# THE OBSERVER'S HANDBOOK FOR 1952

PUBLISHED BY

**The Royal Astronomical Society of Canada**

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

FORTY-FOURTH YEAR OF PUBLICATION

TORONTO
3 Willcocks Street
Printed for the Society
By the University of Toronto Press
1951

## 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 1000 members of these Canadian Centres, there are nearly 400 members not attached to any Centre, mostly resident in other nations, while some 250 additional institutions or persons are on the regular mailing list of our publications. The Society publishes a bi-monthly JOURNAL and a yearly OBSERVER'S HANDBOOK. Single copies of the JOURNAL are 50 cents, and of the HANDBOOK, 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.

## CALENDAR 1952

**Jan.**

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

**Feb.**

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

**Mar.**

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

**April**

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

**May**

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

**June**

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

**July**

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

**Aug.**

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

**Sept.**

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

**Oct.**

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

**Nov.**

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

**Dec.**

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

THE

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## FOR 1952

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## TABLES IN RECENT OBSERVER'S HANDBOOKS



PRINTED IN CANADA

# PREFACE

The HANDBOOK for 1952 is the 44th issue. Its present circulation is 5000 which we hope will be materially increased in order to meet our mounting expense.

In recent years Dr. F. S. Hogg, who was Assistant Editor, assumed the responsibility of preparing the volume; and his death on the first day of 1951 was a great loss to the Royal Astronomical Society of Canada as well as to the world of Astronomy in general.

No notable change has been made in the present volume. Miss Ruth J. Northcott is now Assistant Editor, and she and Prof. J. F. Heard have rendered great help, as in the past.

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; and the calculations for Algol are based on Olin J. Eggen's epoch 2432520.6303 and period 2.86731525 d., as published in the *Astrophysical Journal,* 1948.

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 1951.

## ANNIVERSARIES AND FESTIVALS, 1952

| | | |
|---|---|---|
| New Year's Day | Tue. | Jan. 1 |
| Epiphany | Sun. | Jan. 6 |
| Septuagesima Sunday | | Feb. 10 |
| Quinguagesima (Shrove Sunday) | | Feb. 24 |
| Ash Wednesday | | Feb. 27 |
| St. David | Sat. | Mar. 1 |
| St. Patrick | Mon. | Mar. 17 |
| Palm Sunday | | Apr. 6 |
| Good Friday | | Apr 11 |
| Easter Sunday | | Apr. 13 |
| St. George | Wed. | Apr. 23 |
| Rogation Sunday | | May 18 |
| Ascension Day | Thu. | May 22 |
| Empire Day (Victoria Day) | Sat. | May 24 |
| Birthday of the Queen Mother, Mary (1867) | Fri. | May 30 |
| Pentecost (Whit Sunday) | | June 1 |
| Trinity Sunday | | June 8 |
| Corpus Christi | Thu. | June 12 |
| St. John Baptist (Mid-summer Day) | Tue. | June 24 |
| Dominion Day | Tue. | July 1 |
| Birthday of Queen Elizabeth (1900) | Mon. | Aug. 4 |
| Labour Day | Mon. | Sept. 1 |
| Hebrew New Year (Rosh Hashanah) | Sat. | Sept. 20 |
| St. Michael (Michaelmas Day | Mon. | Sept. 29 |
| All Saints' Day | Sat. | Nov. 1 |
| Remembrance Day | Tue. | Nov. 11 |
| St. Andrew | Sun. | Nov. 30 |
| First Sunday in Advent | | Nov. 30 |
| Accession of King George VI (1936) | Thu. | Dec. 11 |
| Birthday of King George VI (1895) | Sun. | Dec. 14 |
| Christmas Day | Thu. | 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.
$\alpha$ or A.R., Right Ascension; $\delta$ 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 $\phi$)
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 ⊕ = 6.94 miles/sec.

**EARTH'S ORBITAL MOTION**

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

**SOLAR MOTION**

Solar apex, R.A. *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 = $T$° K = $T$°C + 273° = 5/9 ($T$° F + 459°)

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

# 1952 EPHEMERIS OF THE SUN AT 0h GREENWICH CIVIL TIME

| Date 1952 | Apparent R.A. | Corr. to Sun-dial | Apparent Dec. |
|---|---|---|---|
| | h m s | m s | ° ′ |
| Jan. 1 | 18 41 24 | +03 00 | −23 06.4 |
| 4 | 18 54 39 | +04 25 | −22 51.2 |
| 7 | 19 07 50 | +05 47 | −22 31.9 |
| 10 | 19 20 57 | +07 04 | −22 08.6 |
| 13 | 19 33 59 | +08 16 | −21 41.5 |
| 16 | 19 46 55 | +09 23 | −21 10.5 |
| 19 | 19 59 46 | +10 24 | −20 35.9 |
| 22 | 20 12 30 | +11 18 | −19 57.8 |
| 25 | 20 25 07 | +12 06 | −19 16.3 |
| 28 | 20 37 38 | +12 47 | −18 31.6 |
| 31 | 20 50 01 | +13 20 | −17 43.9 |
| Feb. 3 | 21 02 17 | +13 46 | −16 53.4 |
| 6 | 21 14 25 | +14 05 | −16 00.2 |
| 9 | 21 26 26 | +14 16 | −15 04.5 |
| 12 | 21 38 20 | +14 20 | −14 06.6 |
| 15 | 21 50 06 | +14 17 | −13 06.6 |
| 18 | 22 01 46 | +14 08 | −12 04.6 |
| 21 | 22 13 20 | +13 52 | −11 00.9 |
| 24 | 22 24 49 | +13 30 | −09 55.6 |
| 27 | 22 36 11 | +13 03 | −08 49.0 |
| Mar. 1 | 22 47 29 | +12 31 | −07 41.2 |
| 4 | 22 58 42 | +11 54 | −06 32.4 |
| 7 | 23 09 50 | +11 13 | −05 22.8 |
| 10 | 23 20 55 | +10 28 | −04 12.6 |
| 13 | 23 31 57 | +09 41 | −03 01.9 |
| 16 | 23 42 56 | +08 50 | −01 50.9 |
| 19 | 23 53 53 | +07 58 | −00 39.8 |
| 22 | 00 04 49 | +07 04 | +00 31.4 |
| 25 | 00 15 45 | +06 10 | +01 42.3 |
| 28 | 00 26 40 | +05 15 | +02 52.9 |
| 31 | 00 37 35 | +04 21 | +04 03.0 |
| April 3 | 00 48 31 | +03 27 | +05 12.4 |
| 6 | 00 59 28 | +02 34 | +06 21.0 |
| 9 | 01 10 27 | +01 43 | +07 28.5 |
| 12 | 01 21 27 | +00 55 | +08 35.0 |
| 15 | 01 32 31 | +00 09 | +09 40.1 |
| 18 | 01 43 38 | −00 34 | +10 43.8 |
| 21 | 01 54 48 | −01 13 | +11 46.0 |
| 24 | 02 06 03 | −01 48 | +12 46.4 |
| 27 | 02 17 22 | −02 19 | +13 44.9 |
| 30 | 02 28 45 | −02 46 | +14 41.4 |
| May 3 | 02 40 13 | −03 07 | +15 35.7 |
| 6 | 02 51 46 | −03 24 | +16 27.6 |
| 9 | 03 03 23 | −03 37 | +17 17.1 |
| 12 | 03 15 06 | −03 44 | +18 04.0 |
| 15 | 03 26 54 | −03 45 | +18 48.2 |
| 18 | 03 38 47 | −03 42 | +19 29.5 |
| 21 | 03 50 45 | −03 33 | +20 07.9 |
| 24 | 04 02 49 | −03 19 | +20 43.1 |
| 27 | 04 14 57 | −03 01 | +21 15.2 |
| 30 | 04 27 09 | −02 39 | +21 44.0 |
| June 2 | 04 39 25 | −02 13 | +22 09.3 |
| 5 | 04 51 44 | −01 43 | +22 31.2 |
| 8 | 05 04 06 | −01 11 | +22 49.5 |
| 11 | 05 16 30 | −00 36 | +23 04.2 |
| 14 | 05 28 57 | +00 01 | +23 15.3 |
| 17 | 05 41 25 | +00 39 | +23 22.7 |
| 20 | 05 53 54 | +01 19 | +23 26.4 |
| 23 | 06 06 23 | +01 58 | +23 26.4 |
| 26 | 06 18 51 | +02 37 | +23 22.6 |
| 29 | 06 31 18 | +03 14 | +23 15.1 |

| Date 1952 | Apparent R.A. | Corr. to Sun-dial | Apparent Dec. |
|---|---|---|---|
| | h m s | ° ′ | ° ′ |
| July 2 | 06 43 43 | +03 49 | +23 04.0 |
| 5 | 06 56 05 | +04 22 | +22 49.3 |
| 8 | 07 08 25 | +04 52 | +22 31.0 |
| 11 | 07 20 41 | +05 18 | +22 09.1 |
| 14 | 07 32 53 | +05 40 | +21 43.9 |
| 17 | 07 45 01 | +05 58 | +21 15.3 |
| 20 | 07 57 04 | +06 12 | +20 43.5 |
| 23 | 08 09 02 | +06 21 | +20 08.5 |
| 26 | 08 20 56 | +06 24 | +19 30.5 |
| 29 | 08 32 43 | +06 22 | +18 49.6 |
| Aug. 1 | 08 44 25 | +06 15 | +18 05.9 |
| 4 | 08 56 02 | +06 02 | +17 19.5 |
| 7 | 09 07 33 | +05 43 | +16 30.7 |
| 10 | 09 18 59 | +05 19 | +15 39.4 |
| 13 | 09 30 20 | +04 50 | +14 45.9 |
| 16 | 09 41 36 | +04 17 | +13 50.2 |
| 19 | 09 52 47 | +03 38 | +12 52.5 |
| 22 | 10 03 54 | +02 56 | +11 53.0 |
| 25 | 10 14 57 | +02 09 | +10 51.9 |
| 28 | 10 25 56 | +01 18 | +09 49.1 |
| 31 | 10 36 51 | +00 24 | +08 45.0 |
| Sept. 3 | 10 47 44 | −00 33 | +07 39.7 |
| 6 | 10 58 34 | −01 33 | +06 33.2 |
| 9 | 11 09 22 | −02 34 | +05 25.8 |
| 12 | 11 20 09 | −03 37 | +04 17.5 |
| 15 | 11 30 55 | −04 40 | +03 08.5 |
| 18 | 11 41 41 | −05 44 | +01 59.0 |
| 21 | 11 52 27 | −06 48 | +00 49.1 |
| 24 | 12 03 14 | −07 50 | −00 21.0 |
| 27 | 12 14 02 | −08 52 | −01 31.2 |
| 30 | 12 24 52 | −09 52 | −02 41.3 |
| Oct. 3 | 12 35 43 | −10 50 | −03 51.1 |
| 6 | 12 46 38 | −11 45 | −05 00.5 |
| 9 | 12 57 36 | −12 37 | −06 09.4 |
| 12 | 13 08 38 | −13 24 | −07 17.5 |
| 15 | 13 19 45 | −14 07 | −08 24.8 |
| 18 | 13 30 57 | −14 44 | −09 31.0 |
| 21 | 13 42 15 | −15 16 | −10 36.0 |
| 24 | 13 53 38 | −15 43 | −11 39.6 |
| 27 | 14 05 08 | −16 03 | −12 41.5 |
| 30 | 14 16 44 | −16 16 | −13 41.7 |
| Nov. 2 | 14 28 27 | −16 23 | −14 39.9 |
| 5 | 14 40 17 | −16 23 | −15 36.0 |
| 8 | 14 52 15 | −16 15 | −16 29.7 |
| 11 | 15 04 20 | −15 59 | −17 21.0 |
| 14 | 15 16 33 | −15 36 | −18 09.6 |
| 17 | 15 28 54 | −15 04 | −18 55.4 |
| 20 | 15 41 23 | −14 26 | −19 38.1 |
| 23 | 15 53 58 | −13 40 | −20 17.6 |
| 26 | 16 06 41 | −12 47 | −20 53.7 |
| 29 | 16 19 30 | −11 47 | −21 26.3 |
| Dec. 2 | 16 32 25 | −10 42 | −21 55.3 |
| 5 | 16 45 26 | −09 31 | −22 20.4 |
| 8 | 16 58 32 | −08 14 | −22 41.7 |
| 11 | 17 11 42 | −06 53 | −22 59.0 |
| 14 | 17 24 57 | −05 29 | −23 12.2 |
| 17 | 17 38 13 | −04 02 | −23 21.2 |
| 20 | 17 51 32 | −02 33 | −23 26.0 |
| 23 | 18 04 52 | −01 03 | −23 26.5 |
| 26 | 18 18 11 | +00 27 | −23 22.9 |
| 29 | 18 31 29 | +01 55 | −23 15.0 |

## SOLAR AND SIDEREAL TIME

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

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

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

3. *Sidereal Time*—This is time as determined from the stars. It is sidereal noon when the Vernal Equinox or First of Aries is on the meridian. In accurate time-keeping the moment when a star is on the meridian is observed and the corresponding mean time is then computed with the assistance of the Nautical Almanac. When a telescope is mounted equatorially the position of a body in the sky is located by means of the sidereal time.

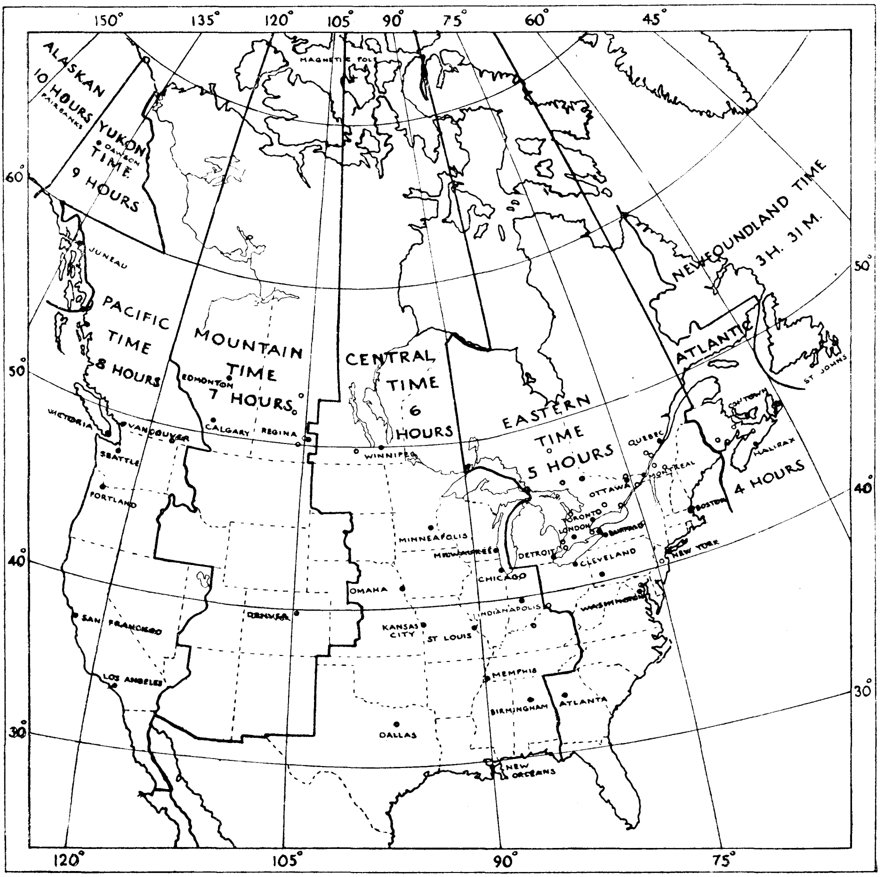
4. *Standard Time*—In everyday life we use still another kind of time. A moment's thought will show that in general two places will not have the same mean time; indeed, difference in longitude between two places is determined from their difference in time. But in travelling it is very inconvenient to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

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

The boundaries of the time belts are shown on the map on page 9.

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

# MAP OF STANDARD TIME ZONES




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

## JULIAN DAY CALENDAR, 1952

J.D. 2,434,000 plus the following:

| | | | | | |
|---|---|---|---|---|---|
| Jan. 1 | 013 | May 1 | 134 | Sept. 1 | 257 |
| Feb. 1 | 044 | June 1 | 165 | Oct. 1 | 287 |
| Mar. 1 | 073 | July 1 | 195 | Nov. 1 | 318 |
| April 1 | 104 | Aug. 1 | 226 | Dec. 1 | 348 |

The Julian Day commences at noon. Thus J.D. 2434013 = Jan. 1.5 G.C.T.

## TIMES OF SUNRISE AND SUNSET

In the tables on pages 11 to 16 are given the times of sunrise and sunset for places in latitudes 32°, 36°, 40°, 44°, 46°, 48°, 50°, and 52°. The times are given in Local Mean Time, and in the table below are given corrections to change from Local Mean to Standard Time for the cities and towns named.

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

### *The Standard Times for Any Station*

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

CANADIAN CITIES AND TOWNS

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

AMERICAN CITIES

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

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

In the above list Owen Sound is under "45°", and the correction is + 24 min. On page 11 the time of sunrise on February 12 for latitude 45° is 7.07; add 24 min. and we get 7.31 (Eastern Standard Time).

| DATE | | Latitude 32° Sunrise | Latitude 32° Sunset | Latitude 36° Sunrise | Latitude 36° Sunset | Latitude 40° Sunrise | Latitude 40° Sunset | Latitude 44° Sunrise | Latitude 44° Sunset | Latitude 46° Sunrise | Latitude 46° Sunset | Latitude 48° Sunrise | Latitude 48° Sunset | Latitude 50° Sunrise | Latitude 50° Sunset | Latitude 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).

