ASTRONOMY 1995

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WESTERN AUSTRALIAN EDITION



A PRACTICAL GUIDE TO THE NIGHT SKY FOR 1995

Glenn Dawes Peter Northfield Ken Wallace

PERTH OBSERVATORY W.A. FOUNDED – 1896

RRP $10.50

1995

JANUARY

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31						

● New Moon ◑ First Quarter ○ Full Moon ◐ Last Quarter

OBS COTTAGE

ASTRONOMY 1995

WESTERN AUSTRALIAN EDITION

A PRACTICAL GUIDE
TO THE NIGHT SKY
FOR 1995

GLENN DAWES PETER NORTHFIELD KEN WALLACE

QUASAR PUBLISHING
1994

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Peter Northfield
Ken Wallace

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INTRODUCTION TO 1995 EDITION

Welcome to **ASTRONOMY 1995 - Western Australian Edition**. A similar format to ASTRONOMY 1994 has been used for this year's production (if it's not broken, don't fix it!). The authors would like to take this opportunity to thank the amateur astronomical community for its valued feedback on the previous editions. As in the case of the 1993 and 1994 publications, this book has been designed for observers specifically in Western Australia.. A separate edition has been produced to cover the rest of Australia (Eastern Edition). These two editions (Eastern and Western) represent a truly national approach in the preparation of these user-friendly yearbooks.

Part 1 is intended as a general quick reference section for those wishing to see which planets are up tonight and when, during the year, is the best time to observe them. This section, in particular, is ideal for those just starting their exploration of the Universe. The "sky view" diagrams are an easy way for you to find your way around the night sky. The planets can be identified and followed throughout the year as these "wanderers" journey through the constellations. A planisphere would make an excellent companion to this publication.

Part 2 contains the more detailed information needed by amateur astronomers. An addition this year has been data to cover the opposition of Mars.

As in previous editions of these yearbooks, the authors would like to conclude this introduction with a brief word to the beginner. Astronomy, like any science, may seem to be "swamped" in jargon. Unfortunately, it is impossible to avoid such words. However, where they have been necessary, astronomical terms have been explained in the text or covered in the glossary. To a beginner some of this information (especially the tables of numbers) may seem difficult to understand. It is important not to allow yourself to become overwhelmed. Comprehension will come with experience and when there is a need to know.

Wishing you clear skies and many hours of enjoyable observing

Glenn Dawes Peter Northfield Ken Wallace.

ACKNOWLEDGEMENTS

The information required for this yearbook was adapted from the following sources :

- Astronomical Almanac for the Year 1995. (US Naval / Royal Greenwich Observatories)
- 1995 Comet Handbook (Nakano/Green - SAO)
- Uranometria 2000.0 (Vol I and II)
- Uranometria 2000.0 Deep Sky Field Guide
- Hubble Guide Star Catalogue
- International Meteor Organisation (IMO) Calendar for 1995
- Observing Variable Stars - (Levy)
- Colours of the Stars (Malin/Murdin)
- Observing Variable Stars (Bateson)
- AAVSO Variable Star Atlas (2nd Edition)
- A Complete Manual of Amateur Astronomy (Sherrod)
- Total Solar Eclipse of 1995 October 24 (NASA RP 1344)

Data was also prepared with the assistance of the following computer software:-

- MICA v1.0 - US Naval Observatory
- Voyager, the Interactive Desktop Planetarium (Carina Software)
- Occultation Software - International Occultation Timing Association (IOTA)
- "Pickles" v 3.82 - University of Texas at Austin/McDonald Observatory
- Redshift 1.0 - Maris Multimedia
- Occult V2.0 (David Herald, IOTA)

The authors would like to recognise the contributions from the following individuals:

- Peter Williams (data re. S Carinae)
- Greg Bryant (proof-reading and comet information)
- Walter I. Nissen Jr. and David Dunham (IOTA)
- Geoff McNamara & Robert McIntyre (proof-reading)

The front cover is the spiral galaxy, NGC 2997. Photograph by David Malin, copyright © Anglo-Australian Observatory.

Rear cover is wide angle (50mm @ f 2.8 lens on 35mm camera) photo of part of Ophiuchus.

PART 1 - MONTHLY SECTION

INTRODUCTION

GENERAL

Part 1 of this publication is designed as a quick reference section for anyone who wants a summary of tonight's sky, without having to refer to lengthy, complicated tables. For convenience and ease of use, the information has been divided into monthly sections. Precise data, like the exact rise/set time or position (RA and Declination) of the planets, is contained in part 2.

Astronomical Terms. Words used in this introduction that are in *italics* have a further explanation in the Glossary.

Is This Useful for Where I Live? In general, part 1 is **useful for anywhere in Australia** (some of it is common for the world). The information in part 1 of this handbook, has been calculated for Perth, WA.

Longitude = 115° 51'E, Latitude = 31° 57'S.

You don't have to live in Perth to find the rise/set charts and sky view diagrams useful guides to the movements of the Sun, Moon and planets.

Time. The times used in part 1 are in **Western Australian Standard Time (WAST)**. WAST is the mean solar time on the meridian of longitude of 120° E.

Observing with this Book. To help preserve your night vision it is recommended, when using this book (or any book or atlas) under the night sky, that a red filter (cellophane) be placed over the end of your torch. Submarines use red lights at night to preserve their night vision in case they have to surface. True dark adaptation can take up to 20 minutes. To obtain any degree of dark adaptation, in a builtup suburban area, it is worthwhile ensuring your observing site is shielded from any direct lights such as traffic or street lights. Sometimes a degree of diplomacy is required when asking your neighbour to turn off their security lighting.

Brightness of Stars. Throughout this book the brightness of stars are given by their *magnitude* (sometimes abbreviated to mag. or magn.). See glossary for explanation.

Twilight. When *twilight* is referred to in this book, it is Astronomical and not Civil Twilight. Astronomical twilight begins or ends when the Sun is 18° below the horizon (about an hour and a half before sunrise or after sunset). Civil twilight begins or ends when the Sun is 6° below the horizon (about 30 minutes before sunrise or after sunset).

Conjunctions, Oppositions and Elongations. A ***conjunction*** of two objects is when they are seen closest to each other in the sky as seen from Earth ie. their minimum angular separation. You will see it most often used in this book when referring to the Moon being close to a star or planet. It is also common to hear this word referring to a planet and the Sun being close together (not exactly the best time to go observing the planet).

Opposition refers to the time a planet is opposite the Sun in the sky. An object in opposition will rise around sunset and will be visible the entire night. Inferior planets ie. the inner planets, Mercury and Venus, can never reach *opposition*. Their orbits are both inside Earth's. The Earth needs to pass between an object and the Sun for *opposition* to occur.

Elongation is often used in reference to the inner planets and their greatest angular distance from the Sun ie. greatest western elongation (in the eastern morning sky just before sunrise) and eastern elongation (a western evening sky object just after sunset).

See also the orbital aspects diagrams on page 53.

Measuring Distances Between Celestial Bodies as seen in the Sky. In using this book it would be useful to have some basic knowledge of angular measurement. Astronomers express the distance between celestial bodies by angles, or degrees of arc. To understand distances in angular measurement all you need to remember is that there are 360 degrees [°] in a circle. Each degree is then divided up into 60 minutes ['] and each minute into 60 seconds ["]. Separations are sometimes recorded as decimal degrees eg. 0.1° equals 6'.

When the position of a celestial object is defined as being 30' (30 minutes of arc) away from another, it simply means the separation distance, measured on the *celestial sphere*, is half of one degree or about one diameter of the Moon or Sun . It is an interesting exercise to go out on nights when there are *conjunctions* and doing your own measurements of the objects' separations and comparing your results with the predictions in this book. The scale on the back cover should assist in this venture (see below) and the "Sky View" diagrams will help in sorting out the planets from the brighter stars.

Use of the Scale on the Back Cover. Printed on the rear cover of this book is a scale divided into 8.7mm divisions. If the scale is held 500mm (half a metre) from the eye, each division will be equivalent to one degree of arc in the sky. The reader can also calibrate his or her open hand, clenched fist or thumb at arm's length, using this scale, for rough estimations in the field where it may not be convenient to use the book. The average hand (open wide) held at arm's length, will correspond to an angular sweep of about 15° to 18°; a clenched fist approximately 7° to 10°.

