THE OBSERVER'S HANDBOOK FOR 1950

PUBLISHED BY

The Royal Astronomical Society of Canada

C. A. CHANT, Editor
F. S. HOGG, Assistant Editor
DAVID DUNLAP OBSERVATORY

FORTY-SECOND YEAR OF PUBLICATION

TORONTO
3 Willcocks Street
Printed for the Society
By the University of Toronto Press
1949

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, Windsor, and Guelph, Ontario; Winnipeg, Man.; Saskatoon, Sask.; Edmonton, Alta.; Vancouver and Victoria, B.C. As well as nearly 1400 members of these Canadian Centres, there are nearly 500 members not attached to any Centre, mostly resident in other nations, while some 300 additional institutions or persons are on the regular mailing list of our publications. The Society publishes a monthly "Journal" and a yearly "Observer's Handbook". Single copies of the Journal are 50 cents, and of the Handbook, 40 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 General Secretary, 3 Willcocks St., Toronto.

JULIAN CALENDAR, 1950

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

Jan. 1	3283	May 1	3403	Sep. 1	3526
Feb. 1	3314	Jun. 1	3434	Oct. 1	3556
Mar. 1	3342	Jul. 1	3464	Nov. 1	3587
Apr. 1	3373	Aug. 1	3495	Dec. 1	3617

The Julian Day commences at noon. Thus J.D. 2,433,283 = Jan. 1.5 G.C.T.

1950 CALENDAR 1950

JANUARY					
Sun.	1	8	15	22	29
Mon.	2	9	16	23	30
Tues.	3	10	17	24	31
Wed.	4	11	18	25	....
Thur.	5	12	19	26	....
Fri.	6	13	20	27	....
Sat.	7	14	21	28	....

FEBRUARY					
Sun.	..	5	12	19	26
Mon.	..	6	13	20	27
Tues.	.	7	14	21	28
Wed.	1	8	15	22	....
Thur.	2	9	16	23	..
Fri.	3	10	17	24	....
Sat.	4	11	18	25	...

MARCH					
Sun.	..	5	12	19	26
Mon.	..	6	13	20	27
Tues.	..	7	14	21	28
Wed.	1	8	15	22	29
Thur.	2	9	16	23	30
Fri.	3	10	17	24	31
Sat.	4	11	18	25	....

APRIL						
Sun.		2	9	16	23	30
Mon.		3	10	17	24	....
Tues.		4	11	18	25	....
Wed.		5	12	19	26	....
Thur.		6	13	20	27	....
Fri.		7	14	21	28	....
Sat.	1	8	15	22	29	....

MAY					
Sun.	..	7	14	21	28
Mon.	1	8	15	22	29
Tues.	2	9	16	23	30
Wed.	3	10	17	24	31
Thur.	4	11	18	25	....
Fri.	5	12	19	26	....
Sat.	6	13	20	27	....

JUNE					
Sun.	..	4	11	18	25
Mon.	..	5	12	19	26
Tues.	..	6	13	20	27
Wed.	..	7	14	21	28
Thur.	1	8	15	22	29
Fri.	2	9	16	23	30
Sat.	3	10	17	24	.

JULY						
Sun.		2	9	16	23	30
Mon.		3	10	17	24	31
Tues.		4	11	18	25	....
Wed.		5	12	19	26	....
Thur.		6	13	20	27	....
Fri.		7	14	21	28	....
Sat.	1	8	15	22	29	....

AUGUST					
Sun.	..	6	13	20	27
Mon.	..	7	14	21	28
Tues.	1	8	15	22	29
Wed.	2	9	16	23	30
Thur.	3	10	17	24	31
Fri.	4	11	18	25	....
Sat.	5	12	19	26	....

SEPTEMBER					
Sun.	..	3	10	17	24
Mon.	..	4	11	18	25
Tues.	..	5	12	19	26
Wed.	..	6	13	20	27
Thur.	..	7	14	21	28
Fri.	1	8	15	22	29
Sat.	2	9	16	23	30

OCTOBER					
Sun.	1	8	15	22	29
Mon.	2	9	16	23	30
Tues.	3	10	17	24	31
Wed.	4	11	18	25	...
Thur.	5	12	19	26	....
Fri.	6	13	20	27	....
Sat.	7	14	21	28	....

NOVEMBER					
Sun.	..	5	12	19	26
Mon.	..	6	13	20	27
Tues.	..	7	14	21	28
Wed.	1	8	15	22	29
Thur.	2	9	16	23	30
Fri.	3	10	17	24	....
Sat.	4	11	18	25	....

DECEMBER						
Sun.		3	10	17	24	31
Mon.		4	11	18	25	....
Tues.		5	12	19	26	....
Wed.		6	13	20	27	....
Thur.		7	14	21	28	....
Fri.	1	8	15	22	29	....
Sat.	2	9	16	23	30	....

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CONTENTS

TABLES IN RECENT OBSERVER'S HANDBOOKS

PRINTED IN CANADA

PREFACE

The HANDBOOK for 1950 is the 42nd issue. During the past decade its circulation has increased from 1500 to 5500. This year, for the third time, some advertisements of astronomical accessories are inserted. The Officers of the Society appreciate this assistance at the present time of financial difficulty.

Four circular star maps 9 inches in diameter at a price of one cent each, and a set of four maps plotted on equatorial co-ordinates at a price of ten 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. Among the recent additions are:

1. *Algol.* Olin J. Eggen's epoch 2432520.6303 and period 2.86731525d., as published in the *Astrophysical Journal*, 1948.
2. *Sunrise, sunset; moonrise, moonset.* The tables now include a wider range of latitude, taking in the southern states.
3. *Sun-spots.* A table of solar rotation numbers for observers of sun-spots, and an ephemeris for physical observations of the sun.

Dr. F. S. Hogg, the Assistant Editor, as in recent years, assumed the responsibility of preparing this volume and to him the chief credit of its success is due; but sincere thanks are tendered to all those names mentioned in the book. Our deep indebtedness to the British *Nautical Almanac* and the *American Ephemeris* is thankfully acknowledged.

C. A. CHANT.

David Dunlap Observatory,
Richmond Hill, Ont., November, 1949.

ANNIVERSARIES AND FESTIVALS 1950

New Year's Day	Sun.	Jan.	1
Epiphany	Fri.	Jan.	6
Septuagesima Sunday		Feb.	5
Quinquagesima (Shrove Sunday)		Feb.	19
Ash Wednesday		Feb.	22
St. David	Wed.	Mar.	1
St. Patrick	Fri.	Mar.	17
Palm Sunday		Apr.	2
Good Friday		Apr.	7
Easter Sunday		Apr.	9
St. George	Sun.	Apr.	23
Rogation Sunday		May	14
Ascension Day	Thu.	May	18
Empire Day (Victoria Day)	Wed.	May	24
Birthday of the Queen Mother, Mary (1867)	Fri.	May	26
Pentecost (Whit Sunday)		May	28
Trinity Sunday		June	4
Corpus Christi	Thu.	June	8
St. John Baptist (Mid-summer Day)	Sat.	June	24
Dominion Day	Sat.	July	1
Birthday of Queen Elizabeth (1900)	Fri.	Aug.	4
Labour Day	Mon.	Sep.	4
Hebrew New Year (Rosh Hashanah)	Tue.	Sep.	12
St. Michael (Michaelmas Day)	Fri.	Sep.	29
All Saints' Day	Wed.	Nov.	1
Remembrance Day	Sat.	Nov.	11
St. Andrew	Thu.	Nov.	30
First Sunday in Advent		Dec.	3
Accession of King George VI (1936)	Mon.	Dec.	11
Birthday of King George VI (1895)	Thu.	Dec.	14
Christmas Day	Mon.	Dec.	25

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	$= 1.60935 \times 10^{5}$ cm.	$=$ 1.60935 km.	
1 astronomical unit	$= 1.49504 \times 10^{13}$ cm.	$=$ 92,897,416 miles	
1 light year	$= 9.463 \times 10^{17}$ cm.	$= 5.880 \times 10^{12}$ miles	$=$ 0.3069 parsecs
1 parsec	$= 30.84 \times 10^{17}$ cm.	$= 19.16 \times 10^{12}$ miles	$=$ 3.259 l.y.
1 megaparsec	$= 30.84 \times 10^{23}$ cm.	$= 19.16 \times 10^{18}$ miles	$= 3.259 \times 10^{6}$ l.y.

Units of Time

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

The Earth

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

Earth's Orbital Motion

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

Solar Motion

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

The Galactic System

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

Extragalactic Nebulae

Red shift $= +530$ km./sec./megaparsec $= +101$ 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 $= 3 \times 10^{-6}$ meter candles
Total energy emitted by a star of zero absolute magnitude $= 5 \times 10^{25}$ horsepower

Miscellaneous

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

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

π $=$ 3.141,592,653,6
No. of square degrees in the sky $=$ 41,253

1950 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

Date 1950	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
	h m s	m s	° ′
Jan. 1	18 43 32	+03 14	−23 04.2
4	18 56 46	+04 38	−22 48.4
7	19 09 56	+05 59	−22 28.5
10	19 23 02	+07 15	−22 04.6
13	19 36 04	+08 27	−21 36.8
16	19 49 00	+09 33	−21 05.2
19	20 01 50	+10 34	−20 30.0
22	20 14 33	+11 27	−19 51.3
25	20 27 09	+12 14	−19 09.3
28	20 39 38	+12 53	−18 24.1
31	20 52 00	+13 25	−17 36.0
Feb. 3	21 04 14	+13 50	−16 45.0
6	21 16 21	+14 07	−15 51.5
9	21 28 21	+14 17	−14 55.4
12	21 40 14	+14 20	−13 57.1
15	21 52 00	+14 17	−12 56.7
18	22 03 39	+14 06	−11 54.4
21	22 15 12	+13 50	−10 50.4
24	22 26 39	+13 27	−09 44.9
27	22 38 01	+12 59	−08 38.1
Mar. 2	22 49 17	+12 26	−07 30.2
5	23 00 29	+11 48	−06 21.3
8	23 11 37	+11 06	−05 11.6
11	23 22 41	+10 21	−04 01.3
14	23 33 43	+09 33	−02 50.5
17	23 44 42	+08 42	−01 39.5
20	23 55 39	+07 50	−00 28.3
23	00 06 35	+06 56	+00 42.9
26	00 17 31	+06 02	+01 53.8
29	00 28 25	+05 07	+03 04.3
Apr. 1	00 39 20	+04 12	+04 14.2
4	00 50 16	+03 18	+05 23.5
7	01 01 13	+02 26	+06 31.8
10	01 12 12	+01 35	+07 39.3
13	01 23 14	+00 47	+08 45.5
16	01 34 18	+00 02	+09 50.5
19	01 45 26	−00 40	+10 54.0
22	01 56 37	−01 19	+11 55.9
25	02 07 52	−01 53	+12 56.0
28	02 19 11	−02 24	+13 54.2
May 1	02 30 35	−02 50	+14 50.3
4	02 42 03	−03 11	+15 44.2
7	02 53 36	−03 27	+16 35.7
10	03 05 15	−03 39	+17 24.8
13	03 16 59	−03 44	+18 11.3
16	03 28 48	−03 45	+18 55.1
19	03 40 42	−03 40	+19 35.9
22	03 52 42	−03 31	+20 13.8
25	04 04 46	−03 16	+20 48.6
28	04 16 54	−02 58	+21 20.1
31	04 29 06	−02 35	+21 48.3
Jun. 3	04 41 22	−02 09	+22 13.1
6	04 53 42	−01 39	+22 34.4
9	05 06 05	−01 06	+22 52.2
12	05 18 30	−00 30	+23 06.3
15	05 30 57	+00 07	+23 16.8
18	05 43 25	+00 46	+23 23.6
21	05 55 54	+01 25	+23 26.7
24	06 08 23	+02 04	+23 26.0
27	06 20 51	+02 43	+23 21.7
30	06 33 17	+03 19	+23 13.6

Date 1950	Apparent R.A.	Corr. to Sun-dial	Apparent Dec.
	h m s	m s	° ′
Jul. 3	06 45 42	+03 54	+23 01.9
6	06 58 04	+04 26	+22 46.6
9	07 10 23	+04 56	+22 27.7
12	07 22 39	+05 22	+22 05.4
15	07 34 51	+05 44	+21 39.6
18	07 46 58	+06 02	+21 10.4
21	07 59 01	+06 15	+20 38.1
24	08 10 58	+06 22	+20 02.6
27	08 22 50	+06 25	+19 24.1
30	08 34 36	+06 22	+18 42.8
Aug. 2	08 46 18	+06 13	+17 58.6
5	08 57 53	+05 59	+17 11.9
8	09 09 24	+05 40	+16 22.6
11	09 20 49	+05 16	+15 30.9
14	09 32 10	+04 46	+14 37.0
17	09 43 25	+04 12	+13 41.0
20	09 54 36	+03 33	+12 43.0
23	10 05 42	+02 49	+11 43.3
26	10 16 43	+02 02	+10 41.9
29	10 27 42	+01 10	+09 38.9
Sep. 1	10 38 37	+00 15	+08 34.6
4	10 49 29	−00 42	+07 29.0
7	11 00 19	−01 42	+06 22.4
10	11 11 07	−02 43	+05 14.7
13	11 21 54	−03 45	+04 06.3
16	11 32 41	−04 49	+02 57.2
19	11 43 26	−05 53	+01 47.6
22	11 54 12	−06 57	+00 37.7
25	12 04 59	−08 00	−00 32.4
28	12 15 47	−09 01	−01 42.5
Oct. 1	12 26 36	−10 01	−02 52.6
4	12 37 29	−10 59	−04 02.3
7	12 48 24	−11 53	−05 11.7
10	12 59 23	−12 43	−06 20.5
13	13 10 27	−13 30	−07 28.6
16	13 21 34	−14 12	−08 35.7
19	13 32 47	−14 49	−09 41.7
22	13 44 05	−15 20	−10 46.4
25	13 55 29	−15 46	−11 49.7
28	13 06 59	−16 05	−12 51.4
31	14 18 36	−16 18	−13 51.2
Nov. 3	14 30 21	−16 24	−14 49.1
6	14 42 12	−16 22	−15 44.8
9	14 54 11	−16 12	−16 38.3
12	15 06 18	−15 55	−17 29.1
15	15 18 33	−15 30	−18 17.3
18	15 30 54	−14 58	−19 02.5
21	15 43 24	−14 18	−19 44.7
24	15 56 00	−13 32	−20 23.7
27	16 08 43	−12 38	−20 59.2
30	16 21 33	−11 38	−21 31.3
Dec. 3	16 34 30	−10 31	−21 59.6
6	16 47 32	−09 19	−22 24.2
9	17 00 39	−08 01	−22 44.8
12	17 13 50	−06 40	−23 01.4
15	17 27 05	−05 15	−23 13.9
18	17 40 22	−03 48	−23 22.3
21	17 53 40	−02 19	−23 26.4
24	18 06 59	−00 49	−23 26.3
27	18 20 18	+00 40	−23 22.0
30	18 33 36	+02 08	−23 13.4

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 *Corr-ction 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.

