44	01 21
13	12 13	01 48	12 00	02 00	11 45	02 14	11 26	02 32	11 07	02 49
14	12 59	02 57	12 43	03 13	12 25	03 30	12 02	03 52	11 39	04 15
15	13 52	04 03	13 35	04 20	13 15	04 40	12 49	05 06	12 23	05 32
16	14 51	05 05	14 34	05 22	14 14	05 42	13 48	06 09	13 22	06 35
17	15 55	05 59	15 39	06 15	15 21	06 34	14 57	06 58	14 33	07 22
18 ⊕	16 59	06 44	16 47	06 59	16 31	07 15	16 12	07 35	15 52	07 55
19	18 03	07 23	17 54	07 34	17 41	07 48	17 27	08 03	17 12	08 19
20	19 04	07 56	18 58	08 04	18 50	08 14	18 40	08 25	18 31	08 36
21	20 04	08 25	20 00	08 30	19 56	08 36	19 51	08 42	19 46	08 49
22	21 01	08 51	21 00	08 54	21 00	08 56	21 00	08 58	20 59	09 00
23	21 57	09 16	22 00	09 16	22 03	09 14	22 07	09 13	22 11	09 11
24	22 53	09 41	22 59	09 38	23 06	09 33	23 14	09 27	23 22	09 21
25	23 50	10 08	23 58	10 01	.. ..	09 53	.. ..	09 43	.. ..	09 34
26 ☾	.. ..	10 37	.. ..	10 27	00 09	10 15	00 22	10 01	00 34	09 48
27	00 47	11 09	00 59	10 57	01 13	10 41	01 30	10 24	01 47	10 06
28	01 45	11 47	02 00	11 33	02 17	11 14	02 39	10 52	03 01	10 29
39	02 45	12 32	03 01	12 15	03 21	11 55	03 45	11 30	04 11	11 03
30	03 42	13 24	03 59	13 06	04 20	12 45	04 46	12 19	05 14	11 51
31	04 37	14 23	04 53	14 06	05 14	13 46	05 39	13 21	06 06	12 55
Feb.										
1	05 26	15 28	05 42	15 14	05 59	14 57	06 22	14 35	06 45	14 12
2	06 10	16 38	06 23	16 25	06 38	16 12	06 56	15 55	07 14	15 38
3 ●	06 48	17 48	06 59	17 39	07 09	17 30	07 23	17 18	07 36	17 07
4	07 24	18 58	07 30	18 53	07 36	18 48	07 44	18 42	07 52	18 37
5	07 56	20 08	07 59	20 07	08 01	20 07	08 04	20 06	08 07	20 07
6	08 28	21 18	08 27	21 21	08 25	21 25	08 23	21 31	08 21	21 36
7	09 00	22 29	08 55	22 36	08 49	22 44	08 41	22 55	08 35	23 06
8	09 35	23 39	09 26	23 50	09 15	.. ..	09 03	.. ..	08 51	.. ..
9	10 14	.. ..	10 01	.. ..	09 47	00 03	09 30	00 19	09 12	00 35
10 ☽	10 57	00 49	10 43	01 03	10 25	01 20	10 03	01 41	09 41	02 02
11	11 48	01 56	11 31	02 13	11 11	02 32	10 46	02 57	10 20	03 22
12	12 44	02 59	12 27	03 16	12 07	03 37	11 40	04 02	11 14	04 29
13	13 45	03 54	13 30	04 11	13 10	04 30	12 46	04 55	12 21	05 21
14	14 49	04 42	14 35	04 56	14 18	05 13	13 57	05 36	13 36	05 58
15	15 52	05 21	15 41	05 34	15 27	05 48	15 11	06 06	14 54	06 23
16	16 53	05 56	16 45	06 06	16 36	06 16	16 24	06 29	16 13	06 42
17 ⊕	17 53	06 27	17 48	06 32	17 43	06 39	17 35	06 48	17 28	06 56
18	18 51	06 53	18 48	06 57	18 47	07 00	18 44	07 04	18 42	07 08
19	19 47	07 19	19 48	07 20	19 50	07 20	19 52	07 19	19 55	07 19
20	20 43	07 44	20 47	07 42	20 53	07 38	21 00	07 34	21 06	07 30
21	21 40	08 11	21 47	08 04	21 56	07 57	22 07	07 50	22 18	07 41
22	22 36	08 38	22 47	08 30	22 59	08 19	23 15	08 07	23 30	07 54
23	23 34	09 09	23 47	08 57	.. ..	08 44	.. ..	08 27	.. ..	08 11
24	.. ..	09 44	.. ..	09 30	00 03	09 13	00 23	08 52	00 43	08 32
25 ☾	00 32	10 25	00 47	10 08	01 06	09 50	01 29	09 26	01 53	09 01
26	01 29	11 12	01 46	10 55	02 07	10 35	02 32	10 09	02 58	09 42
27	02 24	12 06	02 41	11 50	03 01	11 29	03 27	11 03	03 55	10 37
28	03 14	13 08	03 30	12 52	03 50	12 34	04 14	12 10	04 38	11 45

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

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

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

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

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

THE PLANETS FOR 1954

By C. A. Chant

THE SUN

The maximum of sun-spot activity in the present sun-spot cycle occurred about March 1947. There have been spotless days during 1952 and 1953 and the minimum of solar activity is to be expected in 1954 or 1955.

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 1954

Elong. East—Evening Star			Elong. West—Morning Star		
Date	Distance	Mag.	Date	Distance	Mag.
Feb. 13	18°	−0.3	Mar. 28	28°	+0.5
June 9	24°	+0.7	July 26	20°	+0.6
Oct. 5	26°	+0.2	Nov. 14	19°	−0.3

The most favourable elongations to observe are: in the evening, Feb. 13; in the morning, July 26. 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.

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.

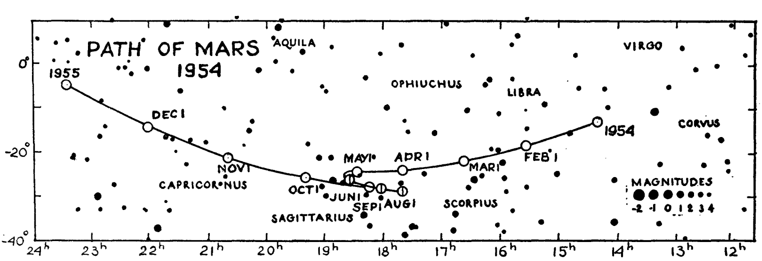
On Jan. 1, 1954, Venus crosses the meridian half an hour before the sun and hence is a morning star. Its declination then is 23° 36′ south. It continues to approach (angularly) the sun and on Jan. 29 is in superior conjunction with the sun being 1° south of it. It now separates from the sun, becoming an evening star which it continues to be all summer. It attains greatest elongation east on Sept. 6 and greatest brilliancy on Oct. 11. It now moves rapidly in towards the sun and on Nov. 15 comes into inferior conjunction with it, being 3° 43′ south. Now it becomes a morning star. On Dec. 21 it attains greatest brilliancy and on Dec. 31 it transits three hours before the sun. It is a fine morning star, in declination 15° south.

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 May 1, 1952, then on June 24, 1954, although it is nearest the earth on July 2; and the next opposition will be on Sept. 10, 1956.

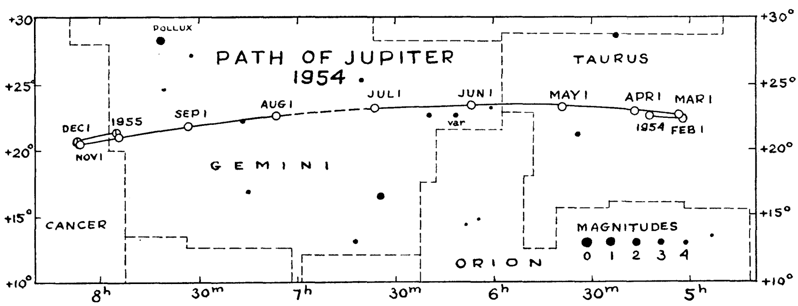
On Jan. 1, 1954, the planet is in Virgo and its stellar mag. is +1.6, slightly fainter than Spica which is +1.2. On June 29 it is −2.3, and on Dec. 31, it is +0.8. For its position among the stars see the map.

JUPITER

Jupiter is the giant of the family of the sun. Its mean diameter is 87,000 miles and its mass is 2½ times that of all the rest of the planets combined! Its mean distance is 483 million miles and the revolution period is 11.9 years. This planet is known to possess 12 satellites, the last discovered in 1951 (see p. 59). Not so long ago it was generally believed that the planet was still cooling down from its original high temperature, but from actual measurements of the radiation from it to the earth it has been deduced that the surface is at about −200°F. The spectroscope shows that its atmosphere is largely ammonia and methane.

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

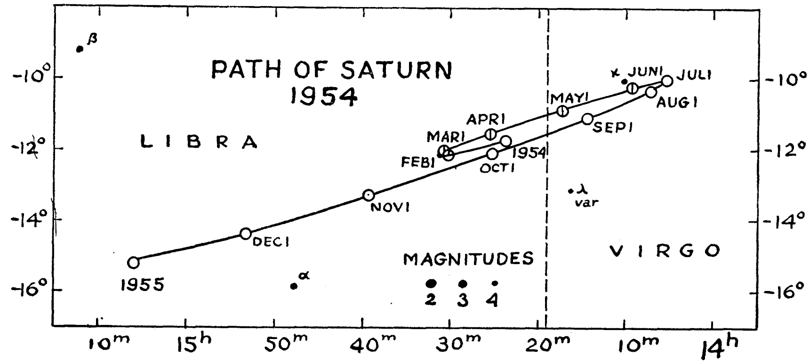
On Jan. 1, 1954, Jupiter crosses the meridian at 10.30 p.m. and is a morning star in the constellation Taurus (see map). The sun moves over to the planet and they are in conjunction on June 30, and Jupiter becomes a morning star. It then separates from the sun until about Jan. 17, 1955, when it comes to opposition and is on the meridian at midnight. On Dec. 31, 1954, it crosses the meridian at about 1.20 a.m. and its stellar magnitude is −2.2.



SATURN

Saturn was the outermost planet known until modern times. In size it is a good second to Jupiter. In addition to its family of nine satellites, this planet has a unique system of rings, and it is one of the finest of celestial objects in a good telescope. The plane of the rings makes an angle of 27° with the plane of the planet's orbit, and twice during the planet's revolution period of 29½ years the rings appear to open out widest; then they slowly close in until, midway between the maxima, the rings are presented edgewise to the sun or the earth, at which times they are invisible. The rings were edgewise in 1937 and 1950, and at maximum in 1944. For the next few years they will be gradually opening out.

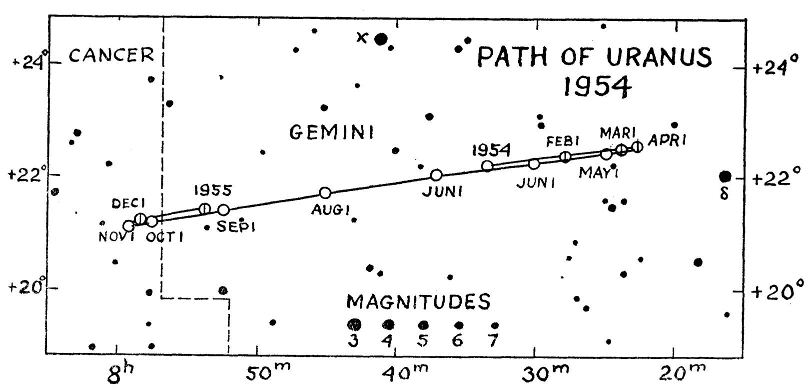
The planet is in the constellation Libra (see map). On April 26 it is in opposition to the sun and is visible all night. Its stellar magnitude then is +0.4, slightly less bright than Rigel. On Nov. 4 it is in conjunction with the sun.



URANUS

Uranus was discovered in 1781 by Sir William Herschel by means of a 6¼-in. mirror-telescope made by himself. The object did not look just like a star and he observed it again four days later. It had moved amongst the stars, and he assumed it to be a comet. He could not believe that it was a new planet. However, computation later showed that it was a planet nearly twice as far from the sun as Saturn. Its period of revolution is 84 years and it rotates on its axis in about 11 hours. Its five satellites are visible only in a large telescope. The fifth satellite was discovered by G. P. Kuiper in 1948 at the McDonald Observatory (see p. 59).

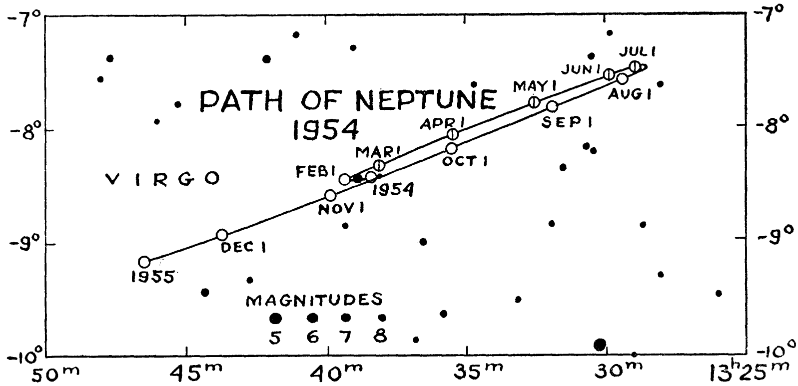
As shown by the chart, Uranus in 1954 is in Gemini. On Jan. 11, it is in opposition with the sun; on July 16 in conjunction.



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 2800 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 1954 Neptune is still in the constellation Virgo. It is in opposition to the sun on April 15. Its stellar magnitude is +7.7 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. 19.



PLUTO

Pluto, the most distant known planet, was discovered at the Lowell Observatory in 1930. Its mean distance from the sun is 3666 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. 12, 1954, at which time its astrometric position is R.A. $9^h\ 58^m$, Dec. +23° 06′.

ECLIPSES, 1954

In 1954 there will be five eclipses, three of the sun and two of the moon.

I. *An Annular Eclipse of the Sun,* January 4, 1954, invisible in North America. This eclipse is visible generally in the Antarctic regions.

II. *A Total Eclipse of the Moon,* January 18, 1954, visible in all of North America and, also, generally, in Europe, Africa and the Arctic. The beginning is not visible in the extreme western and north-western parts of North America because the moon will not yet have risen there at that time.

Circumstances of the Lunar Eclipse, January 18, 1954 (E.S.T.)

☾ enters penumbra	18 h	39.6 m	☾ leaves umbra	23 h	13.5 m
☾ enters umbra	19	50.0	☾ leaves penumbra	0	24.1
Middle of eclipse	21	31.8	Magnitude of eclipse		1.037

III. *A Total Eclipse of the Sun,* June 30, 1954, visible at least as a partial eclipse over the whole eastern and northern part of North America, (all of Canada except the south-western corner of British Columbia) as well as over the Atlantic Ocean, Europe, North Africa and most of Asia. The band of totality, which is about 90 miles wide, begins (at sunrise) in Minnesota, passes over the centre of Lake Superior, across Northern Ontario (including White River and Kapuskasing), touches James Bay and thence passes across Ungava to the Labrador coast, touches the southern tip of Greenland, passes over southern Norway and Sweden, across Lithuania, Poland, the Ukraine, Georgia, Iran, and finally ends at sunset in Northern India. In Northern Ontario totality occurs between 6.10 and 6.15 a.m. E.S.T., depending on the location, the sun being 12 to 16 degrees above the horizon; the duration of totality in the centre of the path is about a minute and a half.

IV. *A Partial Eclipse of the Moon,* July 15, 1954, partly visible in North America and visible generally in Europe, Africa, and South America. The beginning is not visible in North America because the moon will not yet have risen, and the ending is visible only in the eastern and south-eastern parts of North America.

Circumstances of the Lunar Eclipse, July 15, 1954 (E.S.T.)

☾ enters penumbra	16 h	47.7 m	☾ leaves umbra	20 h	31.3 m
☾ enters umbra	18	09.4	☾ leaves penumbra	21	52.9
Middle of eclipse	19	20.3	Magnitude of eclipse		0.411

V. *An Annular Eclipse of the Sun,* December 25, 1954, invisible in North America, visible in South Africa and Australia.

THE SKY MONTH BY MONTH

By J. F. Heard

THE SKY FOR JANUARY, 1954

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

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

The Sun—During January the sun's R.A. increases from 18h 44m to 20h 56m and its Decl. changes from 23° 04′ S. to 17° 19′ S. The equation of time changes from −3m 15s to −13m 34s. The earth is in perihelion or nearest the sun on the 2nd. There is an annular eclipse on the 4th, invisible in North America. For changes in the length of the day, see p. 11.

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. 18. On the night of January 18 there is a total eclipse of the moon, visible in North America.