TIME OF MOONRISE AND MOONSET, 1952. (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** | | 10 20 | 22 04 | 10 24 | 22 02 | 10 30 | 21 58 | 10 37 | 21 54 | 10 40 | 21 52 |
| **2** | | 10 48 | 23 10 | 10 49 | 23 11 | 10 51 | 23 13 | 10 51 | 23 15 | 10 52 | 23 15 |
| **3** | ☽ | 11 15 | — — | 11 12 | — — | 11 09 | — — | 11 05 | — — | 11 03 | — — |
| **4** | | 11 42 | 00 14 | 11 35 | 00 19 | 11 28 | 00 25 | 11 19 | 00 32 | 11 15 | 00 34 |
| **5** | | 12 10 | 01 17 | 12 01 | 01 26 | 11 49 | 01 36 | 11 36 | 01 48 | 11 29 | 01 53 |
| **6** | | 12 42 | 02 20 | 12 29 | 02 32 | 12 14 | 02 46 | 11 55 | 03 04 | 11 46 | 03 12 |
| **7** | | 13 18 | 03 22 | 13 02 | 03 37 | 12 42 | 03 55 | 12 19 | 04 18 | 12 08 | 04 28 |
| **8** | | 14 00 | 04 22 | 13 41 | 04 40 | 13 20 | 05 01 | 12 53 | 05 28 | 12 39 | 05 41 |
| **9** | | 14 47 | 05 19 | 14 28 | 05 38 | 14 05 | 06 01 | 13 36 | 06 30 | 13 21 | 06 45 |
| **10** | | 15 40 | 06 12 | 15 21 | 06 31 | 14 59 | 06 53 | 14 30 | 07 23 | 14 15 | 07 38 |
| **11** | ◯ | 16 37 | 06 58 | 16 20 | 07 16 | 15 59 | 07 37 | 15 33 | 08 04 | 15 20 | 08 17 |
| **12** | | 17 36 | 07 37 | 17 21 | 07 53 | 17 04 | 08 12 | 16 42 | 08 34 | 16 31 | 08 46 |
| **13** | | 18 35 | 08 11 | 18 24 | 08 25 | 18 10 | 08 39 | 17 53 | 08 58 | 17 45 | 09 06 |
| **14** | | 19 34 | 08 41 | 19 27 | 08 51 | 19 16 | 09 02 | 19 04 | 09 15 | 18 58 | 09 22 |
| **15** | | 20 32 | 09 07 | 20 27 | 09 14 | 20 21 | 09 22 | 20 14 | 09 30 | 20 11 | 09 34 |
| **16** | | 21 29 | 09 32 | 21 28 | 09 35 | 21 26 | 09 39 | 21 24 | 09 43 | 21 23 | 09 45 |
| **17** | | 22 27 | 09 56 | 22 29 | 09 55 | 22 32 | 09 55 | 22 35 | 09 55 | 22 36 | 09 54 |
| **18** | | 23 27 | 10 19 | 23 34 | 10 17 | 23 40 | 10 12 | 23 48 | 10 07 | 23 51 | 10 05 |
| **19** | | — — | 10 46 | — — | 10 39 | — — | 10 30 | — — | 10 21 | — — | 10 17 |
| **20** | ☾ | 00 31 | 11 16 | 00 41 | 11 05 | 00 51 | 10 53 | 01 05 | 10 38 | 01 11 | 10 31 |
| **21** | | 01 38 | 11 52 | 01 51 | 11 38 | 02 06 | 11 21 | 02 25 | 11 00 | 02 35 | 10 51 |
| **22** | | 02 48 | 12 36 | 03 05 | 12 19 | 03 24 | 11 59 | 03 49 | 11 33 | 04 02 | 11 20 |
| **23** | | 03 59 | 13 31 | 04 19 | 13 12 | 04 41 | 12 49 | 05 09 | 12 19 | 05 25 | 12 05 |
| **24** | | 05 07 | 14 37 | 05 27 | 14 19 | 05 51 | 13 55 | 06 21 | 13 25 | 06 36 | 13 10 |
| **25** | | 06 08 | 15 52 | 06 25 | 15 35 | 06 48 | 15 14 | 07 15 | 14 48 | 07 28 | 14 36 |
| **26** | ● | 06 59 | 17 11 | 07 13 | 16 57 | 07 31 | 16 41 | 07 53 | 16 21 | 08 03 | 16 11 |
| **27** | | 07 41 | 18 28 | 07 52 | 18 18 | 08 04 | 18 08 | 08 19 | 17 55 | 08 27 | 17 48 |
| **28** | | 08 15 | 19 42 | 08 23 | 19 37 | 08 30 | 19 32 | 08 40 | 19 24 | 08 44 | 19 21 |
| **29** | | 08 46 | 20 52 | 08 49 | 20 52 | 08 52 | 20 51 | 08 56 | 20 49 | 08 58 | 20 49 |
| **30** | | 09 15 | 22 00 | 09 13 | 22 03 | 09 12 | 22 07 | 09 10 | 22 12 | 09 10 | 22 13 |
| **31** | | 09 42 | 23 06 | 09 37 | 23 12 | 09 31 | 23 21 | 09 25 | 23 31 | 09 22 | 23 36 |
| **Feb.** | | | | | | | | | | | |
| **1** | | 10 11 | — — | 10 03 | — — | 09 53 | — — | 09 41 | — — | 09 35 | — — |
| **2** | ☽ | 10 42 | 00 10 | 10 30 | 00 21 | 10 16 | 00 34 | 09 59 | 00 49 | 09 51 | 00 57 |
| **3** | | 11 17 | 01 13 | 11 02 | 01 28 | 10 44 | 01 44 | 10 22 | 02 05 | 10 11 | 02 16 |
| **4** | | 11 57 | 02 16 | 11 40 | 02 32 | 11 19 | 02 53 | 10 52 | 03 18 | 10 39 | 03 31 |
| **5** | | 12 43 | 03 14 | 12 23 | 03 34 | 12 01 | 03 56 | 11 32 | 04 24 | 11 17 | 04 38 |
| **6** | | 13 34 | 04 08 | 13 15 | 04 27 | 12 52 | 04 51 | 12 22 | 05 21 | 12 08 | 05 35 |
| **7** | | 14 30 | 04 56 | 14 13 | 05 15 | 13 50 | 05 36 | 13 23 | 06 05 | 13 09 | 06 17 |
| **8** | | 15 29 | 05 38 | 15 13 | 05 54 | 14 54 | 06 13 | 14 31 | 06 38 | 14 19 | 06 50 |
| **9** | | 16 28 | 06 13 | 16 15 | 06 27 | 16 01 | 06 43 | 15 42 | 07 03 | 15 32 | 07 13 |
| **10** | ◯ | 17 27 | 06 44 | 17 18 | 06 55 | 17 07 | 07 07 | 16 53 | 07 22 | 16 46 | 07 29 |
| **11** | | 18 26 | 07 11 | 18 20 | 07 19 | 18 13 | 07 28 | 18 04 | 07 38 | 18 00 | 07 43 |
| **12** | | 19 24 | 07 37 | 19 21 | 07 40 | 19 18 | 07 46 | 19 15 | 07 52 | 19 13 | 07 54 |
| **13** | | 20 22 | 08 00 | 20 23 | 08 01 | 20 24 | 08 02 | 20 25 | 08 04 | 20 26 | 08 04 |
| **14** | | 21 22 | 08 24 | 21 26 | 08 22 | 21 31 | 08 19 | 21 37 | 08 16 | 21 41 | 08 14 |
| **15** | | 22 23 | 08 50 | 22 31 | 08 44 | 22 41 | 08 37 | 22 52 | 08 28 | 22 58 | 08 24 |
| **16** | | 23 28 | 09 18 | 23 40 | 09 09 | 23 54 | 08 57 | — — | 08 44 | — — | 08 37 |
| **17** | | — — | 09 51 | — — | 09 38 | — — | 09 22 | 00 11 | 09 04 | 00 19 | 08 55 |
| **18** | ☾ | 00 35 | 10 31 | 00 50 | 10 14 | 01 09 | 09 55 | 01 32 | 09 31 | 01 43 | 09 20 |
| **19** | | 01 44 | 11 19 | 02 02 | 11 01 | 02 24 | 10 38 | 02 52 | 10 10 | 03 05 | 09 56 |
| **20** | | 02 51 | 12 18 | 03 10 | 11 59 | 03 34 | 11 35 | 04 04 | 11 05 | 04 19 | 10 50 |
| **21** | | 03 53 | 13 27 | 04 11 | 13 09 | 04 34 | 12 47 | 05 04 | 12 18 | 05 17 | 12 04 |
| **22** | | 04 47 | 14 42 | 05 03 | 14 27 | 05 22 | 14 08 | 05 47 | 13 44 | 05 59 | 13 33 |
| **23** | | 05 31 | 15 59 | 05 44 | 15 47 | 05 59 | 15 34 | 06 18 | 15 16 | 06 26 | 15 08 |
| **24** | | 06 09 | 17 14 | 06 18 | 17 07 | 06 28 | 16 58 | 06 41 | 16 48 | 06 46 | 16 43 |
| **25** | ● | 06 41 | 18 27 | 06 46 | 18 24 | 06 52 | 18 20 | 06 58 | 18 16 | 07 02 | 18 14 |
| **26** | | 07 11 | 19 36 | 07 12 | 19 38 | 07 13 | 19 39 | 07 14 | 19 41 | 07 15 | 19 42 |
| **27** | | 07 40 | 20 45 | 07 37 | 20 51 | 07 33 | 20 57 | 07 29 | 21 04 | 07 28 | 21 08 |
| **28** | | 08 09 | 21 52 | 08 02 | 22 02 | 07 54 | 22 12 | 07 45 | 22 26 | 07 40 | 22 32 |
| **29** | | 08 41 | 22 59 | 08 29 | 23 11 | 08 17 | 23 26 | 08 02 | 23 45 | 07 55 | 23 55 |

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

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

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

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

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

# THE PLANETS FOR 1951

By C. A. Chant

## THE SUN

During the present sun-spot cycle there has been remarkable activity on the sun. The maximum occurred about March 26, 1947, and the activity is still notable. A new increase in activity reached a peak in May 1951, and postponed the coming minimum.

## MERCURY

Mercury is exceptional in many ways. It is the planet nearest the sun and travels fastest in its orbit, its speed varying from 23 mi. per sec. at aphelion to 35 mi. per sec. at perihelion. The amount of heat and light from the sun received by it per square mile is, on the average, 6.7 times the amount received by the earth. Its period of rotation on its axis is believed to be the same as its period of revolution about the sun, which is 88 days.

Mercury's orbit is well within that of the earth, and the planet, as seen from the earth, appears to move quickly from one side of the sun to the other several times in the year. Its quick motion earned for it the name it bears. Its greatest elongation (i.e., its maximum angular distance from the sun) varies between 18° and 28°, and on such occasions it is visible to the naked eye for about two weeks.

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

The most suitable times to observe Mercury are at an eastern elongation in the spring and at a western elongation in the autumn. The dates of greatest elongation this year, together with the planet's separation from the sun and its stellar magnitude, are given in the following table:

*Maximum Elongations of Mercury during 1952*

| Elong. East—Evening Star | | | Elong. West—Morning Star | | |
|---|---|---|---|---|---|
| Date | Distance | Mag. | Date | Distance | Mag. |
| Mar. 18 | 19° | −0.2 | May 3 | 27° | +0.6 |
| July 15 | 27° | +0.6 | Aug. 29 | 18° | +0.4 |
| Nov. 9 | 23° | 0.0 | Dec. 18 | 22° | −0.1 |

The most favourable elongations to observe are: in the evening, Mar. 18; in the morning, Aug. 29. At these times Mercury is about 80 million miles from the earth and in a telescope looks like a half-moon about 7″ in diameter.

## VENUS

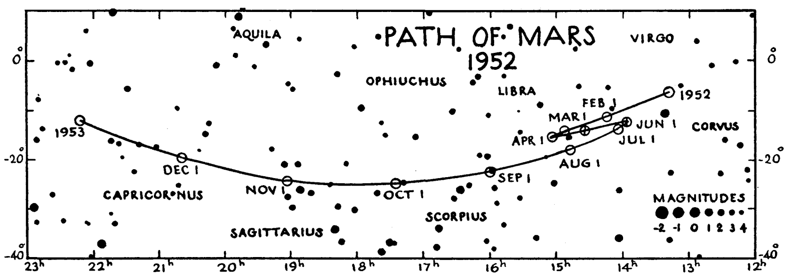
Venus is the next planet in order from the sun. In size and mass it is almost a twin of the earth. Venus being within the earth's orbit, its apparent motion is similar to Mercury's but much slower and more stately. The orbit of Venus is almost circular with radius of 67 million miles, and its orbital speed is 22 miles per sec.

On Jan. 1, 1952, Venus is a morning star, crossing the meridian about 3 hours before the sun. Its declination then is 17° south and hence is not well placed for observers in the northern hemisphere. It slowly approaches the sun and on June 24 is in superior conjunction with it. The planet now becomes an evening star and remains such the rest of the year. On Dec. 31 it crosses the meridian 3 hours after the sun. On Jan. 1 its stellar magnitude is −3.6 and on Dec. 31 it is −3.8 and it does not vary much in brightness during the year.

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

## MARS

The orbit of Mars is outside that of the earth and consequently its planetary phenomena are quite different from those of the two inferior planets discussed above. Its mean distance from the sun is 141 million miles and the eccentricity

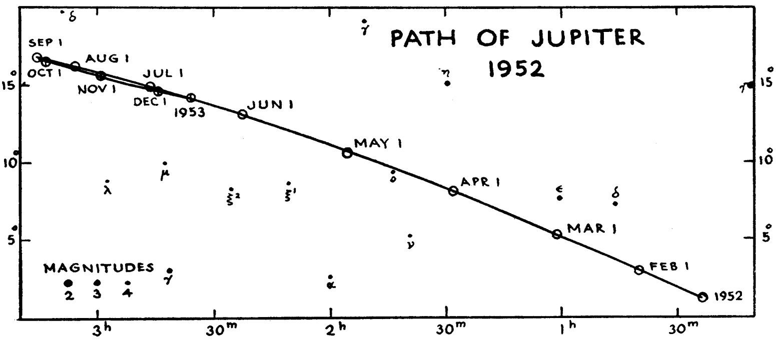



of its orbit is 0.093, and a simple computation shows that its distance from the sun ranges between 128 and 154 million miles. Its distance from the earth varies from 35 to 235 million miles and its brightness changes accordingly. When Mars is nearest it is conspicuous in its fiery red, but when farthest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

The sidereal, or true mechanical, period of revolution of Mars is 687 days; and the synodic period (for example, the interval from one opposition to the next one) is 780 days. This is the average value; it may vary from 764 to 810 days. The planet was in opposition on Mar. 23, 1950; the next opposition is on May 1, 1952, on which occasion it is 52,360,000 miles from the earth, but on May 8 its distance is 51,862,000 miles; and the next close opposition is on Sept. 10, 1956. On Jan. 1 it is about as bright as Spica (mag. 1.2); it gradually increases until on May 4 it equals Sirius (mag. −1.5); then it falls until on Dec. 31 it equals Spica again. For its position among the stars see the map.

## JUPITER

Jupiter is the giant of the family of the sun. Its mean diameter is 87,000 miles and its mass is 2½ times that of all the rest of the planets combined! Its mean distance is 483 million miles and the revolution period is 11.9 years. This




planet is known to possess 12 satellites, the last discovered in 1951 (see p. 59). Not so long ago it was generally believed that the planet was still cooling down from its original high temperature, but from actual measurements of the radiation from it to the earth it has been deduced that the surface is at about −200°F. The spectroscope shows that its atmosphere is largely ammonia and methane.

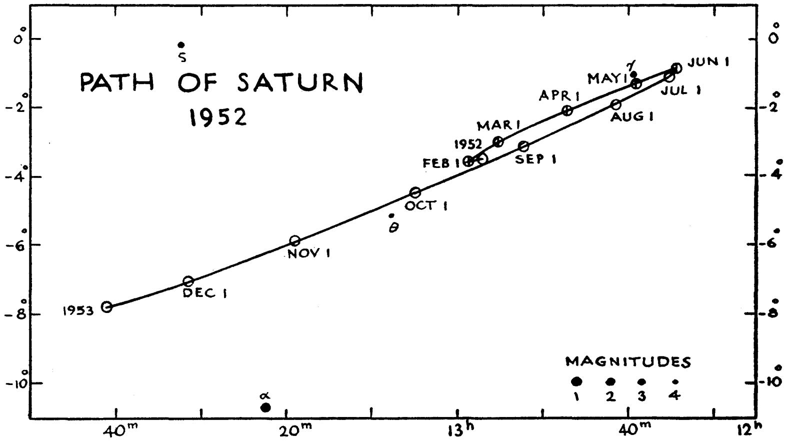
Jupiter is a fine object for the telescope. Many details of the surface as well as the flattening of the planet, due to its short rotation period, are visible, and the phenomena of its satellites provide a continual interest.

On Jan. 1, 1952, Jupiter crosses the meridian at 5.42 p.m. and is an evening star in the constellation Aquarius (see map). The sun moves over to the planet and they are in conjunction on Apr. 17, and Jupiter becomes a morning star. It then separates from the sun until Nov. 8 when it comes to opposition and is on the meridian at midnight. At this time its distance from the earth is 371,000,000 mi. (see p. 45) and its stellar magnitude −2.5. On Dec. 31 it crosses the meridian at about 7.54 p.m.

## SATURN

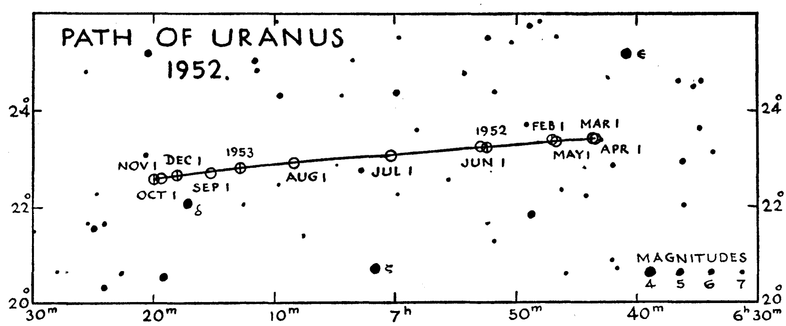
Saturn was the outermost planet known until modern times. In size it is a good second to Jupiter. In addition to its family of nine satellites, this planet has a unique system of rings, and it is one of the finest of celestial objects in a good telescope. The plane of the rings makes an angle of 27° 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. The rings were edgewise in 1937 and 1950, and at maximum in 1944. For the next few years they will be gradually opening out.

The planet is in the constellation Virgo (see map). On April 1 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 Oct. 11 it is in conjunction with the sun.




## URANUS

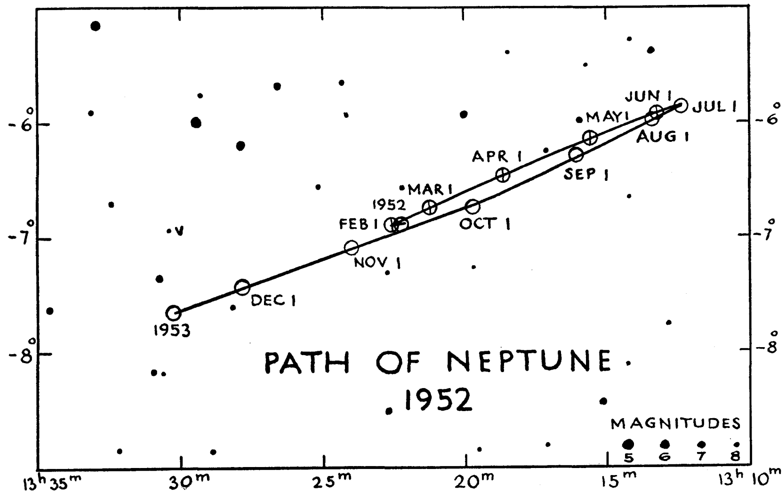
Uranus was discovered in 1781 by Sir William Herschel by means of a 6¼-in. mirror-telescope made by himself. The object did not look just like a star and he observed it again four days later. It had moved amongst the stars, and he assumed it to be a comet. He could not believe that it was a new planet.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




As shown by the chart, Uranus in 1952 is in Gemini. On Jan. 3, it is in opposition with the sun; on July 6 in conjunction.

## NEPTUNE

Neptune was discovered in 1846 after its existence in the sky had been predicted from independent calculations by Leverrier in France and Adams in England. It caused a sensation at the time. Its distance from the sun is 2800 million miles and its period of revolution is 165 years. A satellite was discovered in 1846 soon after the planet. A second satellite was discovered by G. P. Kuiper at the McDonald Observatory on May 1, 1949. Its magnitude is about 19.5, its period about 2 years, and diameter about 200 miles. It is named Nereid.




During 1952 Neptune is still in the constellation Virgo. It is in opposition to the sun on April 10. Its stellar magnitude is +7.7 and hence it is too faint for the naked eye. In the telescope it shows a greenish tint and a diameter of 2″.5. It is in conjunction with the sun on Oct. 14.

## PLUTO

Pluto, the most distant known planet, was discovered at the Lowell Observatory in 1930. Its mean distance from the sun is 3666 million miles and its revotion period is 248 years. It appears as a 15th mag. star in the constellation Cancer. It is in opposition to the sun on Feb. 10, 1952, at which time its astrometric position is R.A. $9^h\ 43^m$, Dec. +23° 25′.

# ECLIPSES, 1952

In 1952 there will be *four* eclipses, two of the sun and two of the moon. Of these only one, a partial eclipse of the moon, will be visible in North America.

I. *A Partial Eclipse of the Moon*, February 10, 1952, visible in North America except the western and north-western parts. Generally speaking, this eclipse will be visible in Asia, Europe, Africa, the Atlantic Ocean and most of North and South America. Only about 9 per cent. of the moon's diameter will be in the earth's shadow.

Circumstances of the Lunar Eclipse, February 10, 1952.

| | E.S.T. | | E.S.T. |
|---|---|---|---|
| ☾ enters penumbra | 17 h 06.2 m | ☾ leaves umbra | 20 h 15.3 m |
| ☾ enters umbra | 19 03.3 | ☾ leaves penumbra | 22 12.4 |
| middle of eclipse | 19 39.3 | magnitude of eclipse | 0.088 |

II. *A Total Eclipse of the Sun*, February 25, 1952, invisible in North America. The path of totality starts in the Atlantic Ocean, crosses central Africa, near eastern Asia, and ends in central Siberia.

III. *A Partial Eclipse of the Moon*, August 5, 1952, invisible in North America. Generally speaking, this eclipse will be visible in Australia, Antarctica, Asia, the Indian Ocean and parts of Africa and South America. About 54 per cent. of the moon's diameter will be in the earth's shadow.

IV. *An Annular Eclipse of the Sun*, August 20, 1952, invisible in North America. The path of the annular eclipse begins in the South Pacific, crosses the central part of South America and ends near Antarctica.

# THE SKY MONTH BY MONTH

By J. F. Heard

## THE SKY FOR JANUARY, 1952

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 41m to 20h 54m and its Decl. changes from 23° 06′ S. to 17° 27′ S. The equation of time changes from —3m 00s to —13m 30s. The earth is in perihelion or nearest the sun on the 4th. 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. 18h 10m, Decl. 22° 56′ S. and transits at 10.37. It is at greatest western elongation on the 6th and may be seen about this time low in the south-east just before sunrise. It is then about 10° east of Antares.

*Venus* on the 15th is in R.A. 16h 54m, Decl. 20° 41′ S. and transits at 9.21. It is a morning star prominent in the south-eastern sky before sunrise.

*Mars* on the 15th is in R.A. 13h 45m, Decl. 8° 54′ S. and transits at 6.11. It is in Virgo near Spica and rises about midnight. Mars begins the year with stellar magnitude +1.3 and brightens rapidly during the next few months.

*Jupiter* on the 15th is in R.A. 0h 30m, Decl. 1° 54′ N. and transits at 16.53. It is prominent in the south at sunset and sets before midnight. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

*Saturn* on the 15th is in R.A. 12h 59m, Decl. 3° 36′ S. and transits at 5.23. It is in Virgo west of Spica, and rises about midnight. On the 25th it is stationary in R.A. and begins to retrograde, or move westward among the stars. The rings are relatively "thin" this year but more open than last year.

*Uranus* on the 15th is in R.A. 6h 50m, Decl. 23° 20′ N. and transits at 23.12.