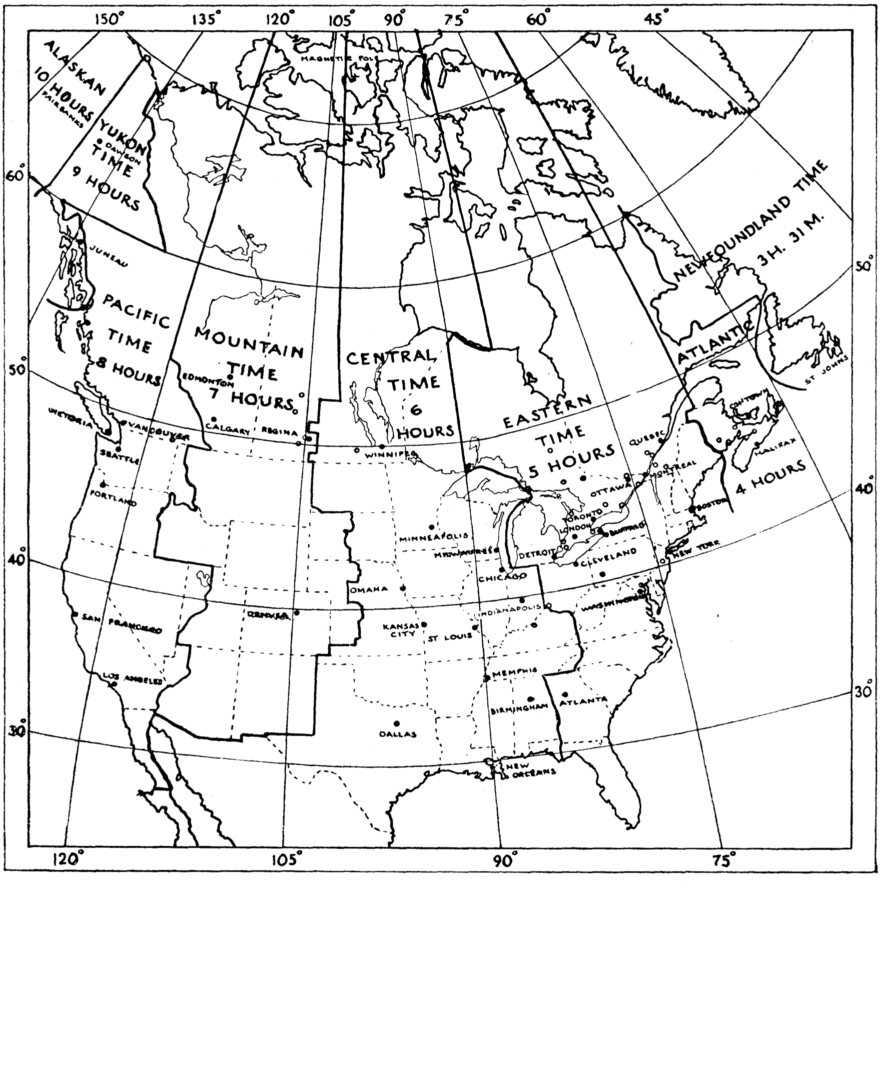
4. *Standard Time*—In everyday life we use still another kind of time. A moment's thought will show that in general two places will not have the same mean time; indeed, difference in longitude between two places is determined from their difference in time. But in travelling it is very inconvenient to 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 six standard time belts, as follows;—60th meridian or Atlantic Time, 4h. slower than Greenwich; 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



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	St. John, N.B.	45	+ 24
Fort William	48	+ 57	St. John's, Nfld.	48	00
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	− 02
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 52° Sunrise	Latitude 52° 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 08	3 59
	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 08	4 01
	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 07	4 03
	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 06	4 06
	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 05	4 08
	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 05	4 11
	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 03	4 14
	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 01	4 18
	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	7 59	4 21
	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	7 57	4 24
	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	7 56	4 27
	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	7 54	4 31
	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	7 51	4 35
	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 48	4 38
	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 46	4 42
	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 43	4 45
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 39	4 49
	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 35	4 53
	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 32	4 56
	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 29	5 00
	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 25	5 03
	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 21	5 07
	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 18	5 10
	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 14	5 14
	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 11	5 18
	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 07	5 22
	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 02	5 26
	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	6 58	5 30
	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 53	5 33
	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 49	5 31

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 52° Sunrise	Latitude 52° 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 46	5 40
	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 41	5 44
	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 37	5 47
	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 32	5 51
	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 28	5 55
	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 23	5 58
	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 19	6 02
	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 14	6 05
	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 09
	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 15
	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 51	6 22
	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 46	6 26
	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 41	6 29
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 37	6 32
	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 32	6 36
	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 28	6 39
	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 23	6 43
	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 19	6 46
	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 14	6 49
	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 10	6 52
	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 06	6 56
	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	5 01	6 59
	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 56	7 02
	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 52	7 06
	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 48	7 09
	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 44	7 13
	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 40	7 16
	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 36	7 20

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 52° Sunrise	Latitude 52° 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 32	7 23
	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 28	7 26
	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 25	7 29
	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 21	7 32
	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 17	7 36
	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 14	7 39
	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 11	7 42
	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	4 07	7 45
	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	4 04	7 48
	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	4 01	7 52
	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 58	7 55
	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 55	7 57
	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 53	8 00
	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 51	8 03
	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 49	8 05
	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 47	8 08
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 45	8 10
	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 44	8 12
	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 42	8 14
	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 41	8 16
	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 40	8 18
	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 40	8 19
	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 39	8 20
	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 39	8 21
	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 39	8 22
	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 39	8 23
	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 39	8 23
	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 40	8 24
	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 41	8 24
	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 42	8 24
	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 43	8 24

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 52° Sunrise	Latitude 52° 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 44	8 23
	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 46	8 22
	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 47	8 21
	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 49	8 20
	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 51	8 18
	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 53	8 17
	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 55	8 15
	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 58	8 13
	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	4 00	8 11
	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	4 03	8 09
	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	4 06	8 07
	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	4 08	8 04
	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 11	8 01
	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 14	7 58
	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 17	7 55
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 21	7 52
	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 24	7 49
	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 27	7 45
	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 30	7 41
	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 33	7 37
	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 36	7 34
	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 39	7 30
	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 42	7 26
	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 46	7 21
	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 49	7 17
	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 52	7 13
	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 56	7 09
	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 59	7 05
	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	5 02	7 00
	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 05	6 56
	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 09	6 51

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 52° Sunrise	Latitude 52° 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 12	6 47
	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 15	6 41
	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 19	6 37
	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 22	6 33
	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 25	6 28
	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 28	6 23
	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 31	6 19
	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 34	6 14
	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 38	6 10
	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 41	6 05
	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 00
	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 54	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 57	5 42
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 00	5 37
	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 04	5 32
	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 07	5 28
	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 11	5 23
	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 14	5 19
	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 17	5 15
	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 21	5 10
	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 25	5 06
	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 28	5 02
	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 32	4 58
	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 35	4 54
	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 39	4 50
	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 43	4 46
	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 47	4 42
	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 50	4 38

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 52° Sunrise	Latitude 52° 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 53	4 34
	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	6 57	4 30
	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 00	4 27
	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 04	4 23
	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 07	4 19
	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 11	4 16
	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 14	4 13
	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 18	4 10
	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 22	4 07
	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 25	4 04
	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 28	4 02
	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 31	4 00
	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 35	3 58
	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 38	3 56
	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 41	3 55
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 44	3 54
	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 47	3 52
	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	7 49	3 51
	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	7 52	3 50
	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	7 54	3 50
	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	7 57	3 49
	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	7 59	3 49
	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 01	3 49
	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 03	3 49
	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 04	3 49
	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 05	3 50
	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 06	3 51
	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 07	3 52
	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 08	3 54
	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 08	3 56
	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 08	3 58

BEGINNING OF MORNING AND ENDING OF EVENING TWILIGHT

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

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).

TIMES OF MOONRISE AND MOONSET, 1950. (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 52° Moon Rise	Latitude 52° Moon Set
Jan.		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1		14 33	04 51	14 16	05 07	13 55	05 28	13 29	05 53	13 16	06 05
2		15 20	05 51	15 01	06 10	14 39	06 33	14 09	07 02	13 55	07 16
3		16 16	06 49	15 57	07 09	15 33	07 32	15 04	08 03	14 49	08 17
4	○	17 19	07 42	17 01	08 00	16 39	08 23	16 12	08 51	15 58	09 05
5		18 25	08 28	18 11	08 44	17 53	09 03	17 30	09 27	17 19	09 38
6		19 34	09 07	19 23	09 20	19 09	09 36	18 52	09 54	18 44	10 03
7		20 43	09 41	20 35	09 51	20 26	10 03	20 15	10 15	20 10	10 20
8		21 50	10 12	21 46	10 17	21 42	10 23	21 37	10 31	21 34	10 34
9		22 57	10 40	22 57	10 41	22 58	10 43	22 58	10 45	22 58	10 46
10		— —	11 07	— —	11 05	— —	11 02	— —	10 59	— —	10 57
11	☾	00 04	11 35	00 09	11 29	00 14	11 23	00 20	11 14	00 23	11 10
12		01 14	12 07	01 23	11 57	01 33	11 45	01 45	11 31	01 51	11 25
13		02 25	12 42	02 38	12 30	02 53	12 13	03 11	11 54	03 20	11 44
14		03 38	13 27	03 55	13 10	04 13	12 49	04 38	12 24	04 50	12 12
15		04 49	14 19	05 08	14 00	05 31	13 37	06 00	13 08	06 14	12 52
16		05 55	15 21	06 15	15 01	06 39	14 37	07 10	14 07	07 25	13 51
17		06 52	16 27	07 12	16 09	07 34	15 48	08 02	15 20	08 15	15 06
18	●	07 40	17 36	07 57	17 21	08 16	17 03	08 40	16 40	08 51	16 29
19		08 19	18 44	08 32	18 32	08 47	18 18	09 05	18 03	09 15	17 53
20		08 51	19 48	09 00	19 40	09 11	19 30	09 24	19 19	09 31	19 13
21		09 18	20 48	09 24	20 44	09 31	20 39	09 39	20 33	09 43	20 30
22		09 43	21 47	09 45	21 46	09 48	21 45	09 51	21 44	09 53	21 43
23		10 06	22 44	10 05	22 46	10 04	22 49	10 02	22 53	10 02	22 55
24		10 29	23 40	10 25	23 46	10 20	23 53	10 14	— —	10 11	— —
25	☽	10 53	— —	10 46	— —	10 37	— —	10 27	00 02	10 22	00 06
26		11 20	00 37	11 09	00 47	10 57	00 58	10 42	01 12	10 34	01 18
27		11 50	01 36	11 37	01 49	11 20	02 04	10 59	02 23	10 50	02 33
28		12 27	02 37	12 10	02 52	11 50	03 12	11 26	03 35	11 13	03 47
29		13 10	03 37	12 51	03 56	12 29	04 17	12 00	04 46	11 46	04 59
30		14 02	04 37	13 42	04 56	13 18	05 20	12 48	05 50	12 33	06 05
31		15 03	05 32	14 43	05 53	14 21	06 14	13 51	06 43	13 37	06 58
Feb.											
1		16 09	06 21	15 52	06 39	15 32	06 59	15 07	07 25	14 55	07 37
2	○	17 19	07 04	17 05	07 18	16 49	07 35	16 30	07 56	16 21	08 05
3		18 29	07 40	18 19	07 51	18 08	08 03	17 56	08 18	17 49	08 25
4		19 38	08 12	19 33	08 19	19 27	08 26	19 20	08 36	19 17	08 41
5		20 47	08 42	20 46	08 44	20 45	08 47	20 44	08 52	20 44	08 53
6		21 56	09 10	21 59	09 08	22 03	09 07	22 08	09 06	22 10	09 04
7		23 06	09 38	23 14	09 33	23 22	09 27	23 33	09 20	23 38	09 17
8		— —	10 09	— —	09 59	— —	09 49	— —	09 36	— —	09 31
9	☾	00 17	10 43	00 29	10 31	00 42	10 15	00 59	09 57	01 07	09 49
10		01 29	11 25	01 44	11 08	02 02	10 49	02 26	10 24	02 37	10 13
11		02 40	12 14	02 59	11 54	03 20	11 32	03 49	11 02	04 02	10 48
12		03 47	13 10	04 06	12 50	04 30	12 27	05 01	11 56	05 16	11 40
13		04 46	14 14	05 04	13 55	05 28	13 32	05 58	13 03	06 13	12 48
14		05 35	15 21	05 52	15 05	06 14	14 45	06 39	14 20	06 52	14 07
15		06 16	16 28	06 31	16 15	06 48	15 59	07 09	15 40	07 18	15 30
16	●	06 50	17 33	07 01	17 24	07 14	17 12	07 29	16 59	07 35	16 52
17		07 19	18 34	07 27	18 29	07 35	18 22	07 45	18 14	07 49	18 10
18		07 44	19 34	07 48	19 32	07 53	19 30	07 57	19 27	08 00	19 25
19		08 08	20 32	08 08	20 33	08 09	20 35	08 09	20 37	08 10	20 38
20		08 31	21 29	08 28	21 34	08 24	21 40	08 20	21 46	08 19	21 49
21		08 54	22 26	08 48	22 35	08 41	22 45	08 33	22 56	08 28	23 01
22		09 20	23 24	09 10	23 36	08 59	23 50	08 46	— —	08 40	— —
23		09 49	— —	09 36	— —	09 21	— —	09 02	00 07	08 54	00 15
24	☽	10 22	00 23	10 06	00 39	09 48	00 57	09 25	01 19	09 13	01 29
25		11 02	01 24	10 43	01 42	10 22	02 03	09 54	02 29	09 41	02 43
26		11 49	02 23	11 29	02 42	11 06	03 06	10 36	03 36	10 21	03 51
27		12 45	03 20	12 25	03 39	12 02	04 03	11 31	04 34	11 16	04 49
28		13 47	04 11	13 30	04 29	13 08	04 52	12 40	05 20	12 27	05 33

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

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

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

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

THE PLANETS FOR 1950

By C. A. Chant

THE SUN

The present sun-spot cycle has some remarkable features. The last minimum was at 1944.25 (about April 1, 1944) and maximum came at 1947.4 (about May 26, 1947). The Wolf-number for May 1947 was 206, the highest since 1778. Just before this the greatest spot-group on record was observed. The activity is decreasing, but the great auroral displays with accompanying magnetic disturbances in October 1949 suggest that there may be much to observe in 1950.

MERCURY

Mercury is exceptional in many ways. It is the planet nearest the sun and it travels fastest in its orbit, its speed varying from 23 mi. per sec. at aphelion to 35 mi. per sec. at perihelion. With the exception of Pluto, its orbit has the greatest eccentricity and the greatest inclination to the ecliptic. It receives from the sun most light and heat per square mile of its surface, the amount on the average being 6.7 times that received by the earth. Again excepting Pluto, whose size and mass are still uncertain, Mercury's size and mass are the smallest; but its period of rotation on its axis is believed to be longest of all.

Mercury's period of revolution is 88 days, and as its orbit is well within that of the earth, 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 1950

Elong. East—Evening Star			Elong. West—Morning Star		
Date	Distance	Mag.	Date	Distance	Mag.
Jan. 1	19°	−0.4	Feb. 10	26°	+0.2
April 22	20°	+0.4	June 9	24°	+0.7
Aug. 21	27°	+0.5	Oct. 2	18°	−0.2

The most favourable elongations to observe are: in the evening, April 22; in the morning, Oct. 2, but June 9 will also be possible. 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 that of Mercury but much slower and more stately. The orbit of Venus is almost a circle with a radius of 67 million miles, and its orbital speed is 22 mi. per sec.

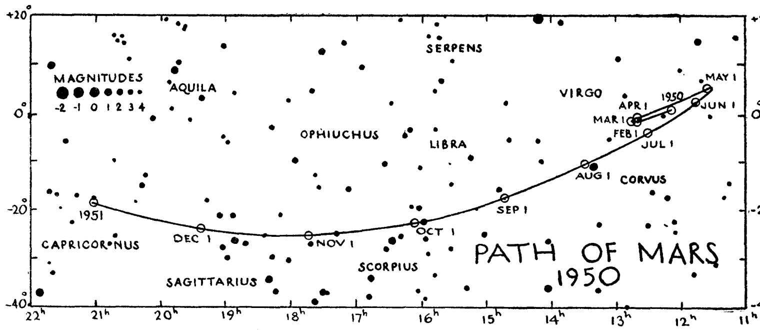
On Jan. 1, 1950, Venus is an evening star. It crosses the meridian about 2½ hours after the sun, but as its declination is 15° S. it is not well placed for observers in the northern hemisphere. It is moving fairly rapidly in towards the sun and comes to inferior conjunction on Jan. 31. It will then equally rapidly separate from the sun and in about a month will be visible as a morning star. It will continue as such until Nov. 13, when it reaches superior conjunction. For the rest of the year it will be an evening star.

On Mar. 6 the planet attains greatest brilliancy, its stellar mag. then being −4.3. On April 11 it reaches greatest elong. W., 46° 21′, and its stellar mag. is −4. Its decl. is 9° S. and it crosses the meridian at 9.09 a.m. It will be a glorious morning star.