Mercury on the 15th is in R.A. 19h 47m, Decl. 23° 12′ S. and transits at 12h 14m. It is in superior conjunction on the 14th and is thus too near the sun for observation this month.

Venus on the 15th is in R.A. 19h 30m, Decl. 22° 33′ S. and transits at 11h 55 m. Superior conjunction is on the 29th and so Venus is too close to the sun for observation during this month.

Mars on the 15th is in R.A. 14h 52m, Decl. 15° 21′ S. and transits at 7h 16m. It is a morning star in Libra visible in the south-east for about five hours before sunrise. It is not prominent, the stellar magnitude being +1.4. Conjunction with Saturn is on the 2nd.

Jupiter on the 15th is in R.A. 5h 06m, Decl. 22° 27′ N. and transits at 21h 26m. It is in Taurus, well up in the east by sunset and visible till nearly dawn. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 14h 27m, Decl. 12° 02′ S. and transits at 6h 50m. It is in Libra rising about two hours after midnight. (See Mars.)

Uranus on the 15th is in R.A. 7h 31m, Decl. 22° 18′ N. and transits at 23h 50m.

Neptune on the 15th is in R.A. 13h 39m, Decl. 8° 28′ S. and transits at 6h 02m.

Pluto—For information in regard to this planet, see p. 29.

ASTRONOMICAL PHENOMENA MONTH BY MONTH

BY RUTH J. NORTHCOTT

	d	h	m	JANUARY 75th Meridian Civil Time	Min. of Algol h m	Phen. of Jupiter's Sat. 23h 30m
Fri.	1	10		☿ in Aphelion		d0234
Sat.	2	3		⊕ in Perihelion. Dist. from ☉, 91,348,000 mi.	22 55	20134
		16		☌ ♂ ♄ ♂ 1° 17′ S.		
Sun.	3			Quadrantid meteors		1034*
Mon.	4			Annular eclipse of ☉. See p. 29		34012
		5		☌ ☿ ♀ ☿ 1° 02′ S.		
		9	27	☌ ♀ ☾ ♀ 1° 10′ N.		
		9	37	☌ ☿ ☾ ☿ 0° 07′ N.		
		21	21	● New Moon		
Tue.	5				19 44	34120
Wed.	6					43201
Thu.	7					41032
Fri.	8				16 34	40123
Sat.	9					4203*
Sun.	10	5		Moon in Perigee. Dist. from ⊕, 229,800 mi.		4103*
Mon.	11	14		☍ ♅ ☉ Dist. from ⊕, 1,646,000,000 mi.	13 23	43012
		19	22	☽ First Quarter		
Tue.	12					31240
Wed.	13					32014
Thu.	14	13		☌ ☿ ☉ Superior	10 12	10324
Fri.	15	20	30	☌ ♃ ☾ ♃ 3° 34′ S.		01234
Sat.	16	12		□ ♆ ☉ west		21034
Sun.	17				7 01	12034
Mon.	18			Total eclipse of ☾. See p. 29		30124
		7	29	☌ ♅ ☾ ♅ 0° 12′ N.		
		21	37	○ Full Moon		
Tue.	19					31204
Wed.	20				3 51	32041
Thu.	21	18		☿ Greatest Hel. Lat. S.		14302
Fri.	22					40123
Sat.	23				0 40	42103
Sun.	24					d4203
Mon.	25	7		Moon in Apogee. Dist. from ⊕, 251,400 mi.	21 29	43012
Tue.	26	6	34	☌ ♆ ☾ ♆ 7° 28′ N.		d4310
		22	28	☾ Last Quarter		
Wed.	27	8	07	☌ ♄ ☾ ♄ 7° 53′ N.		43201
Thu.	28	0		♆ Stationary in R.A.	18 19	41302
		10	03	☌ ♂ ☾ ♂ 5° 44′ N.		
Fri.	29	7		□ ♄ ☉ west		04123
		19		☌ ♀ ☉ Superior		
Sat.	30	16		♀ in Aphelion		21043
Sun.	31				15 08	20134

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

THE SKY FOR FEBRUARY, 1954

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

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

The Sun—During February the sun's R.A. increases from 20h 56m to 22h 46m and its Decl. changes from 17° 19′ S. to 7° 52′ S. The equation of time changes from −13m 34s to a maximum of −14m 20s on the 11th and then to −12m 36s at the end of the month. For changes in the length of the day, see p. 11.

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. 18.

Mercury on the 15th is in R.A. 22h 58m, Decl. 5° 14′ S. and transits at 13h 19m. On the 13th it is at greatest eastern elongation and may be seen at this time as an evening star low in the south-west just after sunset.

Venus on the 15th is in R.A. 22h 09m, Decl. 12° 56′ S. and transits at 12h 32m. It is too close to the sun for easy observation.

Mars on the 15th is in R.A. 16h 04m, Decl. 19° 53′ S. and transits at 6h 25m. Moving from Libra into Scorpius and passing to the north of Antares, it is a morning star rising almost two hours after midnight.

Jupiter on the 15th is in R.A. 5h 01m, Decl. 22° 26′ N. and transits at 19h 19m. It is in Taurus, well up in the east at sunset, seen till about three hours after midnight. On the 10th it is stationary in right ascension and resumes direct, or eastward, motion. For the configurations of Jupiter's satellites see opposite page, and for their eclipse, etc., see p. 54.

Saturn on the 15th is in R.A. 14h 31m, Decl. 12° 13′ S. and transits at 4h 52m. It is in Libra and rises about midnight. On the 17th it is stationary in right ascension and begins to retrograde, i.e., move westward among the stars.

Uranus on the 15th is in R.A. 7h 26m, Decl. 22° 29′ N. and transits at 21h 43m.

Neptune on the 15th is in R.A. 13h 39m, Decl. 8° 26′ S. and transits at 4h 00m.

Pluto—For information in regard to this planet, see p. 29.

FEBRUARY 75th Meridian Civil Time					Min. of Algol	Phen. of Jupiter's Sat. 22h 45m
	d	h	m		h m	
Mon.	1			....		3O24*
Tue.	2			....		31O24
Wed.	3	10	55	● New Moon........................	11 57	32O14
		14	52	☌ ♀ ☾ ♀ 3° 27′ S..................		
Thu.	4	16	00	☌ ☿ ☾ ☿ 4° 29′ S..................		13O4*
Fri.	5			....		O1324
Sat.	6	1	00	Moon in Perigee. Dist. from ⊕, 226,600 mi....	8 46	12O43
Sun.	7			....		42O13
Mon.	8			....		d41O2
Tue.	9	19		☿ in ☊..................................	5 36	d43O2
Wed.	10	3	29	☽ First Quarter......................		432O1
		7		♃ Stationary in R.A..................		
Thu.	11			....		431O*
Fri.	12	0	24	☌ ♃ ☾ ♃ 3° 30′ S..................	2 25	4O312
		18		☍ ♇ ☉ Dist. from ⊕, 3,187,000,000 mi......		
Sat.	13	15		☿ Greatest elongation E., 18° 09′......		412O3
Sun.	14	10		☿ in Perihelion......................	23 14	24O13
		12	23	☌ ♅ ☾ ♅ 0° 07′ N..................		
Mon.	15			....		1O342
Tue.	16			....		d3O24
Wed.	17	14	17	○ Full Moon..........................	20 04	32O4*
		20		♄ Stationary in R.A..................		
Thu.	18			....		312O4
Fri.	19	12		☿ Stationary in R.A..................		O124*
Sat.	20			....	16 53	12O34
Sun.	21	23		♀ Greatest Hel. Lat. S................		2O134
Mon.	22	2		Moon in Apogee. Dist. from ⊕, 251,900 mi....		1O324
		13	47	☌ ♆ ☾ ♆ 7° 22′ N..................		
Tue.	23	16	33	☌ ♄ ☾ ♄ 7° 51′ N..................	13 42	34O12
Wed.	24	16		☿ Greatest Hel. Lat. N................		342O*
		21		☌ ☿ ♀ ☿ 5° 21′ N..................		
Thu.	25	18	29	☾ Last Quarter......................		4321O
		23	53	☌ ♂ ☾ ♂ 4° 20′ N..................		
Fri.	26			....	10 32	4O312
Sat.	27			....		d41O3
Sun.	28			....		42O13

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

THE SKY FOR MARCH, 1954

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

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

The Sun—During March the sun's R.A. increases from 22h 46m to 0h 39m and its Decl. changes from 7° 52′ S. to 4° 15′ N. The equation of time changes from −12m 36s to −4m 10s. On the 20th at 22h 54m 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. 12.

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. 19.

Mercury on the 15th is in R.A. 22h 13m, Decl. 9° 45′ S. and transits at 10h 43m. Inferior conjunction is on the 1st and greatest western elongation is on the 28th. This elongation, however, is very unfavourable, Mercury being too low in the east at sunrise for easy observation.

Venus on the 15th is in R.A. 0h 19m, Decl. 0° 42′ N. and transits at 12h 51m. It is an evening star to be seen, especially later in the month, very low in the west just after sunset.

Mars on the 15th is in R.A. 17h 06m, Decl. 22° 23′ S. and transits at 5h 37m. It is in Scorpius and rises soon after midnight. Western quadrature occurs on the first.

Jupiter on the 15th is in R.A. 5h 08m, Decl. 22° 40′ N. and transits at 17h 37m. It is in Taurus, about on the meridian at sunset and setting about midnight. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 14h 29m, Decl. 11° 56′ S. and transits at 2h 59m. It is in Libra rising about two hours before midnight.

Uranus on the 15th is in R.A. 7h 23m, Decl. 22° 34′ N. and transits at 19h 51m.

Neptune on the 15th is in R.A. 13h 37m, Decl. 8° 14′ S. and transits at 2h 08m.

Pluto—For information in regard to this planet, see p. 29.

MARCH
75th Meridian Civil Time

d	h	m			Min. of Algol h m	Phen. of Jupiter's Sat. 22h 15m
Mon. 1	5		☌ ☿ ☉	Inferior....................	7 21	41O23
	21		□♂☉	West......................		
Tue. 2			....			43O12
Wed. 3			....			3241O
Thu. 4	10	52	☌ ☿ ☾	☿ 0° 09′ S..................	4 10	d32O4
	22	11	●	New Moon.......................		
Fri. 5	17	04	☌ ♀ ☾	♀ 6° 28′ S..................		3O124
Sat. 6	5		Moon in Perigee. Dist. from ⊕, 223, 500 mi. ..			1O234
Sun. 7			....		1 00	2O134
Mon. 8	11		□♃☉	East......................		1O34*
Tue. 9			....		21 49	3O124
Wed. 10			....			321O4
Thu. 11	8	21	☌♃ ☾	♃ 3° 08′ S..................		32O14
	12	51	☽	First Quarter....................		
Fri. 12			....		18 38	43O2*
Sat. 13	13		☿	Stationary in R.A.................		41O23
	16	45	☌ ♅ ☾	♅ 0° 13′ N..................		
Sun. 14			....			42O13
Mon. 15			....		15 27	41O3*
Tue. 16			....			43O12
Wed. 17			....			4312O
Thu. 18			....		12 17	432O1
Fri. 19	7	42	○	Full Moon.......................		43O2*
Sat. 20	2		☿	in ♉............................		14O23
	22	54	☉ enters ♈. Spring commences. Long. of ☉ 0°			
Sun. 21	13		Moon in Apogee. Dist. from ⊕, 252,400 mi....		9 06	2O143
	19	20	☌ ♆ ☾	♆ 7° 14′ N..................		
Mon. 22	21	28	☌ ♄ ☾	♄ 7° 47′ N..................		12O34
Tue. 23			....			dO124
Wed. 24			....		5 55	312O4
Thu. 25			....			32O14
Fri. 26	9	34	☌ ♂ ☾	♂ 2° 35′ N..................		31O24
Sat. 27	11	14	☾	Last Quarter......................	2 44	dO324
	14		♅	Stationary in R.A.................		
Sun. 28	10		☿	Greatest elongation W., 27° 49′......		2O143
Mon. 29			....		23 34	412O3
Tue. 30	9		☿	in Aphelion......................		4O312
Wed. 31			....			d431O

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

THE SKY FOR APRIL, 1954

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

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

The Sun—During April the sun's R.A. increases from 0h 39m to 2h 31m and its Decl. changes from 4° 15′ N. to 14° 51′ N. The equation of time changes from −4m 10s to +2m 52s, being zero on the 16th; that is, the apparent sun moves from east to west of the mean sun on that date. For changes in the length of the day, see p. 12.

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. 19.

Mercury on the 15th is in R.A. 0h 13m, Decl. 1° 25′ S. and transits at 10h 43m. It is west of the sun all month but too close to it for observation.

Venus on the 15th is in R.A. 2h 42m, Decl. 15° 33′ N. and transits at 13h 12m. It is an evening star becoming now a prominent feature low in the west just after sunset.

Mars on the 15th is in R.A. 18h 04m, Decl. 23° 44′ S. and transits at 4h 32m. It is in Sagittarius and rises about midnight. It has now brightened appreciably to stellar magnitude −0.2.

Jupiter on the 15th is in R.A. 5h 27m, Decl. 23° 03′ N. and transits at 15h 54m. It is in Taurus, well past the meridian at sunset and setting about midnight. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 14h 22m, Decl. 11° 17′ S. and transits at 0h 50m. It is just east of Spica and rises about an hour after sunset. Opposition is on the 26th.

Uranus on the 15th is in R.A. 7h 23m, Decl. 22° 33′ N. and transits at 17h 49m.

Neptune on the 15th is in R.A. 13h 34m, Decl. 7° 56′ S. and transits at 0h 03m and 23h 59m.

Pluto—For information in regard to this planet, see p. 29.

			APRIL 75th Meridian Civil Time	Min. of Algol	Phen. of Jupiter's Sat. 21h 45m
d	h	m		h m	
Thu. 1	13	27	☌ ☿ ☾ ☿ 6° 38′ S.	20 23	43201
Fri. 2			....		43102
Sat. 3	7	25	● New Moon		4012*
	15		Moon in Perigee. Dist. from ⊕, 221,900 mi.		
Sun. 4	13	28	☌ ♀ ☾ ♀ 5° 52′ S.	17 12	4203*
Mon. 5	2		♂ in ☋		42103
Tue. 6			....		04132
Wed. 7	21	34	☌ ♃ ☾ ♃ 2° 33′ S.	14 01	31024
Thu. 8			....		32014
Fri. 9	6		□ ♅ ☉ east		3104*
	22	53	☌ ♅ ☾ ♅ 0° 28′ N.		
Sat. 10	0	05	☽ First Quarter	10 50	0124*
Sun. 11			....		21034
Mon. 12			....		d2034
Tue. 13			....	7 40	01324
Wed. 14			....		31042
Thu. 15	0		☍ ♆ ☉ Dist. from ⊕, 2,723,000,000 mi.		32401
Fri. 16			....	4 29	4310*
Sat. 17	15		Moon in Apogee. Dist. from ⊕, 252,600 mi.		43012
	23	58	☌ ♆ ☾ ♆ 7° 11′ N.		
Sun 18	0	48	○ Full Moon		41203
Mon. 19	0	01	☌ ♄ ☾ ♄ 7° 48′ N.	1 18	d4203
	6		♀ in ☊		
	17		☿ Greatest Hel. Lat. S.		
Tue. 20			....		4023*
Wed. 21			Lyrid meteors	22 07	41302
Thu. 22			....		32401
Fri. 23	12	20	☌ ♂ ☾ ♂ 0° 36′ N.		31204
Sat. 24			....	18 56	30124
Sun. 25	23	57	☾ Last Quarter		12034
Mon. 26	15		☍ ♄ ☉ Dist. from ⊕, 817,900,000 mi.		20134
Tue. 27			....	15 45	0234*
Wed. 28			....		13024
Thu. 29			....		32014
Fri. 30			....	12 34	31204

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

THE SKY FOR MAY, 1954

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

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

The Sun—During May the sun's R.A. increases from 2h 31m to 4h 33m and its Decl. changes from 14° 51′ N. to 21° 57′ N. The equation of time changes from +2m 52s to a maximum of +3m 46s on the 15th and then to +2m 28s 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. 3h 54m, Decl. 21° 21′ N. and transits at 12h 29m. Superior conjunction is on the 8th and the planet is poorly placed all month for observation.

Venus on the 15th is in R.A. 5h 14m, Decl. 24° 07′ N. and transits at 13h 47m. It is an evening star prominent in the west for about two hours after sunset.

Mars on the 15th is in R.A. 18h 36m, Decl. 24° 50′ S. and transits at 3h 06m. It is in Sagittarius and rises before midnight. On the 23rd it is stationary in right ascension and begins to retrograde, i.e., move westward among the stars.