*Neptune* on the 15th is in R.A. 13h 23m, Decl. 6° 55′ S. and transits at 5.47.

*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 m | Phen. of Jupiter's Sat. 22h 15m |
|---|---|---|---|---|---|---|
| Tue. | 1 | | | .................................... | | 42O13 |
| Wed. | 2 | 12 | | ☌♂♆ ♂0°10′ N.................... | 18 57 | 4O23* |
| Thur. | 3 | | | Quadrantid meteors.......................... | | 41O32 |
| | | 4 | | ☍♅☉ Dist. from⊕, 1657,000,000 mi.. | | |
| | | 15 | 15 | ☌♃☾ ♃4°43′ S.................. | | |
| | | 23 | 42 | ◑ First Quarter...................... | | |
| Fri. | 4 | 16 | | ⊕ in Perihelion. Dist. from☉, 91,344,000 mi..... | | 432O1 |
| Sat. | 5 | 20 | | □♄☉ West....................... | 15 46 | 3412O |
| Sun. | 6 | 3 | | ☿ Greatest elongation W., 23°02′....... | | 3O412 |
| Mon. | 7 | | | .................................... | | 1O24* |
| Tue. | 8 | | | .................................... | 12 36 | 2O134 |
| Wed. | 9 | | | .................................... | | 1O34* |
| Thur. | 10 | | | .................................... | | dO324 |
| Fri. | 11 | 4 | 23 | ☌♅☾ ♅ 3°34′ S.................... | 09 25 | 32O14 |
| | | 23 | 55 | ○ Full Moon.......................... | | |
| Sat. | 12 | 1 | | Moon in Apogee. Dist. from⊕, 252,500 mi..... | | 321O4 |
| | | 17 | | □♆☉ West...................... | | |
| Sun. | 13 | | | .................................... | | 3O124 |
| Mon. | 14 | | | .................................... | 06 14 | 1O432 |
| Tue. | 15 | | | .................................... | | 24O13 |
| Wed. | 16 | | | .................................... | | 41O3* |
| Thur. | 17 | | | .................................... | 03 03 | 4O132 |
| Fri. | 18 | 9 | | ☿ in☋.............................. | | 432O* |
| Sat. | 19 | 3 | 48 | ☌♄☾ ♄ 6°49′ N.................... | 23 53 | 4321O |
| | | 15 | 51 | ☌♆☾ ♆ 6°18′ N.................... | | |
| Sun. | 20 | 1 | 09 | ☾ Last Quarter.......................... | | 43O12 |
| | | 7 | 29 | ☌♂☾ ♂ 6°55′ N.................... | | |
| Mon. | 21 | 18 | | □♂☉ West........................ | | 413O2 |
| Tue. | 22 | | | .................................... | 20 42 | 24O13 |
| Wed. | 23 | | | .................................... | | 12O43 |
| Thur. | 24 | 2 | | ♆ Stationary in R.A.................. | | O1324 |
| | | 2 | 24 | ☌♀☾ ♀ 6°13′ N.................. | | |
| Fri. | 25 | 11 | 23 | ☌☿☾ ☿ 2°48′ N.................... | 17 31 | 321O4 |
| | | 15 | | ♄ Stationary in R.A.................. | | |
| Sat. | 26 | 7 | | Moon in Perigee. Dist. from⊕, 221,900 mi..... | | 321O4 |
| | | 17 | 26 | ● New Moon........................... | | |
| Sun. | 27 | | | .................................... | | 3O124 |
| Mon. | 28 | 16 | | ☿ in Aphelion.......................... | 14 20 | 13O24 |
| Tue. | 29 | | | .................................... | | 2O134 |
| Wed. | 30 | | | .................................... | | 12O43 |
| Thur. | 31 | 6 | 54 | ☌♃☾ ♃ 5°06′ S.................... | 11 10 | 4O123 |

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

## THE SKY FOR FEBRUARY, 1952

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 54m to 22h 47m and its Decl. changes from 17° 27′ S. to 7° 41′ S. The equation of time changes from —13m 30s to a maximum of —14m 20s on the 12th and then to —12m 31s at the end of the month. On the 25th there is a total eclipse of the sun invisible in North America. For changes in the length of the day, see p. 11.

*The Moon*—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 18. There is a partial eclipse of the moon on the evening of the 10th, visible in North America.

*Mercury* on the 15th is in R.A. 21h 31m, Decl. 16° 54′ S. and transits at 11.58. It is poorly placed for observation, being in superior conjunction on the 21st.

*Venus* on the 15th is in R.A. 19h 37m, Decl. 21° 13′ S. and transits at 10.01. It is a morning star prominent in the south-eastern sky before sunrise.

*Mars* on the 15th is in R.A. 14h 36m, Decl. 13° 11′ S. and transits at 4.59. It moves during this month from Virgo into Libra, being located between Spica and Antares and brighter than either of these. It rises about midnight.

*Jupiter* on the 15th is in R.A. 0h 50m, Decl. 4° 06′ N. and transits at 15.11. It is prominent in the south-west for a few hours 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. 12h 58m, Decl. 3° 21′ S. and transits at 3.20. It is in Virgo just west of Spica, rising before midnight and visible till dawn.

*Uranus* on the 15th is in R.A. 6h 45m, Decl. 23° 26′ N. and transits at 21.05.

*Neptune* on the 15th is in R.A. 13h 22m, Decl. 6° 51′ S. and transits at 3.45.

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

| | | | FEBRUARY<br>75th Meridian Civil Time | Min. of Algol | Phen. of Jupiter's Sat. 20h 00m |
|---|---|---|---|---|---|
| | d | h | m | | h m | |
| Fri. | 1 | | | ...................................... | | 41302 |
| Sat. | 2 | 15 | 01 | ☽ First Quarter...................... | | d4320 |
| Sun. | 3 | | | ...................................... | 07 59 | 4302* |
| Mon. | 4 | | | ...................................... | | 43102 |
| Tue. | 5 | | | ...................................... | | 42013 |
| Wed. | 6 | | | ...................................... | 04 48 | 41203 |
| Thur. | 7 | 8 | 33 | ☌ ♅ ☾ ♅ 3°41′ S.................. | | 40123 |
| Fri. | 8 | 4 | | Moon in Apogee. Dist. from ⊕, 252,400 mi...... | | 14032 |
| Sat. | 9 | 21 | | ☍ ♇ ☉ Dist. from ⊕, 3234,000,000 mi.. | 01 38 | 32014 |
| Sun. | 10 | | | Partial eclipse of ☾. See p. 29............... | | 304** |
| | | 19 | 28 | 🌕 Full Moon........................ | | |
| Mon. | 11 | | | ...................................... | 22 27 | 31024 |
| Tue. | 12 | | | ...................................... | | 20134 |
| Wed. | 13 | | | ...................................... | | 21034 |
| Thur. | 14 | | | ...................................... | 19 16 | 01234 |
| Fri. | 15 | 8 | 58 | ☌ ♄ ☾ ♄ 7°01′ N.................... | | 10324 |
| | | 21 | 31 | ☌ ♆ ☾ ♆ 6°24′N.................... | | |
| Sat. | 16 | | | ...................................... | | 32014 |
| Sun. | 17 | 10 | 00 | ☌ ♂ ☾ ♂ 7°22′N..................... | 16 06 | 34120 |
| Mon. | 18 | 0 | | ☿ Greatest Hel. Lat. S................. | | d4302 |
| | | 13 | 01 | ☾ Last Quarter...................... | | |
| Tue. | 19 | | | ...................................... | | 4201* |
| Wed. | 20 | | | ...................................... | 12 55 | 42103 |
| Thur. | 21 | 22 | | ☌ ♅ ☉ Superior..................... | | 40123 |
| Fri. | 22 | 0 | | ♀ in ☋............................. | | 41032 |
| | | 21 | 39 | ☌ ♀ ☾ ♀ 2°35′ N.................... | | |
| Sat. | 23 | 17 | | Moon in Perigee. Dist. from ⊕, 223,900 mi.... | 09 44 | 42301 |
| Sun. | 24 | | | ...................................... | | 34120 |
| Mon. | 25 | | | Total eclipse of ☉. See p. 29................ | | 34012 |
| | | 4 | 16 | 🌑 New Moon........................ | | |
| | | 11 | 23 | ☌ ☿ ☾ ☿ 2°45′ S.................... | | |
| Tue. | 26 | | | ...................................... | 06 34 | d04** |
| Wed. | 27 | | | ...................................... | | 21034 |
| Thur. | 28 | 2 | 40 | ☌ ♃ ☾ ♃ 5°25′ S.................... | | 02134 |
| Fri. | 29 | | | ...................................... | 03 23 | 10324 |

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

## THE SKY FOR MARCH, 1952

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 47m to 0h 41m and its Decl. changes from 7° 41′ S. to 4° 26′ N. The equation of time changes from —12m 31s to —4m 03s. On the 20th at 11.14 E.S.T. the sun crosses the equator on its way north, enters the sign of Aries and spring commences. This is the vernal equinox. For changes in the length of the day, see p. 12.

*The Moon*—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 19.

*Mercury* on the 15th is in R.A. 0h 42m, Decl. 6° 04′ N. and transits at 13.12. It is an evening star and very well placed for observation at and about the time of greatest eastern elongation on the 18th. Then it is about 16° above the western horizon at sunset.

*Venus* on the 15th is in R.A. 22h 02m, Decl. 13° 03′ S. and transits at 10.33. It is a morning star, low in the south-eastern sky before sunrise.

*Mars* on the 15th is in R.A. 15h 04m, Decl. 15° 21′ S. and transits at 3.32. Located in Libra between Spica and Antares, it rises before midnight. It is becoming noticeably brighter from week to week as it approaches opposition. On the 24th it is stationary in right ascension and begins to retrograde, that is, move westward among the stars.

*Jupiter* on the 15th is in R.A. 1h 13m, Decl. 6° 34′ N. and transits at 13.40. It is well down in the western sky at sunset and it sets a few hours later. 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. 12h 52m, Decl. 2° 38′ S. and transits at 1.21. It is in Virgo just west of Spica and rises shortly after sunset.

*Uranus* on the 15th is in R.A. 6h 43m, Decl. 23° 27′ N. and transits at 19.09.

*Neptune* on the 15th is in R.A. 13h 20m, Decl. 6° 38′ S. and transits at 1.49.

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

| | | | | MARCH<br>75th Meridian Civil Time | Min. of Algol | Phen. of Jupiter's Sat. 19h 45m |
|---|---|---|---|---|---|---|
| | d | h | m | | h m | |
| Sat. | 1 | | | .................................... | | 23O14 |
| Sun. | 2 | | | .................................... | | 321O4 |
| Mon. | 3 | 8 | 43 | ☽ First Quarter.............. | 00 12 | 3O124 |
| Tue. | 4 | | | .................................... | | 3O24* |
| Wed. | 5 | 14 | 14 | ☌ ♅ ☾ ♅ 3°44′ S.............. | 21 01 | 241O3 |
| Thur. | 6 | 18 | | Moon in Apogee. Dist. from ⊕, 251,800 mi.... | | 4O213 |
| Fri. | 7 | | | .................................... | | 41O23 |
| Sat. | 8 | 0 | | ☿ in ☊.............. | 17 51 | 423O1 |
| Sun. | 9 | | | .................................... | | 4321O |
| Mon. | 10 | | | .................................... | | 43O12 |
| Tue. | 11 | 13 | 14 | 🌕 Full Moon.............. | 14 40 | 431O2 |
| Wed. | 12 | 16 | | ☿ in Perihelion.............. | | d42O3 |
| Thur. | 13 | 11 | 59 | ☌ ♄ ☾ ♄ 6°58′ N.............. | | 4O13* |
| Fri. | 14 | 2 | 15 | ☌ ♆ ☾ ♆ 6°21′ N.............. | 11 29 | 1O243 |
| Sat. | 15 | | | .................................... | | d2O14 |
| Sun. | 16 | 2 | 30 | ☌ ♂ ☾ ♂ 7°18′ N.............. | | 321O4 |
| Mon. | 17 | | | .................................... | 08 18 | 3O124 |
| Tue. | 18 | 1 | | ♅ Stationary in R.A.............. | | 31O24 |
| | | 17 | | ☿ Greatest elongation E., 18°31′.......... | | |
| | | 21 | 40 | ☾ Last Quarter.............. | | |
| Wed. | 19 | | | .................................... | | 2O134 |
| Thur. | 20 | 11 | 14 | ☉ enters ♈. Spring commences. Long. of ☉, 0°... | 05 08 | 2O43* |
| Fri. | 21 | | | .................................... | | 1O423 |
| Sat. | 22 | 17 | | Moon in Perigee. Dist. from ⊕, 227,100 mi..... | | 42O31 |
| | | 22 | | ☿ Greatest Hel. Lat. N.............. | | |
| Sun. | 23 | 21 | 22 | ☌ ♀ ☾ ♀ 2°17′ S.............. | 01 57 | 4321O |
| Mon. | 24 | 23 | | ♂ Stationary in R.A.............. | | 43O21 |
| Tue. | 25 | 15 | 12 | 🌑 New Moon.............. | 22 46 | 431O2 |
| Wed. | 26 | 4 | | ☿ Stationary in R.A.............. | | 42O31 |
| | | 17 | 50 | ☌ ☿ ☾ ☿ 0°44′ S.............. | | |
| Thur. | 27 | 0 | 04 | ☌ ♃ ☾ ♃ 5°40′ S.............. | | 421O3 |
| | | 15 | | ♀ in Aphelion.............. | | |
| Fri. | 28 | | | .................................... | 19 35 | 41O23 |
| Sat. | 29 | | | .................................... | | d4O13 |
| Sun. | 30 | 13 | | □ ♅ ☉ ......East.............. | | |
| Mon. | 31 | | | .................................... | 16 25 | |

Explanations of symbols and abbreviations on p. 4, of time on p. 8.
Jupiter being near the sun, phenomena of the satellites are not given from March 30 to May 27.

## THE SKY FOR APRIL, 1952

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 41m to 2h 33m and its Decl. changes from 4° 26′ N. to 15° 00′ N. The equation of time changes from −4m 03s to +2m 53s, being zero on the 14th; that is, the apparent sun moves from east to west of the mean sun on that date. For changes in the length of the day, see p. 12.

*The Moon*—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 19.

*Mercury* on the 15th is in R.A. 0h 34m, Decl. 3° 52′ N. and transits at 10.59. It is in inferior conjunction on the 5th and thereafter becomes a morning star but is not well placed for observation.

*Venus* on the 15th is in R.A. 0h 25m, Decl. 1° 03′ N. and transits at 10.53. It is a morning star but too low in the eastern sky at sunrise for easy observation.

*Mars* on the 15th is in R.A. 14h 55m, Decl. 15° 17′ S. and transits at 1.21. Still in Libra between Spica and Antares, and rising a few hours after sunset, it is now spectacularly bright. Opposition is on the 30th.

*Jupiter* on the 15th is in R.A. 1h 40m, Decl. 9° 19′ N. and transits at 12.06. It is too close to the sun for easy observation, conjunction being on the 17th.

*Saturn* on the 15th is in R.A. 12h 43m, Decl. 1° 42′ S. and transits at 23.06. It is in Virgo just west of Spica, rising before sunset and visible all night. It is in opposition on the 1st.

*Uranus* on the 15th is in R.A. 6h 45m, Decl. 23° 26′ N. and transits at 17.09.

*Neptune* on the 15th is in R.A. 13h 17m, Decl. 6° 19′ S, and transits at 23.40.

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

## APRIL

75th Meridian Civil Time

| | d | h | m | | Min. of Algol h m |
|---|---|---|---|---|---|
| Tue. | 1 | 5 | | ☍♄☉ Dist. from ⊕, 798,900,000 mi.... | |
| | | 22 | 06 | ☌♅☾ ♅ 3°36′ S.................. | |
| Wed. | 2 | 3 | 48 | ☽ First Quarter...................... | |
| Thur. | 3 | 13 | | Moon in Apogee. Dist. from ⊕, 251,300 mi.... | 13 14 |
| Fri. | 4 | | | .............................................. | |
| Sat. | 5 | 5 | | ☌☿☉ Inferior....................... | |
| Sun. | 6 | | | .............................................. | 10 03 |
| Mon. | 7 | | | .............................................. | |
| Tue. | 8 | | | .............................................. | |
| Wed. | 9 | 15 | 26 | ☌♄☾ ♄ 6°50′ N.................. | 06 52 |
| Thur. | 10 | 2 | | ☍♆☉ Dist. from ⊕, 2722,000,000 mi... | |
| | | 3 | 53 | 🌕 Full Moon....................... | |
| | | 8 | 01 | ☌♆☾ ♆ 6°16′ N.................. | |
| Fri. | 11 | | | .............................................. | |
| Sat. | 12 | 5 | 48 | ☌♂☾ ♂ 6°43′ N.................. | 03 41 |
| Sun. | 13 | | | .............................................. | |
| Mon. | 14 | | | .............................................. | |
| Tue. | 15 | 8 | | ☿ in ♉............................ | 00 30 |
| Wed. | 16 | 14 | | ☌☿♀ ☿ 1°19′ N.................. | |
| Thur. | 17 | 2 | | ☌♃☉.............................................. | 21 20 |
| | | 4 | 07 | ☾ Last Quarter...................... | |
| | | 15 | | ☿ Stationary in R.A.................. | |
| Fri. | 18 | 3 | | Moon in Perigee. Dist. from ⊕, 229,800 mi.... | |
| | | 20 | | ♀ Greatest Hel. Lat. S...................... | |
| Sat. | 19 | | | .............................................. | |
| Sun. | 20 | | | .............................................. | 18 09 |
| Mon. | 21 | | | Lyrid meteors ................................ | |
| Tues. | 22 | 10 | 37 | ☌☿☾ ☿ 5° 32′ S.................. | |
| | | 22 | 56 | ☌♀☾ ♀ 5° 49′ S.................. | |
| Wed. | 23 | 20 | 55 | ☌♃☾ ♃ 5°54′ S.................. | 14 58 |
| Thur. | 24 | 2 | 27 | 🌑 New Moon....................... | |
| Fri. | 25 | 15 | | ☿ in Aphelion....................... | |
| Sat. | 26 | | | .............................................. | 11 47 |
| Sun. | 27 | | | .............................................. | |
| Mon. | 28 | | | .............................................. | |
| Tue. | 29 | 7 | 43 | ☌♅☾ ♅ 3°21′ S.................. | 08 36 |
| Wed. | 30 | 20 | | ☍♂☉ Dist. from ⊕, 52,360,000 mi.... | |

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

Jupiter being near the sun, phenomena of the satellites are not given from March 30 to May 27.

## THE SKY FOR MAY, 1952

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 33m to 4h 35m and its Decl. changes from 15° 00′ N. to 22° 01′ N. The equation of time changes from +2m 53s to a maximum of +3m 45s on the 14th and then to +2m 22s 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. 1h 58m, Decl. 9° 00′ N. and transits at 10.28. It is at greatest western elongation on the 3rd, being thus a morning star; but this is not a favourable elongation, Mercury being very low on the eastern horizon at sunrise.

*Venus* on the 15th is in R.A. 2h 44m, Decl. 14° 43′ N. and transits at 11.14. It is a morning star but too near the sun for easy observation.

*Mars* on the 15th is in R.A. 14h 14m, Decl. 13° 16′ S. and transits at 22.37. Moving into Virgo nearer to Spica, it is now well up in the east at sunset and is visible all night. On the 8th Mars is nearest the earth (about 52 million miles), and during this month it reaches greatest brilliance (stellar magnitude −1.5).

*Jupiter* on the 15th is in R.A. 2h 08m, Decl. 11° 49′ N. and transits at 10.35. It is a morning star rising about an hour before the sun. For the configurations of Jupiter's satellites see opposite page, and for their eclipses, etc., see p. 54.

*Saturn* on the 15th is in R.A. 12h 36m, Decl. 1° 02′ S. and transits at 21.01. It is in Virgo just west of Spica. It is well up in the south-east at sunset and is visible most of the night.

*Uranus* on the 15th is in R.A. 6h 49m, Decl. 23° 20′ N. and transits at 15.16.

*Neptune* on the 15th is in R.A. 13h 14m, Decl. 6° 02′ S. and transits at 21.39.