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 with these two numbers 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.



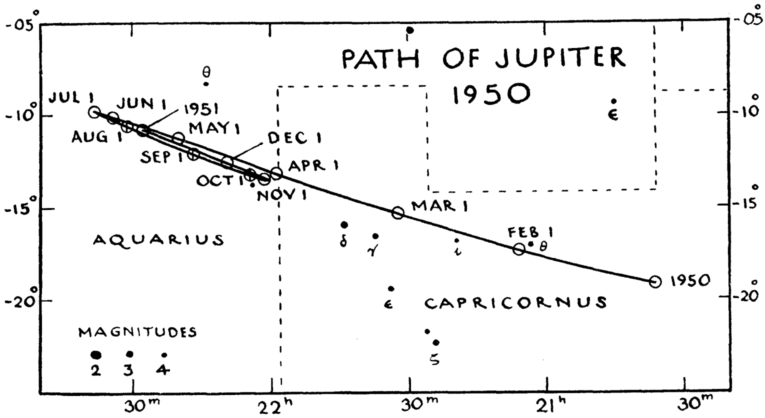
The sidereal, or true mechanical, period of revolution of Mars is 687 days; and the synodic period (for example, the interval from one opposition to the next one) is 780 days. This is the average value; it may vary from 764 to 810 days. The planet was in opposition on Feb. 17, 1948, and it comes to opposition again on Mar. 23, 1950. It is nearest to the earth on Mar. 27 at which time its stellar mag. is −1.1, i.e., it is a little fainter than Sirius whose mag. is −1.6. Its course in the sky is shown in the accompanying 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 11 satellites, two of them discovered in 1938 (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 (marsh-gas).

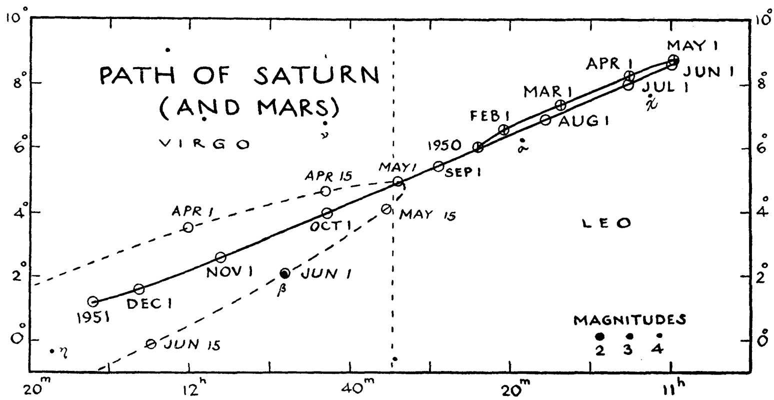
Jupiter is a fine object for the telescope. Many details of the surface as well as the flattening of the planet at the poles, which is undoubtedly due to its short rotation period, are visible. The rapidly varying phenomena of its satellites also provide a continual interest.

On Jan. 1, 1950, Jupiter is an evening star, crossing the meridian about 2 p.m. It is in decl. 19° S. The sun moves over towards the planet and they are in conjunction on Feb. 3, and then Jupiter becomes a morning star. It then separates from the sun until Aug. 26 when it comes to opposition and is on the meridian at midnight. It is in the constellation Aquarius (see accompanying map). At this time its distance from the earth is 371,200,000 mi. (see p. 45) and its stellar mag. is —2.4. In the telescope its equatorial diam. is 49″ and polar 3″ less. At the end of the year it is still an evening star. On Dec. 31 it crosses the meridian at 3.50 p.m.



SATURN

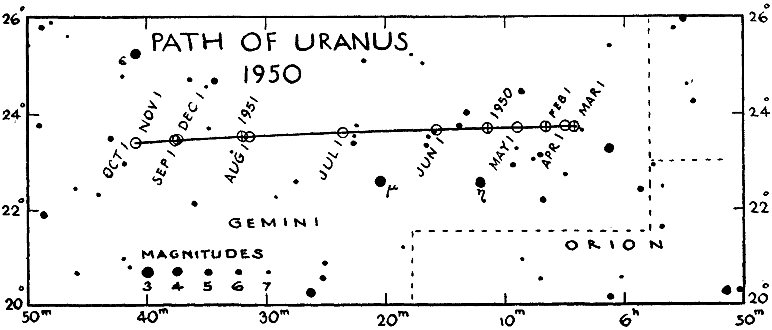
Saturn was the outermost planet known until modern times. In size it is a good second to Jupiter. In addition to its family of nine satellites, this planet has a unique system of rings, and it is one of the finest of celestial objects in a good telescope. The plane of the rings makes an angle of 27° 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. They were invisible in 1936 and at a maximum in 1944. In the early part of 1950 the south face of the rings is seen, but they become continually narrower and on Sept. 14 they become invisible. After that the north face is presented to the earth.



The planet is in the constellations Leo and Virgo (see map). On March 7 it is in opposition to the sun and is visible all night. Its stellar magnitude then is +0.7, slightly less bright than Rigel. On June 13 it is in quadrature with the sun and is on the meridian at sunset. On Sept. 15 it is in conjunction with the sun.

URANUS

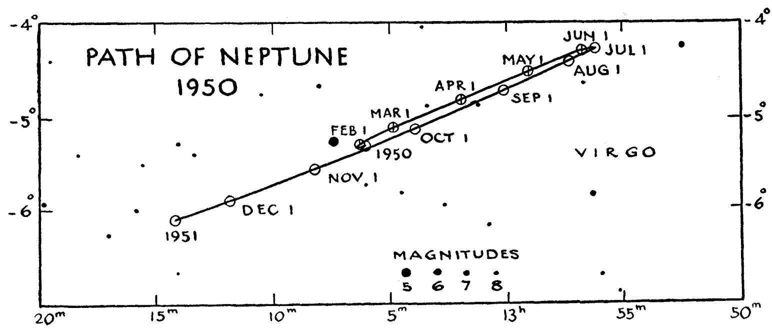
Uranus was discovered in 1781 by Sir William Herschel by means of a 6¼-in. mirror-telescope made by himself. The object did not look just like a star and he observed it again four days later. It had moved amongst the stars, and he assumed it to be a comet. He could not believe that it was a new planet. 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. Its fifth satellite was discovered by G. P. Kuiper in 1948 at the McDonald Observatory (see p. 59). He has named it *Miranda.*



As shown by the chart, Uranus in 1950 is in Gemini. On Dec. 29, it is in opposition with the sun.

NEPTUNE

Neptune was discovered in 1846 after its existence in the sky had been predicted from independent calculations by Leverrier in France and Adams in England. This discovery was a crowning demonstration of the correctness of Newton's law of gravitation. It caused a sensation at the time. The planet's 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 2 years, and diameter about 200 miles.



During 1950 Neptune is still in the constellation Virgo. It begins to retrograde on Jan. 19 and is in opposition with the sun on April 6. Its stellar magnitude then 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.

PLUTO

Pluto, the most distant known planet, was discovered at the Lowell Observatory in 1930, following prolonged mathematical calculations and observations by photography. 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 Cancer. It is in opposition to the sun on Feb. 9, 1950, at which time its position is R.A. $9^h\ 28^m.4$, Dec. $+23° \ 39'$, as taken from the U.S. Nautical Almanac.

ECLIPSES, 1950

In 1950 there will be *four* eclipses, two of the sun, and two of the moon. Of these only one lunar eclipse will be well visible in North America.

I. *An Annular Eclipse of the Sun,* March 18, 1950, invisible from North America. The short path of the annular eclipse lies in the South Atlantic, between South Africa and Antarctica. Even the partial phase will be visible in general only over the ocean. G.C.T. of conjunction in right ascension, March 18th, 14h 26m 38.2s. The moon's disc will have a diameter about 93 per cent. of that of the sun.

II. *A Total Eclipse of the Moon,* April 2, 1950, invisible from Canada. The beginning will be visible from Europe, Asia, Africa and Australia, and the ending from the east coast of South America, the Atlantic, Europe, Asia and Africa. G.C.T. of opposition, April 2, 21h 10m 5.6s.

III. *A Total Eclipse of the Sun,* September 12, 1950, invisible from North America except in the Alaska-Yukon region. The path of totality will pass within a few degrees of the North Pole, cross north eastern Siberia, the westernmost Aleutians, and end in the northern Pacific. The maximum duration of totality, 73.7 seconds, will occur at about the Near Islands of the Aleutians. G.C.T. of conjunction, September 12th, 2h 46m 1.3s.

IV. *A Total Eclipse of the Moon,* September 26, 1950, visible from most of North America. The beginning will be visible from North America, except for the extreme north-western part, South America, most of Europe, Africa and south-western Asia; the ending visible from the Western Hemisphere and Pacific Ocean.

Circumstances of the Lunar Eclipse, September 26, 1950

	G.C.T.		G.C.T.
☾ enters penumbra	01h 20.0m	Total eclipse ends	04h 39.6m
☾ enters umbra	02 31.5	☾ leaves umbra	06 01.9
Total eclipse begins	03 53.8	☾ leaves penumbra	07 13.5
Middle of eclipse	04 16.7	Magnitude of eclipse	1.084

THE SKY MONTH BY MONTH

By J. F. Heard

THE SKY FOR JANUARY, 1950

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 14s to −13m 34s. The earth is in perihelion, or nearest the sun, on the 3rd. 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. 20h 08m, Decl. 17° 36′ S. and transits at 12.26. On the 1st it is at greatest eastern elongation and appears as an evening star about 12° above the south-western horizon at sunset. It rapidly approaches the sun and is in inferior conjunction on the 17th. Thereafter it is a morning star but poorly placed for observation.

Venus on the 15 is in R.A. 21h 18m, Decl. 11° 42′ S. and transits at 13.39. It is an evening star, very low in the south-west after sunset, until the latter part of the month when it approaches the sun rapidly, inferior conjunction being on the 31st.

Mars on the 15th is in R.A. 12h 29m, Decl. 0° 08′ S. and transits at 4.53. It is in Virgo west of Spica and east of Saturn and it rises about midnight. Its stellar magnitude is + 0.5 at mid-month and it will brighten quite rapidly from now until April.

Jupiter on the 15th is in R.A. 20h 49m, Decl. 18° 24′ S. and transits at 13.12. Early in the month it may still be seen low in the south-west just after sunset.

For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

Saturn on the 15th is in R.A. 11h 24m, Decl. 6° 10′ N. and transits at 3.47. It is in Leo, roughly half-way between Regulus and Mars, a little brighter than Regulus. It rises before midnight. This month the ring system is inclined at an angle of only about 1½ degrees to the line of sight so that the rings are very thin in appearance. They will open up some as summer approaches and then close up completely in the autumn, at which time, however, the planet is not to be seen. Therefore this month is the best time to view the "thin" rings.

Uranus on the 15th is in R.A. 6h 09m, Decl. 23° 42′ N. and transits at 22.29.

Neptune on the 15th is in R.A. 13h 06m, Decl. 5° 20′ S. and transits at 5.29.

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

ASTRONOMICAL PHENOMENA MONTH BY MONTH

By Ruth J. Northcott

JANUARY

75th Meridian Civil Time

	d	h	m		Min. of Algol h	Min. of Algol m	Config. of Jupiter's Sat. 17h 30m
Sun.	1	6		☿ Greatest elongation E., 19° 29′	14	59	10234
Mon.	2						20134
Tue.	3			Quadrantid meteors			3204*
		1		⊕ in Perihelion. Dist. from ☉, 91,339,000 mi.			
		6	35	☌ ♅ ☾ ♅ 4° 39′ S.			
Wed.	4	2	48	○ Full Moon	11	48	31024
Thu.	5						30214
Fri.	6	7		☿ in ☊			2104*
Sat.	7	23		□ ♆ ☉	08	37	0413*
Sun.	8	3		☿ Stationary in R.A.			41023
		12		♀ Stationary in R.A.			
		23	53	☌ ♄ ☾ ♄ 0° 12′ N.			
Mon.	9						42013
Tue.	10	5	08	☌ ♂ ☾ ♂ 2° 28′ N.	05	26	42310
		22		☿ in Perihelion			
Wed.	11	1	27	☌ ♆ ☾ ♆ 2° 25′ N.			d4302
		5	31	☾ Last Quarter			
Thu.	12						43012
Fri.	13	1		Moon in Perigee. Dist. from ⊕, 229,800 mi.	02	16	42130
Sat.	14						4013*
Sun.	15				23	05	
Mon.	16						
Tue.	17	12		☌ ☿ ☉ Inferior			
		22	10	☌ ☿ ☾ ☿ 8° 13′ N.			
Wed.	18	2	59	● New Moon	19	54	
Thu.	19	0	19	☌ ♃ ☾ ♃ 3° 56′ N.			
		7		♆ Stationary in R.A.			
		8	37	☌ ♀ ☾ ♀ 9° 33′ N.			
Fri.	20	23		♂ in Aphelion			
Sat.	21	5		☿ Greatest Hel. Lat. N.	16	43	
Sun.	22						
Mon.	23						
Tue.	24				13	33	
Wed.	25	8		☌ ♀ ♃ ♀ 7° 16′ N.			
		17		Moon in Apogee. Dist. from ⊕, 251,200 mi.			
		23	39	☽ First Quarter			
Thu.	26						
Fri.	27				10	22	
Sat.	28	20		☿ Stationary in R.A.			
Sun.	29						
Mon.	30	13	38	☌ ♅ ☾ ♅ 4° 46′ S.	07	11	
Tue.	31	1		♀ in Perihelion			
		2		☌ ♀ ☉ Inferior			

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

THE SKY FOR FEBRUARY, 1950

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° 53′ S. The equation of time changes from – 13m 34s to a maximum of – 14m 20s on the 12th and then to – 12m 38s at the end of the month. For changes in the length of the day, see p. 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. 20h 10m, Decl. 20° 17′ S. and transits at 10.33. It is a morning star but poorly placed for observation even at greatest western elongation on the 10th, at which time it is only about 9° above the south-eastern horizon at sunrise.

Venus on the 15th is in R.A. 20h 17m, Decl. 11° 38′ S. and transits at 10.36. It is too close to the sun for easy observation until late in the month when it can be seen as a morning star very low in the south-east just before sunrise.

Mars on the 15th is in R.A. 12h 46m, Decl. 1° 15′ S. and transits at 3.07. It is in Virgo still, closer to Spica, rising in the late evening. Becoming brighter, it now considerably outshines both Spica and Saturn. On the 12th it is stationary in right ascension and begins to retrograde, or move westward, among the stars.

Jupiter on the 15th is in R.A. 21h 19m, Decl. 16° 20′ S. and transits at 11.39. It is in conjunction with the sun on the 3rd and is too close to the sun all month for 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. 11h 18m, Decl. 6° 54′ N. and transits at 1.39 It is in Leo, about half-way between Regulus and Mars, rising a few hours after sunset. There is a close conjunction of Saturn with the moon on the morning of the 5th.

Uranus on the 15th is in R.A. 6h 05m, Decl. 23° 43′ N. and transits at 20.23.

Neptune on the 15th is in R.A. 13h 06m, Decl. 5° 14′ S. and transits at 3.27.

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

FEBRUARY
75th Meridian Civil Time

d	h	m		Min. of Algol h m
Wed. 1			....	
Thu. 2	17	16	☺ Full Moon..........................	04 01
Fri. 3	15		☌♃☉...........................	
Sat. 4			....	
Sun. 5	4	47	☌♄☾ ♄ 0° 25′ N..............	00 50
Mon. 6	19		Moon in Perigee. Dist. from ⊕, 228,900 mi...	
	21	10	☌♂☾ ♂ 3° 53′ N..............	
Tue. 7	7	04	☌♆☾ ♆ 2° 42′ N..............	21 39
Wed. 8			....	
Thu. 9	13	32	☾ Last Quarter..........................	
Fri. 10	10		☿ Greatest elongation W., 25° 53′........	18 29
Sat. 11			....	
Sun. 12	15		♂ Stationary in R.A....................	
Mon. 13	15		☿ in ☋..............................	15 18
Tue. 14	13	01	☌☿☾ ☿ 4° 47′ N..............	
	16	33	☌♀☾ ♀ 12° 59′ N.............	
Wed. 15	20	34	☌♃☾ ♃ 3° 35′ N..............	
Thu. 16	0		☌☿♀ ☿ 8° 23′ S..............	12 07
	17	53	● New Moon..........................	
Fri. 17			....	
Sat. 18			....	
Sun. 19	23		♀ Stationary in R.A....................	08 57
Mon. 20			....	
Tue. 21	21		♀ Greatest Hel. Lat. N.................	
Wed. 22	13		Moon in Apogee. Dist. from ⊕, 251,500 mi...	05 46
Thu. 23	22		☿ in Aphelion..........................	
Fri. 24	20	52	☽ First Quarter........................	
Sat. 25			....	02 35
Sun. 26	21	52	☌♅☾ ♅ 4° 55′ S..............	
Mon. 27			....	23 25
Tue. 28			....	