Jupiter on the 15th is in R.A. 5h 52m, Decl. 23° 19′ N. and transits at 14h 20m. It is moving into Gemini, is well down in the west at sunset and visible for only an hour or two. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 14h 13m, Decl. 10° 34′ S. and transits at 22h 40m. It is just east of Spica, well up in the east at sunset and visible until nearly dawn.

Uranus on the 15th is in R.A. 7h 27m, Decl. 22° 25′ N. and transits at 15h 55m.

Neptune on the 15th is in R.A. 13h 31m, Decl. 7° 39′ S. and transits at 21h 58m.

Pluto—For information in regard to this planet, see p. 29.

	d	h	m	MAY 75th Meridian Civil Time	Min. of Algol h m	Phen. of Jupiter's Sat. 21h 30m
Sat.	1			. . . .		30412
Sun.	2	2		Moon in Perigee. Dist. from ⊕, 222,200 mi....		41023
		6	21	☌ ☿ ☾ ☿ 6° 13′ S..................		
		15	22	● New Moon........................		
Mon.	3			. . . .	9 23	42013
Tue.	4			Eta Aquarid meteors........................		41023
		7	51	☌ ♀ ☾ ♀ 2° 36′ S..................		
Wed.	5	15	10	☌ ♃ ☾ ♃ 1° 54′ S..................		d4032
Thu.	6			. . . .	6 12	43201
Fri.	7	8	04	☌ ♅ ☾ ♅ 0° 46′ N..................		43210
Sat.	8	18		☿ in ☊..............................		43012
		18		☌ ☿ ☉ Superior..........................		
Sun.	9	13	17	☽ First Quarter......................	3 01	14023
Mon.	10			. . . .		20413
Tue.	11			. . . .	23 50	1034*
Wed.	12			. . . .		01324
Thu.	13	9		☿ in Perihelion.....................		3204*
Fri.	14	21		Moon in Apogee. Dist. from ⊕, 252,300 mi....	20 39	32104
Sat.	15	4	48	☌ ♆ ☾ ♆ 7° 16′ N..................		30124
Sun.	16	2	17	☌ ♄ ☾ ♄ 7° 53′ N..................		1024*
Mon.	17	16	47	○ Full Moon........................	17 28	20143
Tue.	18			. . . .		12403
Wed.	19			. . . .		40132
Thu.	20			. . . .	14 17	4320*
Fri.	21	3	22	☌ ♂ ☾ ♂ 1° 24′ S..................		43210
Sat.	22	23		♀ in Perihelion.....................		43012
Sun.	23	7		☌ ♀ ♃ ♀ 1° 30′ N..................	11 06	4102*
		15		☿ Greatest Hel. Lat. N................		
		16		♂ Stationary in R.A..................		
Mon.	24			. . . .		42013
Tue.	25	8	49	☾ Last Quarter......................		41203
Wed.	26			. . . .	7 55	40132
Thu.	27			. . . .		d3104
Fri.	28			. . . .		d3204
Sat.	29			. . . .	4 44	30124
Sun.	30	8		Moon in Perigee. Dist. from ⊕, 224,200 mi....		13024
Mon.	31	14		☌ ☿ ♃ ☿ 2° 14′ N..................		20134
		23	03	● New Moon........................		

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

THE SKY FOR JUNE, 1954

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

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

The Sun—During June the sun's R.A. increases from 4h 33m to 6h 38m and its Decl. changes from 21° 57′ N. to 23° 27′ N. at the solstice on the 21st at 17h 55m E.S.T., and then to 23° 10′ N. at the end of the month. The equation of time changes from +2m 28s to −3m 31s, being zero on the 14th; that is, the apparent sun changes from being west of the mean sun to being east of it. There is a total eclipse on the 30th, visible in North America. For changes in the ength 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. 7h 11m, Decl. 22° 43′ N. and transits at 13h 39m. Greatest eastern elongation is on the 9th and at about this time Mercury may be seen as an evening star in Gemini about 15° above the western horizon just after sunset.

Venus on the 15th is in R.A. 7h 57m, Decl. 22° 39′ N. and transits at 14h 27m. It is an evening star dominating the western sky for about two hours after sunset.

Mars on the 15th is in R.A. 18h 24m, Decl. 27° 00′ S. and transits at 0h 52m. It is in Sagittarius, rising shortly after sunset. It is now at its brightest (mag. −2.3) and is prominent in the southern sky all night. On the 24th it is in opposition.

Jupiter on the 15th is in R.A. 6h 21m, Decl. 23° 18′ N. and transits at 12h 48m. It is too close to the sun for easy observation. Conjunction with the sun is on the 30th. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 14h 07m, Decl. 10° 05′ S. and transits at 20h 32m. It is just east of Spica and just east of the meridian at sunset.

Uranus on the 15th is in R.A. 7h 33m, Decl. 22° 11′ N. and transits at 13h 59m.

Neptune on the 15th is in R.A. 13h 29m, Decl. 7° 29′ S. and transits at 19h 54m.

Pluto—For information in regard to this planet, see p. 29.

d	h	m	JUNE 75th Meridian Civil Time	Min. of Algol h m	Phen. of Jupiter's Sat. 21h 15m
Tue. 1				1 32	12O34
Wed. 2	11	11	☌ ♃ ☾ ♃ 1° 15′ S.		O1234
	15	21	☌ ☿ ☾ ☿ 1° 06′ N.		
Thu. 3	6	05	☌ ♀ ☾ ♀ 1° 32′ N.	22 21	13O24
	19	47	☌ ♅ ☾ ♅ 1° 02′ N.		
Fri. 4					324O1
Sat. 5					34O2*
Sun. 6				19 10	431O2
Mon. 7					
Tue. 8	4	13	☽ First Quarter		
Wed. 9	2		☿ Greatest elongation E., 24° 01′	15 59	
	23		☌ ♀ ♅ ♀ 1° 23′ N.		
Thu. 10					
Fri. 11	10		Moon in Apogee. Dist. from ⊕, 251,800 mi.		
	10	43	☌ ♆ ☾ ♆ 7° 23′ N.		
Sat. 12	6	13	☌ ♄ ☾ ♄ 7° 57′ N.	12 48	
Sun. 13	18		♀ Greatest Hel. Lat. N.		
Mon. 14					
Tue. 15				9 36	
Wed. 16	2		☿ in ☋		
	7	06	Full Moon		
Thu. 17	2	31	☌ ♂ ☾ ♂ 2° 56′ S.		
Fri. 18				6 25	
Sat. 19					
Sun. 20					
Mon. 21	17	55	☉ enters ♋, Summer commences. Long. of ☉, 90°	3 14	
Tue. 22	9		☿ Stationary in R.A.		
Wed. 23	14	46	☾ Last Quarter		
Thu. 24	12		☍ ♂ ☉ Dist. from ⊕, 40,160,000 mi.	0 03	
Fri. 25					
Sat. 26	9		☿ in Aphelion	20 51	
Sun. 27	5		Moon in Perigee. Dist. from ⊕, 227,300 mi.		
Mon. 28					
Tue. 29				17 40	
Wed. 30			Total eclipse of ☉. See p. 29.		
	7	26	● New Moon		
	7	38	☌ ♃ ☾ ♃ 0° 38′ S.		
	13		☌ ♃ ☉		
	21	07	☌ ☿ ☾ ☿ 3° 41′ S.		

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

Jupiter being near the sun, phenomena of the satellites are not given from June 7 to July 22.

THE SKY FOR JULY, 1954

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

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

The Sun—During July the sun's R.A. increases from 6h 38m to 8h 43m and its Decl. changes from 23° 10′ N. to 18° 13′ N. The equation of time changes from −3m 31s to a maximum of −6m 24s on the 27th and then to −6m 17s at the end of the month. On the 3rd the earth is in aphelion or farthest from the sun. For changes in the length of the day, see p. 14.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 21. There is a partial eclipse of the moon on the night of the 15th, visible in parts of eastern North America.

Mercury on the 15th is in R.A. 6h 40m, Decl. 18° 32′ N. and transits at 11h 08m. Inferior conjunction is on the 6th and greatest western elongation on the 26th. Thus at the end of the month it is a good morning star, being visible ten to fifteen degrees above the eastern horizon in Gemini just before sunrise.

Venus on the 15th is in R.A. 10h 18m, Decl. 12° 09′ N. and transits at 14h 49m. It dominates the western sky for about two hours after sunset.

Mars on the 15th is in R.A. 17h 47m, Decl. 28° 21′ S. and transits at 22h 12m. It is in Sagittarius, well up in the south-east at sunset and visible most of the night. On the 2nd it is nearest the earth and on the 29th it resumes direct, i.e., eastward, motion among the stars.

Jupiter on the 15th is in R.A. 6h 50m, Decl. 22° 56′ N. and transits at 11h 19m. It is too close to the sun for easy observation. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 14h 05m, Decl. 10° 06′ S. and transits at 18h 32m. It is just east of Spica, is past the meridian at sunset and sets before midnight. On the 7th it is stationary in right ascension and resumes direct, or eastward, motion.

Uranus on the 15th is in R.A. 7h 41m, Decl. 21° 54′ N. and transits at 12h 09m.

Neptune on the 15th is in R.A. 13h 29m. Decl. 7° 28′ S. and transits at 17h 56m.

Pluto—For information in regard to this planet, see p. 29.

JULY
75th Meridian Civil Time

	d	h	m		Min. of Algol h m	Phen. of Jupiter's Sat. 4h 45m
Thu.	1	8	23	☌ ♅ ☾ ♅ 1° 13′ N.		
Fri.	2	3		♂ nearest ⊕. Dist. from ⊕, 39,740,000 mi.	14 29	
Sat.	3	9	53	☌ ♀ ☾ ♀ 5° 06′ N.		
		15		⊕ in Aphelion. Dist. from ☉, 94,450,000 mi.		
Sun.	4					
Mon.	5	18		♆ in R.A.	11 17	
Tue.	6	0		☌ ☿ ☉ Inferior		
Wed.	7	10		♄ Stationary in R.A.		
		20	33	☽ First Quarter		
Thu.	8	18	02	☌ ♆ ☾ ♆ 7° 25′ N.	8 06	
Fri.	9	3		Moon in Apogee. Dist. from ⊕, 251,200 mi.		
		12	51	☌ ♄ ☾ ♄ 7° 54′ N.		
Sat.	10	12		☌ ☿ ♃ ☿ 4° 52′ S.		
Sun.	11				4 55	
Mon.	12					
Tue.	13	19	18	☌ ♂ ☾ ♂ 3° 20′ S.		
Wed.	14				1 43	
Thu.	15			Partial eclipse of ☾. See p. 29		
		19	29	🌕 Full Moon		
Fri.	16	5		□ ♆ ☉ east	22 32	
		6		☌ ♅ ☉		
		16		☿ Greatest Hel. Lat. S.		
		23		☿ Stationary in R.A.		
Sat.	17					
Sun.	18					
Mon.	19	21		♃ in ♌	19 21	
Tue.	20					
Wed.	21					
Thu.	22	19	14	☾ Last Quarter	16 09	O2134
Fri.	23	14		Moon in Perigee. Dist. from ⊕, 229,600 mi.		1O234
Sat.	24					23O14
Sun.	25				12 58	321O4
Mon.	26	7		□ ♄ ☉ east		34O12
		22		☿ Greatest elongation W., 19° 49′		
Tue.	27	19		☌ ☿ ♃ ☿ 1° 55′ S.		43O2*
Wed.	28			Delta Aquarid meteors	9 46	421O3
		2	57	☌ ♃ ☾ ♃ 0° 00′		
		3	26	☌ ☿ ☾ ☿ 1° 48′ S.		
		20	10	☌ ♅ ☾ ♅ 1° 22′ N.		
Thu.	29	10		♂ Stationary in R.A.		4O13*
		17	20	🌑 New Moon		
Fri.	30					41O23
Sat.	31				6 35	d42O1

THE SKY FOR AUGUST, 1954

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

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

The Sun—During August the sun's R.A. increases from 8h 43m to 10h 39m and its Decl. changes from 18° 13′ N. to 8° 34′ N. The equation of time changes from −6m 17s to −0m 15s. 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. 9h 09m, Decl. 17° 59′ N. and transits at 11h 41m. It is in superior conjunction on the 21st and is poorly placed for observation all month.

Venus on the 15th is in R.A. 12h 23m, Decl. 3° 01′ S. and transits at 14h 51m. It dominates the western sky for about two hours after sunset. It is in conjunction with Spica on the 31st.

Mars on the 15th is in R.A. 17h 48m, Decl. 28° 01′ S. and transits at 20h 14m. It is in Sagittarius, about on the meridian at sunset and prominent in the south-west until about midnight.

Jupiter on the 15th is in R.A. 7h 19m, Decl. 22° 14′ N. and transits at 9h 46m. It is a morning star in Gemini rising about two hours before the sun. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 14h 10m, Decl. 10° 37′ S. and transits at 16h 35m. It is low in the south-west at sunset and sets about three hours later.

Uranus on the 15th is in R.A. 7h 49m, Decl. 21° 35′ N. and transits at 10h 15m.

Neptune on the 15th is in R.A. 13h 30m, Decl. 7° 39′ S. and transits at 15h 56m.

Pluto—For information in regard to this planet, see p. 29.

			AUGUST 75th Meridian Civil Time	Min. of Algol	Phen. of Jupiter's Sat. 4h 30m
d	h	m		h m	
Sun. 1			....		4321O
Mon. 2	13	18	☌ ♀ ☾ ♀ 5° 52′ N..................		34O12
Tue. 3			....	3 24	31O42
Wed. 4	7		☌ ☿ ♅ ☿ 0° 35′ S..................		d2O34
	17		☿ in ♌..............................		
Thu. 5	2	27	☌ ♆ ☾ ♆ 7° 19′ N..................		O134*
	22		Moon in Apogee. Dist. from ⊕, 251,200 mi....		
	22	08	☌ ♄ ☾ ♄ 7° 40′ N..................		
Fri. 6	13	50	☽ First Quarter......................	0 12	1O234
Sat. 7			....		2O314
Sun. 8	19		♀ in ♉............................	21 01	321O4
Mon. 9	8		☿ in Perihelion......................		3O124
Tue. 10	2	32	☌ ♂ ☾ ♂ 3° 06′ S..................		31O24
Wed. 11			....	17 49	d2O13
Thu. 12			Perseid meteors..........................		42O3*
Fri. 13			....		41O23
Sat. 14	6	03	🌕 Full Moon........................	14 38	d4O13
Sun. 15			....		4231O
Mon. 16			....		43O21
Tue. 17	21		☌ ♇ ☉..	11 26	431O2
Wed. 18	1		Moon in Perigee. Dist. from ⊕, 228,200 mi....		42O1*
Thu. 19	14		☿ Greatest Hel. Lat. N................		2O3**
Fri. 20	23	51	☾ Last Quarter......................	8 15	dO423
Sat. 21	15		☌ ☿ ☉ Superior......................		O2134
Sun. 22			....		231O4
Mon. 23			....	5 03	3O214
Tue. 24	20	08	☌ ♃ ☾ ♃ 0° 39′ N..................		31O24
Wed. 25	6	05	☌ ♅ ☾ ♅ 1° 35′ N..................		2O14*
Thu. 26			....	1 52	21O34
Fri. 27			....		dO423
Sat. 28	5	21	● New Moon........................	22 41	4O123
Sun. 29	1	01	☌ ☿ ☾ ☿ 6° 25′ N..................		4213O
Mon. 30			....		43O1*
Tue. 31			....	19 29	431O2

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

THE SKY FOR SEPTEMBER, 1954

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

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

The Sun—During September the sun's R.A. increases from 10h 39m to 12h 27m and its Decl. changes from 8° 34′ N. to 2° 53′ S. The equation of time changes from −0m 15s to +10m 01s, the apparent sun passing to the west of the mean sun on the 1st. On the 23rd at 8h 56m 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. 15.

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

Mercury on the 15th is in R.A. 12h 38m, Decl. 4° 29′ S. and transits at 13h 05m. It is east of the sun all month but too close to it for observation.

Venus on the 15th is in R.A. 14h 16m, Decl. 17° 17′ S. and transits at 14h 42m. Greatest eastern elongation is on the 6th and the planet is seen for almost two hours after sunset in the south-west. It is in conjunction with Saturn on the 15th.

Mars on the 15th is in R.A. 18h 40m, Decl. 26° 48′ S. and transits at 19h 04m. It is in Sagittarius visible low in the south until nearly midnight.

Jupiter on the 15th is in R.A. 7h 44m, Decl. 21° 23′ N. and transits at 8h 09m. It rises after midnight and dominates the eastern sky until dawn. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 14h 19m, Decl. 11° 33′ S. and transits at 14h 42m. It is very low in the south-west at sunset and sets about two hours later. (See Venus).

Uranus on the 15th is in R.A. 7h 55m, Decl. 21° 19′ N. and transits at 8h 19m.

Neptune on the 15th is in R.A. 13h 33m, Decl. 7° 58′ S. and transits at 13h 57m.