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

| | d | h | m | MAY<br>75th Meridian Civil Time | Min. of Algol<br>h m | Phen. of Jupiter's Sat. 4h 30m |
|---|---|---|---|---|---|---|
| Thur. | 1 | 9 | | Moon in Apogee. Dist. from ⊕, 251,000 mi. | | |
| | | 22 | 58 | ☽ First Quarter | | |
| Fri. | 2 | | | | 05 25 | |
| Sat. | 3 | 6 | | ☿ Greatest elongation W., 26°45′ | | |
| Sun. | 4 | | | Eta Aquarid meteors | | |
| Mon. | 5 | 9 | | ☌♀♃ ♀ 0°19′ S. | 02 14 | |
| Tue. | 6 | 20 | 48 | ☌♄☾ ♄ 6°46′ N. | | |
| Wed. | 7 | 15 | 27 | ☌♆☾ ♆ 6°17′ N. | 23 03 | |
| Thur. | 8 | 9 | | ♂ nearest ⊕. Dist. from ⊕, 51,860,000 mi. | | |
| | | 22 | 28 | ☌♂☾ ♂ 5°30′ N. | | |
| Fri. | 9 | 15 | 16 | ◯ Full Moon | | |
| Sat. | 10 | | | | 19 52 | |
| Sun. | 11 | | | | | |
| Mon. | 12 | | | | | |
| Tue. | 13 | 11 | | Moon in Perigee. Dist. from ⊕, 228,400 mi. | 16 41 | |
| Wed. | 14 | | | | | |
| Thur. | 15 | 23 | | ☿ Greatest Hel. Lat. S. | | |
| Fri. | 16 | 9 | 39 | ☾ Last Quarter | 13 30 | |
| | | 21 | | ☌☿♃ ☿ 1°45′ S. | | |
| Sat. | 17 | | | | | |
| Sun. | 18 | 2 | | ♂ in ♉ | | |
| Mon. | 19 | | | | 10 19 | |
| Tue. | 20 | | | | | |
| Wed. | 21 | 15 | 58 | ☌♃☾ ♃ 6°09′ S. | | |
| Thur. | 22 | 5 | 13 | ☌☿☾ ☿ 7°22′ S. | 07 08 | |
| | | 23 | 35 | ☌♀☾ ♀ 6°02′ S. | | |
| Fri. | 23 | 14 | 28 | ● New Moon | | |
| Sat. | 24 | | | | | |
| Sun. | 25 | | | | 03 57 | |
| Mon. | 26 | 18 | 02 | ☌♅☾ ♅ 3°05′ S. | | |
| Tue. | 27 | | | | | 32014 |
| Wed. | 28 | | | | 00 45 | 31042 |
| Thur. | 29 | 3 | | Moon in Apogee. Dist. from ⊕, 251,500 mi. | | 34021 |
| Fri. | 30 | | | | 21 34 | 4210* |
| Sat. | 31 | 16 | 46 | ☽ First Quarter | | 40213 |

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

Jupiter being near the sun, phenomena of the satellites are not given from March 30 to May 27.

## THE SKY FOR JUNE, 1952

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 35m to 6h 40m and its Decl. changes from 22° 01′ N. to 23° 27′ N. at the solstice on the 21st and then to 23° 08′ N. at the end of the month. The equation of time changes from +2m 22s to —3m 38s, being zero on the 14th; that is, the apparent sun changes from being west of the mean sun to being east of it. 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. 6h 05m, Decl. 25° 02′ N. and transits at 12.36. Superior conjunction is on the 8th and the planet is too near the sun all month for observation.

*Venus* on the 15th is in R.A. 5h 21m, Decl. 23° 10′ N. and transits at 11.49. Superior conjunction is on the 24th, and so the planet is too near the sun all month for observation.

*Mars* on the 15th is in R.A. 13h 55m, Decl. 12° 55′ S. and transits at 20.18. It is in Virgo east of Spica and is about at the meridian at sunset and so visible until after midnight. It is still prominently bright. On the 10th Mars is stationary in right ascension and resumes eastward motion among the stars.

*Jupiter* on the 15th is in R.A. 2h 34m, Decl. 14° 01′ N. and transits at 9.00. It is a prominent object in the eastern sky for a few hours 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. 12h 34m, Decl. 0° 56′ S. and transits at 18.57. It is in Virgo west of Spica. It is west of the meridian at sunset and sets about midnight. On the 11th it is stationary in R.A. and resumes eastward motion among the stars.

*Uranus* on the 15th is in R.A. 6h 56m, Decl. 23° 11′ N. and transits at 13.21.

*Neptune* on the 15th is in R.A. 13h 13m, Decl. 5° 53′ S. and transits at 19.36.

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

| | | | JUNE<br>75th Meridian Civil Time | Min. of Algol | Phen. of Jupiter's Sat. 4h 00m |
|---|---|---|---|---|---|
| d | h | m | | h m | |
| Sun. 1 | | | ........................................ | | 41O23 |
| Mon. 2 | | | ........................................ | 18 23 | 42O13 |
| Tue. 3 | 4 | 14 | ☌♄☾ ♄ 6°48′ N.................... | | 423O* |
| | 23 | 59 | ☌♆☾ ♆ 6°25′ N.................... | | |
| Wed. 4 | 0 | | ☿ in ☊.............................. | | 431O2 |
| | 11 | | ☌☿♀ ☿ 0°28′ N.................... | | |
| | 20 | 22 | ☌♂☾ ♂ 4°15′ N.................... | | |
| Thur. 5 | | | ........................................ | 15 12 | 34O12 |
| Fri. 6 | | | ........................................ | | 2134O |
| Sat. 7 | | | ........................................ | | O134* |
| Sun. 8 | 0 | 07 | ○ Full Moon........................ | 12 01 | 1O234 |
| | 15 | | ☿ in Perihelion........................ | | |
| | 21 | | ☌☿☉ Superior.................... | | |
| Mon. 9 | | | ........................................ | | 2O134 |
| Tue. 10 | 2 | | Moon in Perigee. Dist. from ⊕, 225,200 mi.... | | 213O4 |
| | 19 | | ♂ Stationary in R.A.................. | | |
| Wed. 11 | 10 | | ♄ Stationary in R.A.................. | 08 50 | d3O24 |
| Thur. 12 | | | ........................................ | | 3O124 |
| Fri. 13 | | | ........................................ | | 231O4 |
| Sat. 14 | 4 | | ♀ in ☊.............................. | 05 38 | 2O413 |
| | 15 | 28 | ☾ Last Quarter...................... | | |
| Sun. 15 | | | ........................................ | | 14O23 |
| Mon. 16 | | | ........................................ | | d4O13 |
| Tue. 17 | | | ........................................ | 02 27 | 421O3 |
| Wed. 18 | 8 | 46 | ☌♃☾ ♃ 6°23′ S.................... | | 43O12 |
| | 21 | | ☿ Greatest Hel. Lat. N................ | | |
| Thur. 19 | | | ........................................ | 23 16 | 43O2* |
| Fri. 20 | 17 | | ☌☿♅ ☿ 1°34′ N.................... | | 4321O |
| Sat. 21 | 6 | 13 | ☉ enters ♋, Summer commences. Long. of ☉, 90°. | | 42O31 |
| Sun. 22 | 2 | 12 | ☌♀☾ ♀ 3°45′ S...................... | 20 05 | 41O23 |
| | 3 | 45 | ● New Moon........................ | | |
| Mon. 23 | 4 | 06 | ☌♅☾ ♅ 2°54′ S...................... | | O4213 |
| | 14 | 50 | ☌☿☾ ☿ 0°56′ S...................... | | |
| Tue. 24 | 16 | | ☌♀☉ Superior...................... | | 21O34 |
| Wed. 25 | 18 | | Moon in Apogee. Dist. from ⊕, 252,100 mi.... | 16 53 | 3O214 |
| Thur. 26 | | | ........................................ | | 3O24* |
| Fri. 27 | | | ........................................ | | 321O4 |
| Sat. 28 | | | ........................................ | 13 42 | 2O314 |
| Sun. 29 | | | ........................................ | | 1O234 |
| Mon. 30 | 5 | | □♄☉ East........................ | | O2143 |
| | 8 | 11 | ☽ First Quarter...................... | | |
| | 13 | 12 | ☌♄☾ ♄ 6°56′ N.................... | | |
| | 17 | | ♆ Stationary in R.A.................. | | |

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

## THE SKY FOR JULY, 1952

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 40m to 8h 44m and its Decl. changes from 23° 08′ N. to 18° 06′ N. The equation of time changes from —3m 38s to a maximum of —6m 24s on the 26th and then to —6m 15s at the end of the month. On the 2nd the earth is in aphelion or farthest from the sun. For changes in the length of the day, see p. 14.

*The Moon*—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 21.

*Mercury* on the 15th is in R.A. 9h 25m, Decl. 14° 40′ N. and transits 13.54. It is at greatest eastern elongation on the 15th, and around about this time it may be seen at, and just after, sunset about 13° above the western horizon. It is then about 10° west of Regulus.

*Venus* on the 15th is in R.A. 8h 01m, Decl. 21° 38′ N. and transits at 12.31. It is an evening star but too near the sun for easy observation.

*Mars* on the 15th is in R.A. 14h 21m, Decl. 15° 50′ S. and transits at 18.48. Moving from Virgo back into Libra, it is just past the meridian at sunset and is visible in the south-west all evening. It is now declining appreciably in brightness.

*Jupiter* on the 15th is in R.A. 2h 56m, Decl. 15° 37′ N. and transits at 7.23. It rises about midnight and is prominent in the eastern sky the rest of the 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. 12h 37m, Decl. 1° 25′ S. and transits at 17.03. It is in Virgo west of Spica. It is well down in the south-west by sunset and sets a few hours later.

*Uranus* on the 15th is in R.A. 7h 04m, Decl. 23° 00′ N. and transits at 11.30.

*Neptune* on the 15th is in R.A. 13h 13m, Decl. 5° 54′ S. and transits at 17.38.

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

| | | | | JULY<br>75th Meridian Civil Time | Min. of Algol | | Phen. of Jupiter's Sat.<br>3h 15m |
|---|---|---|---|---|---|---|---|
| | d | h | m | | h | m | |
| Tue. | 1 | 8 | 31 | ☌♆☾ ♆ 6°36′ N. | 10 | 31 | 21O43 |
| Wed. | 2 | 10 | 32 | ☌♂☾ ♂ 3°43′ N. | | | 34O1* |
| | | 21 | | ⊕ in Aphelion. Dist. from ☉, 94,451,000 mi. | | | |
| Thur. | 3 | 10 | | ☌♀♅ ♀ 0°21′ N. | | | 431O2 |
| Fri. | 4 | | | | 07 | 19 | d432O |
| Sat. | 5 | | | | | | 423O1 |
| Sun. | 6 | 4 | | ☌♅☉ | | | 41O23 |
| Mon. | 7 | 7 | 33 | 🌕 Full Moon | 04 | 08 | 4O123 |
| Tue. | 8 | 6 | | Moon in Perigee. Dist. from ⊕, 222,800 mi. | | | 421O3 |
| Wed. | 9 | | | | | | 43O1* |
| Thur. | 10 | | | | 00 | 57 | 31O42 |
| Fri. | 11 | 4 | | □♆☉ East | | | 32O14 |
| Sat. | 12 | 8 | | ☿ in ☋ | 21 | 45 | 2O4** |
| Sun. | 13 | 22 | 42 | ☾ Last Quarter | | | 1O234 |
| Mon. | 14 | | | | | | O1234 |
| Tue. | 15 | 16 | | ☿ Greatest elongation E., 26°40′ | 18 | 34 | 21O34 |
| | | 23 | 19 | ☌♃☾ ♃ 6°36′ S. | | | |
| Wed. | 16 | | | | | | 23O14 |
| Thur. | 17 | | | | | | 31O24 |
| Fri. | 18 | 0 | | ♀ in Perihelion | 15 | 23 | d3O41 |
| Sat. | 19 | | | | | | 243O* |
| Sun. | 20 | 13 | 33 | ☌♅☾ ♅ 2°47′ S. | | | d4O23 |
| Mon. | 21 | 18 | 30 | ● New Moon | 12 | 11 | 4O123 |
| Tue. | 22 | 11 | 26 | ☌♀☾ ♀ 0°02′ S. | | | 421O3 |
| | | 14 | | ☿ in Aphelion | | | |
| Wed. | 23 | 3 | | Moon in Apogee. Dist. from ⊕, 252,500 mi. | | | d42O1 |
| | | 23 | 28 | ☌☿☾ ☿ 2°12′ S. | | | |
| Thur. | 24 | | | | 09 | 00 | 431O2 |
| Fri. | 25 | | | | | | 34O21 |
| Sat. | 26 | | | | | | 2341O |
| Sun. | 27 | 23 | 03 | ☌♄☾ ♄ 7°03′ N. | 05 | 48 | O1243 |
| Mon. | 28 | 16 | 18 | ☌♆☾ ♆ 6°44′ N. | | | O1243 |
| | | 18 | | ☿ Stationary in R.A. | | | |
| | | | | Delta Aquarid meteors | | | |
| Tue. | 29 | 20 | 51 | ☽ First Quarter | | | 21O34 |
| Wed. | 30 | 13 | 32 | ☌♂☾ ♂ 3°34′ N. | 02 | 37 | 2O314 |
| Thur. | 31 | | | | | | 31O24 |

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

# THE SKY FOR AUGUST, 1952

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 44m to 10h 40m and its Decl. changes from 18° 06′ N. to 8° 23′ N. The equation of time changes from —6m 15s to —0m 05s. On the 20th there is an annular eclipse of the sun invisible in North America. For changes in the length of the day, see p. 14.

*The Moon*—For its phases, perigee and apogee times and distances, and its conjunctions with the planets, see opposite page. Times of moonrise and moonset are given on p. 21. There is a partial eclipse of the moon on the 5th, invisible in North America.

*Mercury* on the 15th is in R.A. 9h 17m, Decl. 11° 14′ N. and transits at 11.39. Most of the month it is poorly placed for observation, being in inferior conjunction on the 12th. By the 29th it is at greatest western elongation and is then a good morning star, being visible about 15° above the eastern horizon just before sunrise.

*Venus* on the 15th is in R.A. 10h 34m, Decl. 10° 36′ N. and transits at 13.01. It is an evening star to be seen very low in the western sky just after sunset.

*Mars* on the 15th is in R.A. 15h 19m, Decl. 20° 21′ S. and transits at 17.44. Moving through Libra closer to Antares, it is well down in the south-west after sunset.

*Jupiter* on the 15th is in R.A. 3h 11m, Decl. 16° 35′ N. and transits at 5.36. It rises before midnight and is prominent in the eastern sky the rest of the 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. 12h 46m, Decl. 2° 25′ S. and transits at 15.10. It is low in the south-west at sunset and sets soon after.

*Uranus* on the 15th is in R.A. 7h 12m, Decl. 22° 48′ N. and transits at 9.36.

*Neptune* on the 15th is in R.A. 13h 14m, Decl. 6° 07′ S. and transits at 15.38.

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

# AUGUST

75th Meridian Civil Time

| | d | h | m | | Min. of Algol. h m | Phen. of Jupiter's Sat. 2h 45m |
|---|---|---|---|---|---|---|
| Fri. | 1 | | | | 23 25 | 30214 |
| Sat. | 2 | | | | | 32104 |
| Sun. | 3 | | | | | 0314* |
| Mon. | 4 | 13 | | ☌☿♀ ☿ 6°24′ S. | 20 14 | 4023* |
| Tue. | 5 | | | Partial eclipse of ☾. See p. 29. | | 42103 |
| | | 14 | 40 | ☺ Full Moon | | |
| | | 15 | | Moon in Perigee. Dist. from ⊕, 221,900 mi. | | |
| Wed. | 6 | | | | | 42013 |
| Thur. | 7 | | | | 17 03 | 43102 |
| Fri. | 8 | 16 | | ♀ Greatest Hel. Lat. N. | | 43021 |
| Sat. | 9 | | | | | 43210 |
| Sun. | 10 | | | | 13 51 | 401** |
| Mon. | 11 | 22 | | ☿ Greatest Hel. Lat. S. | | 41023 |
| Tue. | 12 | 7 | | □♃☉ West | | d4203 |
| | | 8 | 27 | ☾ Last Quarter | | |
| | | 11 | 44 | ☌♃☾ ♃ 6°43′ S. | | |
| | | 13 | | ☌☿☉ Inferior | | |
| | | | | Perseid meteors | | |
| Wed. | 13 | 20 | | ☌♇☉ | 10 40 | 20143 |
| Thur. | 14 | | | | | 31024 |
| Fri. | 15 | | | | | 30124 |
| Sat. | 16 | 4 | | □♂☉ East | 07 28 | 32104 |
| | | 22 | 29 | ☌♅☾ ♅ 2°42′ S. | | |
| Sun. | 17 | | | | | 23014 |
| Mon. | 18 | | | | | 10234 |
| Tue. | 19 | 6 | | Moon in Apogee. Dist. from ⊕, 252,500 mi. | 04 17 | d0134 |
| | | 7 | 25 | ☌☿☾ ☿ 4°11′ S. | | |
| Wed. | 20 | | | Annular eclipse of ☉. See p. 29. | | 2043* |
| | | 10 | 20 | ● New Moon | | |
| Thur. | 21 | 19 | | ☿ Stationary in R.A. | | 31402 |
| Fri. | 22 | 0 | 58 | ☌♀☾ ♀ 3°57′ N. | 01 05 | 34012 |
| Sat. | 23 | | | | | 43210 |
| Sun. | 24 | 9 | 38 | ☌♄☾ ♄ 7°07′ N. | 21 54 | 42301 |
| | | 23 | 21 | ☌♆☾ ♆ 6°44′ N. | | |
| Mon. | 25 | | | | | 41023 |
| Tue. | 26 | | | | | 40213 |
| Wed. | 27 | 23 | 35 | ☌♂☾ ♂ 3°16′ N. | 18 43 | 4203* |
| Thur. | 28 | 7 | 03 | ☽ First Quarter | | 43102 |
| Fri. | 29 | 23 | | ☿ Greatest elongation W., 18°11′ | | 34012 |
| Sat. | 30 | 23 | | ☿ in ☊ | 15 31 | 31204 |
| Sun. | 31 | | | | | 23014 |

## THE SKY FOR SEPTEMBER, 1952

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 40m to 12h 28m and its Decl. changes from 8° 23′ N. to 3° 05′ S. The equation of time changes from —0m 05s to +10m 12s, the apparent sun passing to the west of the mean sun on the 1st. On the 22nd at 21.24 E.S.T. the sun crosses the equator moving southward, enters the sign of Libra, and autumn commences. For changes in the length of the day, see p. 15.

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

*Mercury* on the 15th is in R.A. 11h 03m, Decl. 8° 07′ N. and transits at 11.29. It is poorly placed for observation, being in superior conjunction on the 24th.

*Venus* on the 15th is in R.A. 12h 54m, Decl. 4° 55′ S. and transits at 13.19. It is an evening star to be seen very low in the western sky just after sunset.

*Mars* on the 15th is in R.A. 16h 38m, Decl. 24° 09′ S. and transits at 17.02. Moving rapidly through Scorpius past Antares and into Sagittarius, it is well down in the south-west after sunset.

*Jupiter* on the 15th is in R.A. 3h 15m, Decl. 16° 46′ N. and transits at 3.38. It rises a few hours after sunset and dominates the sky the rest of the night. On the 9th it is stationary in R.A. and begins westward, or retrograde, 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. 12h 58m, Decl. 3° 45′ S. and transits at 13.20. It is too near the sun for easy observation.

*Uranus* on the 15th is in R.A. 7h 18m, Decl. 22° 39′ N. and transits at 7.40.

*Neptune* on the 15th is in R.A. 13h 18m, Decl. 6° 28′ S. and transits at 13.39.

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

| | | | | SEPTEMBER<br>75th Meridian Civil Time | Min. of Algol. | Phen. of Jupiter's Sat. 2h 00m |
|---|---|---|---|---|---|---|
| | d | h | m | | h m | |
| Mon. | 1 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | 10324 |
| Tue. | 2 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 12 20 | 02134 |
| Wed. | 3 | 1 | | Moon in Perigee. Dist. from ⊕, 222,700 mi.... | | 21034 |
| | | 22 | 19 | 🌕 Full Moon.......................... | | |
| Thur. | 4 | 14 | | ☿ in Perihelion......................... | | d034* |
| Fri. | 5 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 09 08 | 30124 |
| Sat. | 6 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | 31204 |
| Sun. | 7 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | 23401 |
| Mon. | 8 | 21 | 51 | ☌ ♃ ☾ ♃ 6°44′ S.................... | 05 57 | 41032 |
| Tue. | 9 | 20 | | ♃ Stationary in R.A.................... | | 40123 |
| Wed. | 10 | 21 | 36 | ☾ Last Quarter........................ | | 42103 |
| Thur. | 11 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 02 45 | 4013* |
| Fri. | 12 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | 4302* |
| Sat. | 13 | 7 | 13 | ☌ ♅ ☾ ♅ 2°33′ S.................... | 23 34 | 43120 |
| Sun. | 14 | 20 | | ☿ Greatest Hel. Lat. N.................. | | 32401 |
| Mon. | 15 | 14 | | Moon in Apogee. Dist. from ⊕, 252,100 mi.... | | 10432 |
| | | 18 | | ☌ ♀ ♄ ♀ 1°37′ S.................... | | |
| Tue. | 16 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 20 23 | 01243 |
| Wed. | 17 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | 21034 |
| Thur. | 18 | 20 | 15 | ☌ ☿ ☾ ☿ 4°54′ N.................... | | 20134 |
| Fri. | 19 | 2 | 22 | 🌑 New Moon.......................... | 17 11 | 3024* |
| Sat. | 20 | 4 | | ☌ ♀ ♆ ♀ 1°06′ S.................... | | dd304 |
| | | 21 | 15 | ☌ ♄ ☾ ♄ 7°09′ N.................... | | |
| Sun. | 21 | 6 | 34 | ☌ ♆ ☾ ♆ 6°41′ N.................... | | 32014 |
| | | 9 | 18 | ☌ ♀ ☾ ♀ 5°35′ N.................... | | |
| Mon. | 22 | 21 | 24 | ☉ enters ♎, Autumn commences. Long. of ☉, 180° | 14 00 | 10324 |
| Tue. | 23 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | 04123 |
| Wed. | 24 | 9 | | ☌ ☿ ☉ Superior...................... | | 42103 |
| Thur. | 25 | 13 | 22 | ☌ ♂ ☾ ♂ 2°35′ N.................... | 10 48 | 42013 |
| Fri. | 26 | 15 | 31 | ☽ First Quarter....................... | | 43102 |
| Sat. | 27 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | d4302 |
| Sun. | 28 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 07 37 | 43201 |
| Mon. | 29 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | 41302 |
| Tue. | 30 | | | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | 40123 |

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

## THE SKY FOR OCTOBER, 1952

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 28m to 14h 25m and its Decl. changes from 3° 05′ S. to 14° 21′ S. The equation of time changes from +10m 12s to +16m 22s. For changes in the length of the day, see p. 15.