EXPLANATION OF FEATURES IN PART 1

MOVEMENT OF THE PLANETS Diagrams (see pages 7 and 8) These diagrams have been designed to help observers tell, at a glance, when the planets first become observable after being in *conjunction* with the Sun, or when they are about to go into *conjunction* with our star. The drawings are particularly useful as an observing guide for Mercury (see also appendix J, page 105) which doesn't wander too far from the Sun.

Each monthly chapter in part 1 contains the following :-

RISE/SET CHART. This will enable the reader to quickly determine when (or if) a planet or the Moon is visible in the night sky for any day in that month. Each chart has the midnight line centred, with the evening sky below this line and the morning sky above. The two bands of "lighter" shading show morning and evening astronomical twilight. If you are using a telescope, you'll soon learn to avoid trying to observe a planet close to the horizon (ie. close to rise or set). Turbulence in the much thicker atmosphere, at low altitude , gives very poor "boiling" images. If accurate rise/set times are required, you will need to refer to the specific tables, for the object of interest, in part 2 of this publication. You can also adjust for country (non Perth) locations using appendix F on page 103.

"JUPITER'S MOONS". See page 79 for an expanded explanation. Jupiter is like a miniature solar system with 16 moons orbiting the planet. Also, like the planets, these moons all lie in a similar plane. This plane is also very close to the Earth's orbit. Therefore, as seen from Earth, the Moons appear to move from side-to-side (east-west) of Jupiter, occasionally passing across (a *transit*) or behind (an *occultation*) the planet. These diagrams show the patterns the four major moons of Jupiter make as they move from side-to-side. Each complete period represents one orbit of the satellite. The horizontal date line represents 8:00am WAST (0hr UT). The close pair of parallel vertical lines represents the position of Jupiter. It is interesting to compare the times each moon passes over these lines, with the satellites transit times (see part 2, pp. 79 to 81). The same can be done with the occultation times ie. when the line disappears behind Jupiter. These four moons, ie. Io, Europa, Ganymede and Callisto, are bright enough to be seen in binoculars (7x power or greater is recommended). It may be necessary to mount the binoculars on a tripod to help keep them steady. In the beginning, try looking for Callisto when it is furthest from Jupiter (maximum elongation). It may take a little practice. This happens every 8 days approximately. An example would be the morning of January 29. The power or magnification of the binoculars will determine how close to Jupiter you can follow a moon.

"Phases of the Eclipses" (below "Jupiter's Moon" diagram) shows the positions of the eclipse events for each satellite, for the month, relative to Jupiter. An *eclipse* is when the moon passes into (disappearance or "d") or out of (reappearance or "r") Jupiter's shadow.

"APPEARANCE OF THE PLANETS" diagram. This provides the reader with a telescopic view of each planet drawn to the same scale. Under each image is the date, the planet's angular diameter and magnitude. Phases are also shown for Mercury, Venus and Mars. Each planet is presented with north to the top.

"HIGHLIGHTS FOR THE MONTH" This is designed to point out a few of the interesting events during the month.

The "MOON" and "PLANETS" Text. This provides information on events for the Moon (eg. when is it full?) and general notes on each planet. Emphasis is placed on their suitability for observation and any interesting conjunctions and patterns between the Moon, other planets and bright stars.

The Minor Planets (or asteroids). This section deals with the 20 brightest *asteroids* (see also pages 96 - 97). An entry is included if the asteroid reaches *opposition*, ie. the time it is brightest, during the month. It lists the *magnitude*, date and constellation (the asteroid is in) at the time of *opposition*.

Comets. This brief section deals with the comets know to be visiting the inner solar system in 1995. At the time of publication only the known periodic comets could be considered. It is meant to point out the comets which are bright during the month and include interesting *conjunctions*. Unfortunately, so far, 1995 is a poor year for bright comets. Who knows what spectacular visitor may be lurking around the corner?

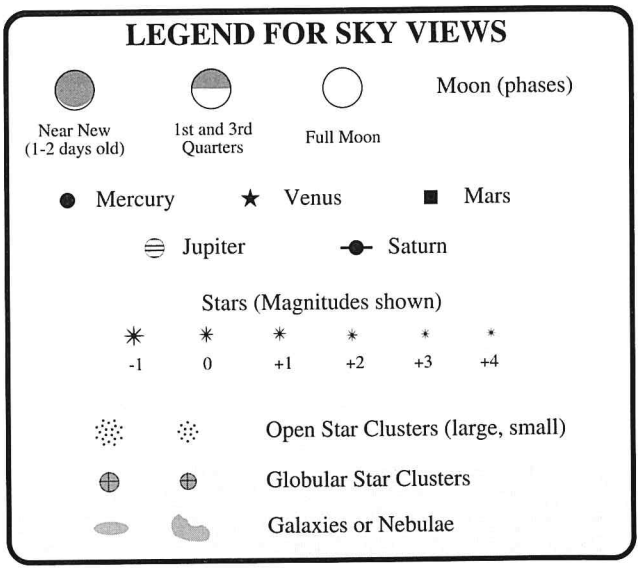
Meteor Showers. On any clear night we can see up to 5 shooting stars per hour, these are known as random or sporadic meteors. There are also annual "showers" which return at the same time each year. Each shower seems to radiate from a focal point in the sky and is named after the constellation or a bright star the radiant lies near. The monthly section lists the major showers for 1995 that are suitable for observation. Full details for all showers are given in part 2 (pages 94-95). The selected showers in part 1 are those largely unaffected by moonlight. It can take great patience to watch for meteors, but the occasional fireball can make it all worthwhile. It is best to do your searching on moonless nights and dark skies (away from light polluted cities) will also help.

The "DAILY EVENTS". This is a list of all general phenomena associated with the planets and Moon. The presentation is keyed to those people who would like to know "what's happening tonight (astronomically speaking)?" Included are :-

- Lunar phases and key events in the planets' orbits.
- Selected conjunctions between the Moon, comets, asteroids (minor planets), brighter stars and deep sky objects for 1995 (see also pages 100-101)

Conjunctions. Differences will be often found between the separation distances (and times quoted) and those found in the remainder of part 1. The information in the daily events was designed to cater for everyone and is *geocentric* ie. as it would look from a position corresponding to the centre of the earth. The exact time of closest approach may be in daylight or the objects of interest may not be above the horizon for Australia. The planetary text and sky views have been tailor made to suit Australia. Sometimes a lunar conjunction is followed by a "*Occ". This indicates that somewhere in the world the object will be occulted (covered) by the Moon. The distance given is measured from the centre of the Moon and the Moon has a diameter of 0.5°. *Occultations* visible from Australia, involving the planets or the brightest stars, will be mentioned in the "Moon" text.

Abbreviations. It is common to use the standard three letter abbreviation for constellations. These are listed in appendix K on page 105. Other abbreviations include; G=galaxy, OC=open cluster, GC=globular cluster, m.p.=minor planet and *Occ=occultation . There are also some astronomical catalogues; *NGC*=New General Catalogue, *IC*=Index Catalogue and "M" for the number in the Messier catalogue.



"SKY VIEW" Diagrams. These are designed to help you find the planets. The date/time of each diagram has been carefully chosen to show the most interesting patterns of the planets and Moon. Some general "sky views" have also been given. Sometimes the times chosen correspond to about one hour (or even down to 30 minutes) before sunrise or after sunset. Although, astronomically speaking, this would still be considered *twilight*, this is sometimes necessary to catch the planets when they are close to the Sun. This is especially relevant for Mercury which never wanders more than 28° from the Sun. Sky views which show a twilight view before sunrise are called "Morning Sky" - evening twilights are "Evening Sky", the rest are "Night Sky".

The "Sky Views" include :

- The Moon (showing approximate phase) and the planets visible with the naked eye.
- All stars down to 4th magnitude.
- Some prominent stars and clusters / nebulae are named (*italic*, lower case).
- Bright star clusters, nebulae and galaxies (down to approximately 5th magnitude). These objects are named using the following codes. A prefix of "N" means the catalogue, which this number belongs, is the NGC or New General Catalogue; an "I" is the IC or Index Catalogue and "M" is a number in the Messier catalogue. All these deep sky objects are also listed on pages 100-101, ie. appendix D - "Non Stellar Objects".
- The constellations are labelled (capital letters) and each represented by lines joining key stars (as per convention in astronomy atlases and books).

See also the legend in this introduction.

Although only stars down to 4th magnitude are shown, the positions of some fainter stars are sometimes indicated in the constellation lines. Wherever there is a bend, or the end of a line, there is a star.