Pluto—For information in regard to this planet, see p. 29.

				SEPTEMBER 75th Meridian Civil Time	Min. of Algol	Phen. of Jupiter's Sat. 4h 15m
	d	h	m		h m	
Wed.	1	9	31	☌ ♀ ☾ ♀ 3° 05′ N.		43201
		11	18	☌ ♆ ☾ ♆ 7° 06′ N.		
Thu.	2	9		☌ ♀ ♆ ♀ 4° 09′ S.		42103
		9	16	☌ ♄ ☾ ♄ 7° 18′ N.		
		17		Moon in Apogee. Dist. from ⊕, 251,600 mi.		
Fri.	3				16 18	40123
Sat.	4					4023*
Sun.	5	7	28	☽ First Quarter		d2410
Mon.	6	1		♀ Greatest elongation E., 46° 14′	13 06	3014*
Tue.	7	4	41	☌ ♂ ☾ ♂ 3° 15′ S.		31024
Wed.	8					32014
Thu.	9	2		♂ Greatest Hel. Lat. S.	9 55	21034
Fri.	10					01234
Sat.	11					10234
Sun.	12	1		☿ in ☋	6 43	d2034
		9		♀ in Aphelion		
		15	19	○ Full Moon. Harvest Moon		
Mon.	13					32014
Tue.	14	15		Moon in Perigee. Dist. from ⊕, 225,000 mi.		31402
Wed.	15	22		☌ ♀ ♄ ♀ 6° 08′ S.	3 32	d4301
Thu.	16					42103
Fri.	17					40213
Sat.	18				0 21	41023
Sun.	19	6	11	☾ Last Quarter		42013
Mon.	20				21 09	4320*
Tue.	21	10	45	☌ ♃ ☾ ♃ 1° 20′ N.		43102
		14	03	☌ ♅ ☾ ♅ 1° 53′ N.		
Wed.	22	8		☿ in Aphelion		3021*
Thu.	23	8	56	☉ enters ♎, Autumn commences. Long. of ☉, 180°	17 58	21034
Fri.	24					02134
Sat.	25					10234
Sun.	26	0		☌ ☿ ♆ ☿ 3° 42′ S.	14 47	20134
		19	50	● New Moon		
Mon.	27					2304*
Tue.	28	19	58	☌ ♆ ☾ ♆ 6° 55′ N.		31024
Wed.	29	3	12	☌ ☿ ☾ ☿ 2° 42′ N.	11 35	30214
		21	19	☌ ♄ ☾ ♄ 6° 54′ N.		
Thu.	30	9		Moon in Apogee. Dist. from ⊕, 252,300 mi.		21304
		17	14	☌ ♀ ☾ ♀ 1° 13′ S.		

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

THE SKY FOR OCTOBER, 1954

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

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

The Sun—During October the sun's R.A. increases from 12h 27m to 14h 23m and its Decl. changes from 2° 53′ S. to 14° 11′ S. The equation of time changes from +10m 01s to +16m 20s. For changes in the length of the day, see p. 15.

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

Mercury on the 15th is in R.A. 14h 42m, Decl. 19° 14′ S. and transits at 13h 08m. It is in greatest eastern elongation on the 5th, but this is an unfavourable elongation, Mercury being too low in the west after sunset for easy observation. Inferior conjunction is on the 29th.

Venus on the 15th is in R.A. 15h 37m, Decl. 25° 38′ S. and transits at 14h 03m. It is seen low in the south-west for a short time after sunset. Greatest brilliancy (mag. −4.4) is on the 11th.

Mars on the 15th is in R.A. 19h 54m, Decl. 23° 37′ S. and transits at 18h 20m. It is in Sagittarius and may be seen in the south and south-west all evening. It sets an hour before midnight. Eastern quadrature occurs on the 28th.

Jupiter on the 15th is in R.A. 8h 01m, Decl. 20° 41′ N. and transits at 6h 28m. It is in Gemini rising about midnight and dominating the eastern sky until dawn. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 15th is in R.A. 14h 32m, Decl. 12° 38′ S. and transits at 12h 57m. It is too close to the sun for easy observation.

Uranus on the 15th is in R.A. 7h 59m, Decl. 21° 09′ N. and transits at 6h 25m.

Neptune on the 15th is in R.A. 13h 37m, Decl. 8° 22′ S. and transits at 12h 03m.

Pluto—For information in regard to this planet, see p. 29.

					Min. of Algol	Phen. of Jupiter's Sat. 3h 45m
				OCTOBER 75th Meridian Civil Time		
	d	h	m		h m	
Fri.	1			....		4O13*
Sat.	2			....	8 24	41O23
Sun.	3			....		42O13
Mon.	4	6		♂ in Perihelion		4231O
		16		♀ Greatest Hel. Lat. S.		
Tue.	5	0	31	☽ First Quarter	5 12	*43O2
		18	47	☌ ♂ ☾ ♂ 3° 59′ S.		
		23		☿ Greatest elongation E., 25° 32′		
Wed.	6			....		43O12
Thu.	7	23		☌ ♃ ♅ ♃ 0° 21′ S.		421O*
Fri.	8			....	2 01	4O13*
Sat.	9	6		☌ ☿ ♄ ☿ 5° 34′ S.		1O423
Sun.	10			....	22 50	2O134
Mon.	11	3		♀ Greatest brilliancy		213O4
Tue.	12	0	10	○ Full Moon. Hunter's Moon		3O124
		16		☿ Greatest Hel. Lat. S.		
		21		Moon in Perigee. Dist. from ⊕, 222,500 mi. ..		
Wed.	13			....	19 39	3O24*
Thu.	14			....		231O4
Fri.	15			....		2O134
Sat.	16			....	16 27	1O243
Sun.	17			....		dO413
Mon.	18	7		☿ Stationary in R.A.		d241O
		15	30	☾ Last Quarter		
		21	07	☌ ♅ ☾ ♅ 2° 13′ N.		
		22	53	☌ ♃ ☾ ♃ 1° 58′ N.		
Tue.	19	13		☌ ♆ ☉	13 16	43O21
Wed.	20			....		43O2*
Thu.	21	9		□ ♅ ☉ west		d432O
Fri.	22			Orionid meteors	10 05	42O13
		16		□ ♃ ☉ west		
Sat.	23			....		41O23
Sun.	24	6		☌ ☿ ♄ ☿ 4° 41′ S.		4O213
Mon.	25	14		♀ Stationary in R.A.	6 54	241O3
Tue.	26	4	12	☌ ♆ ☾ ♆ 6° 50′ N.		3O241
		12	47	● New Moon		
Wed.	27	3	28	☌ ☿ ☾ ☿ 2° 53′ N.		31O24
		9	40	☌ ♄ ☾ ♄ 6° 35′ N.		
		18		Moon in Apogee. Dist. from ⊕, 252,600 mi. ...		
Thu.	28	10		□ ♂ ☉ east	3 42	d32O4
		18	15	☌ ♀ ☾ ♀ 3° 09′ S.		
Fri.	29	16		☌ ☿ ☉ Inferior		2O134
Sat.	30			....		1O234
Sun.	31	16		☿ in ☊	0 31	O2134

THE SKY FOR NOVEMBER, 1954

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

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

The Sun—During November the sun's R.A. increases from 14h 23m to 16h 26m and its Decl. changes from 14° 11′ S. to 21° 41′ S. The equation of time changes from +16m 20s to a maximum of +16m 23s on the 3rd and then to +11m 14s at the end of the month. 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. 14h 06m, Decl. 10° 17′ S. and transits at 10h 32m. Greatest western elongation is on the 14th and at about this time Mercury is a good morning star in Libra some ten to fifteen degrees above the south-eastern horizon just before sunrise.

Venus on the 15th is in R.A. 15h 17m, Decl. 22° 05′ S. and transits at 11h 38m. It is too close to the sun for observation most of the month, inferior conjunction being on the 15th.

Mars on the 15th is in R.A. 21h 18m, Decl. 17° 36′ S. and transits at 17h 42m. It is in Capricornus and is visible low in the south-west all evening, setting an hour before midnight.

Jupiter on the 15th is in R.A. 8h 09m, Decl. 20° 24′ N. and transits at 4h 33m. It is in Gemini, rising in the late evening (3 hr. before midnight) and is visible the rest of the night. On the 17th it is stationary in right ascension 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. 55.

Saturn on the 15th is in R.A. 14h 46m, Decl. 13° 47′ S. and transits at 11h 09m. It is too close to the sun for easy observation. Conjunction with the sun is on the 4th.

Uranus on the 15th is in R.A. 7h 59m, Decl. 21° 09′ N. and transits at 4h 24m.

Neptune on the 15th is in R.A. 13h 42m, Decl. 8° 46′ S. and transits at 10h 05m.

Pluto—For information in regard to this planet, see p. 29.

	h	m	NOVEMBER 75th Meridian Civil Time	Min. of Algol h m	Phen. of Jupiter's Sat. 3h 15m
Mon. 1					21O34
Tue. 2				21 20	3O14*
Wed. 3	15	55	☽ First Quarter		d31O2
	9		♅ Stationary in R.A.		
	14	28	☌ ♂ ☾ ♂ 5° 03′ S.		
Thu. 4	20		☌ ♄ ☉		342O1
Fri. 5	7		☿ in Perihelion	18 09	42O**
Sat. 6					41O23
Sun. 7	8		☿ Stationary in R.A.		4O123
Mon. 8				14 58	421O3
Tue. 9					43O1*
Wed. 10			Taurid meteors		341O2
	8		Moon in Perigee. Dist. from ⊕, 221,500 mi.		
	9	29	🌕 Full Moon		
Thu. 11				11 47	342O1
Fri. 12					23O4*
Sat. 13					dO234
Sun. 14	19		☿ Greatest elongation W., 19° 19′	8 36	O1234
Mon. 15	2		☌ ♀ ☉ Inferior		21O34
	4	46	☌ ♅ ☾ ♅ 2° 29′ N.		
	8	50	☌ ♃ ☾ ♃ 2° 25′ N.		
	14		☿ Greatest Hel. Lat. N.		
Tue. 16			Leonid meteors		32O14
Wed. 17	3		♃ Stationary in R.A.	5 24	31O24
	4	32	☾ Last Quarter		
Thu. 18					d3O14
Fri. 19					231O4
Sat. 20				2 13	4O123
Sun. 21					4O123
Mon. 22	12	10	☌ ♆ ☾ ♆ 6° 52′ N.	23 02	421O3
Tue. 23	19		Moon in Apogee. Dist. from ⊕, 252,600 mi.		423O1
	20		☌ ☿ ♄ ☿ 0° 25′ S.		
	22	06	☌ ♄ ☾ ♄ 6° 23′ N.		
	22	23	☌ ☿ ☾ ☿ 5° 57′ N.		
Wed. 24	1	56	☌ ♀ ☾ ♀ 2° 30′ N.		431O2
Thu. 25	0		☌ ☿ ♀ ☿ 2° 58′ N.	19 51	43O21
	7	30	🌑 New Moon		
Fri. 26					4231O
Sat. 27			Bielid meteors		4O213
Sun. 28	19		☌ ♀ ♄ ♀ 2° 32′ S.	16 40	O23**
Mon. 29	23		♀ in ☊		21O43
Tue. 30					d2O14

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

THE SKY FOR DECEMBER, 1954

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

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

The Sun—During December the sun's R.A. increases from 16h 26m to 18h 43m and its Decl. changes from 21° 41′ S. to 23° 27′ S. at the solstice on the 22nd at 4h 25m E.S.T. and then to 23° 05′ S. at the end of the month. The equation of time changes from +11m 14s to zero on the 25th and then to −3m 08s at the end of the month. There is an annular eclipse on the 25th invisible in North America. 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. 17h 02m, Decl. 23° 25′ S. and transits at 11h 31m. It is in superior conjunction on the 25th and is poorly placed for observation all month.

Venus on the 15th is in R.A. 14h 58m, Decl. 14° 09′ S. and transits at 9h 24m. It is now a morning star dominating the south-eastern sky for about three hours before sunrise.

Mars on the 15th is in R.A. 22h 39m, Decl. 9° 38′ S. and transits at 17h 05m. It is in Aquarius and may be seen low in the south-west all evening. It has now declined to stellar magnitude +0.7.

Jupiter on the 15th is in R.A. 8h 04m, Decl. 20° 45′ N. and transits at 2h 30m. It is in Gemini, rising about three hours after sunset and visible the rest of the night. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 55.

Saturn on the 15th is in R.A. 14h 59m, Decl. 14° 45′ S. and transits at 9h 25m. It is a morning star in Libra rising about three hours before the sun.

Uranus on the 15th is in R.A. 7h 57m, Decl. 21° 18′ N. and transits at 2h 23m.

Neptune on the 15th is in R.A. 13h 45m, Decl. 9° 04′ S. and transits at 8h 11m.

Pluto—For information in regard to this planet, see p. 29.

	d	h	m	DECEMBER 75th Meridian Civil Time	Min. of Algol h m	Phen. of Jupiter's Sat. 2h 30m
Wed.	1			....	13 29	31024
Thu.	2	11	20	☌ ♂ ☾ ♂ 5° 59′ S.		30214
Fri.	3	4	56	☽ First Quarter		23104
Sat.	4	5		♀ Stationary in R.A.	10 18	0134*
Sun.	5			....		10243
Mon.	6			....		d2043
Tue.	7			....	7 07	24031
Wed.	8	21		Moon in Perigee. Dist. from ⊕, 222,700 mi....		43102
Thu.	9	0		☿ in ☋		43021
		19	56	○ Full Moon		
Fri.	10			....	3 57	43210
Sat.	11			....		42031
Sun.	12			Geminid meteors		41023
		13	37	☌ ♅ ☾ ♅ 2° 34′ N.		
		16	44	☌ ♃ ☾ ♃ 2° 31′ N.		
Mon.	13			....	0 46	42013
Tue.	14			....		2403*
Wed.	15	19		☌ ♀ ♄ ♀ 0° 39′ N.	21 35	31042
Thu.	16	21	21	☾ Last Quarter		30124
Fri.	17			....		32104
Sat.	18			....	18 24	20314
Sun.	19	7		☿ in Aphelion		10234
		20	14	☌ ♆ ☾ ♆ 6° 57′ N.		
Mon.	20			....		d0134
Tue.	21	4		Moon in Apogee. Dist. from ⊕, 252,200 mi....	15 13	2034*
		4		♀ Greatest brilliancy		
		10	30	☌ ♄ ☾ ♄ 6° 16′ N.		
		14	46	☌ ♀ ☾ ♀ 7° 20′ N.		
Wed.	22	4	25	☉ enters ♑. Winter commences. Long. of ☉ 270°		31024
Thu.	23			....		d3012
Fri.	24			....	12 02	34210
Sat.	25			Annular eclipse of ☉. See p. 29		4201*
		2	22	☌ ☿ ☾ ☿ 1° 20′ S.		
		7		☌ ☿ ☉ Superior		
		2	33	● New Moon		
Sun.	26			....		41023
Mon.	27			....	8 51	40213
Tue.	28			....		42103
Wed.	29			....		d4302
Thu.	30			....	5 41	34012
Fri.	31	6	40	☌ ♂ ☾ ♂ 6° 16′ S.		32140

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

JANUARY

d	h	m	Sat.	Phen.
1	01	44	I	OD
	04	25	I	ER
	22	54	I	TI
	23	23	I	SI
2	01	05	I	Te
	01	36	I	Se
	02	16	II	TI
	03	16	II	SI
	04	43	II	Te
	20	10	I	OD
	22	54	I	ER
3	17	52	I	SI
	19	32	I	Te
	20	04	I	Se
	20	35	II	OD
4	00	07	II	ER
	03	32	III	TI
5	17	52	II	Te
	19	04	II	Se
7	22	37	III	ER
8	03	29	I	OD
9	00	39	I	TI
	01	18	I	SI
	02	51	I	Te
	03	30	I	Se
	04	33	II	TI
	21	55	I	OD
10	00	49	I	ER
	19	06	I	TI
	19	47	I	SI
	21	17	I	Te
	21	59	I	Se
	22	51	II	OD
11	02	42	II	ER
	19	18	I	ER
12	17	43	II	TI
	19	12	II	SI
	20	10	II	Te
	21	42	II	Se
14	20	40	III	OD
	23	25	III	OR
	23	47	III	ED
15	02	38	III	ER
16	02	25	I	TI
	03	13	I	SI
	23	42	I	OD
17	02	45	I	ER
	20	52	I	TI
	21	41	I	SI
	23	03	I	Te
	23	53	I	Se
18	01	09	II	OD
	18	09	I	OD
	21	14	I	ER
19	18	22	I	Se
	20	04	II	TI
	21	49	II	SI
	22	31	II	Te
20	00	19	II	Se
21	18	36	II	ER
22	00	07	III	OD
	02	53	III	OR
	03	47	III	ED
24	01	30	I	OD
	22	40	I	TI
	23	36	I	SI
25	00	51	I	Te
	01	48	I	Se
	03	30	II	OD
	19	57	I	OD
	20	35	III	Se
	23	09	I	ER
26	18	05	I	SI
	19	18	I	Te
26	20	17	I	Se
	22	27	II	TI
27	00	27	II	SI
	00	55	II	Te
	02	57	II	Se
28	21	12	II	ER
31	03	18	I	OD