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

*Mercury* on the 15th is in R.A. 14h 11m, Decl. 14° 01′ S. and transits at 12.39. It is an evening star but too near the sun for observation.

*Venus* on the 15th is in R.A. 15h 14m, Decl. 18° 34′ S. and transits at 13.41. It is an evening star to be seen low in the south-western sky just after sunset.

*Mars* on the 15th is in R.A. 18h 09m, Decl. 25° 19′ S. and transits at 16.34. Moving eastward in Sagittarius, it is well down in the south-west after sunset. It is no longer prominently bright.

*Jupiter* on the 15th is in R.A. 3h 08m, Decl. 16° 12′ N. and transits at 1.33. It rises a few hours after sunset and dominates the sky the rest of the 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. 13h 11m, Decl. 5° 08′ S. and transits at 11.35. It is too near the sun for observation, conjunction with the sun being on the 11th.

*Uranus* on the 15th is in R.A. 7h 20m, Decl. 22° 34′ N. and transits at 5.45.

*Neptune* on the 15th is in R.A. 13h 22m, Decl. 6° 52′ S. and transits at 11.45.

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

| | d | h | m | OCTOBER<br>75th Meridian Civil Time | Min. of Algol h m | Phen. of Jupiter's Sat. 1h 30m |
|---|---|---|---|---|---|---|
| Wed. | 1 | 8 | | Moon in Perigee. Dist. from ⊕, 225,100 mi. | 04 26 | 12403 |
| Thur. | 2 | | | | | 20413 |
| Fri. | 3 | 7 | 15 | ○ Full Moon | | 31024 |
| | | 17 | | ♀ in ☋ | | |
| | | 19 | | ☌ ☿ ♄ ☿ 1°53′ S. | | |
| Sat. | 4 | | | | 01 14 | 30124 |
| Sun. | 5 | | | | | 3204* |
| Mon. | 6 | 4 | | ☌ ☿ ♆ ☿ 1°29′ S. | 22 03 | 3104* |
| | | 5 | 18 | ☌ ♃ ☾ ♃ 6°40′ S. | | |
| Tue. | 7 | | | | | 01324 |
| Wed. | 8 | 7 | | ☿ in ☋ | | 12034 |
| Thur. | 9 | | | | 18 52 | 20143 |
| Fri. | 10 | 14 | 33 | ☾ Last Quarter | | 13402 |
| | | 15 | 57 | ☌ ♅ ☾ ♅ 2°19′ S. | | |
| Sat. | 11 | 3 | | ☌ ♄ ☉ | | 34012 |
| | | 15 | | □ ♅ ☉ West | | |
| Sun. | 12 | | | | 15 41 | 43210 |
| Mon. | 13 | 5 | | Moon in Apogee. Dist. from ⊕, 251,500 mi. | | d4320 |
| Tue. | 14 | 16 | | ☌ ♆ ☉ | | 40132 |
| Wed. | 15 | | | | 12 29 | 41203 |
| Thur. | 16 | | | | | 42013 |
| Fri. | 17 | | | | | 41302 |
| Sat. | 18 | 10 | 20 | ☌ ♄ ☾ ♄ 7°15′ N. | 09 18 | 34012 |
| | | 14 | | ☿ in Aphelion | | |
| | | 15 | 02 | ☌ ♆ ☾ ♆ 6°40′ N. | | |
| | | 17 | 42 | ● New Moon | | |
| Sun. | 19 | | | | | 32104 |
| Mon. | 20 | 5 | 21 | ☌ ☿ ☾ ☿ 3°51′ N. | | d3204 |
| Tue. | 21 | 9 | 31 | ☌ ♀ ☾ ♀ 4°11′ N. | 06 07 | 01324 |
| Wed. | 22 | | | Orionid meteors | | d1034 |
| | | 3 | | ♂ Greatest Hel. Lat. S. | | |
| Thur. | 23 | | | | | 20134 |
| Fri. | 24 | 5 | 44 | ☌ ♂ ☾ ♂ 1°25′ N. | 02 56 | 10324 |
| | | 12 | | ♅ Stationary in R.A. | | |
| Sat. | 25 | 23 | 04 | ☽ First Quarter | | 30124 |
| Sun. | 26 | | | | 23 44 | 32104 |
| Mon. | 27 | | | | | 34201 |
| Tue. | 28 | | | | | 4032* |
| Wed. | 29 | 1 | | Moon in Perigee. Dist. from ⊕, 228,400 mi. | 20 33 | 41023 |
| Thur. | 30 | | | | | 42013 |
| Fri. | 31 | | | | | 41023 |

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

## THE SKY FOR NOVEMBER, 1952

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 25m to 16h 28m and its Decl. changes from 14° 21′ S. to 21° 46′ S. The equation of time changes from +16m 22s to a maximum of +16m 24s on the 3rd and then to +11m 04s at the end of the month. For changes in the length of the day, see p. 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. 16h 52m, Decl. 25° 05′ S. and transits at 13.15. It is an evening star and reaches greatest eastern elongation on the 9th; but this is a very unfavourable elongation, Mercury being very low in the south-west at sunset. By the 30th it is in inferior conjunction.

*Venus* on the 15th is in R.A. 17h 56m, Decl. 25° 18′ S. and transits at 14.20. It is an evening star to be seen in the south-west after sunset.

*Mars* on the 15th is in R.A. 19h 48m, Decl. 22° 45′ S. and transits at 16.12. Moving from Sagittarius into Capricornus, it is low in the south-west after sunset.

*Jupiter* on the 15th is in R.A. 2h 52m, Decl. 15° 06′ N. and transits at 23.10. It rises about sunset and is prominent all night. It is in opposition on the 8th. 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. 13h 25m, Decl. 6° 29′ S. and transits at 9.47. It is in Virgo to the north of Spica. Now a morning star, it is visible in the south-east for an hour or two before sunrise.

*Uranus* on the 15th is in R.A. 7h 20m, Decl. 22° 37′ N. and transits at 3.42.

*Neptune* on the 15th is in R.A. 13h 26m, Decl. 7° 16′ S. and transits at 9.48.

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

| | d | h | m | NOVEMBER<br>75th Meridian Civil Time | Min. of Algol<br>h m | Phen. of Jupiter's Sat.<br>0h 00m |
|---|---|---|---|---|---|---|
| Sat. | 1 | 18 | 10 | ○ Full Moon | 17 22 | 43O12 |
| Sun. | 2 | 9 | 54 | ☌♃☾ ♃ 6°36′ S. | | 4312O |
| Mon. | 3 | | | | | 342O1 |
| Tue. | 4 | | | | 14 11 | 1O342 |
| Wed. | 5 | | | | | dO243 |
| Thur. | 6 | | | | | 2O134 |
| Fri. | 7 | 0 | 24 | ☌♅☾ ♅ 2°02′ S. | 11 00 | 1O34* |
| | | 8 | | ♀ in Aphelion | | |
| | | 22 | | ☿ Greatest Hel. Lat. S. | | |
| Sat. | 8 | 4 | | ☍♃☉ Dist. from ⊕, 371,000,000 mi. | | 3O124 |
| Sun. | 9 | 10 | 43 | ☾ Last Quarter | | 312O4 |
| | | 22 | | ☿ Greatest elongation E., 22°59′ | | |
| Mon. | 10 | | | Taurid meteors | 07 48 | 32O14 |
| | | 1 | | Moon in Apogee. Dist. from ⊕, 251,200 mi. | | |
| Tue. | 11 | | | | | 1O24* |
| Wed. | 12 | | | | | O4123 |
| Thur. | 13 | | | | 04 37 | 42O3* |
| Fri. | 14 | | | | | 412O3 |
| Sat. | 15 | 0 | 44 | ☌♄☾ ♄ 7°29′ N. | | 43O12 |
| | | 1 | 09 | ☌♆☾ ♆ 6°47′ N. | | |
| Sun. | 16 | | | Leonid meteors | 01 26 | 4312O |
| | | 10 | | ♂ in Perihelion | | |
| Mon. | 17 | 7 | 56 | ● New Moon | | 432O1 |
| | | 21 | | ☌♄♆ ♄ 0°43′ N. | | |
| Tue. | 18 | 21 | 39 | ☌☿☾ ☿ 2°15′ N. | 22 15 | 413O2 |
| Wed. | 19 | | | | | 4O123 |
| Thur. | 20 | 5 | | ☿ Stationary in R.A. | | 241O3 |
| | | 6 | 11 | ☌♀☾ ♀ 1°14′ N. | | |
| Fri. | 21 | | | | 19 04 | 21O43 |
| Sat. | 22 | 0 | 28 | ☌♂☾ ♂ 0°14′ S. | | 3O124 |
| Sun. | 23 | 3 | | Moon in Perigee. Dist. from ⊕, 230,000 mi. | | d31O4 |
| Mon. | 24 | 6 | 34 | ☽ First Quarter | 15 53 | 32O14 |
| Tue. | 25 | | | | | 13O24 |
| Wed. | 26 | 22 | | ☿ in ☊ | | O1234 |
| Thur. | 27 | | | Bielid meteors | 12 42 | 21O34 |
| Fri. | 28 | | | | | d2O43 |
| Sat. | 29 | 12 | 28 | ☌♃☾ ♃ 6°36′ S. | | 43O12 |
| | | 13 | | ♀ Greatest Hel. Lat. S. | | |
| Sun. | 30 | 6 | | ☌☿☉ Inferior | 09 31 | 431O2 |

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

## THE SKY FOR DECEMBER, 1952

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 28m to 18h 45m and its Decl. changes from 21° 46′ S. to 23° 27′ S. at the solstice on the 22nd and then to 23° 03′ S. at the end of the month. The equation of time changes from +11m 04s to zero on the 25th and then to —3m 22s 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. 16h 02m, Decl. 18° 04′ S. and transits at 10.27. It is a morning star and reaches greatest western elongation on the 18th. At this time it may be seen about 12° above the south-eastern horizon just before sunrise. It is then a few degrees above Antares.

*Venus* on the 15th is in R.A. 20h 32m, Decl. 21° 08′ S. and transits at 14.58. It is an evening star prominent in the south-west after sunset for several hours.

*Mars* on the 15th is in R.A. 21h 22m, Decl. 16° 43′ S. and transits at 15.47. Moving through Capricornus into Aquarius, it is low in the south-west during the evening. At the end of the year its stellar magnitude has declined to +1.2.

*Jupiter* on the 15th is in R.A. 2h 39m, Decl. 14° 13′ N. and transits at 21.00. It is well up in the east at sunset and it sets a few hours before sunrise. 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. 13h 36m, Decl. 7° 29′ S. and transits at 8.00. It is in Virgo north-east of Spica, rising in the south-east a few hours after midnight.

*Uranus* on the 15th is in R.A. 7h 16m, Decl. 22° 44′ N. and transits at 1.40.

*Neptune* on the 15th is in R.A. 13h 29m, Decl. 7° 34′ S. and transits at 7.53.

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

| | d | h | m | DECEMBER<br>75th Meridian Civil Time | Min. of Algol h | m | Phen. of Jupiter's Sat. 22h 45m |
|---|---|---|---|---|---|---|---|
| Mon. | 1 | 7 | 41 | 🌕 Full Moon........ | | | 43102 |
| | | 13 | | ☿ in Perihelion........ | | | |
| Tue. | 2 | | | ........ | | | 40132 |
| Wed. | 3 | | | ........ | 06 | 20 | 42103 |
| Thur. | 4 | 7 | 54 | ☌♅☾ ♅ 1°52′ S........ | | | 42013 |
| Fri. | 5 | | | ........ | | | d402* |
| Sat. | 6 | | | ........ | 03 | 09 | 31402 |
| Sun. | 7 | 22 | | Moon in Apogee. Dist. from ⊕, 251,300 mi.... | | | 32014 |
| Mon. | 8 | | | ........ | 23 | 58 | 3104* |
| Tue. | 9 | 8 | 22 | ☾ Last Quarter........ | | | 03124 |
| | | 20 | | ☿ Stationary in R.A........ | | | |
| Wed. | 10 | | | ........ | | | 12034 |
| Thur. | 11 | 20 | | ☿ Greatest Hel. Lat. N........ | 20 | 47 | 20134 |
| Fri. | 12 | | | Geminid meteors........ | | | 10324 |
| | | 12 | 01 | ☌♆☾ ♆ 7°00′ N........ | | | |
| | | 15 | 17 | ☌♄☾ ♄ 7° 48′ N........ | | | |
| Sat. | 13 | | | ........ | | | d3024 |
| Sun. | 14 | | | ........ | 17 | 37 | 32014 |
| Mon. | 15 | 8 | 53 | ☌☿☾ ☿ 7°28′ N........ | | | 34120 |
| Tue. | 16 | 21 | 02 | 🌑 New Moon........ | | | 40312 |
| Wed. | 17 | .... | .... | ........ | 14 | 26 | 41203 |
| Thur. | 18 | 17 | | ☿ Greatest elongation W., 21°37′........ | | | 42013 |
| Fri. | 19 | 16 | | Moon in Perigee. Dist. from ⊕, 227,000 mi.... | | | 41032 |
| Sat. | 20 | 2 | 38 | ☌♀☾ ♀ 2°03′ S........ | 11 | 15 | d4302 |
| | | 21 | 21 | ☌♂☾ ♂ 2°12′ S........ | | | |
| Sun. | 21 | 16 | 44 | ☉ enters ♑, Winter commences. Long. of ☉, 270°. | | | 4320* |
| Mon. | 22 | | | ........ | | | 34120 |
| Tue. | 23 | 14 | 51 | ☽ First Quarter........ | 08 | 04 | 03412 |
| Wed. | 24 | | | ........ | | | d1034 |
| Thur. | 25 | | | ........ | | | 20134 |
| Fri. | 26 | 15 | 17 | ☌♃☾ ♃ 6°39′ S........ | 04 | 53 | 10234 |
| Sat. | 27 | | | ........ | | | 30124 |
| Sun. | 28 | | | ........ | | | 3204* |
| Mon. | 29 | | | ........ | 01 | 42 | 32104 |
| Tue. | 30 | | | ........ | | | 30124 |
| Wed. | 31 | 0 | 05 | 🌕 Full Moon........ | 22 | 31 | 14023 |
| | | 13 | 47 | ☌♅☾ ♅ 1°52′ S........ | | | |

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

## JANUARY

| d | h | m | Sat. | Phen. |
|---|---|---|---|---|
| 1 | 22 | 42 | I | TI |
| 2 | 19 | 40 | II | ER |
| | 20 | 01 | I | OD |
| 3 | 18 | 32 | I | SI |
| | 19 | 24 | I | Te |
| | 20 | 43 | I | Se |
| | 22 | 43 | III | TI |
| 4 | 18 | 02 | I | ER |
| 7 | 18 | 28 | III | ED |
| | 20 | 56 | III | ER |
| | 22 | 39 | II | TI |
| 9 | 19 | 40 | II | OR |
| | 19 | 43 | II | ED |
| | 21 | 58 | I | OD |
| | 22 | 19 | II | ER |
| 10 | 19 | 09 | I | TI |
| | 20 | 28 | I | SI |
| | 21 | 22 | I | Te |
| | 22 | 39 | I | Se |
| 11 | 19 | 58 | I | ER |
| 14 | 19 | 53 | III | OR |
| | 22 | 30 | III | ED |
| 16 | 19 | 42 | II | OD |
| 17 | 21 | 08 | I | TI |
| | 22 | 25 | I | SI |
| 18 | 18 | 25 | I | OD |
| | 19 | 45 | II | Se |
| | 21 | 53 | I | ER |
| 19 | 17 | 50 | I | Te |
| | 19 | 04 | I | Se |
| 21 | 21 | 19 | III | OD |
| 25 | 18 | 52 | III | Se |
| | 19 | 50 | II | SI |
| | 20 | 01 | II | Te |
| | 20 | 24 | I | OD |
| 26 | 18 | 50 | I | SI |
| | 19 | 49 | I | Te |
| | 21 | 01 | I | Se |
| 27 | 18 | 17 | I | ER |

## FEBRUARY

| d | h | m | Sat. | Phen. |
|---|---|---|---|---|
| 1 | 18 | 25 | III | Te |
| | 20 | 07 | II | TI |
| | 20 | 31 | III | SI |
| 2 | 19 | 37 | I | TI |
| | 20 | 46 | I | SI |
| 3 | 19 | 35 | II | ER |
| | 20 | 12 | I | ER |
| 8 | 20 | 01 | III | TI |
| 10 | 18 | 53 | I | OD |
| 11 | 18 | 20 | I | Te |
| | 19 | 22 | I | Se |
| 17 | 20 | 18 | II | OD |
| 18 | 19 | 07 | I | SI |
| | 20 | 22 | I | Te |
| 19 | 18 | 32 | I | ER |
| | 18 | 43 | III | ED |
| | 19 | 26 | II | Se |
| 25 | 20 | 11 | I | TI |
| 26 | 19 | 11 | III | OD |
| | 19 | 32 | II | SI |
| | 20 | 27 | I | ER |
| | 20 | 27 | II | Te |

## MARCH

| d | h | m | Sat. | Phen. |
|---|---|---|---|---|
| 4 | 19 | 27 | I | OD |
| 5 | 18 | 56 | I | Te |
| | 19 | 38 | I | Se |
| 6 | 19 | 29 | II | ER |
| 8 | 19 | 03 | III | Se |
| 12 | 18 | 46 | I | TI |
| 12 | 19 | 23 | I | SI |
| 13 | 18 | 45 | I | ER |
| 22 | 19 | 07 | II | Se |

Jupiter being near the Sun, phenomena of the Satellites are not given from March 31 to May 27.