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 January 15th to March 27th.

THE SKY FOR MARCH, 1950

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° 53′ S. to 4° 14′ N. The equation of time changes from − 12m 38s to − 4m 12s. On the 20th at 23.36 E.S.T., the sun crosses the equator on its way north, enters the sign of Aries and spring commences. There is an annular eclipse of the sun on the 18th, not visible in North America. (See p. 29.) 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 57m, Decl. 9° 05′ S. and transits at 11.31. It is poorly placed for observation. Superior conjunction is on the 27th.

Venus on the 15th is in R.A. 20h 50m, Decl. 13° 15′ S. and transits at 9.22. It is a morning star very prominent in the south-east just before sunrise. Early in the month it is at greatest brilliancy with stellar magnitude − 4.3, and, seen in a telescope, it is a crescent with disc about 25 per cent. illuminated.

Mars on the 15th is in R.A. 12h 25m, Decl. 1° 13′ N. and transits at 0.55. It is about half-way between Saturn and Spica, rising during the evening. Opposition is on the 23rd and closest approach to the earth is on the 27th. Mars is at its brightest (stellar magnitude − 1.1) and biggest (apparent diameter 14.4″) at this time.

Jupiter on the 15th is in R.A. 21h 45m, Decl. 14° 19′ S. and transits at 10.14. It is a morning star and by the end of the month it is to be seen low in the south-east just before sunrise.

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. 11h 10m, Decl. 7° 48′ N. and transits at 23.37. It is in Leo about half-way between Regulus and Mars, rising about sunset and visible all night. It is in opposition on the 7th and is at its brightest at this time with stellar magnitude + 0.7.

Uranus on the 15th is in R.A. 6h 04m, Decl. 23° 43′ N. and transits at 18.32.

Neptune on the 15th is in R.A. 13h 04m, Decl. 5° 00′ S. and transits at 1.34.

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

MARCH
75th Meridian Civil Time

	d	h	m		Min. of Algol h m	Config. of Jupiter's Sat. 6h 15m
Wed.	1	10		☌☿♃ ☿ 1° 14′ S.		
Thu.	2				20 14	
Fri.	3					
Sat.	4	5	34	○ Full Moon		
		10	41	☌♄☾ ♄ 0° 21′ N.		
Sun.	5				17 03	
Mon.	6	0	36	☌♂☾ ♂ 4° 07′ N.		
		8		Moon in Perigee. Dist. from ⊕, 225,400 mi.		
		14	06	☌♆☾ ♆ 2° 49′ N.		
		15		♀ Greatest brilliance		
Tue.	7	0		☍♄☉ Dist. from ⊕, 778,500,000 mi.		
Wed.	8				13 52	
Thu.	9	15		♅ Stationary in R.A.		
Fri.	10	21	38	☾ Last Quarter		
Sat.	11				10 42	
Sun.	12					
Mon.	13					
Tue.	14	12	57	☌♀☾ ♀ 9° 11′ N.	07 31	
Wed.	15	15	05	☌♃☾ ♃ 3° 12′ N.		
Thu.	16	6		☿ Greatest Hel. Lat. S.		
Fri.	17	14	02	☌☿☾ ☿ 0° 17′ S.	04 20	
Sat.	18			Annular eclipse of ☉, see p. 29.		
		10	20	● New Moon		
Sun.	19					
Mon.	20	23	36	☉ enters ♈, Spring commences. Long of ☉, 0°	01 10	
Tue.	21					
Wed.	22	0		□♅☉	21 59	
		6		Moon in Apogee. Dist. from ⊕, 252,100 mi.		
Thu.	23	1		☍♂☉ Dist. from ⊕, 60,520,000 mi.		
Fri.	24					
Sat.	25				18 48	
Sun.	26	6	16	☌♅☾ ♅ 5° 00′ S.		
		15	09	☽ First Quarter		
Mon.	27	1		♂ nearest ⊕. Dist. from ⊕, 60,360,000 mi.		
		21		☌☿☉ Superior		
Tue.	28				15 37	O1234
Wed.	29					21O34
Thu.	30					d2O14
Fri.	31	17	55	☌♄☾ ♄ 0° 08′ N.	12 26	31O24

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

THE SKY FOR APRIL, 1950

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° 14′ N. to 14° 50′ N. The equation of time changes from −4m 12s to +2m 50s, being zero on the 16th; that is, the apparent sun changes from being east of the mean sun to being west of it. 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. There is a total eclipse of the moon on the 2nd, not visible in North America. (see p. 29.)

Mercury on the 15th is in R.A. 2h 35m, Decl. 17° 12′ N. and transits at 13.06. It is an evening star, improving until the 22nd when it is at greatest eastern elongation. This elongation is quite favourable, Mercury then being about 18° above the western horizon at sunset. It is still reasonably well placed at the end of the month.

Venus on the 15th is in R.A. 22h 39m, Decl. 8° 09′ S. and transits at 9.08. It is very prominent in the south-east before sunrise. Greatest western elongation is on the 11th after which Venus begins to approach the sun.

Mars on the 15th is in R.A. 11h 43m, Decl. 4° 42′ N. and transits at 22.07. It has now moved away from Spica closer to Saturn, and is well up in the eastern sky at sunset. Still near maximum brightness, it dominates this part of the sky.

Jupiter on the 15th is in R.A. 22h 09m, Decl. 12° 13′ S. and transits at 8.37. It is a morning star, rising in the south-east about two hours ahead of 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. 11h 02m, Decl. 8° 34′ N. and transits at 21.27. It is about half-way between Regulus and Mars, well up in the east at sunset. There is a close conjunction of Saturn with the moon on the morning of the 28th.

Uranus on the 15th is in R.A. 6h 07m, Decl. 23° 42′ N. and transits at 16.33.

Neptune on the 15th is in R.A. 13h 01m, Decl. 4° 40′ S. and transits at 23.25.

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

			APRIL 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 5h 30m
d	h	m		h m	
Sat. 1	18	37	☌♂☾ ♂ 2° 38′ N.		d3O14
Sun. 2	15	49	🌕 Full Moon.		d23O*
			Total eclipse of ☾, see p. 29.		
	23	09	☌♆☾ ♆ 2° 46′ N.		
Mon. 3	15		Moon in Perigee. Dist. from ⊕, 222,900 mi. . .	09 16	41O23
Tue. 4	6		☿ in ☊.		4O123
Wed. 5	6		☌♀♃ ♀ 2° 19′ N.		421O3
Thu. 6	4		☍♆☉ Dist. from ⊕, 2,721,000,000 mi.	06 05	42O31
Fri. 7			. . . .		431O2
Sat. 8	21		☿ in Perihelion.		43O21
Sun. 9	6	42	☾ Last Quarter.	02 54	4321O
Mon. 10			. . . .		dO3**
Tue. 11	4		♀ Greatest elongation W., 46° 21′.	23 43	O1423
Wed. 12	7	46	☌♃☾ ♃ 2° 44′ N.		12O34
	19	59	☌♀☾ ♀ 3° 42′ N.		
Thu. 13			. . . .		2O134
Fri. 14			. . . .	20 32	31O24
Sat. 15			. . . .		3O214
Sun. 16			. . . .		321O4
Mon. 17	3	25	🌑 New Moon.	17 21	O14**
Tue. 18	14		Moon in Apogee. Dist. from ⊕, 252,500 mi. . .		O423*
	22		♀ in ☋.		
	23	00	☌☿☾ ☿ 1° 01′ S.		
Wed. 19	4		☿ Greatest Hel. Lat. N.		142O3
Thu. 20			. . . .	14 10	42O13
Fri. 21			Lyrid meteors.		413O2
Sat. 22	14	24	☌♅☾ ♅ 4° 57′ S.		43O12
	21		☿ Greatest elongation E., 20° 13′.		
Sun. 23			. . . .	11 00	4321O
Mon. 24			. . . .		42O1*
Tue. 25	5	40	☽ First Quarter.		4O23*
Wed. 26			. . . .	07 49	d41O3
Thu. 27			. . . .		24O13
Fri. 28	1	42	☌♄☾ ♄ 0° 01′ N.		13O24
	17	55	☌♂☾ ♂ 0° 46′ N.		
Sat. 29			. . . .	04 38	3O124
Sun. 30	9	00	☌♆☾ ♆ 2° 42′ N.		321O4

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

THE SKY FOR MAY, 1950

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° 50′ N. to 21° 57′ N. The equation of time changes from + 2m 50s to a maximum of + 3m 45s on the 15th and then to + 2m 27s 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 24m, Decl. 17° 58′ N. and transits at 11.51. It is an evening star early in the month but it rapidly approaches the sun and is in conjunction (inferior) on the 14th. By the end of the month it may be glimpsed as a morning star very low in the east before sunrise.

Venus on the 15th is in R.A. 0h 40m, Decl. 2° 26′ N. and transits at 9.11. It is still a morning star prominent in the east before sunrise.

Mars on the 15th is in R.A. 11h 36m, Decl. 4° 08′ N. and transits at 20.03. Still in about the same position among the stars, it is now nearly to the meridian at sunset and sets soon after midnight. On the 4th it is stationary in right ascension and resumes direct, or eastward motion, among the stars.

Jupiter on the 15th is in R.A. 22h 27m, Decl. 10° 38′ S. and transits at 6.57. It is a morning star in Aquarius, well up in the south-eastern sky by sunrise.

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. 10h 59m, Decl. 8° 49′ N. and transits at 19.26. It is just west of Mars, about on the meridian at sunset and setting about midnight. On the 15th it is stationary in right ascension, resuming direct, or eastward, motion among the stars.

Uranus on the 15th is in R.A. 6h 12m, Decl. 23° 41′ N. and transits at 14.40.

Neptune on the 15th is in R.A. 12h 58m, Decl. 4° 24′ S. and transits at 21.25.

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

			MAY 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 4h 15m
d	h	m		h m	
Mon. 1			....		32O14
Tue. 2	0	19	♉ Full Moon........................	01 27	1O324
	2		Moon in Perigee. Dist. from ⊕, 221,800 mi...		
Wed. 3	22		☿ Stationary in R.A..................		O1234
Thu. 4			Eta Aquarid meteors......................	22 16	2O34*
	22		♂ Stationary in R.A..................		
Fri. 5			....		d1O24
Sat. 6			....		34O12
Sun. 7			....	19 05	3412O
Mon. 8	17	32	☾ Last Quarter......................		432O1
Tue. 9	22	42	☌♃☾ ♃ 2° 09′ N.............		41O32
Wed. 10			....	15 54	4O123
Thu. 11			....		42O3*
Fri. 12	14		☿ in ☋..............................		41O3*
	20	55	☌♀☾ ♀ 1° 58′ S.............		
Sat. 13			....	12 43	43O12
Sun. 14	13		☌☿☉ Inferior....................		312O*
Mon. 15	17		Moon in Apogee. Dist. from ⊕, 252,600 mi...		32O14
	20		♄ Stationary in R.A..................		
Tue. 16	15	36	☌☿☾ ☿ 5° 05′ S.............	09 32	1O324
	19	54	● New Moon........................		
Wed. 17			....		O1234
Thu. 18			....		21O34
Fri. 19	22	32	☌♅☾ ♅ 4° 50′ S.............	06 21	dO34*
Sat. 20			....		3O124
Sun. 21			....		312O4
Mon. 22	21		☿ in Aphelion........................	03 10	32O41
Tue. 23	6		♀ in Aphelion........................		14O2*
Wed. 24	16	28	☽ First Quarter......................	23 58	4O123
Thu. 25	9	32	☌♄☾ ♄ 0° 07′ N.............		421O3
Fri. 26	6	50	☌♂☾ ♂ 0° 01′ N.............		42O13
	19		☿ Stationary in R.A..................		
Sat. 27	17		□♃☉....................................	20 47	43O2*
	17	59	☌♆☾ ♆ 2° 46′ N.............		
Sun. 28			....		d431O
Mon. 29			....		432O1
Tue. 30	11		Moon in Perigee. Dist. from ⊕, 222,600 mi...	17 36	413O2
Wed. 31	7	43	♉ Full Moon........................		O4123

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

THE SKY FOR JUNE, 1950

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 37m and its Decl. changes from 21° 57′ N. to 23° 27′ N. at the summer solstice on the 21st and then to 23° 10′ N. at the end of the month. The equation of time changes from + 2m 27s to − 3m 31s, being zero on the 14th when the apparent sun moves to the east of the mean sun. For changes in the length of the day, see p. 13.

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

Mercury on the 15th is in R.A. 3h 56m, Decl. 17° 19′ N. and transits at 10.26. It is a morning star all month. Greatest western elongation is on the 9th but this is not a very favourable one, Mercury being only about 10° above the eastern horizon at sunrise.

Venus on the 15th is in R.A. 2h 54m, Decl. 14° 28′ N. and transits at 9.24. It is a morning star prominent in the east before sunrise. The brightness has declined appreciably since March, the stellar magnitude now being − 3.4. Seen in a telescope the disc is now about 75 per cent. illuminated.

Mars on the 15th is in R.A. 12h 05m, Decl. 0° 07′ S. and transits at 18.32. It is now moving towards Spica, and is well past the meridian at sunset and sets about midnight. Although appreciably fainter than before, it still outshines everything in that part of the sky.

Jupiter on the 15th is in R.A. 22h 37m, Decl. 9° 48′ S. and transits at 5.05. It rises about midnight and dominates the south-eastern sky the rest of the night. On the 27th it is stationary in right ascension and begins to retrograde, or move westward, among the stars.

For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc. see p. 54.

Saturn on the 15th is in R.A. 11h 02m, Decl. 8° 25′ N. and transits at 17.28. It is about half-way between Regulus and Mars, well past the meridian at sunset and setting before midnight.

Uranus on the 15th is in R.A. 6h 19m, Decl. 23° 38′ N. and transits at 12.46.

Neptune on the 15th is in R.A. 12h 56m, Decl. 4° 15′ S. and transits at 19.22.

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

			JUNE 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 3h 0m
d	h	m		h m	
Thu. 1			....		21043
Fri. 2			....	14 25	20134
Sat. 3	21		□♄☉..		3024*
Sun. 4			....		d3024
Mon. 5			....	11 14	32014
Tue. 6	11	37	☌♃☾ ♃ 1° 33′ N.		1304*
Wed. 7	6	35	☾ Last Quarter........................		01234
Thu. 8			....	08 03	12043
Fri. 9	22		☿ Greatest elongation W., 23° 45′.........		42013
Sat. 10			....		d4102
Sun. 11			....	04 51	43012
Mon. 12	1		Moon in Apogee. Dist. from ⊕, 252,200 mi...		43201
	2	47	☌♀☾ ♀ 5° 36′ S.............		
	5		☿ Greatest Hel. Lat. S.................		
Tue. 13	12	13	☌☿☾ ☿ 7° 31′ S.............		4310*
Wed. 14	19		♀ Greatest Hel. Lat. S..................	01 40	40132
Thu. 15	10	53	● New Moon........................		41203
Fri. 16	7	18	☌♅☾ ♅ 4° 44′ S.............	22 29	2013*
Sat. 17			....		10342
Sun. 18			....		30124
Mon. 19			....	19 18	3204*
Tue. 20			....		3104*
Wed. 21	17	43	☌♄☾ ♄ 0° 25′ N.............		01324
	18	37	☉ enters ♋, Summer commences. Long. of ☉, 90°		
Thu. 22			....	16 06	d1034
Fri. 23	0	12	☽ First Quarter.......................		20134
	6	29	☌♂☾ ♂ 0° 22′ N.............		
Sat. 24	1	16	☌♆☾ ♆ 2° 58′ N.............		10324
Sun. 25			....	12 55	d3012
Mon. 26	19		♆ Stationary in R.A..................		34210
Tue. 27	5		☌♅☉..		d4320
	10		♃ Stationary in R.A..................		
	16		Moon in Perigee. Dist. from ⊕, 224,900 mi...		
Wed. 28			....	09 44	40312
Thu. 29	14	58	○ Full Moon..........................		d4103
	15		□♂☉..		
Fri. 30			....		42013

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

THE SKY FOR JULY, 1950

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

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

The Sun—During July the sun's R.A. increases from 6h 37m to 8h 42m and its Decl. changes from 23° 10′ N. to 18° 14′ N. The equation of time changes from − 3m 31s to a maximum of − 6m 25s on the 27th and then to − 6m 17s at the end of the month. On the 5th the earth is in aphelion, that is, 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.