FEBRUARY

d	h	m	Sat.	Phen.
1	00	28	I	TI
	01	31	I	SI
	02	39	I	Te
	20	09	III	Te
	21	43	III	SI
	21	46	I	OD
2	00	36	III	Se
	01	04	I	ER
	18	56	I	TI
	20	00	I	SI
	21	07	I	Te
	22	12	I	Se
3	00	52	II	TI
	03	05	II	SI
	19	33	I	ER
4	19	05	II	OD
	23	48	II	ER
6	18	54	II	Se
8	02	18	I	TI
	21	03	III	TI
	23	36	I	OD
	23	49	III	Te
9	01	44	III	SI
	20	46	I	TI
	21	55	I	SI
	22	57	I	Te
10	00	07	I	Se
	21	29	I	ER
11	18	36	I	Se
	21	31	II	OD
12	02	25	II	ER
	18	44	III	ER
13	19	01	II	SI
	19	03	II	Te
	21	31	II	Se
16	00	47	III	TI
	01	28	I	OD
	22	37	I	TI
	23	50	I	SI
17	00	49	I	Te
	02	02	I	Se
	19	56	I	OD
	23	25	I	ER
18	18	19	I	SI
	19	17	I	Te
	20	31	I	Se
19	00	01	II	OD
	19	50	III	ED
	22	46	III	ER
20	19	06	II	TI
	21	35	II	Te
	21	38	II	SI
21	00	09	II	Se
24	00	30	I	TI
	01	46	I	SI
	21	49	I	OD
25	01	20	I	ER
	18	58	I	TI
	20	14	I	SI
	21	10	I	Te
	22	27	I	Se
26	18	38	III	OD
	19	49	I	ER
	21	29	III	OR
26	23	50	III	ED
27	21	40	II	TI
28	00	08	II	Te
	00	16	II	SI

MARCH

d	h	m	Sat.	Phen.
1	20	57	II	ER
3	23	43	I	OD
4	20	53	I	TI
	22	10	I	SI
	23	04	I	Te
5	00	22	I	Se
	21	44	I	ER
	22	34	III	OD
6	18	51	I	Se
7	00	15	II	TI
8	20	55	II	OR
	21	01	II	ED
	23	34	II	ER
9	20	42	III	Se
10	18	42	II	Se
11	22	48	I	TI
12	00	05	I	SI
	20	08	I	OD
	23	40	I	ER
13	19	28	I	Te
	20	46	I	Se
15	21	01	II	OD
	23	32	II	OR
	23	38	II	ED
16	19	24	III	Te
	21	46	III	SI
17	18	48	II	SI
	21	19	II	Se
19	22	04	I	OD
20	19	13	I	TI
	20	29	I	SI
	21	25	I	Te
	22	42	I	Se
	20	04	I	ER
22	23	41	II	OD
23	20	39	III	TI
	23	32	III	Te
24	21	22	II	Te
	21	24	II	SI
	23	56	II	Se
27	21	10	I	TI
	22	25	I	SI
	23	23	I	Te
28	22	00	I	ER
29	19	06	I	Se
31	21	34	II	TI

APRIL

d	h	m	Sat.	Phen.
2	20	45	II	ER
3	19	52	III	ED
	22	55	III	ER
	23	08	I	TI
4	20	29	I	OD
5	19	50	I	Te
	21	02	I	Se
10	19	14	III	OD
	22	12	III	OR
11	22	28	I	OD
12	19	37	I	TI
	20	45	I	SI
	21	50	I	Te
	22	58	I	Se
13	20	19	I	ER
16	21	12	II	OD
18	21	04	II	Se
19	21	37	I	TI
19	22	40	I	SI
20	22	14	I	ER
21	19	22	I	Se
	20	51	III	Se
25	21	07	II	SI
	21	41	II	Te
27	20	57	I	OD
28	20	20	I	Te
	20	56	III	Te
	21	18	I	Se
	21	49	III	SI

MAY

d	h	m	Sat.	Phen.
2	21	55	II	TI
4	20	34	II	ER
5	20	07	I	TI
	20	59	I	SI
6	20	33	I	ER
20	20	45	II	Se
21	20	54	I	Te

JUNE

d	h	m	Sat.	Phen.
5	20	02	I	OD

Jupiter being near the Sun, phenomena of the satellites are not given from June 8 to July 22.

JULY

d	h	m	Sat.	Phen.
25	04	29	IV	Se
27	04	13	I	ED
28	04	13	I	Te

AUGUST

d	h	m	Sat.	Phen
4	03	58	I	TI
5	04	03	II	ED
14	03	41	II	Se
19	04	05	IV	ED
	04	23	I	ED
20	03	57	I	Se
	04	45	I	Te
21	03	36	II	SI
23	03	00	II	OR
25	03	41	III	ED
27	03	36	I	SI
	04	29	I	TI
28	03	55	I	OR

SEPTEMBER

d	h	m	Sat.	Phen.
4	02	38	I	ED
5	02	13	I	Se
	03	13	I	Te
	05	08	III	Te
6	03	46	II	ED
8	02	46	II	Te
11	04	32	I	ED
12	01	52	I	SI
	02	56	I	TI
	04	07	I	Se
	05	01	III	Se
	05	12	I	Te
13	02	21	I	OR
15	02	46	II	TI
	03	15	II	Se

d	h	m	Sat.	Phen.
19	03	46	I	SI
	04	54	I	TI
20	04	19	I	OR
21	01	39	I	Te
22	02	59	IV	OD
	03	10	II	SI
23	03	46	III	OR
24	03	23	II	OR
27	02	47	I	ED
28	01	20	I	TI
	02	23	I	Se
	03	36	I	Te
30	02	08	IV	SI
	02	55	III	ER
	04	29	III	OD
	05	07	IV	Se

OCTOBER

d	h	m	Sat.	Phen.
1	00	50	II	ED
4	04	40	I	ED
5	02	02	I	SI
	03	16	I	TI
	04	17	I	Se
	05	32	I	Te
6	02	41	I	OR
7	03	31	III	ED
8	03	25	II	ED
9	01	41	IV	OR
10	00	17	II	Se
	02	52	II	Te
11	02	12	III	Te
12	03	56	I	SI
	05	11	I	TI
13	01	02	I	ED
	04	36	I	OR
14	00	39	I	Se
	01	55	I	Te
17	00	10	II	SI
	02	43	II	TI
	02	52	II	Se
	05	29	II	Te
18	00	57	III	Se
	02	46	III	TI
19	00	39	II	OR
	05	49	I	SI
20	02	55	I	ED
21	00	17	I	SI
	01	34	I	TI
	02	32	I	Se
	03	49	I	Te
22	00	59	I	OR
24	02	45	II	SI
	05	19	II	TI
	05	27	II	Se
25	01	33	III	SI
	03	58	IV	ED
	04	56	III	Se
26	03	13	II	OR
27	04	49	I	ED
28	02	11	I	SI
	03	27	I	TI
	04	26	I	Se
	05	42	I	Te
	23	17	I	ED
29	00	07	III	OR
	02	52	I	OR
30	00	10	I	Te
31	05	20	II	SI

NOVEMBER

d	h	m	Sat.	Phen.
1	05	31	III	SI
2	00	27	II	ED
	05	45	II	OR
3	01	35	IV	TI
	05	27	IV	Te
	23	54	II	Te
4	04	04	I	SI
	05	18	I	TI
	22	51	III	ER
5	00	28	III	OD
	01	11	I	ED
	04	00	III	OR
	04	43	I	OR
	23	46	I	TI
6	00	47	I	Se
	02	02	I	Te
	23	11	I	OR
9	03	01	II	ED
10	23	38	II	TI
	23	56	II	Se
11	01	24	IV	ER
	02	25	II	Te
	05	58	I	SI
	23	23	III	ED
12	02	49	III	ER
	03	04	I	ED
	04	15	III	OD
13	00	26	I	SI
	01	37	I	TI
	02	41	I	Se
	03	52	I	Te
14	01	02	I	OR
	22	20	I	Te
16	05	35	II	ED
17	23	47	II	SI
18	02	05	II	TI
	02	31	II	Se
	04	53	II	Te
19	03	21	III	ED
	04	58	I	ED
	22	19	IV	Te
	23	54	II	OR
20	02	19	I	SI
	03	26	I	TI
	04	34	I	Se
	05	42	I	Te
	23	26	I	ED
21	02	51	I	OR
21	21	53	I	TI
	23	03	I	Se
22	00	09	I	Te
	21	51	III	TI
23	01	21	III	Te
25	02	22	II	SI
	04	32	II	TI
	05	07	II	Se
26	21	26	II	ED
27	02	18	II	OR
	04	12	I	SI
	05	14	I	TI
	06	28	I	Se
28	01	20	I	ED
	01	41	IV	OD
	04	40	I	OR
	05	45	IV	OR
	22	41	I	SI
	23	41	I	TI
29	00	56	I	Se
	01	57	I	Te
	21	24	III	SI
	23	07	I	OR
30	00	50	III	Se
	01	27	III	TI
	04	57	III	Te

DECEMBER

d	h	m	Sat.	Phen.
2	04	58	II	SI
4	00	00	II	ED
	04	39	II	OR
	06	06	I	SI
5	03	14	I	ED
	06	27	I	OR
	21	01	II	Se
	22	54	II	Te
6	00	34	I	SI
	01	28	I	TI
	01	55	IV	SI
	02	50	I	Se
	03	44	I	Te
	05	31	IV	Se
	21	42	I	ED
7	00	54	I	OR
	01	22	III	SI
	04	49	III	Se
	04	57	III	TI
	21	18	I	Se
	22	10	I	Te
10	22	08	III	OR
11	02	34	II	ED
12	05	08	I	ED
	20	52	II	SI
	22	26	II	TI
	23	38	II	Se
13	01	15	II	Te
	02	27	I	SI
	03	13	I	TI
	04	43	I	Se
13	05	30	I	Te
	23	36	I	ED
14	02	40	I	OR
14	05	20	III	SI
	20	07	II	OR
	20	56	I	SI
	21	05	IV	OR
	21	40	I	TI
	23	11	I	Se
	23	56	I	Te
15	21	06	I	OR
18	01	33	III	OR
	05	08	II	ED
19	23	28	II	SI
20	00	44	II	TI
	02	15	II	Se
	03	34	II	Te
	04	21	I	SI
	04	58	I	TI
	06	37	I	Se
21	01	30	I	ED
	04	25	I	OR
	22	23	II	OR
	22	49	I	SI
	23	24	I	TI
22	01	05	I	Se
	01	41	I	Te
	19	52	IV	SI
	19	59	I	ED
	22	51	I	OR
	23	36	IV	Se
23	01	05	IV	TI
	05	06	IV	Te
	19	33	I	Se
	20	07	I	Te
24	23	14	III	ED
25	04	54	III	OR
27	02	04	II	SI
	03	02	II	TI
	04	51	II	Se
	05	51	II	Te
	06	14	I	SI
	06	42	I	TI
28	03	24	I	ED
	06	10	I	OR
	20	59	II	ED
29	00	37	II	OR
	00	43	I	SI
	01	08	I	TI
	02	59	I	Se
	03	25	I	Te
	21	53	I	ED
30	00	36	I	OR
	18	59	II	Te
	19	11	I	SI
	19	34	I	TI
	21	28	I	Se
	21	51	I	Te
31	03	56	IV	ED
	19	02	I	OR
32	03	13	III	ED

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. 8.)

LUNAR OCCULTATIONS

Prepared by IAN HALLIDAY

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 1954 Nautical Almanac, give the times of immersion or emersion or both for occultations of stars of magnitude 4.5 or brighter visible at Toronto and at Montreal and also at Vancouver and Calgary, 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—

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

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.

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1954

Date	Star	Mag.	I or E	Age of Moon	Toronto				Montreal			
					E.S.T.	—	b	P	E.S.T.	a	b	P
				d	h m	m	m	°	h m	m	m	°
Feb. 10	η Tau	3.0	I	7.3	Sun	—	—	—	17 15.7	−1.1	+2.6	37
10	27 Tau	3.8	I	7.3	17 48.0	−1.6	+1.1	73	17 59.5	−1.7	+0.8	72
10	η Tau	3.0	E	7.3	18 07.7	−2.2	−0.7	290	18 18.4	−2.1	−1.1	292
Mar. 25	σ Scr	3.1	E	20.2	Low	..	..	..	1 30.1	−0.4	−0.4	329
Apr. 9	δ Gem	3.5	I	6.5	20 49.6	−2.2	+0.1	64	21 05.1	—	—	41
9	δ Gem	3.5	E	6.5	21 37.6	+0.1	−3.2	341	21 26.8	—	—	3
May 9	o Leo	3.8	I	7.3	23 16.9	−0.7	−1.5	91	23 17.6	−0.5	−1.4	83
June 14	σ Scr	3.1	E	13.9	Low	..	..	..	20 13.1	−1.6	+1.3	261
Nov. 13	1 Gem	4.3	I	17.7	6 12.7	−0.1	−3.0	149	6 09.2	−0.3	−2.3	135

LUNAR OCCULTATIONS VISIBLE AT VANCOUVER, 1954

Date	Star	Mag.	I or E	Age of Moon	Vancouver			
					P.S.T.	a	b	P
				d	h m	m	m	°
May 25	θ Aqr	4.3	I	22.7	3 07.1	−1.3	+1.2	106

EPHEMERIS FOR THE PHYSICAL OBSERVATION OF THE SUN, 1954

For 0 h Greenwich Civil Time

Date	P	B_0	L_0	Date	P	B_0	L_0
Jan. 1	+ 2°.26	−3°.05	0°.92	July 5	− 1°.11	+3°.32	79°.19
6	− 0.17	−3.62	295.07	10	+ 1.16	+3.84	13.01
11	− 2.59	−4.16	229.23	15	+ 3.41	+4.34	306.84
16	− 4.96	−4.67	163.39	20	+ 5.61	+4.81	240.68
21	− 7.27	−5.15	97.55	25	+ 7.76	+5.24	174.53
26	− 9.50	−5.58	31.72	30	+ 9.84	+5.64	108.40
31	−11.63	−5.97	325.88	Aug. 4	+11.84	+6.00	42.28
Feb. 5	−13.65	−6.31	260.05	9	+13.74	+6.32	336.16
10	−15.55	−6.60	194.22	14	+15.53	+6.60	270.06
15	−17.31	−6.84	128.38	19	+17.22	+6.83	203.97
20	−18.94	−7.02	62.54	24	+18.78	+7.01	137.89
25	−20.42	−7.15	356.68	29	+20.21	+7.14	71.83
Mar. 2	−21.74	−7.23	290.82	Sept. 3	+21.51	+7.22	5.79
7	−22.91	−7.25	224.95	8	+22.67	+7.25	299.75
12	−23.91	−7.21	159.07	13	+23.68	+7.23	233.73
17	−24.75	−7.12	93.17	18	+24.54	+7.15	167.72
22	−25.42	−6.98	27.25	23	+25.25	+7.02	101.72
27	−25.91	−6.78	321.31	28	+25.78	+6.84	35.73
Apr. 1	−26.23	−6.54	255.36	Oct. 3	+26.15	+6.61	329.75
6	−26.36	−6.24	189.39	8	+26.34	+6.33	263.78
11	−26.32	−5.90	123.40	13	+26.35	+6.01	197.82
16	−26.09	−5.52	57.38	18	+26.17	+5.63	131.87
21	−25.68	−5.10	351.35	23	+25.81	+5.22	65.92
26	−25.08	−4.64	285.29	28	+25.25	+4.76	359.98
May 1	−24.30	−4.15	219.22	Nov. 2	+24.49	+4.26	294.05
6	−23.34	−3.64	153.13	7	+23.53	+3.74	228.12
11	−22.21	−3.10	87.02	12	+22.38	+3.18	162.20
16	−20.90	−2.54	20.90	17	+21.04	+2.60	96.29
21	−19.43	−1.96	314.76	22	+19.51	+1.99	30.38
26	−17.81	−1.37	248.61	27	+17.81	+1.37	324.48
31	−16.04	−0.77	182.45	Dec. 2	+15.94	+0.74	258.58
June 5	−14.15	−0.17	116.28	7	+13.92	+0.10	192.69
10	−12.14	+0.44	50.10	12	+11.78	−0.54	126.81
15	−10.05	+1.04	343.92	17	+ 9.53	−1.18	60.93
20	− 7.88	+1.63	277.73	22	+ 7.20	−1.81	355.07
25	− 5.65	+2.21	211.55	27	+ 4.80	−2.42	289.20
30	− 3.39	+2.77	145.36	Jan. 1	+ 2.38	−3.02	223.35