When using these "windows to the sky" it is important to keep in mind that the horizon shown is theoretical (eg. looking out over the ocean). You will soon learn to make mental adjustments for local hills, buildings and trees etc. The scale has been kept constant and the view is 37° in azimuth (along the horizon) by 49° in altitude (a 10° reference scale is also marked). Sometimes the altitude of an object of interest is such that the field of view is not large enough to include the horizon.

Uranus and Neptune have been excluded from the "Sky Views" since they are not generally visible to the naked eye. Uranus would certainly need "dark sky" conditions to be visible to the unaided eye. Neptune will always need at least binoculars. In either case, because of the many faint stars of similar brightness close by, the finder chart, on page 88, would be needed to identify these outer worlds. Pluto would need at least a 20cm telescope to glimpse this faint distant member of our Solar System and so is not marked on the "sky views". Finder charts can be found on pages 88 and 89.

The "sky view" diagrams were designed for the unaided eye, but binoculars can be very useful. Binoculars can help you find:

- stars and planets during twilight
- fainter stars
- stars dimmed by the nearby Moon
- stars close to the horizon.

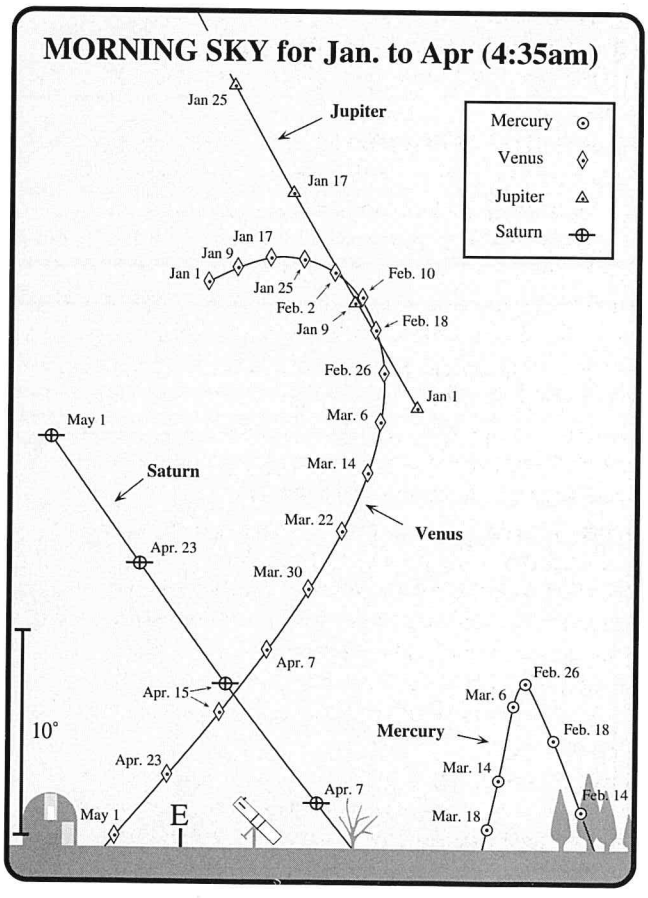
The "sky views" are useful for more than just the date and time on the drawings. During the year, the Sun's apparent motion (due to the Earth orbiting the Sun) takes it once around the sky relative to the stars. This results in the pattern of stars relative to the horizon, at any one time, being the same one month from now but 2 hours earlier (of course the Moon and planets will have moved). Compare the sky views for April 26 (5:20am) with that for May 24 (3:20am). The "Hours of Right Ascension / Constellations on the Meridian" diagram (page 104) can be used as a reference for when the sky (stars visible) will appear the same. For example from the diagram, the hour of right ascension (RA) on the meridian (sidereal time) on April 26, at 5:20am, is approximately 20 hours. Following this diagonal (parallel to the RA lines) shows the equivalent time for other dates.

Using the "Sky Views" for other places in Western Australia.

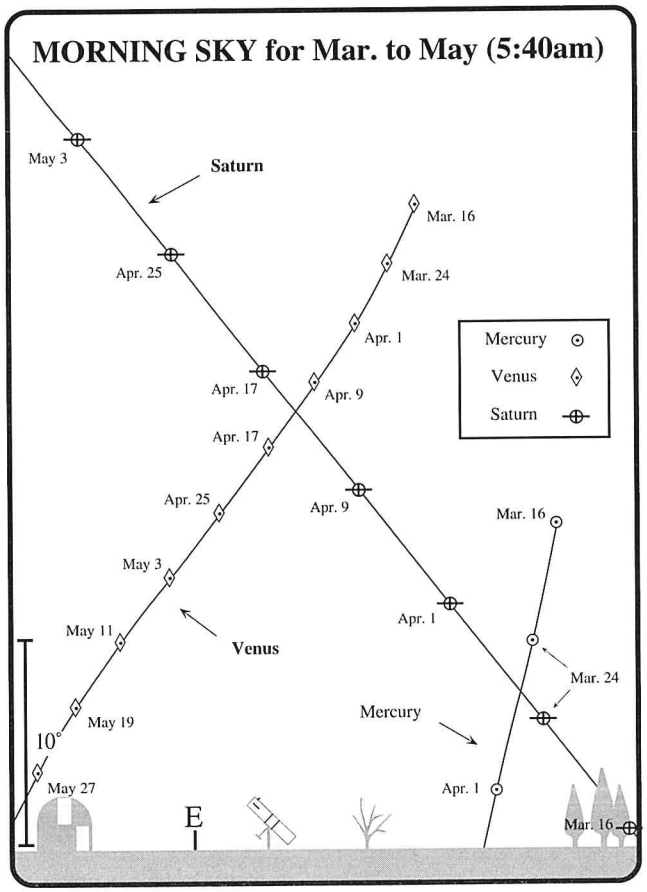
For any location with a similar latitude to Perth, the appearance of the sky would be identical to these diagrams. The equivalent time will vary slightly with a change in longitude. A change in latitude will cause the appearance of the sky to look slightly different compared to these sky views. The further north, the more stars, familiar to our northern hemisphere friends, are seen above the northern horizon. The "sky views" are optimised for Perth (latitude 31° 57' S). If you were in Broome (lat. 17° 58' S) you could see to the north 14° more than from Perth (Perth to the south would see 14° more than Broome). 14° being the difference in latitude.

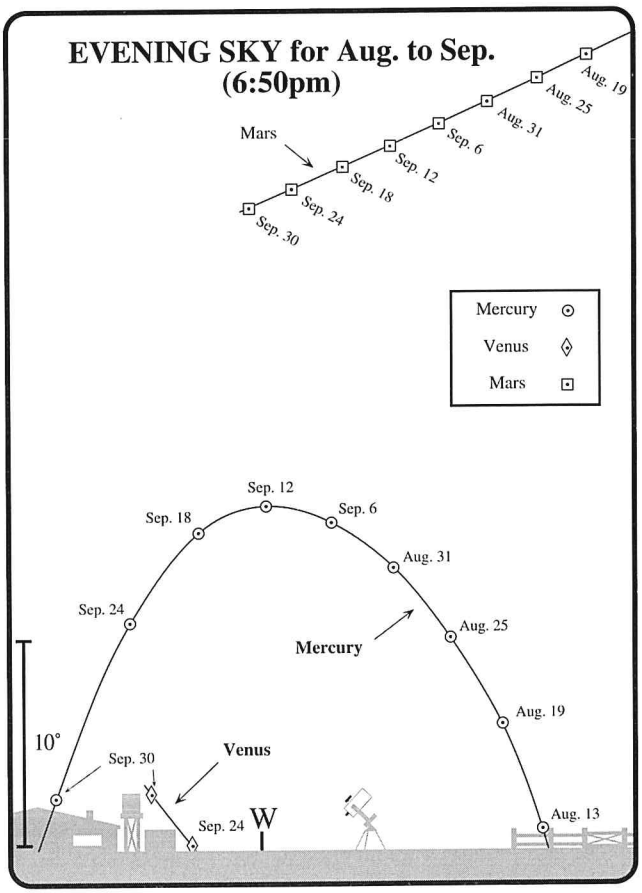
Although a change in latitude causes some differences, the sky views remain general enough for the observer to at least recognise the patterns of the stars and planets. Hence this should not detract from their usefulness.