Mercury on the 15th is in R.A. 7h 55m, Decl. 22° 34′ N. and transits at 12.30. It is poorly placed for observation all month. Conjunction (superior) is on the 10th.

Venus on the 15th is in R.A. 5h 20m, Decl. 21° 55′ N. and transits at 9.52. It is a morning star, prominent in the east before sunrise.

Mars on the 15th is in R.A. 12h 55m, Decl. 6° 09′ S. and transits at 17.24. Now closing in on Spica, and passing it to the eastward late in the month, it is well down in the south-west by sunset and sets a few hours later.

Jupiter on the 15th is in R.A. 22h 36m, Decl. 10° 03′ S. and transits at 3.06. Rising in the late evening it is prominent in the southern sky during the rest of the night. There is a fairly close conjunction of Jupiter with the moon on the evening of the 3rd, and again on the morning of the 31st.

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. 11h 10m, Decl. 7° 32′ N. and transits at 15.38. It is in Leo still, east of Regulus, well down in the west by sunset and setting a few hours later.

Uranus on the 15th is in R.A. 6h 27m, Decl. 23° 34′ N. and transits at 10.56.

Neptune on the 15th is in R.A. 12h 57m, Decl. 4° 18′ S. and transits at 17.24.

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

				JULY 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 2h 15m
	d	h	m		h m	
Sat.	1	3		♂ in ♉	06 33	41O23
		6		☿ in ♌		
Sun.	2					43O12
Mon.	3	21	37	☌ ♃ ☾ ♃ 1° 05′ N		3214O
Tue.	4				03 21	32O14
Wed.	5	2		☌ ☿ ♅ ☿ 0° 26′ N		O24**
		17		⊕ in Aphelion. Dist. from ☉, 94,450,000 mi.		
		21		☿ in Perihelion		
Thu.	6	21	53	☾ Last Quarter		1O234
Fri.	7	2		□ ♆ ☉	00 10	2O134
Sat.	8					1O234
Sun.	9	16		Moon in Apogee. Dist. from ⊕, 251,600 mi.	20 59	3O124
Mon.	10	23		☌ ☿ ☉ Superior		312O4
Tue.	11					32O14
Wed.	12	6	39	☌ ♀ ☾ ♀ 6° 14′ S	17 47	4O2**
Thu.	13	17	07	☌ ♅ ☾ ♅ 4° 45′ S		41O23
Fri.	14					42O13
Sat.	15	0	05	● New Moon	14 36	41O3*
		9	30	☌ ☿ ☾ ☿ 2° 49′ S		
		19		☌ ♂ ♆ ♂ 2° 03′ S		
Sun.	16	3		☿ Greatest Hel. Lat. N		43O12
Mon.	17					4312O
Tue.	18				11 24	432O1
Wed.	19	3	15	☌ ♄ ☾ ♄ 0° 48′ N		431O2
Thu.	20					dO23*
Fri.	21	7	25	☌ ♆ ☾ ♆ 3° 14′ N	08 13	2O143
		12	43	☌ ♂ ☾ ♂ 1° 21′ N		
Sat.	22	5	50	☽ First Quarter		12O34
Sun.	23					3O124
Mon.	24				05 02	312O4
Tue.	25	8		Moon in Perigee. Dist. from ⊕, 228,000 mi.		32O14
Wed.	26					31O24
Thu.	27				01 50	O1234
Fri.	28			Delta Aquarid meteors		2O43*
		10		☌ ♀ ♅ ♀ 0° 52′ S		
		23	17	○ Full Moon		
Sat.	29				22 39	421O3
Sun.	30					d4O12
Mon.	31	3	51	☌ ♃ ☾ ♃ 0° 56′ N		d431O

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

THE SKY FOR AUGUST, 1950

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 42m to 10h 39m and its Decl. changes from 18° 14′ N. to 8° 35′ 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. 11h 15m, Decl. 3° 47′ N. and transits at 13.44. It is an evening star all month but very poorly placed for observation even on the 21st when it is at greatest eastern elongation.

Venus on the 15th is in R.A. 8h 01m, Decl. 20° 46′ N. and transits at 10.30. It is a morning star, prominent in the east just before sunrise.

Mars on the 15th is in R.A. 14h 01m, Decl. 13° 05′ S. and transits at 16.28. East of Spica and now only a little brighter, it is well down in the south-west at sunset and sets about two hours later.

Jupiter on the 15th is in R.A. 22h 25m, Decl. 11° 15′ S. and transits at 0.53. It rises soon after sunset and is prominent in the southern sky for the rest of the night. It is in opposition with the sun on the 26th.

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. 11h 22m, Decl. 6° 14′ N. and transits at 13.48. At the first of the month it is still to be seen low in the west after sunset but by the end of the month it is too close to the sun.

Uranus on the 15th is in R.A. 6h 34m, Decl. 23° 29′ N. and transits at 9.01.

Neptune on the 15th is in R.A. 12h 59m, Decl. 4° 32′ S. and transits at 15.24.

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

			Config. of Jupiter's Sat. 1h 15m
AUGUST 75th Meridian Civil Time		Min. of Algol	

	d	h	m		h m	
Tue.	1			....	19 27	43201
Wed.	2			....		43102
Thu.	3			....		40132
Fri.	4			....	16 16	42103
Sat.	5	14	56	☾ Last Quarter........................		d4203
Sun.	6	10		Moon in Apogee. Dist. from ⊕, 251,200 mi...		03142
Mon.	7			....	13 04	31024
Tue.	8	14		☿ in ☋..................................		32014
Wed.	9			....		31024
Thu.	10	1		♀ in ☊..................................	09 53	03124
		3	49	☌ ♅ ☾ ♅ 4° 50′ S..............		
Fri.	11	9	46	☌ ♀ ☾ ♀ 4° 43′ S..............		21034
Sat.	12			Perseid meteors........................		d2034
Sun.	13	11	48	● New Moon........................	06 42	01324
Mon.	14			....		d3102
Tue.	15	13	00	☌ ☿ ☾ ☿ 2° 14′ S..............		34201
		15	01	☌ ♄ ☾ ♄ 1° 11′ N..............		
Wed.	16	17		☌ ☿ ♄ ☿ 3° 31′ S..............	03 30	4310*
Thu.	17	14	02	☌ ♆ ☾ ♆ 3° 27′ N..............		40312
Fri.	18	20		☿ in Aphelion........................		41203
		23	01	☌ ♂ ☾ ♂ 2° 31′ N..............		
Sat.	19			....	00 19	42013
Sun.	20	0		Moon in Perigee. Dist. from ⊕, 229,800 mi...		4032*
		10	35	☽ First Quarter........................		
Mon.	21	6		☿ Greatest elongation E., 27° 24′.........	21 07	43102
Tue.	22			....		32401
Wed.	23			....		31204
Thu.	24			....	17 56	0124*
Fri.	25			....		12034
Sat.	26	2		☍ ♃ ☉ Dist. from ⊕, 371,200,000 mi...		20134
Sun.	27	6	31	☌ ♃ ☾ ♃ 1° 07′ N..............	14 43	10234
		9	51	○ Full Moon........................		
Mon.	28			....		31024
Tue.	29			....		32014
Wed.	30			....	11 33	31204
Thu.	31			....		43012

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

THE SKY FOR SEPTEMBER, 1950

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° 35′ 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 9.44 E.S.T. the sun crosses the equator southward, enters the sign of Libra, and autumn commences. There is a total eclipse of the sun on the 11th, not visible in North America generally. (see p. 29.) For changes in the length of the day, see p. 15.

The Moon—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 22. There is a total eclipse of the moon on the night of the 25th - 26th, visible in North America. (See p. 29.) The full moon at the time of this eclipse is the Harvest Moon.

Mercury on the 15th is in R.A. 11h 40m, Decl. 1° 55′ S. and transits at 12.02. Until late in the month it is poorly placed for observation. After inferior conjunction on the 17th it rapidly improves as a morning star and by the end of the month it is about 15° above the eastern horizon at sunrise.

Venus on the 15th is in R.A. 10h 33m, Decl. 10° 27′ N. and transits at 11.00. It is still visible as a morning star low in the east before sunrise but its position is rapidly worsening and by the end of the month it is too low at sunrise for easy observation.

Mars on the 15th is in R.A. 15h 20m, Decl. 19° 27′ S. and transits at 15.45. It is just west of Antares and comparable with it in brightness and colour. It is low in the south-west at sunset and sets shortly after.

Jupiter on the 15th is in R.A. 22h 10m, Decl. 12° 42′ S. and transits at 22.32. It rises about sunset and is prominent in the southern sky all night.

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. 11h 36m, Decl. 4° 44′ N. and transits at 12.00. It is too close to the sun for observation, conjunction being on the 15th. It is at this time that the earth passes through the plane of the rings. For the next 14½ years we will be seeing the north side of the rings.

Uranus on the 15th is in R.A. 6h 40m, Decl. 23° 26′ N. and transits at 7.04.

Neptune on the 15th is in R.A. 13h 02m, Decl. 4° 54′ S. and transits at 13.25.

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

			SEPTEMBER 75th Meridian Civil Time	Min. of Algol	Config. of Jupiter's Sat. 23h 30m
d	h	m		h m	
Fri. 1					42013
Sat. 2				08 22	41023
Sun. 3	5		Moon in Apogee. Dist. from ⊕, 251,300 mi.		43012
	9		☿ Stationary in R A.		
Mon. 4	8	53	☾ Last Quarter		4320*
Tue. 5				05 10	43210
Wed. 6	14	33	☌ ♅ ☾ ♅ 4° 54′ S.		43012
Thu. 7					1023*
Fri. 8	4		☿ Greatest Hel. Lat. S.	01 59	20143
Sat. 9					10234
Sun. 10	14	40	☌ ♀ ☾ ♀ 1° 24′ S.	22 47	d0124
Mon. 11	22	29	🌑 New Moon		32104
			Total eclipse of ☉, see p. 29.		
Tue. 12	5	21	☌ ♄ ☾ ♄ 1° 33′ N.		32104
	11	49	☌ ☿ ☾ ☿ 4° 35′ S.		
	15		♀ in Perihelion		
Wed. 13	22	43	☌ ♆ ☾ ♆ 3° 35′ N.	19 36	30124
Thu. 14					10234
Fri. 15	2		Moon in Perigee. Dist. from ⊕, 227,500 mi.		20413
	22		☌ ♄ ☉		
Sat. 16	0		☌ ☿ ♄ ☿ 5° 51′ S.	16 24	4103*
	12	13	☌ ♂ ☾ ♂ 3° 26′ N.		
Sun. 17	3		☌ ☿ ☉ Inferior		40312
Mon. 18	15	54	☽ First Quarter		43210
Tue. 19				13 13	d4320
Wed. 20					43012
Thu. 21					41032
Fri. 22				10 02	42013
Sat. 23	7	37	☌ ♃ ☾ ♃ 1° 25′ N.		14203
	9	44	☉ enters ♎, Autumn commences. Long. of ☉, 180°		
	22		☌ ☿ ♀ ☿ 2° 39′ S.		
Sun. 24					03412
Mon. 25	12		☿ Stationary in R.A.	06 50	31204
	23	21	🌕 Full Moon. Harvest Moon		
			Total eclipse of ☾, see p. 29.		
Tue. 26					32014
Wed. 27	5		☿ in ☊		3024*
Thu. 28				03 39	1024*
Fri. 29	17		☌ ♀ ♄ ♀ 0° 33′ S.		20134
Sat. 30	23		Moon in Apogee. Dist. from ⊕, 251,800 mi.		12034

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

THE SKY FOR OCTOBER, 1950

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 21s. For changes in the length of 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. The full moon of the 25th is the Hunter's Moon.

Mercury on the 15th is in R.A. 12h 35m, Decl. 1° 44′ S. and transits at 11.05. It is a morning star all month. Greatest western elongation is on the 2nd, this being quite a favourable elongation. For about a week at this time Mercury should be easily found low in the eastern sky just before sunrise. On the morning of the sixth it is interestingly close to Saturn.

Venus on the 15th is in R.A. 12h 52m, Decl. 4° 02′ S. and transits at 11.20. It is too close to the sun for easy observation.

Mars on the 15th is in R.A. 16h 48m, Decl. 23° 41′ S. and transits at 15.16. Moving rapidly eastward past Antares it may still be seen low in the south-west for a short time after sunset.

Jupiter on the 15th is in R.A. 22h 01m, Decl. 13° 27′ S. and transits at 20.25. It is well up in the south-east by sunset and dominates the southern sky most of the night. On the 24th it is stationary in right ascension and resumes direct, or eastward, motion among the stars.

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. 11h 49m, Decl. 3° 19′ N. and transits at 10.15. It is a morning star in Virgo, rising an hour or two before the sun. The rings are still quite thin after their recent edgewise presentation. On the morning of the 6th Saturn and Mercury are interestingly close together.

Uranus on the 15th is in R.A. 6h 41m, Decl. 23° 25′ N, and transits at 5.08.

Neptune on the 15th is in R.A. 13h 06m, Decl. 5° 20′ S. and transits at 11.32.

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

OCTOBER

75th Meridian Civil Time

d		h	m	Phenomenon			Min. of Algol h m	Config. of Jupiter's Sat. 21h 45m
Sun.	1	20		☿	in Perihelion		00 28	03142
Mon.	2	20		☿	Greatest elongation W., 17° 55′			d3140
Tue.	3	0		□♅☉			21 16	34201
Wed.	4	0	02	☌♅☾	♅	4° 54′ S.		43102
		2	53	☾	Last Quarter			
		13		♀	Greatest Hel. Lat. N.			
Thu.	5							d402*
Fri.	6	4		☌☿♄	☿	0° 16′ S.	18 05	42013
Sat.	7							42103
Sun.	8							40132
Mon.	9	21	28	☌♄☾	♄	1° 57′ N.	14 54	1302
Tue.	10	7	32	☌☿☾	☿	2° 32′ N.		32401
		19		☌♆☉				
		19	11	☌♀☾	♀	2° 39′ N.		
Wed.	11	8	33	●	New Moon			3104*
		9	57	☌♆☾	♆	3° 40′ N.		
Thu.	12	2		☿	Greatest Hel. Lat. N.		11 42	30124
		23		Moon in Perigee.	Dist. from ⊕, 224,300 mi.			
Fri.	13							2034*
Sat.	14							21034
Sun.	15	4	00	☌♂☾	♂	3° 52′ N.	08 31	01234
		19		♅	Stationary in R.A.			
Mon.	16							13024
Tue.	17	23	18	☽	First Quarter			32014
Wed.	18	0		☌♀♆	♀	0° 15′ S.	05 20	3104*
Thu.	19	20		☌☿♆	☿	0° 03′ N.		43012
Fri.	20	10	27	☌♃☾	♃	1° 33′ N.		4203*
Sat.	21						02 09	42103
Sun.	22			Orionid meteors				40123
Mon.	23						22 57	41302
Tue.	24	9		♃	Stationary in R.A.			43201
		23		☌☿♀	☿	0° 03′ S.		
Wed.	25	15	46	○	Full Moon.	Hunter's Moon		43120
Thu.	26						19 46	43012
Fri.	27							12043
Sat.	28	15		Moon in Apogee.	Dist. from ⊕, 252,400 mi.			d2043
Sun.	29						16 35	01234
Mon.	30							d1024
Tue.	31	7	13	☌♅☾	♅	4° 46′ S.		32014

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

THE SKY FOR NOVEMBER, 1950

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 21s to a maximum of + 16m 24s on the 4th and then to + 11m 16s 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. 15h 49m, Decl. 21° 11′ S. and transits at 12.17. It is an evening star all month after superior conjunction on the 1st but it is very poorly placed for observation.