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, 1954

No.	Commences	No.	Commences	No.	Commences
1342	Jan. 1.07	1347	May 17.58	1352	Sept. 30.71
1343	Jan. 28.41	1348	June 13.79	1353	Oct. 28.00
1344	Feb. 24.75	1349	July 10.98	1354	Nov. 24.31
1345	Mar. 24.07	1350	Aug. 7.20	1355	Dec. 21.63
1346	Apr. 20.35	1351	Sept. 3.44		

PRINCIPAL ELEMENTS OF THE SOLAR SYSTEM

ORBITAL ELEMENTS (1944, Dec. 31, 12^h)

Planet	Mean Distance from Sun (a) ⊕ = 1	Mean Distance from Sun (a) millions of miles	Period (P)	Eccentricity (e)	Inclination (i)	Long. of Node (☊)	Long. of Perihelion (π)	Mean Long. of Planet
					°	°	°	°
Mercury.......	.387	36.0	88.0days	.206	7.0	47.6	76.5	120.5
Venus.........	.723	67.2	224.7	.007	3.4	76.1	130.7	36.0
Earth..........	1.000	92.9	365.3	.017	....	.....	101.9	99.8
Mars..........	1.524	141.5	687.0	.093	1.9	49.1	334.9	267.4
Jupiter........	5.203	483.3	11.86yrs.	.048	1.3	99.8	13.3	164.4
Saturn.........	9.54	886.	29.46	.056	2.5	113.1	91.8	97.1
Uranus........	19.19	1783.	84.0	.047	0.8	73.7	169.7	76.8
Neptune.......	30.07	2793.	164.8	.009	1.8	131.1	44.1	184.0
Pluto..........	39.46	3666.	247.7	.249	17.1	109.5	223.4	158.3

PHYSICAL ELEMENTS

Object	Symbol	Mean Diameter miles	Mass ⊕ = 1	Density water = 1	Axial Rotation	Mean Surface Gravity ⊕ = 1	Albedo Bond's	Magnitude at Opposition or Elongation
Sun........	☉	864,000	332,000	1.4	$24^d.7$ (equatorial)	27.9		− 26.7
Moon.......	☾	2,160	.0123	3.3	$27^d\ 7.7^h$	.16	.07	− 12.6
Mercury....	☿	3,010	.056	3.8	88^d	.27	.07	0±
Venus......	♀	7,580	.82	4.9	30^d ?	.85	.59	− 4±
Earth.......	⊕	7,918	1.00	5.5	$23^h\ 56^m$	1.00	.29	
Mars.......	♂	4,220	.108	4.0	$24^h\ 37^m$	.38	.15	− 2±
Jupiter.....	♃	87,000	318.	1.3	$9^h\ 50^m$±	2.6	.56?	− 2±
Saturn......	♄	72,000	95.	.7	$10^h 15^m$±	1.2	.63?	0±
Uranus.....	♅	31,000	14.6	1.3	$10^h.8$±	.9	.63?	+ 5.7
Neptune....	♆	33,000	17.2	1.3	16^h ?	1.0	.73?	+ 7.6
Pluto.......	♇	4,000?	.8 ?					+ 14

SATELLITES OF THE SOLAR SYSTEM

Name	Stellar Mag.	Mean Dist. from Planet ″ *	Mean Dist. from Planet Miles	Revolution Period d	h	m	Diameter Miles	Discoverer
Satellite of the Earth								
Moon	−12.6	530	238,857	27	07	43	2160	
Satellites of Mars								
Phobos	12	8	5,800	0	07	39	10?	Hall, 1877
Deimos	13	21	14,600	1	06	18	5?	Hall, 1877
Satellites of Jupiter								
V	13	48	112,600	0	11	57	100?	Barnard, 1892
Io	5	112	261,800	1	18	28	2300	Galileo, 1610
Europa	6	178	416,600	3	13	14	2000	Galileo, 1610
Ganymede	5	284	664,200	7	03	43	3200	Galileo, 1610
Callisto	6	499	1,169,000	16	16	32	3200	Galileo, 1610
VI	14	3037	7,114,000	250	16		100?	Perrine, 1904
VII	16	3113	7,292,000	260	01		40?	Perrine, 1905
X	18	3116	7,300,000	260			15?	Nicholson, 1938
XI	18	5990	14,000,000	692			15?	Nicholson, 1938
VIII	16	6240	14,600,000	739			40?	Melotte, 1908
IX	17	6360	14,900,000	758			20?	Nicholson, 1914
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

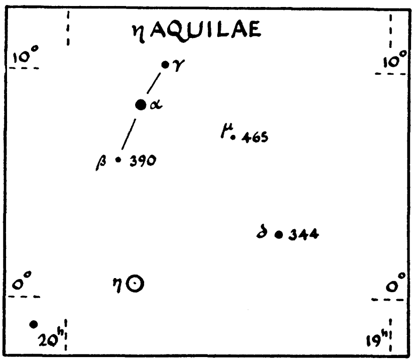
*As seen from the sun.

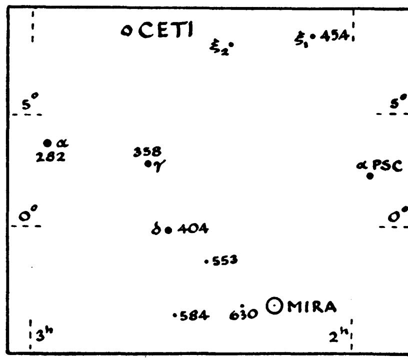
Satellites Io, Europa, Ganymede, Callisto are usually denoted I, II, III, IV respectively, in order of distance from the planet.

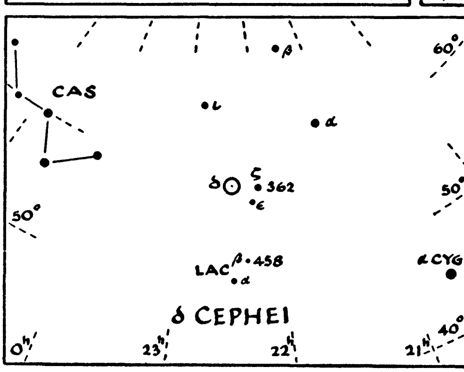
VARIABLE STARS

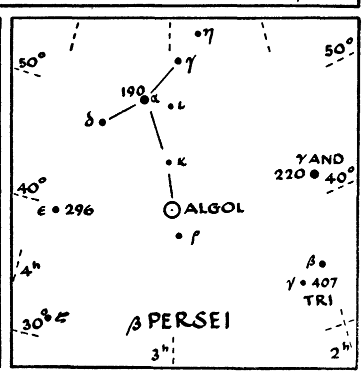
Much pleasure may be derived from the estimation of the brightness of variable stars. Maps of the fields of four bright variable stars are given below. In each case the magnitudes of several suitable comparison stars are given. These magnitudes are given as magnitudes, tenths and hundredths, with the decimal point omitted. Thus a star 362 is of magnitude 3.62. To determine the brightness of the variable at any time, carefully estimate the brightness as some fraction of the interval between two comparison stars, one brighter and one fainter than the variable. The result may then be expressed in magnitudes and tenths. Record the magnitude 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. Such studies of naked-eye estimates of brightness will at once reveal the differences in variation between the different kinds of variable. For each short period variable the observations made on any one cycle may be carried forward one, two or any number of periods to form a combined light curve.

For the two cepheids, good mean curves may be readily found by observing the variables once a night on as many nights as possible. For Algol, which changes rapidly for a few hours before and after minimum, estimates should be made at quarter or half hour intervals around the times of minimum as tabulated on pages 31–53. Mira may be observed for a couple of months as it rises from the naked-eye limit to 2nd or 3rd magnitude maximum and fades again.









REPRESENTATIVE BRIGHT VARIABLE STARS

Name	Design.	Max.	Min.	Sp.	Period	Type	Date	Discoverer
η Aql	194700	3.7	4.4	G4	7.17652	Cep	1784	Pigott
N Aql	184300	-0.2	10.9	Q	Irr.	Nova	1918	Bower
ε Aur	045443	3.3	4.1	F5p	9833.	Ecl	1821	Fritsch
δ Cep	222557	3.6	4.3	G0	5.36640	Cep	1784	Goodricke
U Cep	005381	6.8	9.2	A0	2.49293	Ecl	1880	W. Ceraski
o Cet[1]	0214*03*	2.0	10.1	M5e	331.8	LPV	1596	Fabricius
RR Cet	012700	8.4	9.0	F0	0.55304	Clus	1906	Oppolzer
R CrB	154428	5.8	13.8	cG0e	Irr.	RCrB	1795	Pigott
χ Cyg	194632	4.2	14.0	M7e	412.9	LPV	1686	Kirch
P Cyg	201437a	3.5	6.0	B1qk	Irr.	Nova	1600	Blaeu
SS Cyg	213843	8.1	12.0	Pec.	Irr.	SSCyg	1896	Wells
XX Cyg	200158	11.4	12.1	A	0.13486	Clus	1904	L. Ceraski
ζ Gem	065820	3.7	4.1	cG1	10.15353	Cep	1847	Schmidt
η Gem	060822	3.3	4.2	M2	235.58	LPV	1865	Schmidt
R Gem	070122a	6.5	14.3	Se	370.1	LPV	1848	Hind
U Gem	074922	8.8	13.8	Pec.	Irr.	SSCyg	1855	Hind
α Her	171014	3.1	3.9	M5	Irr.	SemiR	1795	W. Herschel
R Hya	1324*22*	3.5	10.1	M7e	414.7	LPV	1670	Montanari
R Leo	094211	5.0	10.5	M7e	310.3	LPV	1782	Koch
β Lyr	184633	3.4	4.3	B5e	12.92504	Ecl	1784	Goodricke
RR Lyr	192242	7.2	8.0	A5	0.56685	Clus	1901	Fleming
α Ori[2]	054907	0.2	1.2	M2	2070.Irr.	SemiR	1840	J. Herschel
U Ori	054920	5.4	12.2	M7e	376.9	LPV	1885	Gore
β Per[3]	030140	2.3	3.5	B8	2.86731	Ecl	1669	Montanari
ρ Per	025838	3.3	4.1	M4	Irr.	Irr.	1854	Schmidt
R Sge	200916	8.6	10.4	cG7	70.84	SemiR	1859	Baxendell
R Sct	1842*05*	4.5	9.0	K5e	141.5	SemiR	1795	Pigott
λ Tau	035512	3.8	4.1	B3	3.95294	Ecl	1848	Baxendell
RV Tau	044126	9.4	12.5	K0	78.60	SemiR	1905	L. Ceraski
SU Tau	054319	9.5	15.4	G0e	Irr.	RCrB	1908	Cannon
α UMi[4]	012288	2.3	2.4	cF7	3.96858	Cep	1911	Hertzsprung
N Her	180445	1.5	14.0	Q	Irr.	Nova	1934	Prentice
N Lac	221255	2.2	—	Q	Irr.	Nova	1936	Peltier

[1]oCet (Mira); [2]αOri (Betelgeuse); [3]βPer (Algol); [4]αUMi (Polaris).

The designation (Harvard) gives the 1900 position of the variable; here the first two figures give the hours, and the next two figures the minutes of R.A., while the last two figures give the declination in degrees, italicised for southern declinations. Thus the position of the fourth star of the list, δ Cep (222557) is R.A. 22h 25m, Dec. $+ 57°$. The period is in days and decimals of a day. The type is based on the classification of Gaposchkin and Gaposchkin's comprehensive text-book, *Variable Stars*. The abbreviations here used are: Ecl, Eclipsing Binaries; LPV, Long Period Variables; Semi R, Semiregular; Cep, Cepheids; Clus, cluster type; Nova; SS Cyg and R Cr B, irregular variables of which SS Cygni and R Coronae Borealis are prototypes; and Irr, other irregular variables.

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.

THE BRIGHTEST STARS†

Their Magnitudes, Types, Proper Motions, Distances and Radial Velocities

The accompanying table contains the principal facts regarding 259 stars brighter than apparent magnitude 3.51 which it is thought may be of interest to our amateur members. The various columns should be self-explanatory but some comments may be in order.

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

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

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

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

Of the 259 stars or star systems here listed 146 are south and 113 north of the equator. This is to be expected from the fact that the northern half of the sky includes less of the Milky Way than the southern.

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

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

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

†This feature of the HANDBOOK, first appearing in the 1925 edition, was prepared and frequently revised by the late Dr. W. E. Harper (1878-1940).

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec
α Andr	0 6	+28 49	2.2	A1	.217	.034	96	−0.1	−13.0*
β Cass	6	+58 52	2.4	F2	.561	.080	41	1.9	+11 4
γ Pegs	11	+14 54	2.9	B2	.015	.005	652	−3.6	+ 5.0*
β Hydi	23	−77 32	2.9	G0	2.243	.162	21	4.0	+22.8
α Phoe	24	−42 35	2.4	G5	.448	.040	81	0.4	+74.6*
δ Andr	37	+30 35	3.5	K3	.167	.026	125	0.6	− 7.1*
α Cass	38	+56 16	2.2–2.8	G8	.062	.018	181	−1.5	− 3.8
β Ceti	41	−18 16	2.2	G7	.233	.052	63	0.8	+13.1
‖γ Cass	54	+60 27	2.2	B0e	.031	.035	93	−0.1	− 6.8
‖β Phoe	1 04	−46 59	3.4	G4	.043	.020	163	−0.1	− 1.2
β Andr	07	+35 21	2.4	M0	.219	.041	79	0.5	+ 0.1
δ Cass	23	+59 59	2.8–2.9	A3	.308	.050	65	1.3	+ 6.8
γ Phoe	26	−43 34	3.4	M1	223	.008	407	−2 1	+25.7*
α Erid	36	−57 29	0.6	B9	.093	.046	71	−1.1	+19
‖α U Min	49	+89 02	2.3-2.4	F7	.043	.008	407	−3.4	−17.4*
ε Cass	51	+63 25	3.4	B5	.043	.011	296	−1.4	− 8.1
β Arie	52	+20 34	2.7	A3	.150	.066	49	1.8	− 0.6*
α Hydi	57	−61 49	3.0	A7	.255	.080	41	2.5	+ 7.0*
‖γ Andr	2 01	+42 05	2.3	K0	.073	.020	163	−1.2	−11.7
α Arie	04	+23 14	2.2	K2	.242	.045	72	0.5	−14.3
β Tria	07	+34 45	3.1	A6	.161	.029	112	0.4	+10.4*
‖o Ceti	17	− 3 12	1.7–9.6	M6e	.239	.013	251	−2.7	+57.8*
‖θ Erid	56	−40 30	3.4	A2	.068	.032	102	0.9	+11.9*
α Ceti	3 00	+ 3 54	2.8	M1	.080	.018	181	−0.9	−25.7
γ Pers	01	+53 19	3.1	F9	.012	.017	192	−0.7	+ 1.0*
ρ Pers	02	+38 39	3.3–4.1	M6	.176	.024	136	0.3	+28.2
β Pers	05	+40 46	2.1–3.2	B8	.011	.033	99	−0.3	+ 5.7*
α Pers	21	+49 41	1.9	F4	.041	.017	192	−2.0	− 2.4
δ Pers	39	+47 38	3.1	B5	.047	.012	272	−1.5	−10. *
‖η Taur	45	+23 57	3.0	B5p	.053	.014	233	−1.3	+10.3
γ Hydi	48	−74 24	3.2	M3	.124	.008	407	−2.3	+16.0
ζ Pers	51	+31 44	2.9	B1	.023	.008	407	−2.6	+20.9
‖ε Pers	54	+39 52	3.0	B2	.041	.006	543	−3.1	− 6 *
γ Erid	56	−13 39	3.2	M0	.133	.012	272	−1.6	+61.7
λ Taur	58	+12 21	3.8–4.2	B3	.015	.008	407	−2.2	+13.0*
α Reti	4 14	−62 36	3.4	G5	070	.016	204	−0 6	+35.6

α U Min, *Polaris:* R.A. 1h 51.5m; Dec. + 89° 03′ (1954)