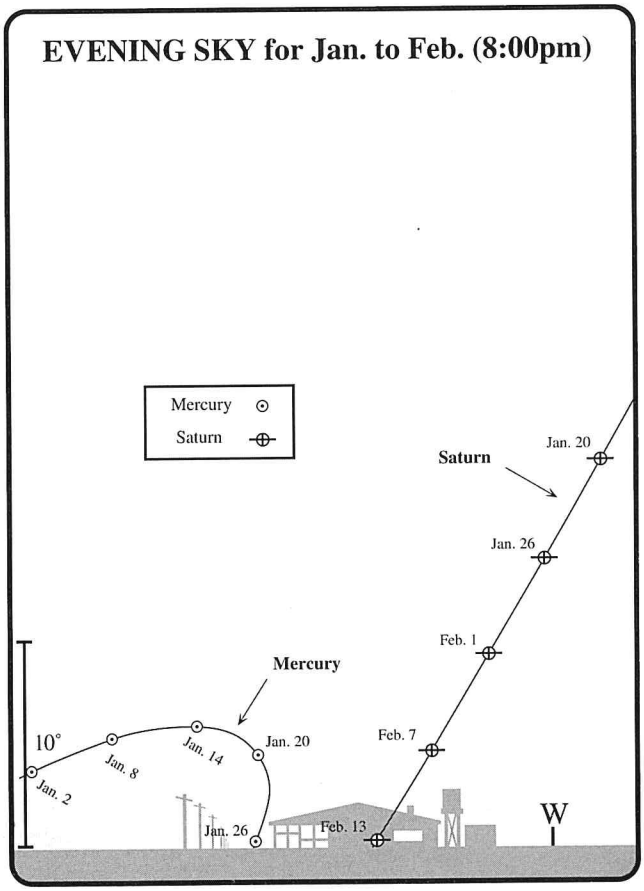
MOVEMENT OF THE PLANETS

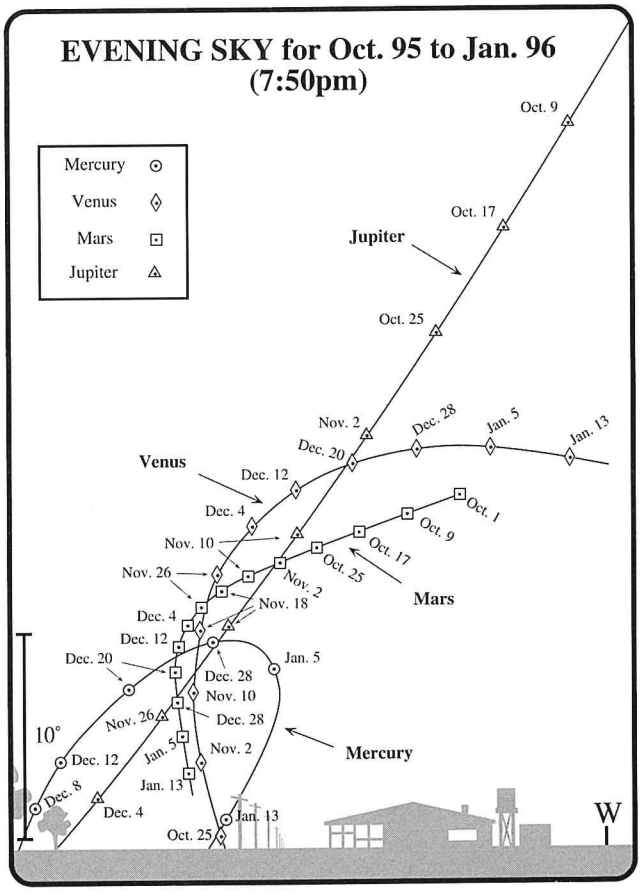


MOVEMENT OF THE PLANETS



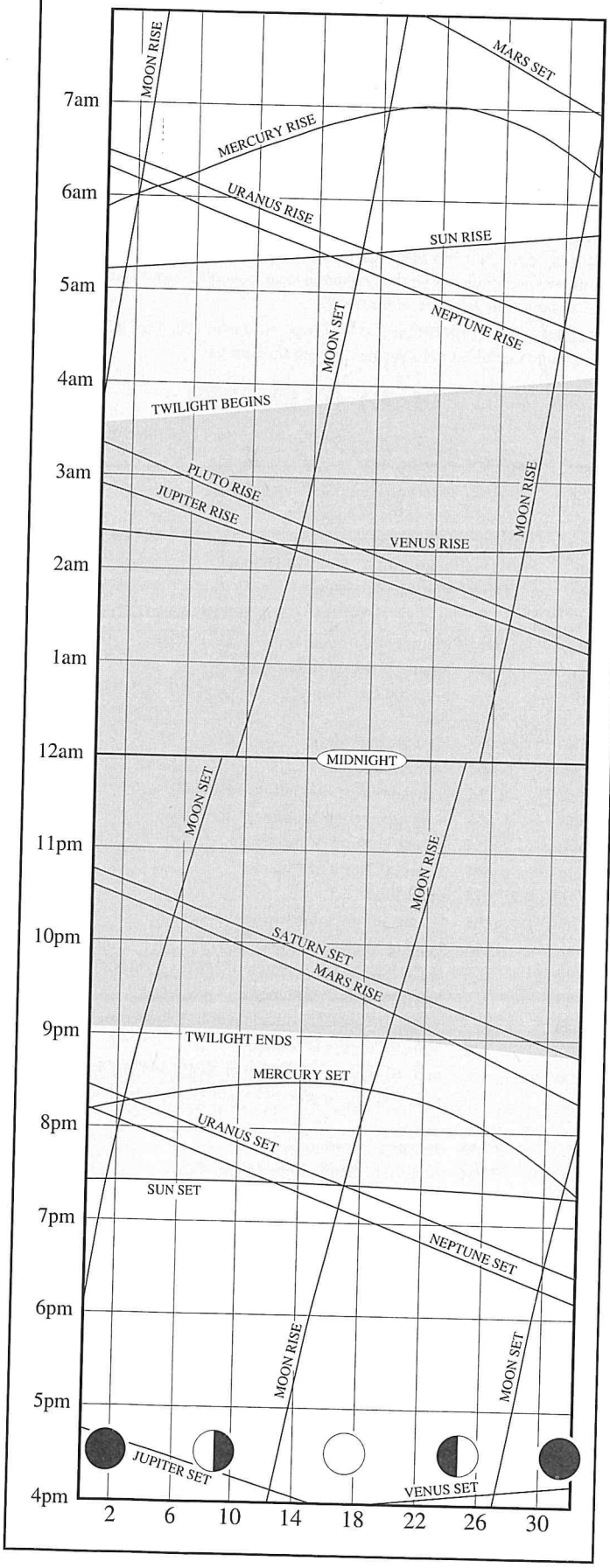




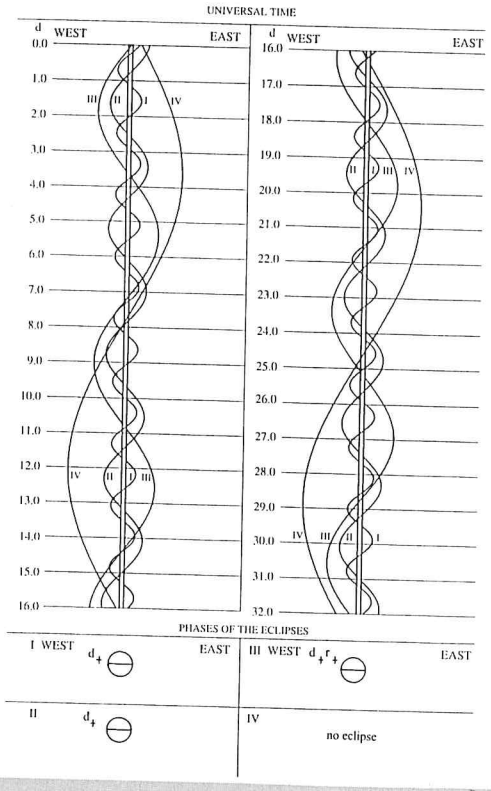


JANUARY

RISE/SET CHART

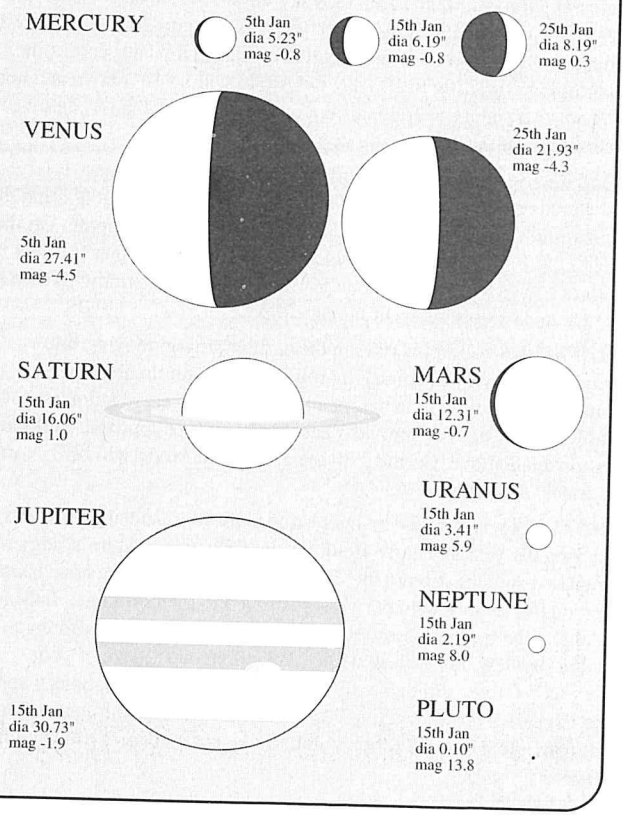


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



JANUARY

HIGHLIGHTS FOR THE MONTH

- Venus is well placed for observing in the morning sky .
- Venus and Jupiter are close together in the morning sky, mid month.
- On the 23rd/24th, the Moon makes a close approach to the star Spica.
- Jupiter and the Moon only 2° apart on the morning of the 27th.

THE MOON

1st New Moon, 6:56pm.
8th First Quarter, 11:46pm.
12th Moon at apogee (furthest from Earth - 411240 km, size 29.1').
17th Full Moon, 4:26am.
23rd Occultation of Spica by the Moon (not visible from Australia).
24th Last Quarter, 12:58pm.
27th Occultation of Venus by the Moon (not visible from Australia, see Venus below).
28th Moon at perigee (closest to Earth - 359630 kms, size 33.2').
31st New Moon, 6:48am.

THE PLANETS

MERCURY is visible for most of January in the western evening sky, setting about an hour after the Sun. The greatest elongation east of the Sun occurs on the 19th (19°), but the best time for observation in a dark evening sky, during the year, is from late August to late September. For experienced observers, with a low western horizon, the planet (at magnitude -1.0) can be seen around 8pm, 4° above the horizon at the beginning of the month. Towards the end of January (around the 24th), Mercury gets too close to the Sun for observation. Inferior conjunction occurs early next month.

VENUS is in the constellation Libra early in the month. It rises around 2am and it is well placed high in the eastern morning sky when twilight begins. Do not confuse Venus with nearby Jupiter. At mag. -3.9 Venus is two magnitudes brighter than the giant planet. From the beginning of the month, Venus moves toward the south as Jupiter gains altitude. From the 12th to the 17th, the pair appear within 4° of each other, with closest approach on the 15th (see sky view). In January, Venus moves from the constellation Libra into Scorpius (passing less than 9° from 1st mag. Antares) and then into Ophiuchus during the later part of the month. On the 27th, the 25 day old Moon will be 10° above and north of Venus (very close to Jupiter), and on the 28th, less than 4° below and slightly south of Venus (see sky view for 27th).