## JUNE

| d | h | m | Sat. | Phen. |
|---|---|---|---|---|
| 11 | 03 | 58 | I | Se |
| 17 | 03 | 17 | III | Se |
| 18 | 03 | 43 | I | SI |
| 19 | 04 | 01 | I | OR |
| 23 | 02 | 28 | II | SI |
| 26 | 02 | 44 | I | ED |
| 27 | 02 | 15 | I | Se |
| | 03 | 20 | I | Te |

## JULY

| d | h | m | Sat. | Phen. |
|---|---|---|---|---|
| 4 | 02 | 00 | I | SI |
| | 03 | 10 | I | TI |
| | 04 | 09 | I | Se |
| 5 | 02 | 29 | I | OR |
| | 04 | 03 | III | OD |
| 9 | 02 | 46 | II | ED |
| 11 | 01 | 54 | II | Te |
| | 03 | 54 | I | SI |
| 12 | 03 | 12 | III | ED |
| 13 | 01 | 45 | I | Te |
| 18 | 02 | 01 | II | Se |
| | 02 | 17 | II | TI |
| 19 | 02 | 56 | I | ED |
| 20 | 01 | 34 | I | TI |
| | 02 | 25 | I | Se |
| | 03 | 41 | I | Te |
| 21 | 00 | 54 | I | OR |
| 23 | 02 | 39 | III | TI |
| 25 | 02 | 14 | II | SI |
| 27 | 02 | 10 | I | SI |
| | 02 | 16 | II | OR |
| | 03 | 30 | I | TI |
| | 04 | 18 | I | Se |
| 28 | 02 | 50 | I | OR |
| 30 | 01 | 13 | III | SI |
| | 03 | 18 | III | Se |

## AUGUST

| d | h | m | Sat. | Phen. |
|---|---|---|---|---|
| 3 | 02 | 12 | II | ER |
| | 02 | 34 | II | OD |
| | 04 | 04 | I | SI |
| 4 | 01 | 12 | I | ED |
| 5 | 00 | 40 | I | Se |
| | 02 | 01 | I | Te |
| 10 | 01 | 00 | III | OD |
| | 02 | 22 | II | ED |
| | 02 | 52 | III | OR |
| 11 | 03 | 07 | I | ED |
| | 23 | 39 | II | TI |
| 12 | 00 | 26 | I | SI |
| | 01 | 48 | I | TI |
| | 01 | 56 | II | Te |
| | 02 | 34 | I | Se |
| | 03 | 55 | I | Te |
| 13 | 01 | 09 | I | OR |
| 16 | 23 | 15 | III | ED |
| 17 | 01 | 22 | III | ER |
| 18 | 23 | 24 | II | SI |
| 19 | 01 | 48 | II | Se |
| | 02 | 16 | II | TI |
| | 02 | 19 | I | SI |
| | 03 | 41 | I | TI |
| 19 | 04 | 27 | I | Se |
| | 04 | 32 | II | Te |
| | 23 | 29 | I | ED |
| 20 | 03 | 02 | I | OR |
| | 23 | 17 | II | OR |
| 21 | 00 | 16 | I | Te |
| 24 | 03 | 16 | III | ED |
| 26 | 02 | 02 | II | SI |
| | 04 | 13 | I | SI |
| | 04 | 25 | II | Se |
| | 04 | 50 | II | TI |
| 27 | 01 | 24 | I | ED |
| | 04 | 55 | I | OR |
| | 22 | 41 | I | SI |
| | 22 | 50 | III | TI |
| | 23 | 12 | II | ER |
| | 23 | 31 | II | OD |
| 28 | 00 | 01 | I | TI |
| | 00 | 32 | III | Te |
| | 00 | 49 | I | Se |
| | 01 | 47 | II | OR |
| | 02 | 07 | I | Te |
| | 23 | 23 | I | OR |

## SEPTEMBER

| d | h | m | Sat. | Phen. |
|---|---|---|---|---|
| 2 | 04 | 39 | II | SI |
| 3 | 03 | 18 | I | ED |
| | 23 | 18 | III | Se |
| | 23 | 23 | II | ED |
| 4 | 00 | 35 | I | SI |
| | 01 | 46 | II | ER |
| | 01 | 51 | I | TI |
| | 01 | 59 | II | OD |
| | 02 | 38 | III | TI |
| | 02 | 43 | I | Se |
| | 03 | 58 | I | Te |
| | 04 | 15 | II | OR |
| | 04 | 18 | III | Te |
| 5 | 01 | 14 | I | OR |
| | 22 | 25 | I | Te |
| | 22 | 51 | II | Te |
| 10 | 05 | 12 | I | ED |
| 11 | 01 | 14 | III | SI |
| | 01 | 57 | II | ED |
| | 02 | 28 | I | SI |
| | 03 | 18 | III | Se |
| | 03 | 41 | I | TI |
| | 04 | 20 | II | ER |
| | 04 | 25 | II | OD |
| | 04 | 37 | I | Se |
| | 23 | 41 | I | ED |
| 12 | 03 | 04 | I | OR |
| | 22 | 08 | I | TI |
| | 22 | 57 | II | Se |
| | 23 | 05 | I | Se |
| | 23 | 06 | II | TI |
| 13 | 00 | 15 | I | Te |
| | 01 | 19 | II | Te |
| | 21 | 31 | I | OR |
| 14 | 21 | 56 | III | OR |
| 18 | 04 | 22 | I | SI |
| | 04 | 32 | II | ED |
| | 05 | 14 | III | SI |
| 19 | 01 | 35 | I | ED |
| | 04 | 52 | I | OR |
| | 22 | 50 | I | SI |
| | 23 | 12 | II | SI |
| | 23 | 56 | I | TI |
| 20 | 00 | 59 | I | Se |
| | 01 | 31 | II | TI |
| | 01 | 35 | II | Se |
| | 02 | 03 | I | Te |
| | 03 | 45 | II | Te |
| | 23 | 19 | I | OR |
| 21 | 21 | 25 | III | ER |
| 21 | 22 | 15 | II | OR |
| | 23 | 54 | III | OD |
| 22 | 01 | 31 | III | OR |
| 26 | 03 | 30 | I | ED |
| 27 | 00 | 44 | I | SI |
| | 01 | 43 | I | TI |
| | 01 | 49 | II | SI |
| | 02 | 53 | I | Se |
| | 03 | 50 | I | Te |
| | 03 | 54 | II | TI |
| | 04 | 12 | II | Se |
| | 21 | 58 | I | ED |
| 28 | 01 | 07 | I | OR |
| | 21 | 21 | I | Se |
| | 22 | 16 | I | Te |
| | 23 | 19 | III | ED |
| 29 | 00 | 35 | II | OR |
| | 01 | 25 | III | ER |
| | 03 | 26 | III | OD |
| | 05 | 01 | III | OR |

## OCTOBER

| d | h | m | Sat. | Phen. |
|---|---|---|---|---|
| 3 | 05 | 24 | I | ED |
| 4 | 02 | 38 | I | SI |
| | 03 | 29 | I | TI |
| | 04 | 27 | II | SI |
| | 04 | 46 | I | Se |
| | 05 | 36 | I | Te |
| | 23 | 53 | I | ED |
| 5 | 02 | 53 | I | OR |
| | 21 | 06 | I | SI |
| | 21 | 55 | I | TI |
| | 22 | 58 | II | ED |
| | 23 | 15 | I | Se |
| 6 | 00 | 02 | I | Te |
| | 02 | 53 | II | OR |
| | 03 | 20 | III | ED |
| | 05 | 26 | III | ER |
| | 21 | 19 | I | OR |
| 7 | 20 | 09 | II | Se |
| | 21 | 39 | II | Te |
| 9 | 20 | 30 | III | TI |
| | 22 | 02 | III | Te |
| 11 | 04 | 31 | I | SI |
| | 05 | 14 | I | TI |
| 12 | 01 | 48 | I | ED |
| | 04 | 38 | I | OR |
| | 23 | 00 | I | SI |
| | 23 | 40 | I | TI |
| 13 | 01 | 09 | I | Se |
| | 01 | 32 | II | ED |
| | 01 | 47 | I | Te |
| | 05 | 09 | II | OR |
| | 20 | 16 | I | ED |
| | 23 | 04 | I | OR |
| 14 | 19 | 37 | I | Se |
| | 20 | 13 | I | Te |
| | 20 | 23 | II | SI |
| | 21 | 43 | II | TI |
| | 22 | 46 | II | Se |
| | 23 | 57 | II | Te |
| 16 | 21 | 15 | III | SI |
| | 23 | 20 | III | Se |
| | 23 | 50 | III | TI |
| 17 | 01 | 22 | III | Te |
| 19 | 03 | 42 | I | ED |
| 20 | 00 | 54 | I | SI |
| | 01 | 24 | I | TI |
| | 03 | 03 | I | Se |
| | 03 | 31 | I | Te |
| | 04 | 07 | II | ED |
| | 22 | 11 | I | ED |
| 21 | 00 | 49 | I | OR |
| | 19 | 22 | I | SI |

| d | h | m | Sat. | Phen. |
|---|---|---|---|---|
| 21 | 19 | 50 | I | TI |
| | 21 | 31 | I | Se |
| | 21 | 57 | I | Te |
| | 23 | 01 | II | SI |
| 22 | 00 | 00 | II | TI |
| | 01 | 23 | II | Se |
| | 02 | 14 | II | Te |
| | 19 | 15 | I | OR |
| 23 | 20 | 31 | II | OR |
| 24 | 01 | 16 | III | SI |
| | 03 | 08 | III | TI |
| | 03 | 21 | III | Se |
| | 04 | 41 | III | Te |
| 26 | 05 | 37 | I | ED |
| 27 | 02 | 48 | I | SI |
| | 03 | 08 | I | TI |
| | 04 | 57 | I | Se |
| | 05 | 15 | I | Te |
| | 18 | 28 | III | OR |
| 28 | 00 | 06 | I | ED |
| | 02 | 33 | I | OR |
| | 21 | 17 | I | SI |
| | 21 | 34 | I | TI |
| | 23 | 26 | I | Se |
| | 23 | 41 | I | Te |
| 29 | 01 | 38 | II | SI |
| | 02 | 15 | II | TI |
| | 04 | 01 | II | Se |
| | 04 | 30 | II | Te |
| | 18 | 34 | I | ED |
| | 20 | 59 | I | OR |
| 30 | 20 | 00 | II | ED |
| | 22 | 44 | II | OR |
| 31 | 05 | 16 | III | SI |
| **NOVEMBER** | | | | |
| d | h | m | Sat. | Phen. |
| 3 | 04 | 42 | I | SI |
| | 04 | 51 | I | TI |
| | 19 | 24 | III | ED |
| | 21 | 44 | III | OR |
| 4 | 02 | 01 | I | ED |
| | 04 | 16 | I | OR |
| | 23 | 11 | I | SI |
| | 23 | 17 | I | TI |
| 5 | 01 | 20 | I | Se |
| | 01 | 24 | I | Te |
| | 04 | 16 | II | SI |
| | 04 | 29 | II | TI |
| | 20 | 30 | I | ED |
| | 22 | 42 | I | OR |
| 6 | 19 | 49 | I | Se |
| 6 | 19 | 50 | I | Te |
| | 22 | 35 | II | ED |
| 7 | 00 | 58 | II | OR |
| 8 | 19 | 52 | II | Te |
| | 19 | 57 | II | Se |
| 10 | 23 | 20 | III | OD |
| 11 | 01 | 32 | III | ER |
| | 03 | 52 | I | OD |
| 12 | 01 | 00 | I | TI |
| | 01 | 05 | I | SI |
| | 03 | 08 | I | Te |
| | 03 | 15 | I | Se |
| | 22 | 18 | I | OD |
| 13 | 00 | 35 | I | ER |
| | 19 | 26 | I | TI |
| | 19 | 34 | I | SI |
| | 21 | 34 | I | Te |
| | 21 | 43 | I | Se |
| 14 | 00 | 55 | II | OD |
| | 03 | 32 | II | ER |
| | 19 | 03 | I | ER |
| 15 | 19 | 50 | II | TI |
| | 20 | 13 | II | SI |
| | 22 | 07 | II | Te |
| | 22 | 35 | II | Se |
| 18 | 02 | 34 | III | OD |
| 19 | 02 | 43 | I | TI |
| | 03 | 00 | I | SI |
| | 04 | 51 | I | Te |
| | 05 | 09 | I | Se |
| 20 | 00 | 01 | I | OD |
| | 02 | 30 | I | ER |
| | 21 | 09 | I | TI |
| | 21 | 29 | I | SI |
| | 23 | 17 | I | Te |
| | 23 | 38 | I | Se |
| 21 | 03 | 08 | II | OD |
| | 17 | 48 | III | Te |
| | 18 | 27 | I | OD |
| | 19 | 26 | III | Se |
| | 20 | 58 | I | ER |
| 22 | 17 | 43 | I | Te |
| | 18 | 07 | I | Se |
| | 22 | 05 | II | TI |
| | 22 | 50 | II | SI |
| 23 | 00 | 23 | II | Te |
| | 01 | 12 | II | Se |
| 24 | 19 | 26 | II | ER |
| 26 | 04 | 28 | I | TI |
| 27 | 01 | 46 | I | OD |
| | 04 | 25 | I | ER |
| | 22 | 54 | I | TI |
| 27 | 23 | 24 | I | SI |
| 28 | 01 | 02 | I | Te |
| | 01 | 33 | I | Se |
| | 19 | 21 | III | TI |
| | 20 | 12 | I | OD |
| | 21 | 08 | III | Te |
| | 21 | 21 | III | SI |
| | 22 | 54 | I | ER |
| | 23 | 27 | III | Se |
| 29 | 17 | 20 | I | TI |
| | 17 | 52 | I | SI |
| | 19 | 28 | I | Te |
| | 20 | 02 | I | Se |
| 30 | 00 | 21 | II | TI |
| | 01 | 28 | II | SI |
| | 02 | 40 | II | Te |
| | 03 | 50 | II | Se |
| | 17 | 23 | I | ER |
| **DECEMBER** | | | | |
| d | h | m | Sat. | Phen. |
| 1 | 18 | 30 | II | OD |
| | 22 | 02 | II | ER |
| 4 | 03 | 32 | I | OD |
| 5 | 00 | 39 | I | TI |
| | 01 | 19 | I | SI |
| | 02 | 47 | I | Te |
| | 03 | 28 | I | Se |
| | 21 | 58 | I | OD |
| | 22 | 40 | III | TI |
| 6 | 00 | 31 | III | Te |
| | 00 | 49 | I | ER |
| | 01 | 22 | III | SI |
| | 03 | 28 | III | Se |
| | 19 | 05 | I | TI |
| | 19 | 48 | I | SI |
| | 21 | 14 | I | Te |
| | 21 | 57 | I | Se |
| 7 | 02 | 39 | II | TI |
| | 19 | 18 | I | ER |
| 8 | 20 | 47 | II | OD |
| 9 | 00 | 39 | II | ER |
| | 17 | 39 | III | ER |
| 10 | 17 | 25 | II | SI |
| | 18 | 08 | II | Te |
| | 19 | 46 | II | Se |
| 12 | 02 | 25 | I | TI |
| | 03 | 14 | I | SI |
| | 23 | 44 | I | OD |
| 13 | 02 | 03 | III | TI |
| | 02 | 44 | I | ER |
| | 20 | 52 | I | TI |
| 13 | 21 | 43 | I | SI |
| | 23 | 00 | I | Te |
| | 23 | 52 | I | Se |
| 14 | 18 | 11 | I | OD |
| | 21 | 13 | I | ER |
| 15 | 17 | 27 | I | Te |
| | 18 | 20 | I | Se |
| | 23 | 06 | II | OD |
| 16 | 03 | 15 | II | ER |
| | 17 | 54 | III | OR |
| | 19 | 33 | III | ED |
| | 21 | 41 | III | ER |
| 17 | 18 | 10 | II | TI |
| | 20 | 02 | II | SI |
| | 20 | 30 | II | Te |
| | 22 | 23 | II | Se |
| 20 | 01 | 31 | I | OD |
| | 22 | 39 | I | TI |
| | 23 | 38 | I | SI |
| 21 | 00 | 48 | I | Te |
| | 01 | 47 | I | Se |
| | 19 | 59 | I | OD |
| | 23 | 09 | I | ER |
| 22 | 18 | 07 | I | SI |
| | 19 | 15 | I | Te |
| | 20 | 16 | I | Se |
| 23 | 01 | 27 | II | OD |
| | 17 | 38 | I | ER |
| | 19 | 25 | III | OD |
| | 21 | 28 | III | OR |
| | 23 | 34 | III | ED |
| 24 | 01 | 42 | III | ER |
| | 20 | 33 | II | TI |
| | 22 | 40 | II | SI |
| | 22 | 53 | II | Te |
| 25 | 01 | 00 | II | Se |
| 26 | 19 | 11 | II | ER |
| 28 | 00 | 28 | I | TI |
| | 01 | 33 | I | SI |
| | 21 | 48 | I | OD |
| 29 | 01 | 04 | I | ER |
| | 18 | 56 | I | TI |
| | 20 | 02 | I | SI |
| | 21 | 04 | I | Te |
| | 22 | 11 | I | Se |
| 30 | 19 | 33 | I | ER |
| | 23 | 00 | III | OD |
| 31 | 01 | 06 | III | OR |
| | 22 | 58 | II | TI |
| 32 | 01 | 17 | II | SI |
| | 01 | 20 | 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 IAN HALLIDAY

When the moon passes between the observer and a star that star is said to be occulted by the moon and the phenomenon is known as a lunar occultation. The passage of the star behind the east limb of the moon is called the immersion and its appearance from behind the west limb the emersion. As in the case of eclipses, the times of immersion and emersion and the duration of the occultation are different for different places on the earth's surface. The tables given below, adapted from the 1952 Nautical Almanac, give the times of immersion or emersion or both for occultations of stars of magnitude 4.5 or brighter visible at Toronto and at Montreal and also at Vancouver and Calgary, at night. The terms *a* and *b* are for determining corrections to the times of the phenomena for stations within 300 miles of the standard stations. Thus if $\lambda_0, \phi_0$, be the longitude and latitude of the standard station and $\lambda$, $\phi$, the longitude and latitude of the neighbouring station then for the neighbouring station we have—

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

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

LUNAR OCCULTATIONS VISIBLE AT TORONTO AND MONTREAL, 1952

| Date | Star | Mag. | I or E | Age of Moon | Toronto | | | | Montreal | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | E.S.T. | a | b | P | E.S.T. | a | b | P |
| | | | | d | h m | m | m | ° | h m | m | m | ° |
| Jan. 10 | 136 Tau | 4.5 | I | 12.8 | 1 41.4 | −1.1 | −2.0 | 113 | 1 44.1 | −1.0 | −1.6 | 101 |
| Mar. 31 | 136 Tau | 4.5 | I | 6.3 | 23 20.3 | −0.7 | −0.3 | 49 | 23 26.6 | — | — | 27 |
| Apr. 8 | $\upsilon$ Leo | 4.5 | I | 13.5 | 3 23.1 | −0.4 | −1.9 | 126 | 3 21.8 | −0.3 | −1.9 | 122 |
| Jun. 1 | $\upsilon$ Leo | 4.5 | I | 9.2 | Sun | ..... | ..... | ... | 19 55.9 | −2.6 | −0.3 | 79 |
| 12 | $\iota$ Cap | 4.3 | I | 19.5 | 0 28.1 | −0.9 | +2.1 | 31 | 0 37.4 | −1.0 | +2.0 | 29 |
| 12 | $\iota$ Cap | 4.3 | E | 19.5 | 1 24.2 | −1.4 | +1.0 | 281 | 1 34.8 | −1.6 | +0.9 | 280 |
| Aug. 13 | $q$ Tau | 4.4 | I | 22.3 | 0 04.7 | +0.3 | +1.4 | 75 | 0 06.2 | +0.1 | +1.5 | 78 |
| 13 | 20 Tau | 4.0 | I | 22.3 | 0 21.6 | −0.2 | +1.0 | 110 | 0 24.9 | −0.4 | +1.0 | 114 |
| 13 | $q$ Tau | 4.4 | E | 22.3 | 1 00.2 | +0.1 | +1.7 | 245 | 1 03.3 | 0.0 | +1.8 | 241 |
| 13 | 20 Tau | 4.0 | E | 22.3 | 1 04.7 | +0.5 | +2.3 | 210 | 1 06.3 | +0.5 | +2.5 | 205 |
| Nov. 3 | $q$ Tau | 4.4 | I | 15.4 | 4 49.8 | −0.9 | −1.6 | 98 | 4 52.1 | −0.8 | −1.3 | 88 |
| 3 | 20 Tau | 4.0 | I | 15.5 | 5 14.8 | −0.4 | −2.9 | 127 | 5 12.6 | −0.4 | −2.2 | 114 |
| 3 | $q$ Tau | 4.4 | E | 15.5 | 5 54.7 | −0.7 | −0.7 | 250 | Sun | ..... | ..... | ... |
| 20 | $\sigma$ Sgr | 2.1 | I | 3.4 | 17 08.0 | −0.8 | +0.2 | 40 | 17 12.6 | −0.7 | −0.1 | 45 |
| Dec. 5 | $\delta$ Cnc | 4.2 | I | 18.7 | 22 36.0 | −0.7 | −0.7 | 148 | 22 39.1 | −0.8 | −0.6 | 145 |
| 5 | $\delta$ Cnc | 4.2 | E | 18.7 | 23 25.7 | −0.4 | +2.8 | 243 | 23 33.9 | −0.8 | +2.6 | 248 |
| 27 | $q$ Tau | 4.4 | I | 11.0 | 18 38.7 | −1.0 | +1.6 | 76 | 18 48.2 | −1.3 | +1.4 | 79 |
| 27 | 20 Tau | 4.0 | I | 11.0 | 19 01.4 | −1.9 | +0.3 | 112 | 19 13.2 | −2.2 | −0.3 | 116 |

LUNAR OCCULTATIONS VISIBLE AT VANCOUVER AND CALGARY, 1952

| Date | Star | Mag. | I or E | Age of Moon | Vancouver | | | | Calgary | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | P.S.T. | a | b | P | M.S.T. | a | b | P |
| | | | | d | h m | m | m | ° | h m | m | m | ° |
| Jan. 9 | 136 Tau | 4.5 | I | 12.8 | 21 21.5 | −1.8 | −0.1 | 110 | 22 37.1 | −1.8 | −0.5 | 108 |
| Feb. 19 | $\tau$ Scr | 2.9 | I | 23.7 | Low | ..... | ..... | ... | 6 29.2 | −1.5 | +0.4 | 92 |
| 19 | $\tau$ Scr | 2.9 | E | 23.7 | 6 30.7 | −1.5 | 0.0 | 285 | Sun | ..... | ..... | ... |
| Mar. 26 | Mercury* | 1.4 | I | 1.1 | 15 00.3 | — | — | 127 | 16 15.3 | — | — | 135 |
| 26 | Mercury* | 1.4 | E | 1.1 | 15 27.0 | — | — | 171 | 16 33.7 | — | — | 166 |
| 31 | 136 Tau | 4.5 | I | 6.3 | 19 31.2 | −1.4 | −1.1 | 93 | 20 41.7 | −1.3 | −1.0 | 80 |
| Apr. 7-8 | $\upsilon$ Leo | 4.5 | I | 13.5 | 23 42.2 | −0.4 | −2.1 | 168 | 0 44.9 | −0.7 | −1.9 | 152 |
| Nov. 3 | $q$ Tau | 4.4 | I | 15.4 | 0 41.1 | −1.5 | +0.8 | 75 | 1 56.0 | −1.5 | +0.3 | 77 |
| 3 | 20 Tau | 4.0 | I | 15.5 | 1 02.9 | −1.9 | −0.7 | 107 | 2 18.0 | −1.7 | −1.2 | 107 |
| 3 | $q$ Tau | 4.4 | E | 15.5 | 1 59.4 | −1.6 | +0.2 | 252 | 3 12.8 | −1.4 | −0.3 | 255 |
| 3 | 20 Tau | 4.0 | E | 15.5 | 2 09.1 | −1.4 | +1.6 | 222 | 3 24.1 | −1.4 | +0.9 | 227 |
| 22 | $\theta$ Cap | 4.2 | I | 5.6 | 20 15.6 | +0.2 | +1.1 | 11 | Low | ..... | ..... | ... |
| Dec. 27 | 20 Tau | 4.0 | I | 11.0 | Sun | ..... | ..... | ... | 16 48.4 | +0.1 | +2.0 | 51 |
| 27 | $q$ Tau | 4.4 | I | 11.0 | No occ. | ..... | ..... | ... | 16 51.2 | +1.0 | +3.2 | 8 |
| 27 | $\eta$ Tau | 3.0 | I | 11.0 | 16 34.1 | — | — | 141 | No occ. | ..... | ..... | ... |
| 27 | $\eta$ Tau | 3.0 | E | 11.0 | 16 53.8 | — | — | 179 | No occ. | ..... | ..... | ... |

* Daytime occultation.