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km / sec.
α **Taur**.......	4 33	+16 24	1.1	K8	.205	.060	54	0.0	+54.1
α Dora.......	33	−55 09	3.5	A0p	......	..	.....	......	+25.6
π^3 Orio........	47	+ 6 52	3.3	F5	.474	.124	26	3.8	+24.6
ι Auri........	54	+33 05	2.9	K4	.030	.020	163	−0.6	+17.6
ε Auri........	58	+43 45	3.1–3.8	F2	.015	.006	543	−2.7	−4.1 *
η Auri........	5 03	+41 10	3.3	B3	.082	013	251	−1.1	+ 7.8
ε Leps........	03	−22 26	3.3	K5	.074	.016	204	−0.7	+ 1.0
β Erid........	05	− 5 09	2.9	A1	.117	.055	59	1.6	− 7
μ Leps........	11	−16 16	3.3	A0p	.053	.020	163	−0.2	+27.7
‖β **Orio**........	12	− 8 15	0.3	B8p	.005	.006	543	−5.8	+23.6*
‖α **Auri**........	13	+45 57	0.2	G1	.439	.078	42	−0.3	+30.2
‖η Orio........	22	− 2 26	3.4	B0	.009	.006	543	−2.7	+19.5*
γ Orio........	22	+ 6 18	1.7	B2	.019	.015	217	−2.4	+18.0
β Taur........	23	+28 34	1.8	B8	.180	.028	116	−1.0	+ 8.0
β Leps........	26	−20 48	3.0	G2	.095	.018	181	−0.7	−13.5
‖δ Orio........	29	− 0 20	2.4–2.5	B0	.006	.007	466	−3.4	+19.9*
α Leps........	31	−17 51	2.7	F6	.006	.012	272	−2.1	+24.7
ι Orio........	33	− 5 56	2.9	O8	.007	.021	155	−0.5	+21.5*
ε Orio........	34	− 1 14	1.8	B0	.004	.008	407	−3.7	+25.8
ζ Taur........	35	+21 07	3.0	B3e	028	.010	326	−2.0	+16.4*
‖ζ Orio........	38	− 1 58	1.8	B0	.012	.011	296	−3.0	+18.8
α Colm.......	38	−34 06	2.8	B8	.036	.022	148	−0.6	+34.6
κ Orio........	45	− 9 41	2.2	B0	.009	.006	543	−3.9	+20.1
β Colm.......	49	−35 47	3.2	K0	.397	.026	125	0.3	+89.4
α **Orio**........	52	+ 7 24	0.5–1.1	M2	.032	.012	272	−4.1	+21.0*
β Auri........	56	+44 57	2.1–2.2	A0p	.046	.052	63	0.7	−18.1*
‖θ Auri........	56	+37 13	2.7	A1	.106	.029	112	0.0	+28.6
η Gemi.......	6 12	+22 31	3.2–4.2	M2	.062	.014	233	−1.1	+21.4*
ζ C Maj......	18	−30 02	3.1	B3	.012	.013	251	−0.7	+33.1*
μ Gemi.......	20	+22 32	3.2	M3	.129	.016	204	−0.8	+54.8
β C Maj......	20	−17 56	2.0	B1	.003	.014	233	−2.3	+34.4*
α **Cari**........	23	−52 40	−0.9	F0	.022	.005	652	−7.4	+20.5
γ Gemi.......	35	+16 27	1.9	A2	.066	.050	65	0.4	−11.3*
ν Pupp.......	36	−43 09	3.2	B8	.021	.023	148	0.0	+28.2*
ε Gemi.......	41	+25 12	3.2	G9	.020	.009	362	−2.0	+ 9.9
ξ Gemi.......	42	+12 57	3.4	F5	.230	.054	60	2.1	+25.1
‖α **C Maj**......	43	−16 39	−1.6	A2	1.315	.386	8	1.3	− 7.5*
α Pict........	48	−61 53	3.3	A5	271	.....	.....	......	+20.6

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
τ Pupp..	6 49	−50 33	2.8	G8	.091	.025	130	−0.2	+36.4*
‖ε C Maj......	57	−28 54	1.6	B1	.005	.010	326	−3.4	+27.4
ζ Gemi.......	7 01	+20 39	3.7–4.3	G0p	.007	.005	652	−2.8	+ 6.7*
o^2 C Maj......	01	−23 45	3.1	B5p	.006	.007	466	−2.7	+48.6
δ C Maj......	06	−26 19	2.0	G4p	.003	.006	543	−4.1	+34.3*
L^2 Pupp.......	12	−44 33	3.4–6.2	M5e	.332	.018	181	−0.3	+53.0
π Pupp.......	15	−37 00	2.7	K5	.004	.018	181	−1.0	+15.8
η C Maj......	22	−29 12	2.4	B5p	.007	.012	272	−2.2	+40.4
β C Min......	24	+ 8 23	3.1	B8	.063	.022	148	−0.2	+23 *
σ Pupp.......	28	−43 12	3.3	M0	.191	.016	204	−0.7	+88.1*
$α_1$ Gemi.......	31	+32 00	2.0	A2	.201	.074	44	1.4	+ 6.0*
$α_2$ Gemi.......	31	+32 00	2.8	A0	.209	.074	44	2.2	− 1.2*
‖**α C Min**......	37	+5 21	0.5	F5	1.242	.316	10	3.0	− 3.0*
β Gemi......	42	+28 09	1.2	G9	.623	.105	31	1.3	+ 3.3
ξ Pupp.......	47	−24 44	3.5	K1	.004	.006	543	−2.6	+ 3.7*
ζ Pupp.......	8 02	−39 52	2.3	O8	.032	.004	815	−4.7	−24
ρ Pupp.......	05	−24 10	2.9	F6	.097	.025	130	−0.1	+46.6
γVelr.........	08	−47 12	2.2	OW9	.002	.....	.....	......	+ 3.5
‖ε Cari........	21	−59 21	1.7	K0	.030	.010	326	−3.3	+11.5
o U Maj......	26	+60 53	3.5	G2	.166	.014	233	−0.8	+19.8
/‖δ Velr........	43	−54 32	2.0	A0	.093	.030	109	−0.6	+ 2.2
‖ε Hyda.......	44	+ 6 36	3.5	F9	.193	.012	272	−1.1	+36.8*
ζ Hyda.......	53	+ 6 08	3.3	G7	.101	.026	125	0.3	+22.6
‖ι U Maj......	56	+48 14	3.1	A4	.500	.060	54	2.0	+12.6
λ Velr........	9 06	−43 14	2.2	K4	.024	.016	204	−1.8	+18.4
β Cari........	13	−69 31	1.8	A0	.192	.....	.....	......	− 5.
ι Cari........	16	−59 04	2.2	F0	.023	.....	.....	......	+13.3
α Lync.......	18	+34 36	3.3	K8	.214	.022	148	0.0	+37.4
κ Velr........	21	−54 48	2.6	B3	.017	.017	192	−1.2	+21.7*
α Hyda.......	25	− 8 26	2.2	K4	.036	.018	181	−1.5	− 4.4
θ U Maj......	30	+51 54	3.3	F7	1.096	.072	45	2.6	+15.8
N Velr........	30	−56 49	3.4–4.2	K5	.038	.022	148	0.1	−13.9
ε Leon........	43	+24 00	3.1	G0	.045	.009	362	−2.1	+ 5.1
‖υ Cari........	46	−64 50	3.1	F0	.019	.....	.....	......	+13.6
α Leon.......	10 06	+12 13	1.3	B6	.244	.046	71	−0.4	+ 2 6
q Cari........	15	−61 05	3.4	K5	.043	.014	233	−0.9	+ 8.6

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′				″	″		km./sec.
‖γ Leo........	10 17	+20 06	2.3	G8	.347	.024	136	−0.8	−36.8
μ U Maj......	19	+41 45	3.2	K4	.082	.031	105	0.7	−20.3*
θ Cari........	41	−64 08	3.0	B0	.022	.007	466	−2.8	+24. *
η Cari........	43	−59 25	1.0–7.4	Pec	.007	.....	.....	.....	−25.0
‖μ Velr........	45	−49 09	2.8	G5	.079	.033	99	0.4	+ 6.9
ν Hyda.......	47	−15 56	3.3	K3	.218	.020	163	−0.2	− 1.0
β U Maj......	59	+56 39	2.4	A3	.089	.045	72	0.7	−12.1*
α U Maj......	11 01	+62 01	2.0	G5	.137	.036	91	−0.2	− 8.6*
ψ U Maj......	07	+44 46	3.2	K0	067	.035	93	0.9	− 3.6
δ Leon........	11	+20 47	2.6	A2	208	.058	56	1.4	−23.2
θ Leon........	12	+15 42	3.4	A2	.103	.025	130	0.4	+ 7.8
λ Cent........	33	−62 45	3.3	B9	.045	.031	105	0.8	+ 7.9
β Leon........	47	+14 51	2.2	A2	.507	.084	39	1.8	− 2.3
γ U Maj......	51	+53 58	2.5	A0	.095	.035	93	0.2	−11.1
δ Cent........	12 06	−50 27	2.9	B3e	.040	.015	217	−1.2	+ 9.
ε Corv........	08	−22 30	3.2	K2	.063	.024	136	0.1	+ 4.9
δ Cruc........	12	−58 28	3.1	B3	.045	.017	192	−0.7	+26.4
δ U Maj......	13	+57 19	3.4	A0	.113	.050	65	1.9	−12.
γ Corv........	13	−17 16	2.8	B8	.159	.024	136	−0.3	− 4.2*
α^1 Cruc........	24	−62 49	1.6	B1	.048	.022	148	−1.7	−12.2*
α^2 Cruc........	24	−62 49	2.1	B3	.048	.022	148	−1.2	+ 0.3*
‖δ Corv........	27	−16 14	3.1	A0	.249	.026	125	0.2	+ 8.7
γ Cruc........	28	−56 50	1.5	M4	.270	.....	.....	.....	+21.3
β Corv........	32	−23 07	2.8	G5	.059	.027	121	0.0	− 7.7
α Musc.......	34	−68 52	2.9	B5	.040	.015	217	−1.2	+18.
‖γ Cent........	39	−48 41	2.4	A0	.200	.032	102	−0.1	− 7.5
‖γ Virg........	39	− 1 10	2.9	F0	.561	.080	41	2.4	−19.6
‖β Musc.......	43	−67 50	3.3	B3	.039	.011	296	−1.5	+42. *
β Cruc........	45	−59 25	1.5	B1	.054	.007	466	−4.3	−20. *
ε U Maj......	52	+56 14	1.7	A2	.117	.067	49	0.8	−11.9*
‖α^2 C. Ven......	54	+38 35	2.8	A1	.233	.030	109	0.2	− 3.5
ε Virg........	13 00	+11 14	3.0	G6	.270	.037	88	0.8	−14.0
γ Hyda.......	16	−22 54	3.3	G7	.085	.028	116	0.5	− 5.4
ι Cent.......	18	−36 27	2.9	A2	.351	.049	67	1.4	+ 0.1
‖ζ^1 U Maj......	22	+55 11	2.4	A2p	.131	.042	78	0.5	− 9.9*
α Virg........	23	−10 54	1.2	B2	.051	.018	181	−2.5	+ 1.6*
ζ Virg........	32	− 0 20	3.4	A2	.285	.038	86	1.3	−13.1

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
ε Cent........	13 37	−53 13	2.6	B2	.039	.012	272	−2.0	− 5.6
η U. Maj......	46	+49 34	1.9	B3	.116	.015	217	−2.2	−10 9
μ Cent	47	−42 13	3.3	B3e	.026	.009	362	−1.9	+12.6
ζ Cent........	52	−47 02	3.1	B3	.080	.013	251	−1.3	*
η Boot........	52	+18 39	2.8	G1	.370	.100	33	2.8	− 0.2*
β Cent.......	14 00	−60 08	0.9	B3	.039	.026	125	−2.0	−12. *
π Hyda.......	04	−26 26	3.5	K3	.164	.037	88	1.3	+27.2
θ Cent........	04	−36 07	2.3	G8	.745	.056	58	1.0	+ 1.3
α Boot.......	13	+19 26	0.2	K0	2.287	.102	32	0.2	− 5.1
γ Boot........	30	+38 32	3.0	A3	.182	.063	52	2.0	−35.5
η Cent........	32	−41 56	2.6	B3	.046	.012	272	−2.0	− 0.2*
||**α Cent**.......	36	−60 38	0.1	G0	3.682	.768	4	4.5	−22.2*
α Circ........	38	−64 46	3.4	F0	.308	.063	52	2.4	+ 7.4
α Lupi........	39	−46 10	2.9	B2	.033	.009	362	−2.3	+ 7.3*
||ε Boot........	43	+27 17	2.7	G8	.045	.019	172	−0.9	−16.4
||α^2 Libr........	48	−15 47	2.9	F1	.128	.056	58	1.6	−10. *
β U. Min......	51	+74 22	2.2	K4	.028	.030	109	−0.4	+16.9
β Lupi........	55	−42 56	2.8	B3	.067	.012	272	−1.8	− 0.3*
κ Cent........	56	−41 54	3.4	B2	.034	.011	296	−1.4	+ 9.1*
σ Libr........	15 01	−25 05	3.4	M4	.091	.020	163	−0.1	− 4.3
ζ Lupi........	09	−51 55	3.5	G5	.125	.027	121	0.7	− 9.7
γ Tr. Au......	14	−68 30	3.1	A0	.064	.....	.....	......	0.
β Libr........	14	− 9 12	2.7	B8	.100	.015	217	−1.4	−37. *
δ Lupi........	18	−40 28	3.4	B3	.031	.012	272	−1.2	+ 1.6
γ U. Min......	21	+72 01	3.1	A2	.016	.022	148	−0.2	− 3.9*
ι Drac........	24	+59 08	3.5	K3	.010	.030	109	0.9	−11.1
||γ Lupi........	32	−41 00	3.0	B3	.038	.013	251	−1.4	+ 6.
α Cor. B......	33	+26 53	2.3	A0	.160	.054	60	1.0	+ 1.0*
α Serp........	42	+ 6 35	2.8	K3	.142	.043	76	1.0	+ 3.0
β Tr. Au......	51	−63 17	3.0	F0	.436	.096	34	2.9	− 0.3
π Scor........	56	−25 58	3.0	B3	.037	.012	272	−1.6	− 3.0*
δ Scor........	57	−22 29	2.5	B1	.039	.011	296	−2.3	−16. *
||β Scor........	16 03	−19 40	2.8	B3	.029	.016	204	−1.2	− 9.3*
δ Ophi........	12	− 3 34	3.3	K8	.159	.030	109	0.7	−19.8
ε Ophi........	16	− 4 34	3.3	G9	.088	.031	105	0.8	−10.3
||σ Scor........	18	−25 28	3.1	B1	.033	.009	362	−2.1	− 0.4*
||η Drac........	23	+61 38	2.9	G5	.062	.038	86	0.8	−14.3

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	°			"	"			km./sec.
||α **Scor**........	16 26	−26 19	1.2	M1	.032	.019	172	−2.4	− 3.2*
β Herc........	28	+21 36	2.8	G4	.104	.020	163	−0.7	−25.8*
τ Scor........	33	−28 07	2.9	B1	.037	.009	362	−2.3	+ 0.6
ζ Ophi........	34	−10 28	2.7	B0	.023	.008	407	−2.8	−19. *
||ζ Herc........	39	+31 42	3.0	G0	.601	.105	31	3.1	−70.8*
α Tr. Au......	43	−68 56	1.9	K5	.031	.025	130	−1.1	− 3.7
ε Scor........	47	−34 12	2.4	G9	.665	.038	86	0.3	− 2.5
μ¹ Scor........	48	−37 58	3.1	B3p	.030	.011	296	−1.7	*
ζ Arae........	54	−55 55	3.1	K5	.046	.028	116	0.3	− 6.0
κ Ophi........	55	+ 9 27	3.1–4.0	K3	.290	.042	78	1.2	−55.6
||η Ophi........	17 08	−15 40	2.6	A2	.095	.047	69	1.0	− 1.0
η Scor........	08	−43 11	3.4	A7	.294	.066	49	2.5	−28.4
ζ Drac........	09	+65 47	3.2	B8	.023	.028	116	0.4	−14.1
||α¹ Herc........	12	+14 27	3.1–3.9	M7	.030	.008	407	−2.4	−32.5
δ Herc........	13	+24 54	3.2	A2	.164	.036	91	1.0	−39. *
π Herc........	13	+36 52	3.4	K3	.021	.018	181	−0.3	−25.7
θ Ophi........	19	−24 57	3.4	B2	.031	.008	407	−2.1	− 3.6
β Arae........	21	−55 29	2.8	K1	.036	.023	142	−0.4	− 0.4
υ Scor........	27	−37 15	2.8	B3	.042	.010	326	−2.2	+18. *
α Arae........	28	−49 50	3.0	B3e	.090	.015	217	−1.1	− 2.2
β Drac........	29	+52 20	3.0	G0	.012	.007	466	−2.8	−20.1
λ Scor........	30	−37 04	1.7	B2	.036	.016	204	−2.3	0. *
α Ophi........	33	+12 35	2.1	A0	.264	.060	54	1.0	+15. *
θ Scor........	34	−42 58	2.0	F0	.012	.024	136	−1.1	+ 1.4
κ Scor........	39	−39 00	2.5	B3	.028	.009	362	−2.7	−10. *
β Ophi........	41	+ 4 35	2.9	K2	.157	.030	109	0.3	−11.9
ι¹ Scor........	44	−40 06	3.1	F8	.004	.008	407	−2.4	−27.6*
||μ Herc........	44	+27 45	3.5	G5	.817	.114	28	3.8	−16.1
G Scor........	46	−37 02	3.2	K2	.069	.029	112	0.5	+24.7
ν Ophi........	56	− 9 46	3.5	G7	.118	.022	148	0.2	+12.4
γ Drac........	55	+51 30	2.4	K5	.026	.026	125	−0.5	−27.8
γ Sgtr........	18 03	−30 26	3.1	K0	.202	.030	109	0.5	+22.3*
η Sgtr........	14	−36 47	3.2	M4	.216	.030	109	0.6	+ 0.5
δ Sgtr........	18	−29 51	2.8	K4	.052	.033	99	0.4	−20.0
η Serp........	19	− 2 55	3.4	G9	.898	.050	65	1.9	+ 8.9
ε Sgtr........	21	−34 25	2.0	A0	.139	.020	163	−1.5	−10.8
λ Sgtr........	25	−25 27	2.9	K1	.196	.036	91	0.7	−43.3
α **Lyra**.......	35	+38 44	0.1	A1	.348	.140	23	0.8	−13.8