MARS rises in the late evening in the constellation of Leo. It is distinctive as a bright orange "star" which remains about 4° from the 1st magnitude star Regulus (Alpha Leonis) for the entire month. On the 19th the 17 day old Moon will be 8° from the Red Planet (see sky view). Mars comes to opposition on the 12th February, providing its best show since its last opposition in January 1993.

JUPITER in Scorpius rises in the early morning, moving into Ophiuchus by mid-January. Throughout the month the planet, at magnitude -1.9, will be within a few degrees of 1st magnitude Antares (Alpha Scorpii). Jupiter and Venus make a close approach mid-month as detailed above. On the 27th the 25 day old Moon will be 3° north of Jupiter (see sky view).

SATURN will provide an interesting sight for planetary observers during the year and early 1996. Since 1988, when Saturn's rings were at maximum inclination to the Earth (at their widest), they have been gradually closing with our view restricted to the north face. In May and August the Earth crosses into the plane of the rings and affords us an edge-on view. For a short while (depending on the size of your telescope) they will be nearly invisible. For this month, Saturn appears in the early western evening sky in Aquarius (setting around 10pm). On the 5th, the 4 day old Moon will be 7° below and north of the planet (see sky view).

URANUS & NEPTUNE, in the evening twilight are both within about 5° of Mercury early in the month. Due to their closeness to the Sun they are unobservable until February.

PLUTO, in the early eastern morning sky, moves from Libra into Ophiuchus early in the month.

MINOR PLANETS at opposition this month include Zelinda on 1st January at mag. 10.0 in Gemini, Echo on 15th at mag. 10.0 in Gemini and Fortuna on 19th at mag. 10.0 in Cancer. Pallas does not reach opposition this year but is brightest in early January at mag. 8.5 in Fornax. Vesta also does not reach opposition this year, but is brightest in early January at mag. 6.6 on the Orion/Gemini border.

METEOR SHOWERS

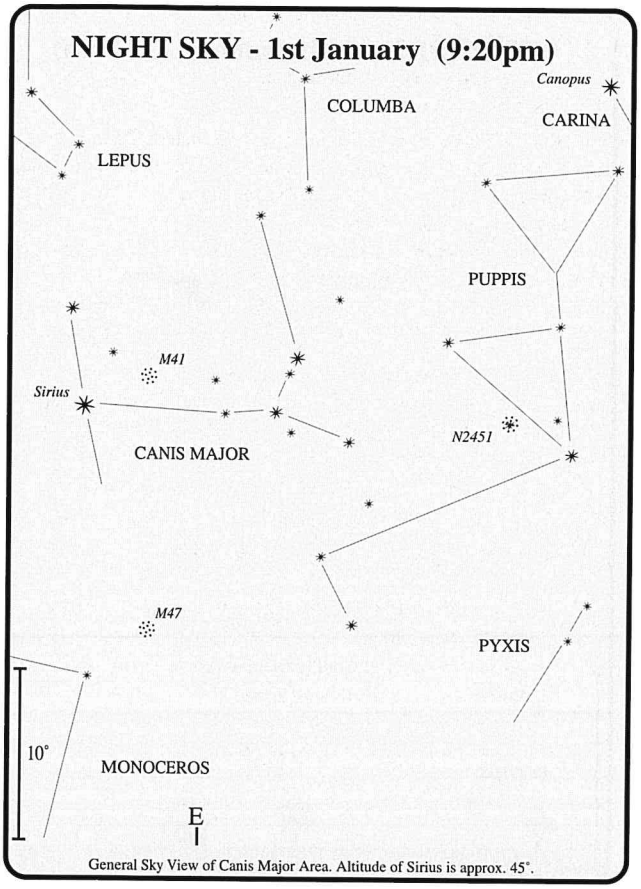
ALPHA CARINIDS are a minor southern shower. They are active from 24th Jan through to 9th Feb, with maximum on the 30th of this month. Little is known about this shower, its radiant is near Canopus (Alpha Carinae) and it will be visible for most of the night.

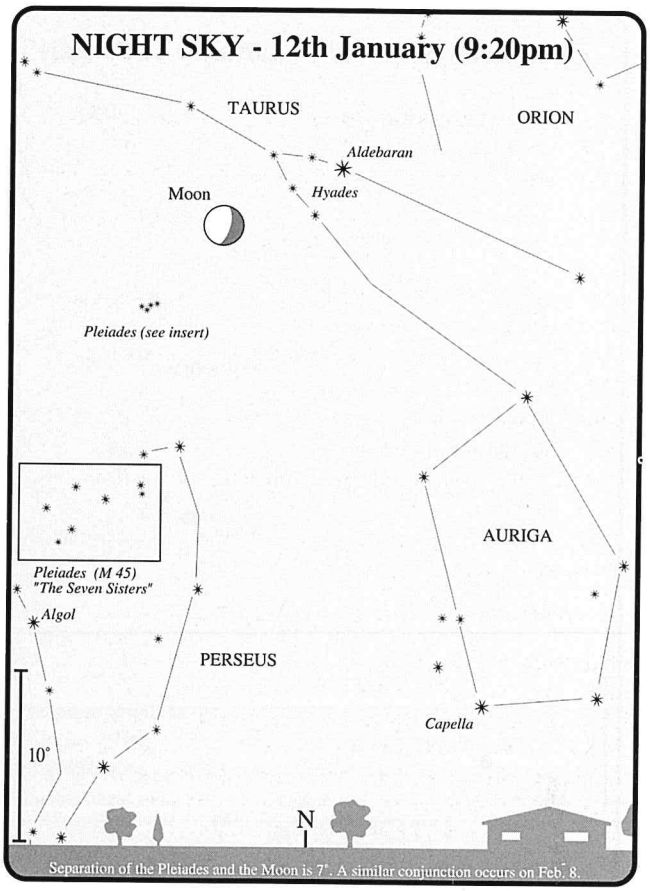
THETA CENTAURIDS are active from 23rd Jan to 12th Mar, with maximum on the 1st Feb. See next month for details.