# 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

*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 | $10^h15^m$± | 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

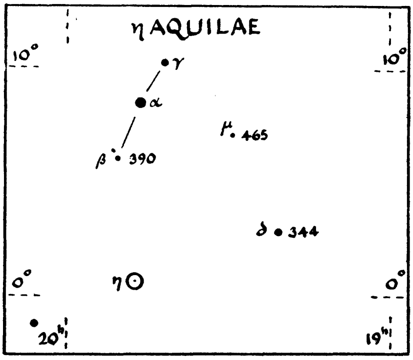
| Name | Stellar Mag. | Mean Dist. from Planet | | Revolution Period | | | Diameter Miles | Discoverer |
|---|---|---|---|---|---|---|---|---|
| | | ″ * | Miles | d | h | m | | |
| **SATELLITE OF THE EARTH** | | | | | | | | |
| **Moon** | **−12.6** | 530 | 238,857 | 27 | 07 | 43 | 2160 | |
| **SATELLITES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

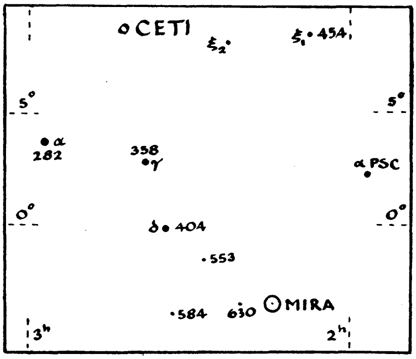
*As seen from the sun.

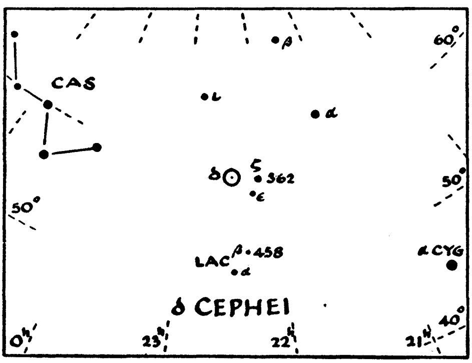
Satellites Io, Europa, Ganymede, Callisto are usually denoted I, II, III, IV respectively, in order of distance from the planet.

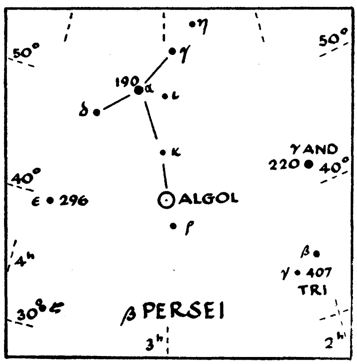
Much pleasure may be derived from the estimation of the brightness of variable stars. Maps of the fields of four bright variable stars are given below. In each case the magnitudes of several suitable comparison stars are given. These magnitudes are given as magnitudes, tenths and hundredths, with the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

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



## REPRESENTATIVE BRIGHT VARIABLE STARS

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

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

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

# DOUBLE AND MULTIPLE STARS

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

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

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

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

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

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

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

## REPRESENTATIVE DOUBLE STARS

| Star | | α 1950 | δ | Mag. and Spect. | d | D | Remarks |
|---|---|---|---|---|---|---|---|
| | | h m | ° ′ | | ″ | L.Y. | |
| π | And | 00 34.2 | +33 27 | 4.4B3; 8.5 | 36 | 470 | † |
| η | Cas | 00 46.0 | +57 33 | 3.6F8; 7.2M0 | 8 | 18 | 526y; 66AU |
| α | UMi | 01 48.8 | +89 02 | var. F8; 8.8 | 19 | 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.

†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* |
| \|\|ο Ceti. . . . . . . . | 17 | − 3 12 | 1.7–9.6 | M6e | .239 | .013 | 251 | −2.7 | +57.8* |
| \|\|θ Erid. . . . . . . . | 56 | −40 30 | 3.4 | A2 | .068 | .032 | 102 | 0.9 | +11.9* |
| | | | | | | | | | |
| α Ceti. . . . . . . . | 3 00 | + 3 54 | 2.8 | M1 | .080 | .018 | 181 | −0.9 | −25.7 |
| γ Pers. . . . . . . . | 01 | +53 19 | 3.1 | F9 | .012 | .017 | 192 | −0.7 | + 1.0* |
| ρ Pers. . . . . . . . | 02 | +38 39 | 3.3–4.1 | M6 | .176 | .024 | 136 | 0.3 | +28.2 |
| β Pers. . . . . . . . | 05 | +40 46 | 2.1–3.2 | B8 | .011 | .033 | 99 | −0.3 | + 5.7* |
| α Pers. . . . . . . . | 21 | +49 41 | 1.9 | F4 | .041 | .017 | 192 | −2.0 | − 2.4 |
| δ Pers. . . . . . . . | 39 | +47 38 | 3.1 | B5 | .047 | .012 | 272 | −1.5 | −10. * |
| \|\|η Taur. . . . . . . . | 45 | +23 57 | 3.0 | B5p | .053 | .014 | 233 | −1.3 | +10.3 |
| γ Hydi. . . . . . . . | 48 | −74 24 | 3.2 | M3 | .124 | .008 | 407 | −2.3 | +16.0 |
| ζ Pers. . . . . . . . | 51 | +31 44 | 2.9 | B1 | .023 | .008 | 407 | −2.6 | +20.9 |
| \|\|ε Pers. . . . . . . . | 54 | +39 52 | 3.0 | B2 | .041 | .006 | 543 | −3.1 | − 6 * |
| γ Erid. . . . . . . . | 56 | −13 39 | 3.2 | M0 | .133 | .012 | 272 | −1.6 | +61.7 |
| λ Taur. . . . . . . . | 58 | +12 21 | 3.8–4.2 | B3 | .015 | .008 | 407 | −2.2 | +13.0* |
| | | | | | | | | | |
| α Reti. . . . . . | 4 14 | −62 36 | 3.4 | G5 | .070 | .016 | 204 | −0.6 | +35.6 |

α U. Min., *Polaris:* R.A. 1h 50.1m; Dec. + 89° 02′ (1952)

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

| Star | R.A. 1950 | Decl. 1950 | Mag. | Type | Ann. Proper Motion | Parallax | Distance in Light Years | Abs. Mag. | Rad. Vel. |
|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | | ″ | ″ | | | km. sec. |
| τ Pupp.. .... | 6 49 | −50 33 | 2.8 | G8 | .091 | .025 | 130 | −0.2 | +36 4* |
| \|\|ε C Maj...... | 57 | −28 54 | 1.6 | B1 | .005 | .010 | 326 | −3.4 | +27 4 |
| ζ Gemi....... | 7 01 | +20 39 | 3.7–4.3 | G0p | .007 | .005 | 652 | −2.8 | + 6.7* |
| $o^2$ C Maj...... | 01 | −23 45 | 3.1 | B5p | .006 | .007 | 466 | −2.7 | +48.6 |
| δ C Maj...... | 06 | −26 19 | 2.0 | G4p | .003 | .006 | 543 | −4.1 | +34.3* |
| $L^2$ Pupp....... | 12 | −44 33 | 3.4–6.2 | M5e | .332 | .018 | 181 | −0.3 | +53.0 |
| π Pupp....... | 15 | −37 00 | 2.7 | K5 | .004 | .018 | 181 | −1.0 | +15.8 |
| η C Maj...... | 22 | −29 12 | 2.4 | B5p | .007 | .012 | 272 | −2.2 | +40.4 |
| β C Min...... | 24 | + 8 23 | 3.1 | B8 | .063 | .022 | 148 | −0.2 | +23 * |
| σ Pupp....... | 28 | −43 12 | 3.3 | M0 | .191 | .016 | 204 | −0.7 | +88.1* |
| $α_1$ Gemi....... | 31 | +32 00 | 2.0 | A2 | .201 | .074 | 44 | 1.4 | + 6.0* |
| $α_2$ Gemi....... | 31 | +32 00 | 2.8 | A0 | .209 | .074 | 44 | 2.2 | − 1.2* |
| \|\|**α C Min**...... | 37 | +5 21 | 0.5 | F5 | 1.242 | .316 | 10 | 3.0 | − 3.0* |
| **β Gemi**...... | 42 | +28 09 | 1.2 | G9 | .623 | .105 | 31 | 1.3 | + 3.3 |
| ξ Pupp....... | 47 | −24 44 | 3.5 | K1 | .004 | .006 | 543 | −2.6 | + 3.7* |
| ζ Pupp....... | 8 02 | −39 52 | 2.3 | O8 | .032 | .004 | 815 | −4.7 | −24. |
| ρ Pupp....... | 05 | −24 10 | 2.9 | F6 | .097 | .025 | 130 | −0.1 | +46.6 |
| γVelr......... | 08 | −47 12 | 2.2 | OW9 | .002 | ..... | ..... | ...... | + 3.5 |
| \|\|ε Cari........ | 21 | −59 21 | 1.7 | K0 | .030 | .010 | 326 | −3.3 | +11.5 |
| o U Maj...... | 26 | +60 53 | 3.5 | G2 | .166 | .014 | 233 | −0.8 | +19.8 |
| \|\|δ Velr........ | 43 | −54 32 | 2.0 | A0 | .093 | .030 | 109 | −0.6 | + 2.2 |
| \|\|ε Hyda....... | 44 | + 6 36 | 3.5 | F9 | .193 | .012 | 272 | −1.1 | +36.8* |
| ζ Hyda....... | 53 | + 6 08 | 3.3 | G7 | .101 | .026 | 125 | 0.3 | +22.6 |
| \|\|ι U Maj...... | 56 | +48 14 | 3.1 | A4 | .500 | .060 | 54 | 2.0 | +12.6 |
| λ Velr........ | 9 06 | −43 14 | 2.2 | K4 | .024 | .016 | 204 | −1.8 | +18.4 |
| β Cari........ | 13 | −69 31 | 1.8 | A0 | .192 | ..... | ..... | ...... | − 5. |
| ι Cari........ | 16 | −59 04 | 2.2 | F0 | .023 | ..... | ..... | ...... | +13.3 |
| α Lync....... | 18 | +34 36 | 3.3 | K8 | .214 | .022 | 148 | 0.0 | +37.4 |
| κ Velr........ | 21 | −54 48 | 2.6 | B3 | .017 | .017 | 192 | −1.2 | +21.7* |
| α Hyda....... | 25 | − 8 26 | 2.2 | K4 | .036 | .018 | 181 | −1.5 | − 4.4 |
| θ U Maj...... | 30 | +51 54 | 3.3 | F7 | 1.096 | .072 | 45 | 2.6 | +15.8 |
| N Velr........ | 30 | −56 49 | 3.4–4.2 | K5 | .038 | .022 | 148 | 0.1 | −13.9 |
| ε Leon........ | 43 | +24 00 | 3.1 | G0 | .045 | .009 | 362 | −2.1 | + 5.1 |
| \|\|υ Cari........ | 46 | −64 50 | 3.1 | F0 | .019 | ..... | ..... | ...... | +13.6 |
| **α Leon**....... | 10 06 | +12 13 | 1.3 | B6 | .244 | .046 | 71 | −0.4 | + 2.6 |
| q Cari........ | 15 | −61 05 | 3.4 | K5 | .043 | .014 | 233 | −0.9 | + 8.6 |

| Star | R.A. 1950 | Decl. 1950 | Mag. | Type | Ann. Proper Motion | Parallax | Distance in Light Years | Abs. Mag. | Rad. Vel. |
|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | | | ″ | ″ | | km./sec |
| ‖γ Leo......... | 10 17 | +20 06 | 2.3 | G8 | .347 | .024 | 136 | −0.8 | −36.8 |
| μ U Maj...... | 19 | +41 45 | 3.2 | K4 | .082 | .031 | 105 | 0.7 | −20.3* |
| θ Cari........ | 41 | −64 08 | 3.0 | B0 | .022 | .007 | 466 | −2.8 | +24. * |
| η Cari........ | 43 | −59 25 | 1.0–7.4 | Pec | .007 | ..... | ..... | ...... | −25.0 |
| ‖μ Velr........ | 45 | −49 09 | 2.8 | G5 | .079 | .033 | 99 | 0.4 | + 6.9 |
| ν Hyda....... | 47 | −15 56 | 3.3 | K3 | .218 | .020 | 163 | −0.2 | − 1.0 |
| β U Maj...... | 59 | +56 39 | 2.4 | A3 | .089 | .045 | 72 | 0.7 | −12.1* |
| α U Maj...... | 11 01 | +62 01 | 2.0 | G5 | .137 | .036 | 91 | −0.2 | − 8.6* |
| ψ U Maj...... | 07 | +44 46 | 3.2 | K0 | 067 | .035 | 93 | 0.9 | − 3.6 |
| δ Leon........ | 11 | +20 47 | 2.6 | A2 | 208 | .058 | 56 | 1.4 | −23.2 |
| θ Leon........ | 12 | +15 42 | 3.4 | A2 | .103 | .025 | 130 | 0.4 | + 7.8 |
| λ Cent........ | 33 | −62 45 | 3.3 | B9 | .045 | .031 | 105 | 0.8 | + 7.9 |
| β Leon........ | 47 | +14 51 | 2.2 | A2 | .507 | 084 | 39 | 1.8 | − 2.3 |
| γ U Maj...... | 51 | +53 58 | 2.5 | A0 | .095 | .035 | 93 | 0.2 | −11.1 |
| δ Cent........ | 12 06 | −50 27 | 2.9 | B3e | .040 | .015 | 217 | −1.2 | + 9. |
| ε Corv........ | 08 | −22 30 | 3.2 | K2 | .063 | .024 | 136 | 0.1 | + 4.9 |
| δ Cruc........ | 12 | −58 28 | 3.1 | B3 | .045 | .017 | 192 | −0.7 | +26.4 |
| δ U Maj...... | 13 | +57 19 | 3.4 | A0 | .113 | .050 | 65 | 1.9 | −12. |
| γ Corv........ | 13 | −17 16 | 2.8 | B8 | .159 | .024 | 136 | −0.3 | − 4.2* |
| $\alpha^1$ Cruc........ | 24 | −62 49 | 1.6 | B1 | .048 | .022 | 148 | −1.7 | −12.2* |
| $\alpha^2$ 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* |
| ‖$\alpha^2$ 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 |
| ‖$\zeta^1$ U. Maj...... | 22 | +55 11 | 2.4 | A2p | .131 | .042 | 78 | 0.5 | − 9.9* |
| α Virg........ | 23 | −10 54 | 1.2 | B2 | .051 | .018 | 181 | −2.5 | + 1.6* |
| ζ Virg........ | 32 | − 0 20 | 3.4 | A2 | .285 | .038 | 86 | 1.3 | −13.1 |

| Star | R.A. 1950 | Decl. 1950 | Mag. | Type | Ann. Proper Motion | Parallax | Distance in Light Years | Abs. Mag. | Rad. Vel. |
|---|---|---|---|---|---|---|---|---|---|
| | h m | ° ′ | | | ″ | ″ | | | km./sec. |
| ε Cent | 13 37 | −53 13 | 2.6 | B2 | .039 | .012 | 272 | −2.0 | − 5.6 |
| η U. Maj | 46 | +49 34 | 1.9 | B3 | .116 | .015 | 217 | −2.2 | −10.9 |
| μ Cent | 47 | −42 13 | 3.3 | B3e | .026 | .009 | 362 | −1.9 | +12.6 |
| ζ Cent | 52 | −47 02 | 3.1 | B3 | .080 | .013 | 251 | −1.3 | * |
| η Boot | 52 | +18 39 | 2.8 | G1 | .370 | .100 | 33 | 2.8 | − 0.2* |
| **β Cent** | 14 00 | −60 08 | 0.9 | B3 | .039 | .026 | 125 | −2.0 | −12. * |
| π Hyda | 04 | −26 26 | 3.5 | K3 | .164 | .037 | 88 | 1.3 | +27.2 |
| θ Cent | 04 | −36 07 | 2.3 | G8 | .745 | .056 | 58 | 1.0 | + 1.3 |
| **α Boot** | 13 | +19 26 | 0.2 | K0 | 2.287 | .102 | 32 | 0.2 | − 5.1 |
| γ Boot | 30 | +38 32 | 3.0 | A3 | .182 | .063 | 52 | 2.0 | −35.5 |
| η Cent | 32 | −41 56 | 2.6 | B3 | .046 | .012 | 272 | −2.0 | − 0.2* |
| ‖**α Cent** | 36 | −60 38 | 0.1 | G0 | 3.682 | .768 | 4 | 4.5 | −22.2* |
| α Circ | 38 | −64 46 | 3.4 | F0 | .308 | .063 | 52 | 2.4 | + 7.4 |
| α Lupi | 39 | −46 10 | 2.9 | B2 | .033 | .009 | 362 | −2.3 | + 7.3* |
| ‖ε Boot | 43 | +27 17 | 2.7 | G8 | .045 | .019 | 172 | −0.9 | −16.4 |
| ‖$α^2$ Libr | 48 | −15 47 | 2.9 | F1 | .128 | .056 | 58 | 1.6 | −10. * |
| β U. Min | 51 | +74 22 | 2.2 | K4 | .028 | .030 | 109 | −0.4 | +16.9 |
| β Lupi | 55 | −42 56 | 2.8 | B3 | .067 | .012 | 272 | −1.8 | − 0.3* |
| κ Cent | 56 | −41 54 | 3.4 | B2 | .034 | .011 | 296 | −1.4 | + 9.1* |
| σ Libr | 15 01 | −25 05 | 3.4 | M4 | .091 | .020 | 163 | −0.1 | − 4.3 |
| ζ Lupi | 09 | −51 55 | 3.5 | G5 | .125 | .027 | 121 | 0.7 | − 9.7 |
| γ Tr. Au | 14 | −68 30 | 3.1 | A0 | .064 | ..... | ..... | ...... | 0. |
| β Libr | 14 | − 9 12 | 2.7 | B8 | .100 | .015 | 217 | −1.4 | −37. * |
| δ Lupi | 18 | −40 28 | 3.4 | B3 | .031 | .012 | 272 | −1.2 | + 1.6 |
| γ U. Min | 21 | +72 01 | 3.1 | A2 | .016 | .022 | 148 | −0.2 | − 3.9* |
| ι Drac | 24 | +59 08 | 3.5 | K3 | .010 | .030 | 109 | 0.9 | −11.1 |
| ‖γ Lupi | 32 | −41 00 | 3.0 | B3 | .038 | .013 | 251 | −1.4 | + 6. |
| α Cor. B | 33 | +26 53 | 2.3 | A0 | .160 | .054 | 60 | 1.0 | + 1.0* |
| α Serp | 42 | + 6 35 | 2.8 | K3 | .142 | .043 | 76 | 1.0 | + 3.0 |
| β Tr. Au | 51 | −63 17 | 3.0 | F0 | .436 | .096 | 34 | 2.9 | − 0.3 |
| π Scor | 56 | −25 58 | 3.0 | B3 | .037 | .012 | 272 | −1.6 | − 3.0* |
| δ Scor | 57 | −22 29 | 2.5 | B1 | .039 | .011 | 296 | −2.3 | −16. * |
| ‖β Scor | 16 03 | −19 40 | 2.8 | B3 | .029 | .016 | 204 | −1.2 | − 9.3* |
| δ Ophi | 12 | − 3 34 | 3.3 | K8 | .159 | .030 | 109 | 0.7 | −19.8 |
| ε Ophi | 16 | − 4 34 | 3.3 | G9 | .088 | .031 | 105 | 0.8 | −10.3 |
| ‖σ Scor | 18 | −25 28 | 3.1 | B1 | .033 | .009 | 362 | −2.1 | − 0.4* |
| ‖η Drac | 23 | +61 38 | 2.9 | G5 | .062 | .038 | 86 | 0.8 | −14.3 |