Venus on the 15th is in RA. 15h 20m, Decl. 17° 48′ S. and transits at 11.47. It is too close to the sun all month for observation, being in superior conjunction on the 13th.

Mars on the 15th is in R.A. 18h 29m, Decl. 24° 36′ S. and transits at 14.54. It is now in Sagittarius and still visible after sunset because of its rapid eastward motion among the stars.

Jupiter on the 15th is in R.A. 22h 04m, Decl. 13° 09′ S. and transits at 18.26. It is well up in the south-east at sunset and is prominent in the south-western sky until about midnight.

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. 12h 01m, Decl. 2° 05′ N. and transits at 8.25. It is a morning star in Virgo, rising a few hours before the sun.

Uranus on the 15th is in R.A. 6h 40m, Decl. 23° 27′ N. and transits at 3.04.

Neptune on the 15th is in R.A. 13h 10m, Decl. 5° 44′ S. and transits at 9.34.

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

d	h	m	NOVEMBER 75th Meridian Civil Time	Min. of Algol h m	Config. of Jupiter's Sat. 20h 30m
Wed. 1	12		☌☿☉ Superior	13 24	31204
Thu. 2	20	00	☾ Last Quarter		30124
Fri. 3					10234
Sat. 4	13		☿ in ☋	10 13	20143
Sun. 5					4023*
Mon. 6	13	38	☌♄☾ ♄ 2° 26′ N		41032
Tue. 7	22	38	☌♆☾ ♆ 3° 48′ N	07 01	43201
Wed. 8					43210
Thu. 9	18	25	● New Moon		43012
	19	06	☌♀☾ ♀ 4° 53′ N		41032
Fri. 10			Taurid meteors		
	4	47	☌☿☾ ☿ 3° 45′ N	03 50	
	8		Moon in Perigee. Dist. from ⊕, 222,000 mi.		
Sat. 11					42013
Sun. 12	22	34	☌♂☾ ♂ 3° 44′ N		4103*
Mon. 13	18		☌♀☉ Superior	00 39	d0432
Tue. 14	20		☿ in Aphelion		32014
Wed. 15				21 28	32104
Thu. 16			Leonid meteors		30124
	10	06	☽ First Quarter		
	18	03	☌♃☾ ♃ 1° 22′ N		
Fri. 17					1024*
Sat. 18				18 17	20134
Sun. 19					1034*
Mon. 20					01324
Tue. 21	15		□♃☉	15 06	d320*
Wed. 22					34210
Thu. 23					43012
Fri. 24	10	14	○ Full Moon	11 55	41302
	19		Moon in Apogee. Dist. from ⊕, 252,600 mi.		
Sat. 25					42013
Sun. 26					41203
Mon. 27			Bielid meteors		40132
	12	08	☌♅☾ ♅ 4° 35′ S	08 44	
Tue. 28					d430*
Wed. 29	15		♀ in ☋		32410
Thu. 30				05 33	30214

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

THE SKY FOR DECEMBER, 1950

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 42m and its Decl. changes from 21° 41′ S. to 23° 27′ S. at the winter solstice on the 22nd and then to 23° 05′ S. at the end of the month. The equation of time changes from + 11m 16s to – 3m 06s, being zero on the 25th when the apparent sun passes to the east of the mean sun. For changes in the length of the day, see p. 16.

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

Mercury on the 15th is in R.A. 18h 57m, Decl. 24° 43′ S. and transits at 13.25. It is an evening star all month, but even at greatest eastern elongation on the 15th it is hard to see, being very low in the south-west at sunset.

Venus on the 15th is in R.A. 18h 00m, Decl. 24° 03′ S. and transits at 12.29. It is an evening star but poorly placed all month for easy observation.

Mars on the 15th is in R.A. 20h 09m, Decl. 21° 27′ S. and transits at 14.36. Moving into Capricornus, it is still to be seen in the south-west after sunset. It has now faded to magnitude 1.3.

Jupiter on the 15th is in R.A. 22h 17m, Decl. 11° 52′ S. and transits at 16.41. It is on the meridian shortly after sunset and is prominent in the south-western sky during the evening.

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. 12h 10m, Decl. 1° 21′ N. and transits at 6.35. It is a morning star in Virgo, rising soon after midnight.

Uranus on the 15th is in R.A. 6h 35m, Decl. 23° 32′ N. and transits at 1.02.

Neptune on the 15th is in R.A. 13h 13m, Decl. 6° 01′ S. and transits at 7.39.

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

	d	h	m	DECEMBER 75th Meridian Civil Time	Min. of Algol h m	Config. of Jupiter's Sat. 19h 30m
Fri.	1					31O24
Sat.	2	11	22	☾ Last Quarter		2O134
Sun.	3				02 22	12O34
Mon.	4	3	24	☌♄☾ ♄ 3′ 01′ N		O1234
Tue.	5	4		☿ Greatest Hel. Lat. S	23 11	d1O24
		4		♂ Greatest Hel. Lat. S		
		10	33	☌♆☾ ♆ 4° 04′ N		
Wed.	6					d32O4
Thu.	7					3O4**
Fri.	8	20		Moon in Perigee. Dist. from ⊕, 221,700 mi.	20 00	314O2
Sat.	9	4	28	☾ Last Quarter		42O13
		15	28	☌♀☾ ♀ 4° 36′ N		
Sun.	10	13	19	☌☿☾ ☿ 2° 38′ N		421O3
Mon.	11	20	19	☌♂☾ ♂ 3° 01′ N	16 49	4O123
Tue.	12			Geminid meteors		41O32
Wed.	13					432O1
Thu.	14	7	43	☌♃☾ ♃ 0° 53′ N	13 38	43O**
Fri.	15	10		☿ Greatest elongation E., 20° 29′		431O2
Sat.	16	0	56	☽ First Quarter		24O1*
Sun.	17				10 27	21O43
Mon.	18					O1234
Tue.	19					1O324
Wed.	20				07 17	23O14
Thu.	21	21		Moon in Apogee. Dist. from ⊕, 252,400 mi.		321O4
Fri.	22	5	14	☉ enters ♑, Winter commences. Long. of ☉, 270°		d3O24
Sat.	23	5		☿ Stationary in R.A.	04 06	2O14*
Sun.	24	4		☿ in ☊		21O43
		5		□♄☉		
		5	23	🌕 Full Moon		
		16	04	☌♅☾ ♅ 4° 30′ S		
Mon.	25					4O213
Tue.	26				00 55	41O23
Wed.	27	16		☌☿♀ ☿ 2° 09′ N		423O1
Thu.	28	19		☿ in Perihelion	21 44	4321O
Fri.	29	13		☍♅☉ Dist. from ⊕, 1,663,000,000 mi.		431O2
Sat.	30	10		♂ in Perihelion		d43O*
Sun.	31	12	57	☌♄☾ ♄ 3° 36′ N	18 33	421O3
						4O213

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

PHENOMENA OF JUPITER'S SATELLITES, 1950

By Charles E. Apgar, Westfield, New Jersey

JANUARY

d	h	m	Sat.	Phen.
7	17	40	IV	TI
10	17	52	I	OD
11	17	56	I	Se

Jupiter being near the Sun, phenomena of the Satellites are not given from January 15 to March 28.

APRIL

d	h	m	Sat.	Phen.
3	4	46	I	Te
10	4	28	I	TI
17	3	52	III	ER
17	4	49	III	OD
24	4	13	III	ED
25	4	26	I	ED
26	3	40	II	Se
26	3	59	I	Se

MAY

d	h	m	Sat.	Phen.
3	3	24	II	SI
3	3	36	I	SI
4	4	25	I	OR
5	3	23	III	TI
5	3	26	II	OR
12	3	32	I	Te
14	2	54	IV	OD
19	3	10	II	ED
19	3	11	I	TI
19	4	7	I	Se
20	2	46	I	OR
21	3	34	II	Te
23	1	50	III	OD
26	3	45	I	SI
28	1	49	I	Te
28	3	19	II	TI
28	3	26	II	Se
30	3	52	III	ER
31	1	53	IV	OR

JUNE

d	h	m	Sat.	Phen.
3	2	54	I	ED
4	1	27	I	TI
4	2	27	I	Se
4	3	10	II	SI
4	3	42	I	Te
5	1	3	I	OR
6	3	8	II	OR
10	3	5	III	Te
11	2	0	I	SI
11	3	19	I	TI
12	2	55	I	OR
15	0	37	II	Te
16	2	36	IV	ED
17	1	43	III	Se
17	3	28	III	TI
18	3	54	I	SI
19	1	10	I	ED
20	0	38	I	Se
20	1	53	I	Te
20	2	43	II	ED
22	0	15	II	TI
22	0	35	II	Se
22	3	7	II	Te
24	2	9	III	SI
25	0	5	IV	TI
26	3	5	I	ED
27	0	16	I	SI
27	1	27	I	TI
27	2	32	I	Se
27	3	43	I	Te
28	0	42	III	OR
28	1	4	I	OR
29	0	18	II	SI
29	2	43	II	TI
29	3	11	II	Se
30	23	46	II	OR

JULY

d	h	m	Sat.	Phen.
3	1	28	IV	ER
4	2	9	I	SI
4	3	16	I	TI
4	23	27	I	ED
4	23	52	III	ER
5	0	53	III	OD
5	2	53	I	OR
5	22	54	I	Se
5	23	59	I	Te
6	2	54	II	SI
8	2	10	II	OR
11	4	3	I	SI
12	0	17	III	ED
12	1	21	I	ED
12	3	51	III	ER
12	22	31	I	SI
12	23	30	I	TI
13	0	48	I	Se
13	1	46	I	Te
13	19	50	I	OR
14	23	43	II	ED
16	23	33	II	Te
19	3	16	I	ED
19	4	17	III	ED
19	22	20	IV	OD
20	0	25	I	SI
20	1	17	I	TI
20	2	42	I	Se
20	3	32	IV	OR
20	3	33	I	Te
21	0	53	I	OR
21	21	59	I	Te
22	2	18	II	ED
23	0	56	III	Te
23	23	2	II	TI
24	0	18	II	Se
24	1	53	II	Te
27	2	19	I	SI
27	3	2	I	TI
27	23	39	I	ED
28	0	25	IV	SI
28	2	39	I	OR
28	21	29	I	TI
28	23	4	I	Se
28	23	45	I	Te
29	22	10	III	SI
30	0	56	III	TI
30	1	42	III	Se
30	4	19	III	Te
31	0	1	II	SI
31	1	20	II	TI
31	2	55	II	Se
31	4	11	II	Te

AUGUST

d	h	m	Sat.	Phen.
1	22	17	II	OR
3	4	13	I	SI
4	1	33	I	ED
4	4	24	I	OR
4	22	41	I	SI
4	23	13	I	TI
5	0	58	I	Se
5	1	30	I	Te
5	22	50	I	OR
6	2	10	III	SI
6	4	16	III	TI
7	2	37	II	SI
7	3	36	II	TI
8	20	47	II	ED
9	0	32	II	OR
9	21	29	III	OR
11	3	28	I	ED
12	0	35	I	SI
12	0	57	I	TI
12	2	53	I	Se
12	3	14	I	Te
12	21	56	I	ED
13	0	34	I	OR
13	21	21	I	Se
13	21	40	I	Te
13	21	51	IV	TI
13	23	17	IV	Se
14	2	3	IV	Te
15	23	23	II	ED
16	2	47	II	OR
16	20	20	III	ED
17	0	47	III	OR
17	21	25	II	Se
17	21	50	II	Te
19	2	30	I	SI
19	2	41	I	TI
19	4	47	I	Se
19	23	51	I	ED
20	2	17	I	OR
20	20	58	I	SI
20	21	7	I	TI
20	23	16	I	Se
20	23	24	I	Te
21	20	43	I	OR
22	3	19	IV	ED
23	1	59	II	ED
24	0	21	III	ED
24	4	3	III	OR
24	21	8	II	SI
24	21	12	II	TI
25	0	1	II	Se
25	0	4	II	Te
26	4	25	I	SI
26	4	25	I	TI
27	1	44	I	OD
27	4	3	I	ER
27	22	50	I	TI
27	22	53	I	SI
28	1	7	I	Te
28	1	11	I	Se
28	20	10	I	OD
28	22	32	I	ER
29	19	33	I	Te
29	19	39	I	Se
30	4	23	II	OD
31	3	52	III	OD
31	23	26	II	TI
31	23	45	II	SI

SEPTEMBER

d	h	m	Sat.	Phen.
1	2	18	II	Te
1	2	37	II	Se
2	20	48	II	ER
3	3	28	I	OD
3	20	47	III	Te
3	21	44	III	Se
4	0	34	I	TI
4	0	48	I	SI
4	2	51	I	Te
4	3	6	I	Se
4	21	54	I	OD
5	0	26	I	ER
5	19	17	I	SI
5	21	17	I	Te
5	21	34	I	Se
8	1	41	II	TI
8	2	2	IV	ER
8	2	21	II	SI
9	19	45	II	OD
9	23	25	II	ER
10	20	39	III	TI
10	22	16	III	SI
11	0	5	III	Te
11	1	46	III	Se
11	2	19	I	TI
11	2	43	I	SI
11	23	38	I	OD
12	2	21	I	ER
12	20	45	I	TI
12	21	17	I	SI
12	23	2	I	Te
12	23	29	I	Se
13	20	50	I	ER
16	2	7	IV	TI
16	22	2	II	OD
17	2	2	II	ER
17	23	58	III	TI
18	2	17	III	SI
18	19	56	II	Te
18	21	7	II	Se
19	1	23	I	OD
19	22	30	I	TI
19	23	7	I	SI
20	0	47	I	Te
20	1	24	I	Se
20	19	49	I	OD
20	22	45	I	ER
21	19	14	I	Te
21	19	53	I	Se
21	19	57	III	ER
24	0	19	II	OD
24	20	12	IV	ER
25	19	23	II	TI
25	20	52	II	SI
25	22	14	II	Te
25	23	43	II	Se
27	0	16	I	TI
27	1	3	I	SI
27	2	33	I	Te
27	21	35	I	OD
28	0	40	I	ER
28	18	43	I	TI
28	19	31	I	SI
28	21	0	I	Te
28	21	48	I	Se
28	23	58	III	ER
29	19	9	I	ER

OCTOBER

d	h	m	Sat.	Phen.
2	21	22	IV	Te
2	21	42	II	TI
2	23	28	II	SI
3	0	33	II	Te
3	1	29	IV	SI
4	2	4	I	TI
4	20	37	II	ER

October—cont'd

d	h	m	Sat.	Phen.
4	23	22	I	OD
5	20	31	I	TI
5	20	40	III	OD
5	21	27	I	SI
5	22	47	I	Te
5	23	44	I	Se
6	0	10	III	OR
6	0	31	III	ED
6	21	4	I	ER
7	18	13	I	Se
10	0	4	II	TI
11	0	20	IV	OD
11	18	14	II	OD
11	23	15	II	ER
12	1	11	I	OD
12	22	19	I	TI
12	23	23	I	SI
13	0	13	III	OD
13	0	36	I	Te
13	18	12	II	Se
13	19	38	I	OD
13	22	59	I	ER
14	19	3	I	Te
14	20	8	I	Se
16	18	24	III	SI
16	21	50	III	Se
18	20	40	II	OD
19	19	47	IV	SI
20	0	5	IV	Se
20	0	9	I	TI
20	17	58	II	SI
20	18	31	II	Te
20	20	48	II	Se
20	21	28	I	OD
21	0	54	I	ER
21	18	37	I	TI
21	19	47	I	SI
21	20	54	I	Te
21	22	4	I	Se
22	19	23	I	ER
23	21	3	III	Te
23	22	27	III	SI
25	23	8	II	OD
27	18	8	II	TI
27	20	35	II	SI
27	20	59	II	Te
27	21	7	IV	OR
27	23	18	I	OD
27	23	24	II	Se
28	20	29	I	TI
28	21	43	I	SI
28	22	45	I	Te
28	23	59	I	Se
29	17	46	I	OD
29	17	51	II	ER
29	21	18	I	ER
30	18	28	I	Se
30	21	22	III	TI