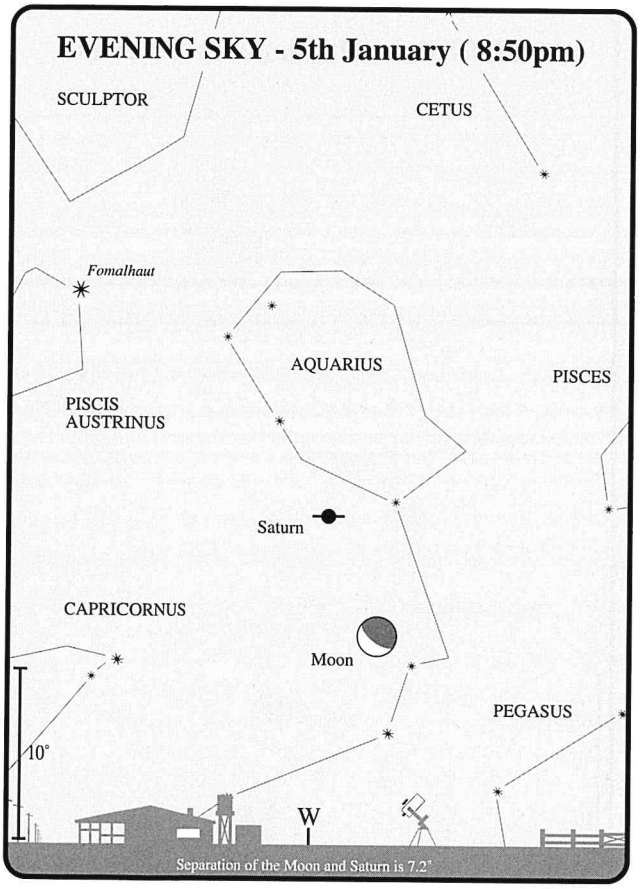
DIARY OF EVENTS

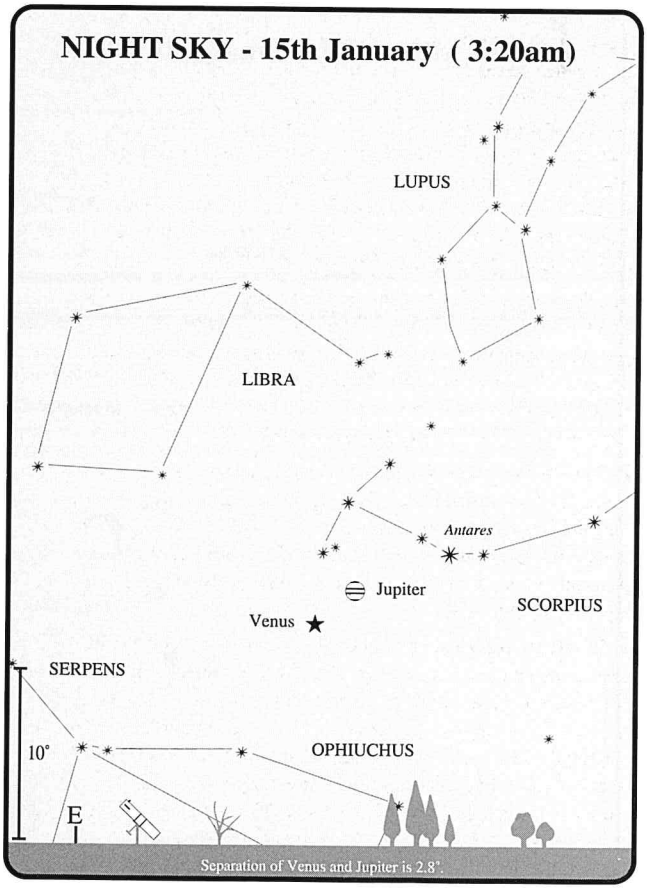
1st		Mercury at Greatest Latitude South (Heliocentric).
1st	6:56 PM	New Moon
2nd	10 AM	Mercury 3° South of Neptune
3rd	3 AM	m.p. 2 Pallas stationary
4th	9 AM	Mars stationary
4th	9 AM	Mercury 1.7° South of Uranus
4th	7 PM	Earth at perihelion
6th		m.p. 88 Thisbe 0.1° South of NGC 6234 (GC) in Oph
6th		Mercury 0.5° South of M75 (GC) in Sgr
6th	1 AM	Saturn 7° South of the Moon
7th		m.p. 704 Interamnia 0.7° South of NGC 6553 (GC) in Sgr
8th	11:46 PM	First Quarter Moon
12th	6 AM	Moon at apogee
13th	8 PM	Venus greatest elongation West (47°)
14th	1 AM	Neptune in conjunction with the Sun
14th	5 PM	Venus 3° North of Jupiter
16th	6 AM	Venus 8° North of Antares
17th	4:26 AM	Full Moon
17th	8 AM	Uranus in conjunction with the Sun
19th	4 PM	Mercury greatest elongation East (19°)
20th		m.p. 10 Hygiea 0.3° South of M8 (Lagoon Neb.) in Sgr
20th		Mercury at ascending node.
20th		Venus at Greatest Latitude North (Heliocentric).
20th	3 AM	Mars 9° North of the Moon
21st		m.p. 10 Hygiea 0.5° North of NGC 6544 (GC) in Sgr.
21st		m.p. 704 Interamnia 0.4° South of NGC 6638 (GC) in Sgr
23rd	9 AM	Jupiter 5° North of Antares
23rd	7 PM	Spica 0.6° South of the Moon *Occ
24th		Comet Borrelly 0.3° West of NGC 2976 (G) in UMa
24th	12:58 PM	Last Quarter Moon
25th		Mercury at perihelion.
25th	8 PM	Mercury stationary
26th		m.p. 3 Juno 0.6° North of NGC 6309 in Oph
27th		Saturn 1° South of m.p. 16 Psyche
27th		Venus 0.5° South of NGC 6342 (GC) in Oph
27th	1 AM	Jupiter 1.7° South of the Moon
27th	8 PM	Venus 0.2° South of the Moon *Occ
28th	7 AM	Moon at perigee
29th	2 AM	Mars 4° North of Regulus
30th	4 AM	Neptune 4° South of the Moon
31st		m.p. 10 Hygiea 0.5° North of M28 (GC) in Sgr
31st	6:48 AM	New Moon

JANUARY

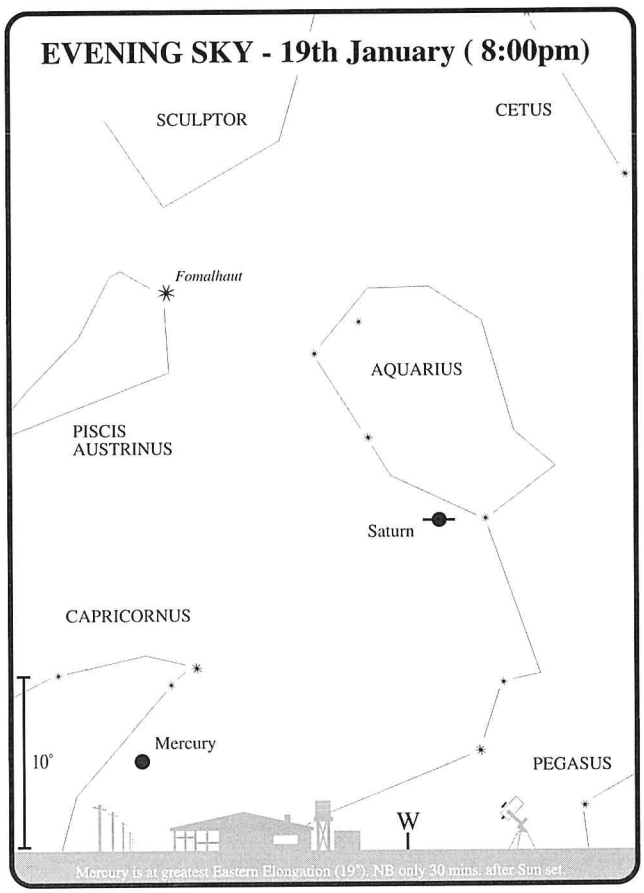

NIGHT SKY - 1st January (9:20pm)
Canopus
COLUMBA
CARINA
LEPUS
PUPPIS
M41
Sirius
CANIS MAJOR
N2451
M47
PYXIS
10°
MONOCEROS
E
General Sky View of Canis Major Area. Altitude of Sirius is approx. 45°.