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

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

# STAR CLUSTERS

The star clusters for this observing list have been selected to include the more conspicuous members of the two main classes—open clusters and globular clusters. Most of the data are from Shapley's *Star Clusters* and from Trumpler's catalogue in Lick Bulletin No. 420. In the following table *N.G.C.* indicates the serial number of the cluster in the New General Catalogue of Clusters and Nebulae; *M*, its number in Messier's catalogue; *Con.*, the constellation in which it is located; $\alpha$ and $\delta$, 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. | $\alpha$ 1950 h m | $\delta$ ° ′ | Cl. | Diam. ′ | Mag. B.S. | No. | Int. mag. | Dist. l.y. |
|---|---|---|---|---|---|---|---|---|---|---|
| 869 | | h Per | 02 15.5 | +56 55 | Op | 30 | 7 | | | 4,300 |
| 884 | | χPer | 02 18.9 | +56 53 | Op | 30 | 7 | | | 4,300 |
| 1039 | 34 | Per | 02 38.3 | +42 35 | Op | 30 | 9 | 80 | | 1,500 |
| Pleiades | 45 | Tau | 03 44.5 | +23 58 | Op | 120 | 4.2 | 250 | | 490 |
| Hyades | | Tau | 04 17 | +15 30 | Op | 400 | 4.0 | 100 | | 120 |
| 1912 | 38 | Aur | 05 25.3 | +35 48 | Op | 18 | 9.7 | 100 | | 2,800 |
| 2099 | 37 | Aur | 05 49.0 | +32 33 | Op | 24 | 9.7 | 150 | | 2,700 |
| 2168 | 35 | Gem | 06 05.7 | +24 21 | Op | 29 | 9.0 | 120 | | 2,700 |
| 2287 | 41 | C Ma | 06 44.9 | −20 42 | Op | 32 | 9 | 50 | | 1,300 |
| 2632 | 44 | Cnc | 08 37.2 | +20 10 | Op | 90 | 6.5 | 350 | | 490 |
| 5139 | | ωCen | 13 23.7 | −47 03 | Gl | 23 | 12.9 | | 3 | 22,000 |
| 5272 | 3 | C Vn | 13 39.9 | +28 38 | Gl | 10 | 14.2 | | 4.5 | 40,000 |
| 5904 | 5 | Ser | 15 15.9 | +02 16 | Gl | 13 | 14.0 | | 3.6 | 35,000 |
| 6121 | 4 | Scr | 16 20.5 | −26 24 | Gl | 14 | 13.9 | | 5.2 | 24,000 |
| 6205 | 13 | Her | 16 39.9 | +36 33 | Gl | 10 | 13.8 | | 4.0 | 34,000 |
| 6218 | 12 | Oph | 16 44.6 | −01 51 | Gl | 9 | 14.0 | | 6.0 | 36,000 |
| 6254 | 10 | Oph | 16 54.5 | −04 02 | Gl | 8 | 14.1 | | 5.4 | 36,000 |
| 6341 | 92 | Her | 17 15.6 | +43 12 | Gl | 8 | 13.9 | | 5.1 | 36,000 |
| 6494 | 23 | Sgr | 17 54.0 | −19 01 | Op | 27 | 10.2 | 120 | | 2,200 |
| 6611 | 16 | Ser | 18 16.0 | −13 48 | Op | 8 | 10.6 | 55 | | 6,700 |
| 6656 | 22 | Sgr | 18 33.3 | −23 57 | Gl | 17 | 12.9 | | 3.6 | 22,000 |
| 7078 | 15 | Peg | 21 27.6 | +11 57 | Gl | 7 | 14.3 | | 5.2 | 43,000 |
| 7089 | 2 | Aqr | 21 30.9 | −01 04 | Gl | 8 | 14.6 | | 5.0 | 45,000 |
| 7092 | 39 | Cyg | 21 30.5 | +48 13 | Op | 32 | 6.5 | 25 | | 1,000 |
| 7654 | 52 | Cas | 23 22.0 | +61 19 | Op | 13 | 11.0 | 120 | | 4,400 |

# GALACTIC NEBULAE

**The galactic nebulae here listed have been selected to include the most readily observable representatives of planetary nebulae such as the Ring Nebula in Lyra, diffuse bright nebulae like the Orion nebula and dark absorbing nebulosities such as the Coal Sack. These objects are all located in our own galactic system. The first five columns give the identification and position as in the table of clusters. In the *Cl* column is given the classification of the nebula, planetary nebulae being listed as *Pl,* diffuse nebulae as *Dif,* and dark nebulae as *Drk. Size* indicates approximately the greatest apparent diameter in minutes of arc; and *m n* is the magnitude of the planetary nebula and *m ** is the magnitude of its central star. The distance is given in light years, and the name of the nebulae is added for the better known objects.**

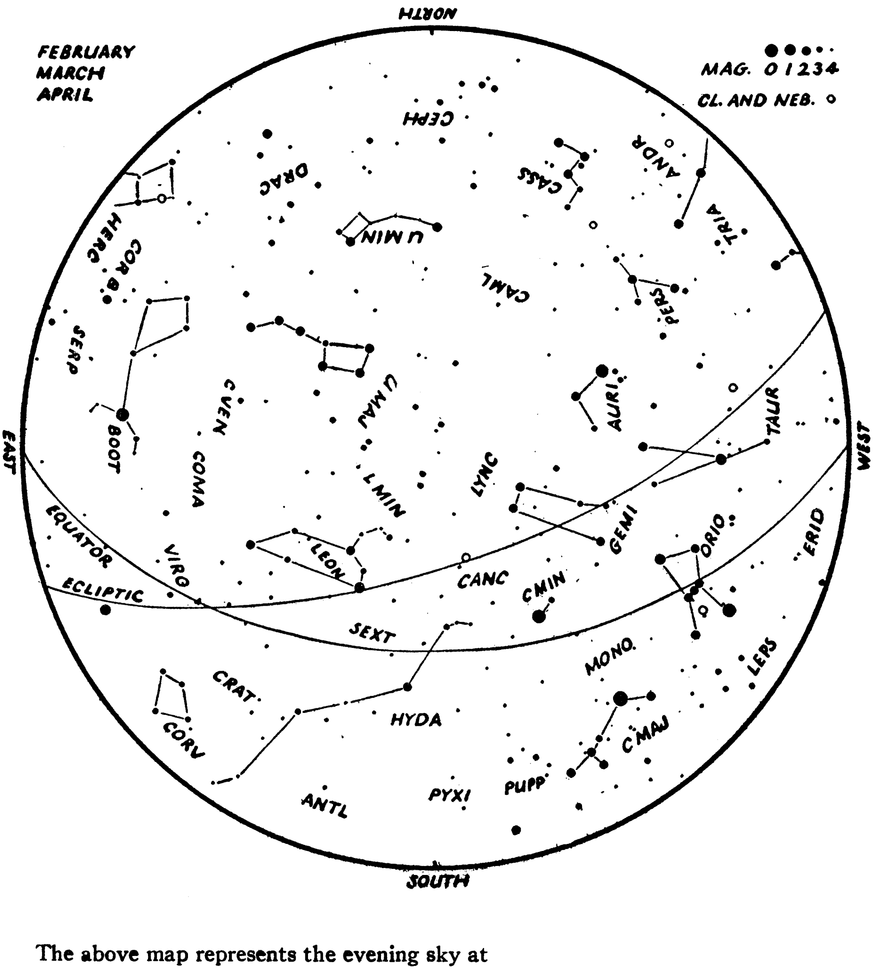
| N.G.C. | M | Con | α 1950 h m | δ ° ′ | Cl | Size ′ | m n | m * | Dist. l.y. | Name |
|---|---|---|---|---|---|---|---|---|---|---|
| 650 | 76 | Per | 01 38.3 | +51 20 | Pl | 1.5 | 11 | 17 | 15,000 | |
| 1952 | 1 | Tau | 05 31.5 | +21 59 | Pl | 6 | 11 | 16 | 10,000 | Crab |
| 1976 | 42 | Ori | 05 32.5 | −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

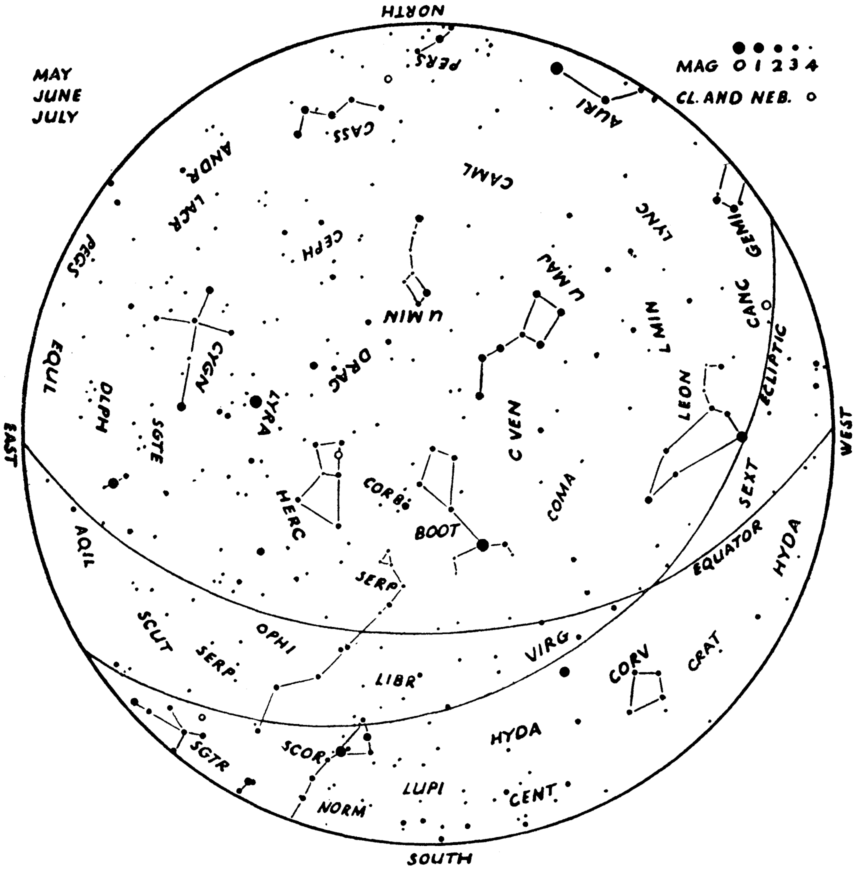



The above map represents the evening sky at

| | |
|---|---|
| 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

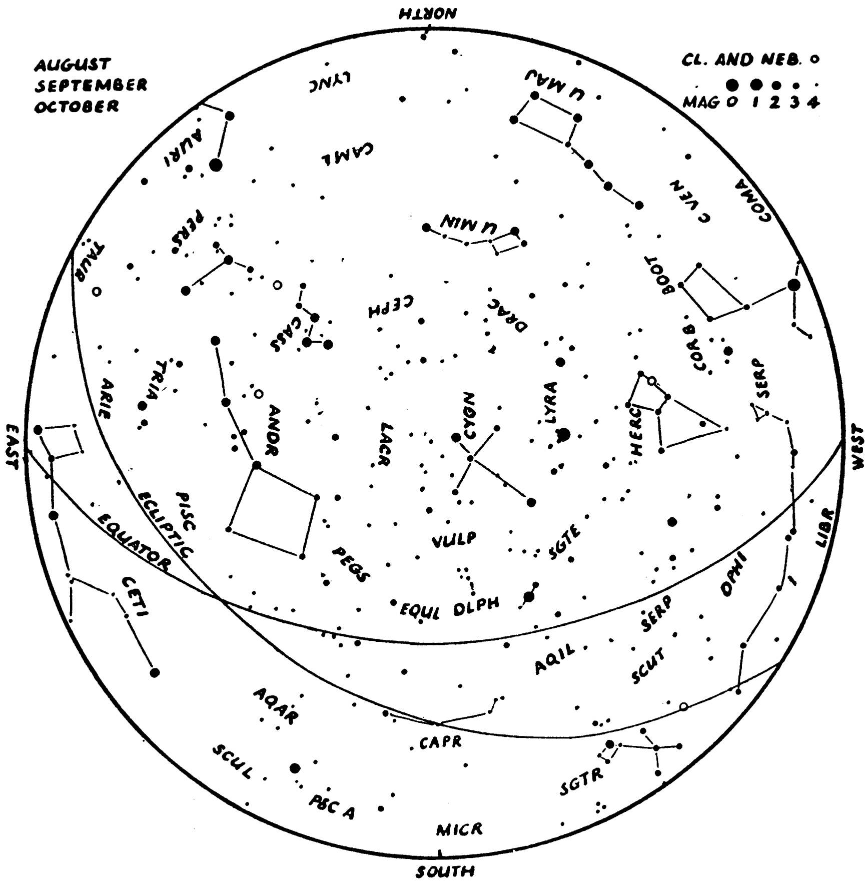



The above map represents the evening sky at

| | |
|---|---|
| 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

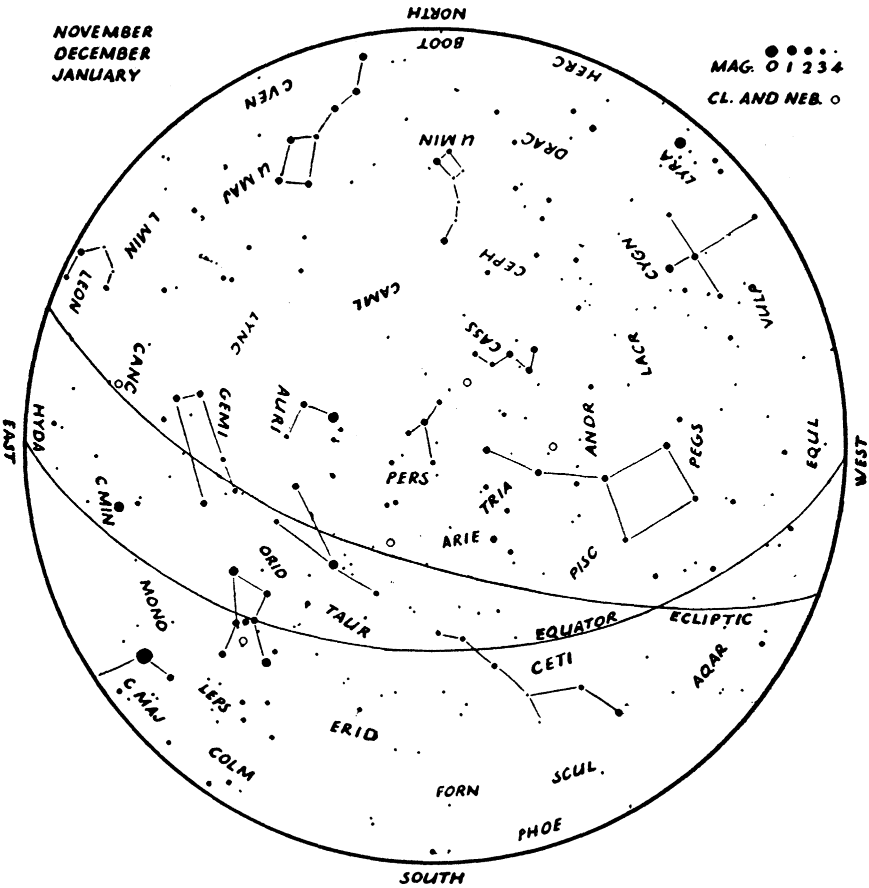



The above map represents the evening sky at

| | | |
|---|---|---|
| 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 | + 2.50 | −2.99 | 289.22 | July 4 | − 1.34 | +3.27 | 7.52 |
| 6 | + 0.07 | −3.57 | 223.37 | 9 | + 0.93 | +3.79 | 301.35 |
| 11 | − 2.34 | −4.11 | 157.52 | 14 | + 3.18 | +4.29 | 235.18 |
| 16 | − 4.72 | −4.62 | 91.68 | 19 | + 5.39 | +4.76 | 169.02 |
| 21 | − 7.04 | −5.10 | 25.85 | 24 | + 7.55 | +5.20 | 102.87 |
| 26 | − 9.28 | −5.54 | 320.02 | 29 | + 9.63 | +5.61 | 36.73 |
| 31 | −11.42 | −5.93 | 254.18 | Aug. 3 | +11.64 | +5.97 | 330.60 |
| Feb. 5 | −13.45 | −6.28 | 188.35 | 8 | +13.55 | +6.29 | 264.48 |
| 10 | −15.36 | −6.57 | 122.52 | 13 | +15.35 | +6.57 | 198.38 |
| 15 | −17.14 | −6.82 | 56.68 | 18 | +17.05 | +6.81 | 132.29 |
| 20 | −18.78 | −7.01 | 350.84 | 23 | +18.62 | +6.99 | 66.21 |
| 25 | −20.28 | −7.14 | 284.99 | 28 | +20.08 | +7.13 | 00.15 |
| Mar. 1 | −21.62 | −7.22 | 219.13 | Sept. 2 | +21.39 | +7.21 | 294.10 |
| 6 | −22.80 | −7.25 | 153.26 | 7 | +22.56 | +7.25 | 228.07 |
| 11 | −23.82 | −7.22 | 87.38 | 12 | +23.59 | +7.23 | 162.04 |
| 16 | −24.68 | −7.13 | 21.48 | 17 | +24.47 | +7.16 | 96.03 |
| 21 | −25.36 | −6.99 | 315.56 | 22 | +25.18 | +7.04 | 30.03 |
| 26 | −25.87 | −6.80 | 249.63 | 27 | +25.74 | +6.86 | 324.04 |
| 31 | −26.21 | −6.56 | 183.68 | Oct. 2 | +26.12 | +6.64 | 258.06 |
| April 5 | −26.36 | −6.27 | 117.71 | 7 | +26.33 | +6.36 | 192.09 |
| 10 | −26.34 | −5.94 | 51.72 | 12 | +26.36 | +6.04 | 126.13 |
| 15 | −26.13 | −5.56 | 345.70 | 17 | +26.20 | +5.67 | 60.18 |
| 20 | −25.73 | −5.14 | 279.67 | 22 | +25.86 | +5.26 | 354.23 |
| 25 | −25.16 | −4.69 | 213.62 | 27 | +25.32 | +4.80 | 288.29 |
| 30 | −24.40 | −4.20 | 147.55 | Nov. 1 | +24.58 | +4.31 | 222.36 |
| May 5 | −23.45 | −3.69 | 81.46 | 6 | +23.64 | +3.79 | 156.43 |
| 10 | −22.33 | −3.15 | 15.35 | 11 | +22.51 | +3.23 | 90.51 |
| 15 | −21.04 | −2.59 | 309.23 | 16 | +21.19 | +2.65 | 24.59 |
| 20 | −19.59 | −2.02 | 243.09 | 21 | +19.68 | +2.05 | 318.69 |
| 25 | −17.98 | −1.42 | 176.95 | 26 | +17.99 | +1.43 | 252.78 |
| 30 | −16.23 | −0.83 | 110.78 | Dec. 1 | +16.14 | +0.80 | 186.89 |
| June 4 | −14.35 | −0.23 | 44.61 | 6 | +14.14 | +0.16 | 121.00 |
| 9 | −12.35 | +0.38 | 338.44 | 11 | +12.01 | −0.48 | 55.11 |
| 14 | −10.26 | +0.98 | 272.25 | 16 | + 9.77 | −1.12 | 349.24 |
| 19 | − 8.10 | +1.57 | 206.07 | 21 | + 7.44 | −1.75 | 283.37 |
| 24 | − 5.88 | +2.15 | 139.89 | 26 | + 5.05 | −2.36 | 217.51 |
| 29 | − 3.62 | +2.72 | 73.70 | 31 | + 2.63 | −2.96 | 151.65 |

P —The position angle of the axis of rotation, measured eastward from the north point of the disk.
$B_0$—The heliographic latitude of the centre of the disk.
$L_0$—The heliographic longitude of the centre of the disk, from Carrington's solar meridian.

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

| No. | Commences | No. | Commences | No. | Commences |
|---|---|---|---|---|---|
| 1315 | 1951 Dec. 26.63 | 1320 | 1952 May 11.16 | 1325 | 1952 Sept. 24.28 |
| 1316 | 1952 Jan. 22.96 | 1321 | June 7.37 | 1326 | Oct. 21.56 |
| 1317 | Feb. 19.30 | 1322 | July 4.57 | 1327 | Nov. 17.87 |
| 1318 | Mar. 17.63 | 1323 | July 31.78 | 1328 | Dec. 15.18 |
| 1319 | April 13.92 | 1324 | Aug. 28.01 | | |

*Continued from page 57.*

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.

## 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) |
|---|---|---|---|---|---|---|---|
| | $\alpha$ | $\delta$ | | | | | |
| 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 |