NOVEMBER

d	h	m	Sat.	Phen.
3	20	4	III	ER
3	20	38	II	TI
3	23	11	II	SI
3	23	28	II	Te
4	22	21	I	TI
4	23	39	I	SI
5	18	17	IV	Se
5	19	39	I	OD
5	20	30	II	ER
5	23	13	I	ER
6	18	8	I	SI
6	19	7	I	Te
6	20	24	I	Se
7	17	42	I	ER
10	18	46	III	OR
10	20	40	III	ED
10	23	10	II	TI
12	17	31	II	OD
12	21	32	I	OD
12	23	9	II	ER
13	18	44	I	TI
13	20	4	I	SI
13	21	1	I	Te
13	22	20	I	Se
13	22	34	IV	ED
14	17	54	II	Se
14	19	38	I	ER
17	19	12	III	OD
17	22	44	III	OR
19	20	8	II	OD
20	20	40	I	TI
20	22	0	I	SI
20	22	56	I	Te
21	17	41	II	SI
21	17	52	II	Te
21	17	56	I	OD
21	17	58	III	Se
21	19	19	IV	TI
21	20	29	II	Se
21	21	33	I	ER
22	17	25	I	Te
22	18	45	I	Se
27	22	36	I	TI
28	17	40	II	TI
28	18	39	III	SI
28	19	52	I	OD
28	20	17	II	SI
28	20	30	II	Te
28	22	0	III	Se
29	18	25	I	SI
29	19	22	I	Te
29	20	41	I	Se
30	17	46	II	ER
30	17	57	I	ER
30	20	54	IV	ER

DECEMBER

d	h	m	Sat.	Phen.
5	17	20	III	TI
5	20	19	II	TI
5	20	50	III	Te
5	21	49	I	OD
6	19	3	I	TI
6	20	21	I	SI
6	21	20	I	Te
7	19	52	I	ER
7	20	25	II	ER
8	18	37	IV	Te
12	21	33	III	TI
13	21	1	I	TI
14	17	36	II	OD
14	18	16	I	OD
15	17	48	I	Te
15	19	2	I	Se
16	17	35	II	Se
16	20	13	III	ER
21	20	15	I	OD
21	20	22	II	OD
22	17	31	I	TI
22	18	42	I	SI
22	19	48	I	Te
22	20	58	I	Se
23	17	23	II	SI
23	17	54	II	Te
23	18	12	I	ER
23	19	32	III	OR
23	20	11	II	Se
23	20	53	III	ED
29	19	31	I	TI
29	20	38	I	SI
30	17	48	II	TI
30	19	59	II	SI
30	20	7	I	ER
30	20	22	III	OD
30	20	38	II	Te

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 J. F. Heard

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 1950 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. Emersions at the bright limb of the moon are given only in the case of stars brighter than magnitude 3.5. 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, 1950

Date	Star	Mag.	I or E	Age of Moon	Toronto E.S.T.	Toronto a	Toronto b	Toronto P	Montreal E.S.T.	Montreal a	Montreal b	Montreal P
				d	h m	m	m	°	h m	m	m	°
Aug. 7	27 Tau	3.8	E	23.1	Low	.. ..	.....	...	00 24.8	−0.4	+0.7	304
20	π Scr	3.0	I	7.3	Sun	.....	.....	...	18.59.8	−1.9	−0.3	73
20	π Scr	3.0	E	7.3	19 58.1	−1.6	−1.4	315	20 04.6	−1.5	−1.5	318
Oct. 27	23 Tau	4.2	I	16.6	20 53.9	−0.2	+1.9	63	20 59.0	−0.4	+1.9	68
27	η Tau	3.0	I	16.6	21.34.6	−0.3	+2.1	56	21 41.0	−0.6	+2.0	61
27	23 Tau	4.2	E	16.6	22 00.6	−0.6	+1.9	246	22 08.3	−0.7	+2.0	240
27	27 Tau	3.8	I	16.6	22 31.3	−1.9	+0.6	111	22 44.3	−2.5	−0.2	119
27	η Tau	3.0	E	16.6	22 45.1	−1.0	+1.8	251	22 54.7	−1.1	+1.8	246
27	27 Tau	3.8	E	16.6	23 21.8	−0.1	+3.5	197	23 28.8	+0.1	+4.2	189
Nov. 24	η Tau	3.0	I	14.5	06 18.3	+0.1	−1.2	84	Low	.....	.....	...

LUNAR OCCULTATIONS VISIBLE AT VANCOUVER AND CALGARY, 1950

Date	Star	Mag.	I or E	Age of Moon	Vancouver P.S.T.	Vancouver a	Vancouver b	Vancouver P	Calgary M.S.T.	Calgary a	Calgary b	Calgary P
				d	h m	m	m	°	h m	m	m	°
Jan. 2	136 Tau	4.5	I	14.3	17 14.5	0.0	+1.4	92	18 18.0	−0.3	+1.3	101
11	α Vir	1.2	I	22.8	06 02.4	+0.1	−2.0	182	07 03.2	−0.6	−1.3	161
11	α Vir	1.2	E	22.8	06 43.7	−2.5	+0.3	251	08 01.2	−1.7	−0.8	269
30	136 Tau	4.5	I	12.2	04 26.4	+0.5	−1.6	117	Low	.....	.....	...
Apr. 19	27 Tau	3.8	I	2.8	20 27.5	—	—	10	No. occ.	.....	.....	...
Sep. 3	17 Tau	3.8	I	20.8	03 23.4	−1.1	+1.9	56	04 37.2	−1.4	+1.4	64
3	20 Tau	4.0	I	20.8	04 24.5	−0.6	+3.5	19	Sun	.....	.....	...
3	17 Tau	3.8	E	20.8	04 44.6	−1.7	+0.8	255	Sun	...	.....	...
26-27	ε Psc	4.4	I	15.2	23 53.0	−1.3	+1.4	56	01 07.4	−1.5	+0.8	67
27	ε Psc	4.4	E	15.2	01 11.2	−1.2	+1.2	226	02 22.8	−1.0	+1.1	218
Oct. 27	23 Tau	4.2	E	16.6	18 46.6	—	—	319	19 52.4	−0.5	+1.0	306
27	27 Tau	3.8	I	16.6	19 24.7	+0.4	+1.9	45	20 24.6	+0.2	+1.9	52
27	27 Tau	3.8	E	16.6	20 18.9	−0.3	+1.6	270	21 24.2	−0.4	+1.7	261
Nov. 24	η Tau	3.0	I	14.5	02 50.6	−1.1	−2.0	102	03 56.5	−0.8	−1.7	93
24	η Tau	3.0	E	14.5	03 58.5	−0.9	−0.3	235	05 04.5	−0.6	−0.9	247

METEORS AND METEORITES

By Peter M. Millman

A meteor or "shooting star" appears when one of the larger particles comprising the dust of space happens to encounter the earth's atmosphere at high velocity. In general the particle is completely vapourized high in the upper atmosphere but occasionally it is large enough so that a portion reaches the earth's surface, and this solid lump of iron or stone is known as a meteorite. The study of meteors and meteorites contributes a large amount of valuable information concerning the nature and origin of the universe and there are many intriguing problems in this field awaiting solution. The amateur can do work of lasting value here, as the large and very expensive instrumental equipment required for most astronomical research is not needed for the study of meteors.

For any given observation point there is no way of predicting in advance just where the next meteor will appear, in other words, it is chiefly a matter of chance whether it appears north, south, east, west, or directly overhead. Taking an overall average for the whole year and all parts of the night a single observer with an unobstructed view of the sky will see 10 meteors per hour on a clear moonless night. This statement must be qualified by the fact that meteors are roughly twice as numerous during the second half of the night as they are during the first, and their rate of appearance is approximately doubled for the second half of the year as compared with the first six months. There is also a great variation in meteor frequency from one night to the next. The observed meteors range in brightness all the way from those only visible in fairly large telescopes up to great fireballs exceeding the full moon in luminosity. The frequency of meteors increases approximately in inverse proportion to their brightness.

In addition to the stray so-called "sporadic" meteors which appear on any night of the year, there are various swarms of meteors, each swarm moving along in its particular elliptical orbit about the sun. In most cases these meteor orbits are found to correspond closely with those of certain comets. When the earth encounters such a swarm of meteors the apparent paths, when projected backwards in the sky, all seem to meet in a point, a result of perspective. This point indicates the direction from which the meteors are coming and is called the "radiant". The meteor shower is commonly called after the constellation in which the radiant is located. The best known meteor showers are listed in the accompanying table which has been compiled from various sources. Of these showers the Perseids and Geminids are the most consistent. Some, such as the Leonids, Giacobinids, and Bielids, have provided spectacular displays in certain years and in others have been almost or totally absent. The Bielids have scarcely been observed at all since the 19th century; the Giacobinids were first observed in 1933. The hourly number listed in the table is the approximate number of meteors which are likely to be seen in one hour by a single observer on a clear moonless night at the shower maximum in a normal year.

Amateur cooperation assists greatly in the scientific study of meteors. Visual observations may be divided into two types:

(a) *Systematic programs.* These may be carried out either by a single observer or by groups of observers. In this case the sky is observed continuously for a period of time and the numbers of meteors seen, their brightness, colour, position, and other characteristics recorded. Plotting the observations on a star map is more important when the program is carried out in cooperation with another party observing some distance away.

(b) *The chance observation of a bright meteor or fireball.* Any meteor markedly brighter than Jupiter (mag. −2) should be carefully recorded and the observation forwarded to some observatory where meteor records are being kept. In this case it is very important to note the position of the meteor in the sky, as well as all other features observed. Information equally important, but often forgotten, is the exact time and date of the phenomenon and an accurate description of where the observer was situated, given within 100 yds. if possible.

Skilled visual or photographic observations from two or more stations make possible the computation of meteor heights. Most meteors are visible in the range from 40 to 80 miles above the earth's surface and move with velocities ranging from 20 to 60 miles per second.

Continued on page 80.

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
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
II	19	400	5,500,000		2 yr.		200?	Kuiper, 1949

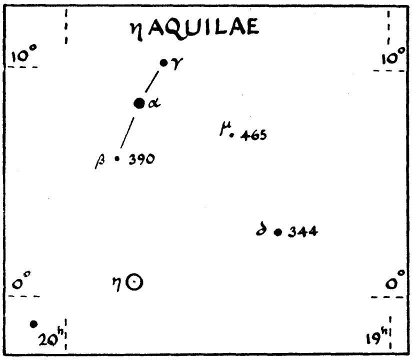
***As seen from the sun.**

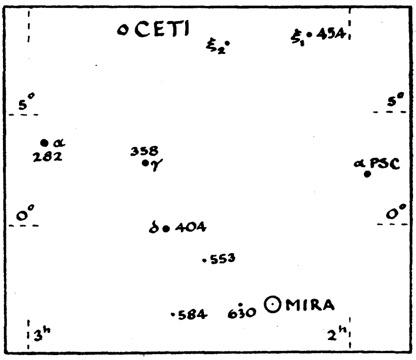
Satellites Io, Europa, Ganymede, Callisto are usually denoted I, II, III, IV respectively, in order of distance from the planet.

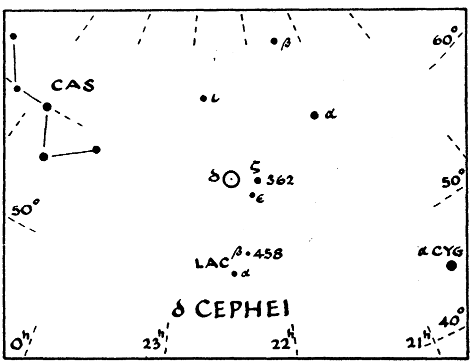
VARIABLE STARS

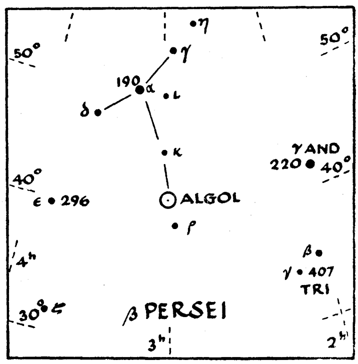
Much pleasure may be derived from the estimation of the brightness of variable stars. Maps of the fields of four bright variable stars are given below. In each case the magnitudes of several suitable comparison stars are given. These magnitudes are given as magnitudes, tenths and hundredths, with the 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	Schmodt
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.	18	54Schmidt
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	470	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	5.0A; 6.3G5	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.

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†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

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
‖γ Velr.	08	−47 12	2.2	OW9	.002	. . . . .	. . . . .	. . . . . .	+ 3.5
‖ε Cari.	21	−59 21	1.7	K0	.030	.010	326	−3.3	+11.5
ο 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
μ^1 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
||α^1 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
ι^1 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 Agil........	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.	Dist. l.y
869		h Per	02 15.5	+56 55	Op	30	7			4,300
884		χ Per	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.

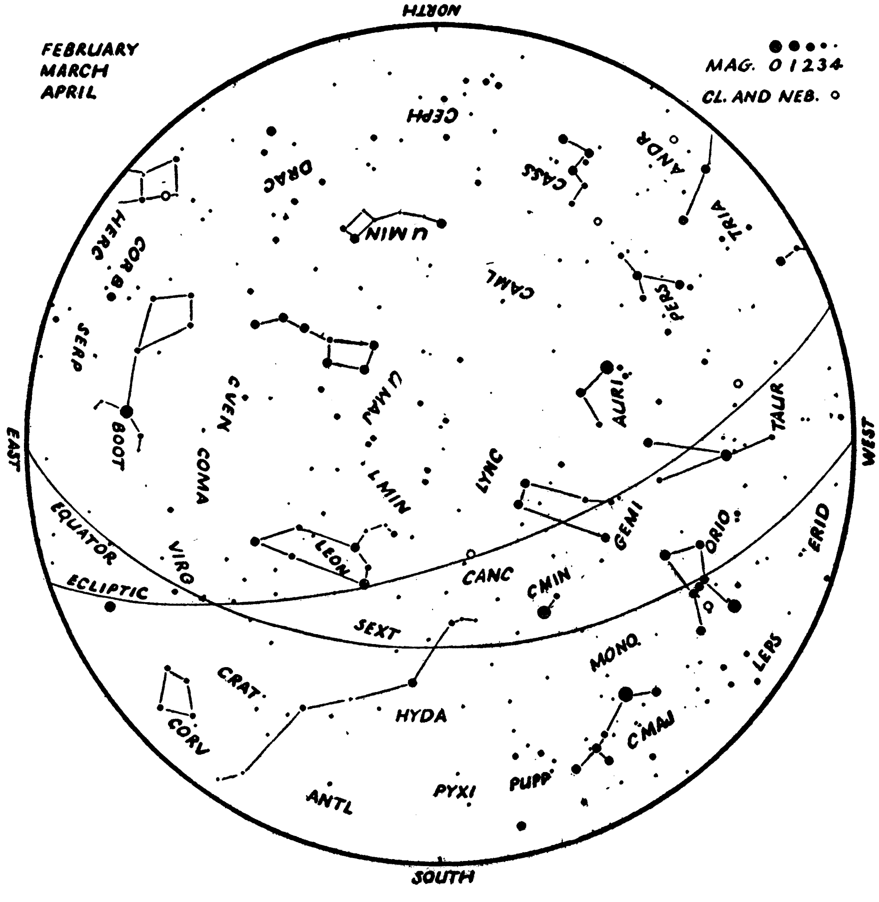
N.G.C.	M	Con	α 1950 h m	δ ° ′	Cl	Size ′	m n	m *	Dist. l.y.	Name
650	76	Per	01 38.3	+51 20	Pl	1.5	11	17	15,000	
1952	1	Tau	05 31.5	+21 59	Pl	6	11	16	10,000	Crab
1976	42	Ori	05 32.5	−05 25	Dif	30			1,800	Orion
B33		Ori	05 38.0	−02 29	Drk	4			300	Horsehead
2261		Mon	06 36.4	+08 47	Dif	2				Hubble's var
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 l.y.	Vel. km/sec
221	32	And	00 39.9	+40 36	E	3×3	8.8	800,000	− 185
224	31	And	00 40.0	+41 00	Sb	160×40	5.0	800,000	− 220
SMC		Tuc	00 53	−72 38	I	220×220	1.5	100,000	+ 170
598	33	Tri	01 31.0	+30 24	Sc	60×40	7.0	700,000	− 70
LMC		Dor	05 21	−69 27	I	430×530	0.5	90,000	+ 280
3031	81	UMa	09 51.5	+69 18	Sb	16×10	8.3	2,400,000	− 30
3034	82	UMa	09 51.8	+69 58	I	7× 2	9.0	2,600,000	+ 290
3368	96	Leo	10 44.1	+12 05	Sa	7× 4	10.0	5,700,000	+ 940
3623	65	Leo	11 16.3	+13 22	Sb	8× 2	9.9	5,000,000	+ 800
3627	66	Leo	11 17.6	+13 16	Sb	8× 2	9.1	4,300,000	+ 650
4258		CVn	12 16.5	+47 34	Sb	20× 6	8.7	4,600,000	+ 500
4374	84	Vir	12 22.5	+13 09	E	3× 2	9.9	6,000,000	+1050
4382	85	Com	12 22.9	+18 28	E	4× 2	10.0	3,700,000	+ 500
4472	49	Vir	12 27.2	+08 16	E	5× 4	10.1	5,700,000	+ 850
4565		Com	12 33.9	+26 16	Sb	15× 1	11.0	7,600,000	+1100
4594		Vir	12 37.4	−11 20	Sa	7× 2	9.2	7,200,000	+1140
4649	60	Vir	12 41.1	+11 50	E	4× 3	9.5	7,500,000	+1090
4736	94	CVn	12 48.6	+41 24	Sb	5× 4	8.4	3,000,000	+ 290
4826	64	Com	12 54.3	+21 57	Sb	8× 4	9.2	1,300,000	+ 150
5005		CVn	13 08.6	+37 20	Sc	5× 2	11.1	6,600,000	+ 900
5055	63	CVn	13 13.6	+42 18	Sb	8× 3	9.6	3,600,000	+ 450
5194	51	CVn	13 27.8	+47 27	Sc	12× 6	7.4	3,000,000	+ 250
5236	83	Hya	13 34.2	−29 36	Sc	10× 8	8	2,900,000	+ 500
6822		Sgr	19 42.4	−14 53	I	20×10	11	1,000,000	− 150
7331		Peg	22 34.8	+33 59	Sb	9× 2	10.4	5,200,000	+ 500