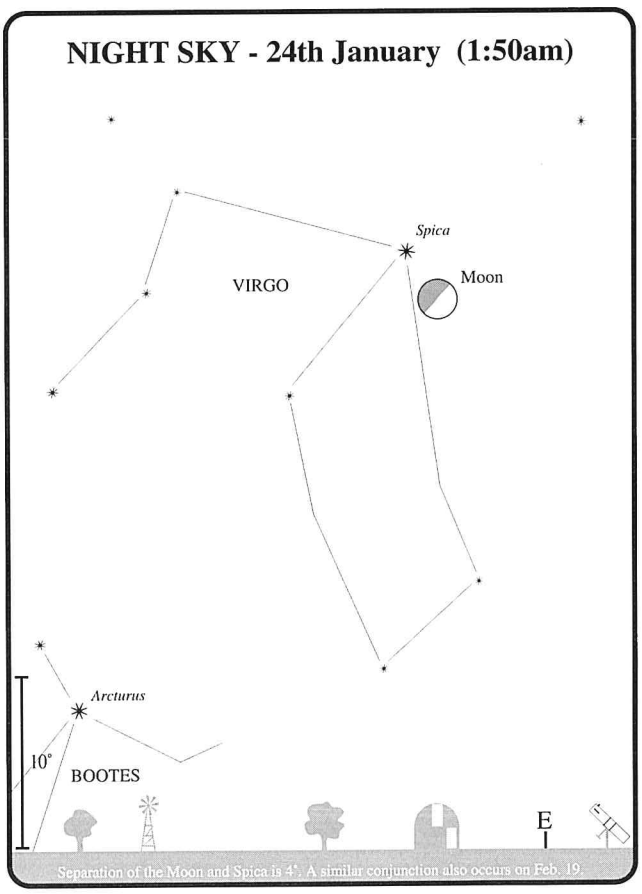

NIGHT SKY - 12th January (9:20pm)
TAURUS
ORION
Aldebaran
Hyades
Moon
Pleiades (see insert)
AURIGA
Pleiades (M 45)
"The Seven Sisters"
Algol
PERSEUS
Capella
10°
N
Separation of the Pleiades and the Moon is 7°. A similar conjunction occurs on Feb. 8.

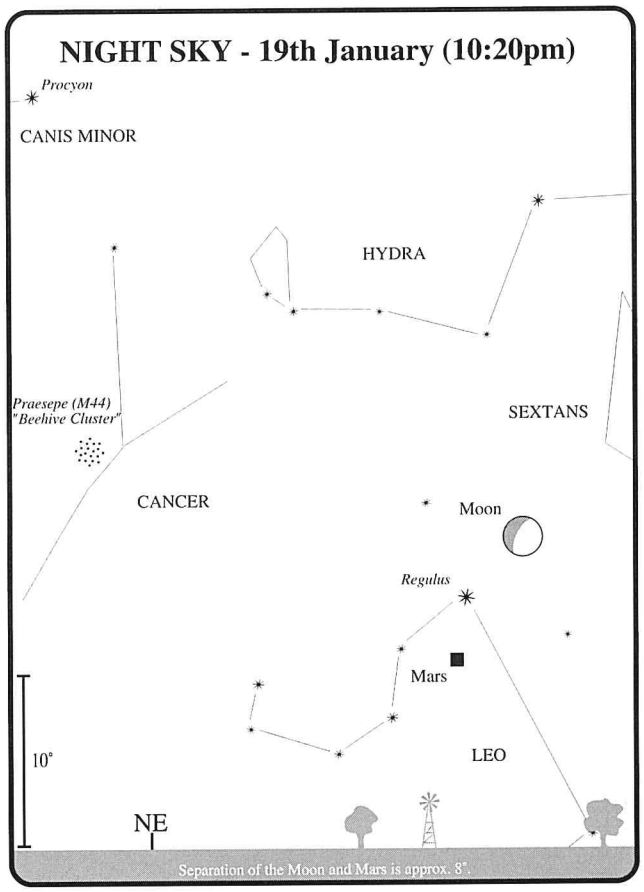

EVENING SKY - 5th January (8:50pm)
SCULPTOR
CETUS
Fomalhaut
AQUARIUS
PISCES
PISCIS
AUSTRINUS
Saturn
CAPRICORNUS
Moon
PEGASUS
10°
W
Separation of the Moon and Saturn is 7.2°

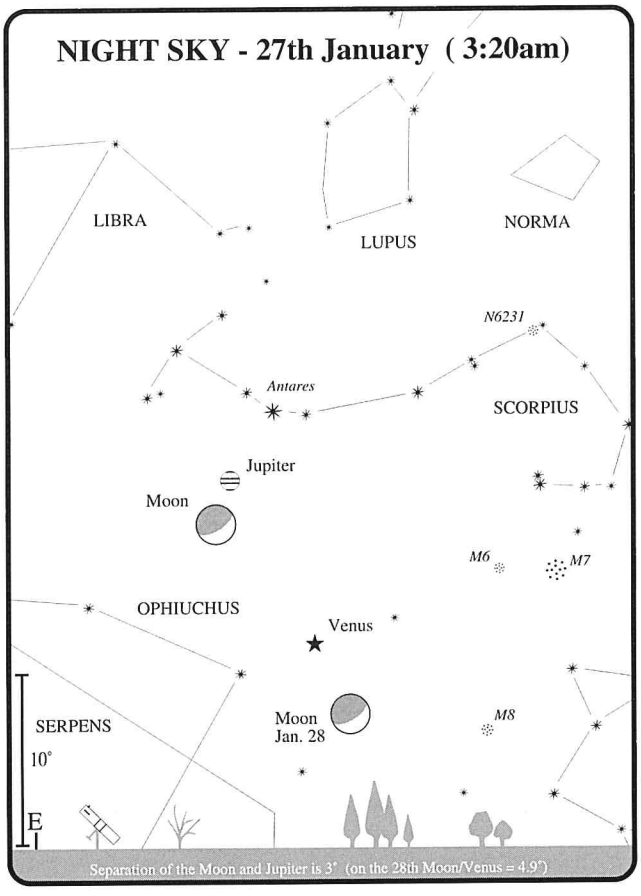

NIGHT SKY - 15th January (3:20am)
LUPUS
LIBRA
Antares
Jupiter
Venus
SCORPIUS
SERPENS
10°
OPHIUCHUS
E
Separation of Venus and Jupiter is 2.8°.

JANUARY


EVENING SKY - 19th January (8:00pm)
SCULPTOR
CETUS
Fomalhaut
AQUARIUS
PISCIS AUSTRINUS
Saturn
CAPRICORNUS
10°
Mercury
PEGASUS
W
Mercury is at greatest Eastern Elongation (19°). NB only 30 mins. after Sun set.