Star	R.A. 1950	Decl. 1950	Mag.	Type	Ann. Proper Motion	Parallax	Distance in Light Years	Abs. Mag.	Rad. Vel.
	h m	° ′			″	″			km./sec.
φ Sgtr........	18 43	−27 03	3.3	B8	.150	.015	217	−0.8	+21.5*
‖β Lyra........	48	+33 18	3.4–4.1	B2p	.011	.006	543	−2.7	−19.0*
σ Sgtr........	52	−26 22	2.1	B3	.067	.021	155	−1.3	−10.7
γ Lyra........	57	+32 37	3.3	B9p	.008	.016	204	−0.7	−21.5*
‖ζ Sgtr........	59	−29 57	2.7	A2	.019	.035	93	0.4	+22.1
ζ Aqil.........	19 03	+13 47	3.0	A0	.103	.038	86	0.9	−25. *
τ Sgtr........	04	−27 45	3.4	K0	.268	.036	91	1.2	+45.4*
π Sgtr........	07	−21 06	3.0	F2	.041	.017	192	−0.8	− 9.8
δ Drac........	13	+67 34	3.2	G8	.135	.028	116	0.4	+24.8
δ Aqil........	23	+ 3 01	3.4	A3	.267	.052	63	2.0	−32.3*
‖β¹ Cygn.......	29	+27 51	3.2	K0	.010	.010	326	−1.8	−23.9*
‖δ Cygn.......	43	+45 00	3.0	A1	.067	.023	116	0.2	−20.
γ Aqil........	44	+10 29	2.8	K3	.018	.018	181	−0.9	− 2.0
α **Aqil**.......	48	+ 8 44	0.9	A2	.659	.184	18	2.2	−26.1
θ Aqil........	20 09	− 0 58	3.4	A0	.035	.018	181	−0.3	−28.6*
β Capr........	18	−14 56	3.2	F8	.042	.022	148	−0.1	−19.0*
γ Cygn.......	20	+40 06	2.3	F8	.006	.008	407	−3.2	− 7.6
α Pavo.......	22	−56 54	2.1	B3	.087	.014	233	−2.2	+ 1.8*
α Indi........	34	−47 28	3.2	G2	.072	.034	96	0.9	− 1.1
α **Cygn**.......	40	+45 06	1.3	A2p	.004	.002	1630	−7.2	− 6.3*
ε Cygn.......	44	+33 47	2.6	G7	.485	.040	81	0.6	−10.5*
ζ Cygn.......	21 11	+30 01	3.4	G6	.061	.018	181	−0.3	+16.9*
α Ceph.......	17	+62 22	2.6	A2	.163	.076	43	2.0	− 8.
β Ceph.......	28	+70 20	3.3–3.4	B1	.013	.006	543	−2.8	− 7.2
β Aqar........	29	− 5 48	3.1	G1	.020	.008	407	−2.4	+ 6.7
ε Pegs........	42	+ 9 39	2.5	K2	.028	.014	233	−1.8	+ 5.2
δ Capr........	44	−16 21	3.0	A3	.395	.062	53	2.0	− 6.4*
γ Grus........	51	−37 36	3.2	B8	.114	.020	163	−0.3	− 2.1
α Aqar........	22 03	− 0 34	3.2	G0	.019	.006	543	−2.9	+ 7.6
α Grus........	05	−47 12	2.2	B5	.202	.036	91	0.0	+11.8
α Tucn.......	15	−60 31	2.9	K5	.088	.019	172	−0.7	+42.2*
β Grus........	40	−47 09	2.2	M6	.131	.010	326	−2.8	+ 1.6
η Pegs........	41	+29 58	3.1	G1	.039	.016	204	−0.9	+ 4.4*
α **Psc. A**......	55	−29 53	1.3	A3	.367	.118	28	1.7	+ 6.5
β Pegs........	23 01	+27 49	2.6	M3	.235	.020	163	−0.9	+ 8.6
α Pegs........	02	+14 56	2.6	A0	.077	.033	99	0.2	− 4. *
γ Ceph.......	37	+77 21	3.4	K1	.167	.062	53	2.4	−42.0

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.	Dis. 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 nebulae is added for the better known objects.

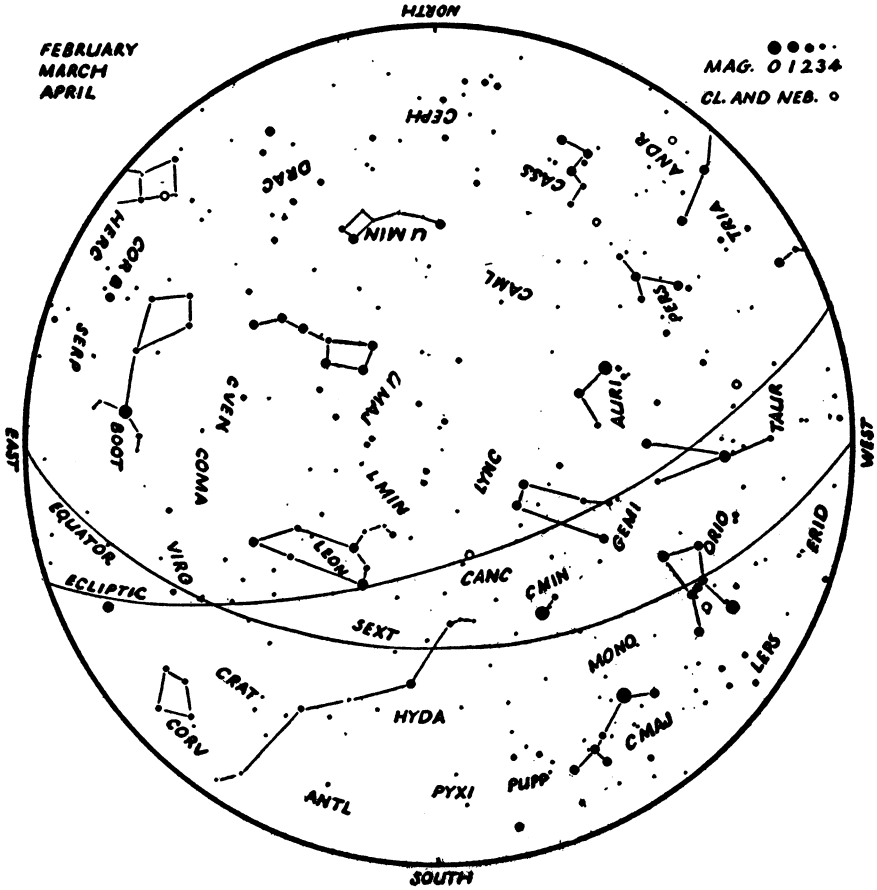
N.G.C.	M	Con	α 1950 h m	δ ° ′	Cl	Size ′	m n	m *	Dist. l.y.	Name
650	76	Per	01 38.3	+51 20	Pl	1.5	11	17	15,000	
1952	1	Tau	05 31.5	+21 59	Pl	6	11	16	10,000	Crab
1976	42	Ori	05 32.5	−05 25	Dif	30			1,800	Orion
B33		Ori	05 38.0	−02 29	Drk	4			300	Horsehead
2261		Mon	06 36.4	+08 47	Dif	2				Hubble's var
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

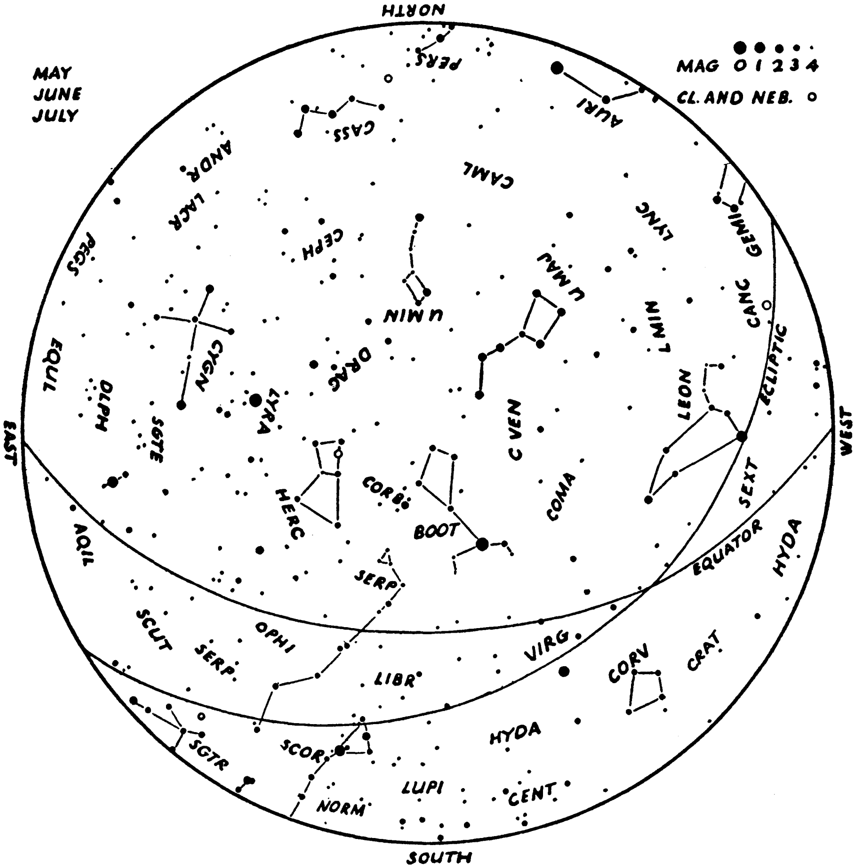


The above map represents the evening sky at

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

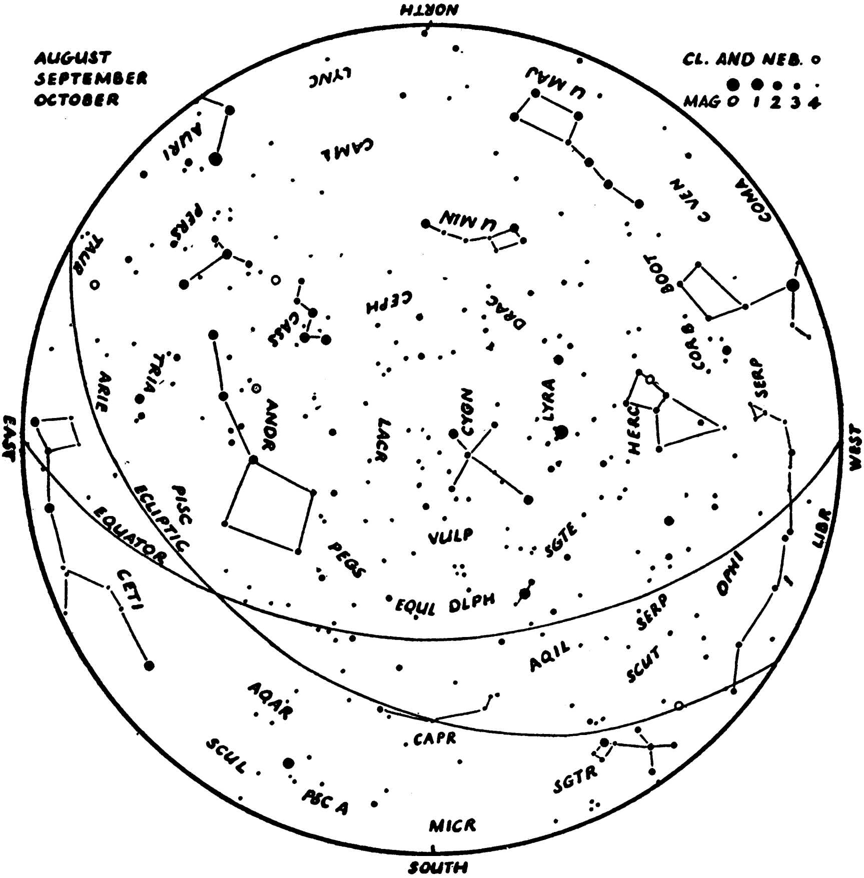


The above map represents the evening sky at

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

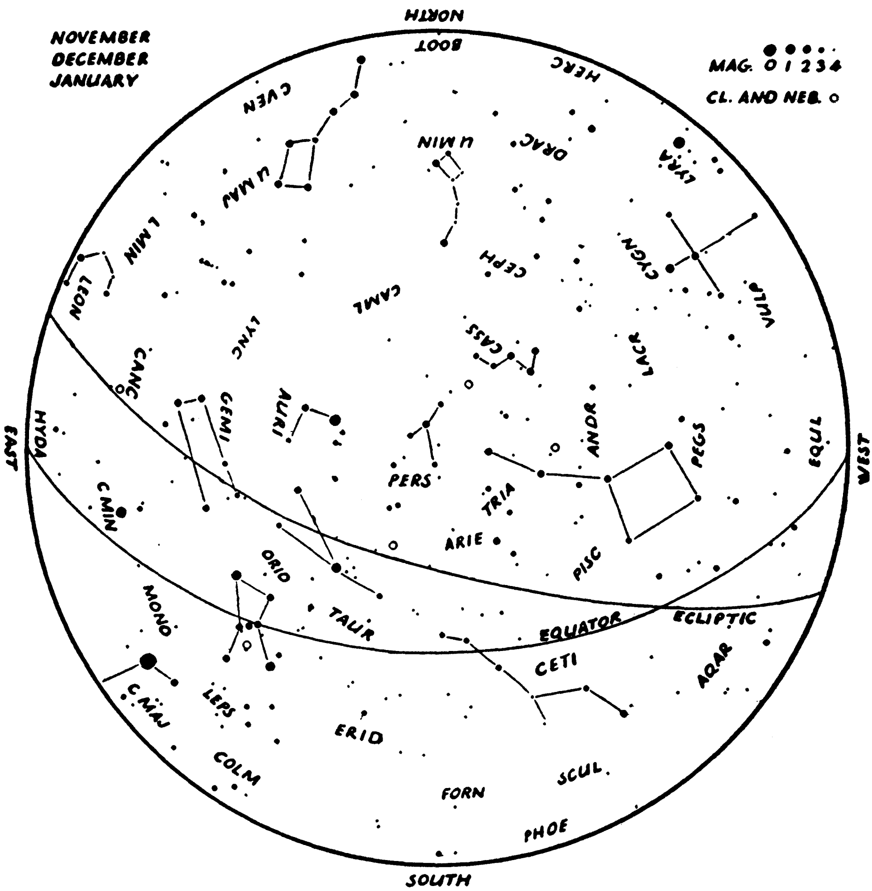


The above map represents the evening sky at

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.

PRINCIPAL METEOR SHOWERS FOR THE NORTHERN HEMISPHERE

Shower	Approx. Radiant α	Approx. Radiant δ	Current Maximum Date	Spectacular Displays	Hourly Number (all meteors)	Duration (in days)	Abbreviations (for use in observing records)
Quadrantids....	232°	+52°	Jan. 3		20	4	Q
Lyrids.........	280	+37	Apr. 21		10	4	Y
Eta Aquarids...	336	− 1	May 4		10	8	E
Delta Aquarids .	340	−17	July 28		20	12	D
Perseids........	47	+57	Aug. 12		50	25	P
Giacobinids.....	267	+55	Oct. 9	1933, 1946		1	J
Orionids.......	96	+15	Oct. 22		20	14	O
Taurids........	56	+16	Nov. 10?			30	T
Leonids........	152	+22	Nov. 16	1799, 1833, 1866, 1867	20	14	L
Bielids.........	25	+45	Nov. 27	1872, 1885			B
Geminids.......	110	+33	Dec. 12		30	14	G

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