STAR MAP I

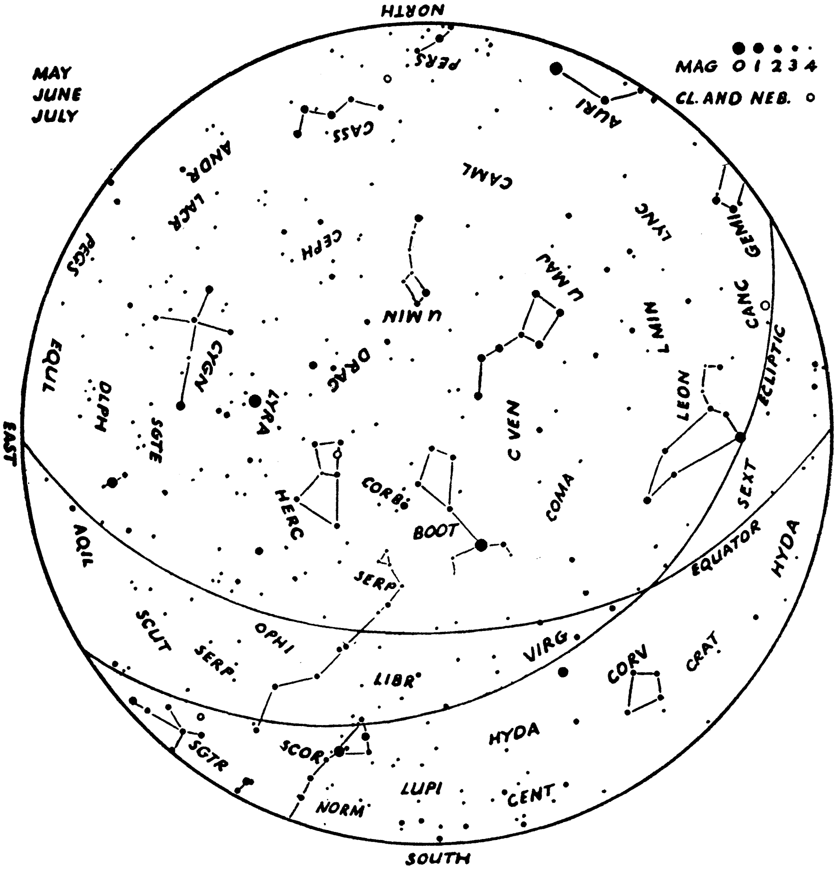


The above map represents the evening sky at

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

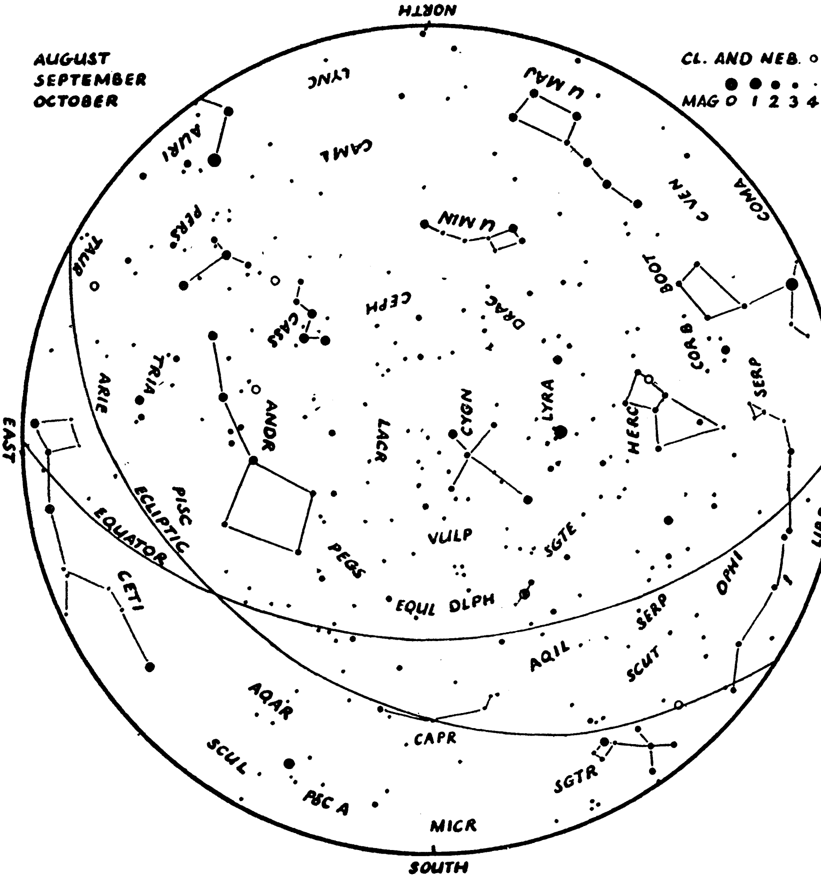


The above map represents the evening sky at

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

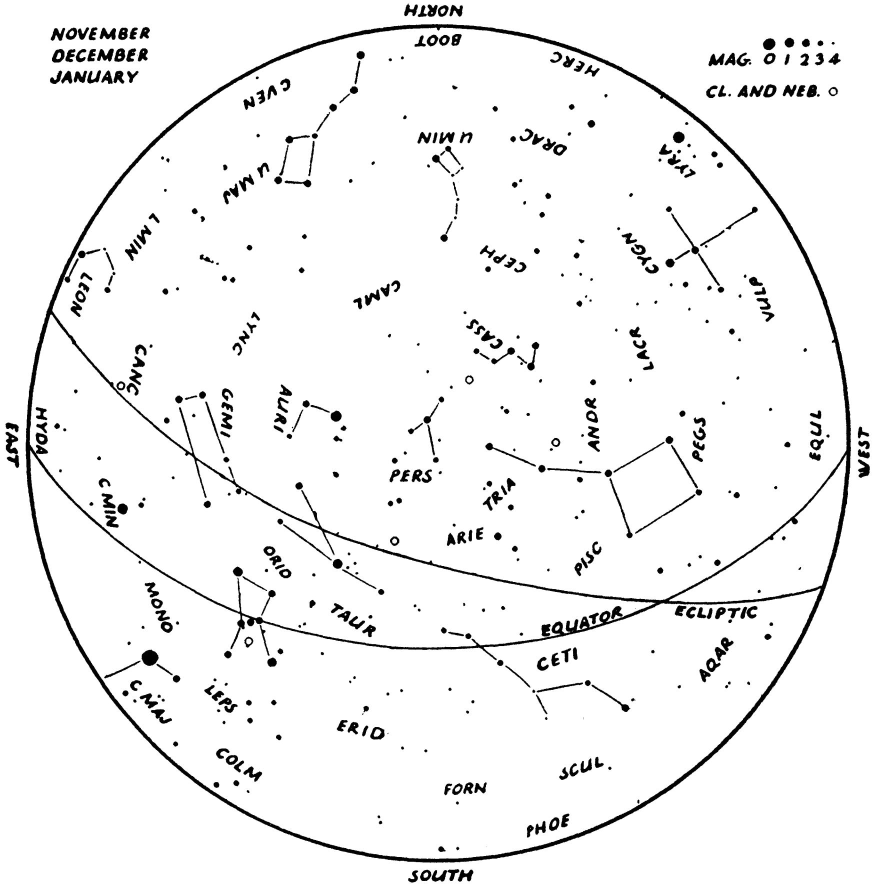


The above map represents the evening sky at

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.

Date	P	B_0	L_0	Date	P	B_0	L_0
	°	°	°		°	°	°
Jan. 1	+ 2.27	−3.05	204.35	July 5	− 1.12	+3.32	282.62
6	− 0.16	−3.62	138.50	10	+ 1.15	+3.85	216.44
11	− 2.58	−4.16	72.65	15	+ 3.40	+4.34	150.28
16	− 4.95	−4.68	6.81	20	+ 5.60	+4.81	84.12
21	− 7.26	−5.15	300.98	25	+ 7.75	+5.25	17.97
26	− 9.49	−5.58	235.15	30	+ 9.83	+5.64	311.83
31	−11.63	−5.97	169.32	Aug. 4	+11.83	+6.00	245.70
Feb. 5	−13.65	−6.31	103.48	9	+13.73	+6.32	179.59
10	−15.54	−6.60	37.65	14	+15.52	+6.60	113.49
15	−17.31	−6.84	331.81	19	+17.21	+6.83	47.40
20	−18.94	−7.02	265.97	24	+18.78	+7.01	341.33
25	−20.42	−7.16	200.12	29	+20.21	+7.14	275.26
Mar. 2	−21.74	−7.23	134.26	Sep. 3	+21.51	+7.22	209.21
7	−22.91	−7.25	68.39	8	+22.67	+7.25	143.18
12	−23.92	−7.21	2.50	13	+23.69	+7.23	77.16
17	−24.75	−7.12	296.60	18	+24.55	+7.15	11.15
22	−25.42	−6.98	230.69	23	+25.25	+7.02	305.15
27	−25.92	−6.78	164.75	28	+25.78	+6.84	239.16
April 1	−26.24	−6.53	98.80	Oct. 3	+26.16	+6.61	173.18
6	−26.37	−6.24	32.82	8	+26.35	+6.33	107.21
11	−26.33	−5.90	326.83	13	+26.36	+6.00	41.25
16	−26.10	−5.52	260.82	18	+26.18	+5.63	335.30
21	−25.69	−5.10	194.79	23	+25.82	+5.21	269.35
26	−25.09	−4.64	128.73	28	+25.26	+4.76	203.41
May 1	−24.32	−4.15	62.66	Nov. 2	+24.50	+4.26	137.48
6	−23.35	−3.64	356.57	7	+23.54	+3.73	71.55
11	−22.22	−3.09	290.46	12	+22.40	+3.18	5.63
16	−20.91	−2.53	224.33	17	+21.05	+2.59	299.72
21	−19.44	−1.95	158.20	22	+19.53	+1.99	233.81
26	−17.82	−1.36	92.05	27	+17.82	+1.37	167.91
31	−16.05	−0.77	25.88	Dec. 2	+15.96	+0.74	102.01
June 5	−14.16	−0.16	319.71	7	+13.94	+0.10	36.12
10	−12.16	+0.44	253.53	12	+11.80	−0.54	330.24
15	−10.06	+1.04	187.35	17	+ 9.54	−1.18	264.37
20	− 7.89	+1.63	121.17	22	+ 7.21	−1.81	198.50
25	− 5.66	+2.21	54.99	27	+ 4.82	−2.42	132.63
30	− 3.40	+2.78	348.80	Jan. 1	+ 2.39	−3.02	66.78

P—The position angle of the axis 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 logitude of the centre of the disk, from Carrington's solar meridian.

Carrington's Rotation Numbers—Greenwich date of commencement of the synodic rotations.

No.	Commences	No.	Commences	No.	Commences
1288	1949 Dec. 20.18	1293	1950 May 5.74	1298	1950 Sept. 18.84
1289	1950 Jan. 16.52	1294	June 1.96	1299	Oct. 16.13
1290	Feb. 12.86	1295	June 29.15	1300	Nov. 12.43
1291	Mar. 12.19	1296	July 26.36	1301	Dec. 9.74
1292	Apr. 8.49	1297	Aug. 22.59		

Continued from page 57.

METEORS AND METEORITES

Many common terrestrial stones have mistakenly been thought to have a meteoric origin, and any supposed meteorite should be investigated carefully. Contrary to popular belief, meteorites do not contain valuable minerals in quantities sufficient to make them of commercial interest, but they have a definite scientific value. Meteorites are of two main types, iron and stone. The irons have specific gravity ranging from 7 to 8 and are amost entirely composed of metallic nickel-iron. The stones have a specific gravity ranging from 2 to 4 or greater and, with very few exceptions, contain metallic inclusions that are revealed on grinding or filing the specimen. A freshly fallen meteorite is covered by a smooth black fusion crust but oxidation removes this where the object has lain in the ground for any length of time. Any object whose history and structure indicate that it is of meteoric origin should be submitted to some authority for further study

A more detailed discussion of both visual and photographic observations of meteors will be found in "General Instructions for Meteor Observing." Meteor observations for the United States may be sent to the American Meteor Society, Flower Observatory, Upper Darby, Pa.; those for Canada to the writer at the Dominion Observatory, Ottawa, Ont.

PRINCIPAL METEOR SHOWERS FOR THE NORTHERN HEMISPHERE

Shower	Approx. Radiant		Current Maximum Date	Spectacular Displays	Hourly Number (all meteors)	Duration (in days)	Abbreviations (for use in observing records)
	α	δ					
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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Save More than ½ Regular Cost!

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METAL PARTS — Set includes all Metal Parts—Completely finished—for assembly of 7 × 50 Binoculars. No machining required. A sturdy Binocular Carrying Case is optional with each set of Metal Parts.
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plus $4.80 for Case—Total, $44.20

OPTICS—Set includes all Lenses and Prisms you need for assembling 7 × 50 Binoculars These Optics are in excellent condition—perfect or near perfect—and have new low reflection coating.
Stock No. 5102-J—7 × 50 Optics
$25.00 Postpaid

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COMPLETE OPTICS & METAL PARTS—Model M-13A1, 6 × 30 Binoculars (Waterproof Model). Everything you need—ready for assembly. When finished will look like regular factory job costing $102 to $120. Optics are new, in perfect or near-perfect condition. Have new low reflection coating. Metal Parts new and perfect, all completely finished. Complete assembly instructions included.
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