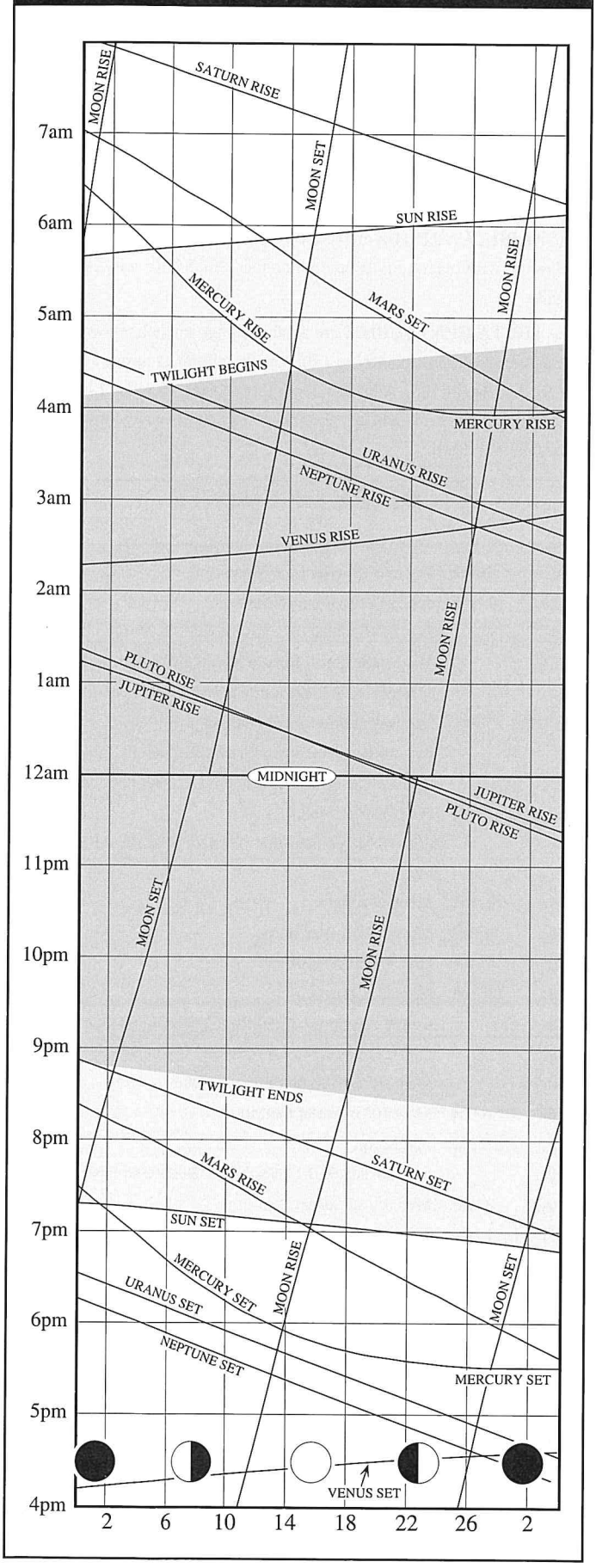

NIGHT SKY - 24th January (1:50am)
Spica
VIRGO
Moon
Arcturus
10°
BOOTES
E
Separation of the Moon and Spica is 4°. A similar conjunction also occurs on Feb. 19.


NIGHT SKY - 19th January (10:20pm)
Procyon
CANIS MINOR
HYDRA
Praesepe (M44) "Beehive Cluster"
SEXTANS
CANCER
Moon
Regulus
Mars
10°
LEO
NE
Separation of the Moon and Mars is approx. 8°.

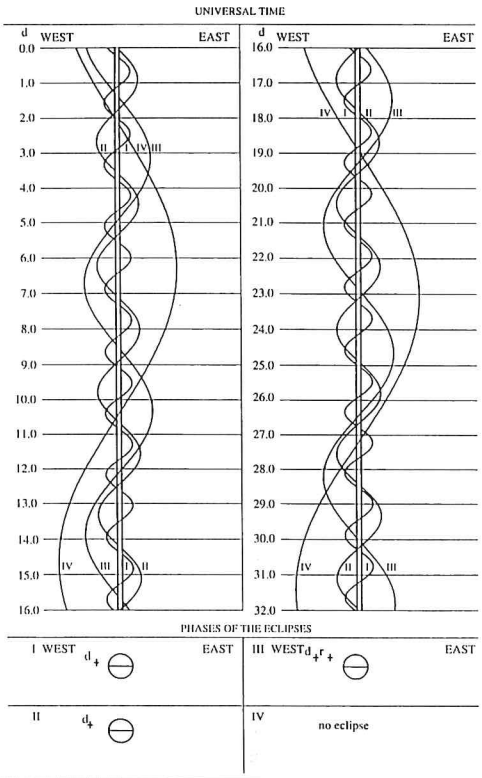

NIGHT SKY - 27th January (3:20am)
LIBRA
LUPUS
NORMA
N6231
Antares
SCORPIUS
Jupiter
Moon
M6
M7
OPHIUCHUS
Venus
SERPENS
Moon Jan. 28
M8
10°
E
Separation of the Moon and Jupiter is 3° (on the 28th Moon/Venus = 4.9°)

FEBRUARY

RISE/SET CHART

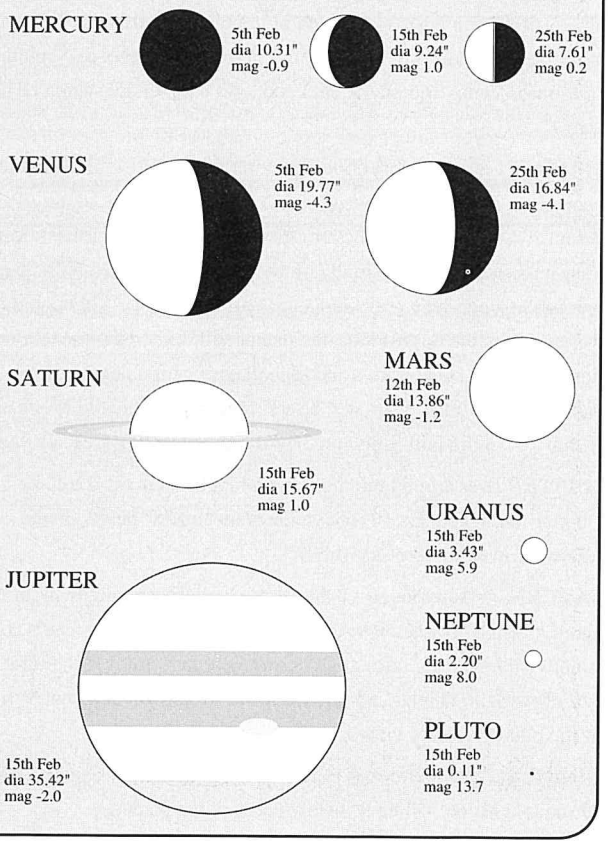


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



FEBRUARY

HIGHLIGHTS FOR THE MONTH

- The best time to observe Mars (opposition occurs on the 12th).
- Late Feb/early March is the best view of Mercury in the morning sky, for the year.
- Venus is still prominent in the morning sky.
- In late February, Venus and Neptune make a close approach.
- On the 20th, the Moon and Spica are only 1° apart.

THE MOON

7th First Quarter, 8:54pm.

9th Moon at apogee (furthest from Earth - 409300 kms, size 29.2').

15th Full Moon, 8:15pm.

20th Occultation of Spica by the Moon (not visible from Australia, but the 19 day old Moon, at 1am, will be 1° from the star.

22nd Last Quarter: 9:04pm.

23rd Moon at perigee (closest to Earth - 368460 kms, size 32.4').

THE PLANETS

MERCURY leaves the evening sky as it moves into inferior conjunction (between the Earth and the Sun) on the 4th. It moves quickly into the morning sky, and by mid month can be seen in a dark sky before twilight. On the 27th the 26 day old thin crescent Moon will be 7° north of Mercury (see sky view for the 26th), with Venus shining brightly well above the pair. With Mercury in a dark sky before twilight, the period from mid month to the 3rd week in March provides the best morning viewing of the planet this year.

VENUS, high in the morning sky, spends the early part of the month in Ophiuchus before moving into Sagittarius. It passes less than 10 arc minutes from 4th magnitude Mu Sagittarii on the 8th. On the 26th, the 26 day old Moon appears 5° north of the planet, and on the following morning 11° below (see sky view). Throughout the month Neptune rises up to meet Venus and on the 26th and 27th the pair are separated by less than 1°.

MARS, in Leo, will be at opposition on the 12th. At -1.2 magnitude the planet is at its brightest since the last close approach in January 1993. Because the planet is at aphelion (the point in its orbit furthest from the Sun) its disk diameter is small (14 arc seconds compared with 25 arc seconds at a perihelic opposition, see part 2 page 74). Although the worst of possible oppositions, the planet still deserves some telescope time and under steady skies and high magnification detail will be visible. On the 14th, Mars will be 13° from the 13 day old Moon and within 10° of the Full Moon on the following evening (see sky view).

JUPITER rises around midnight in Ophiuchus. On the 23rd, the Last Quarter Moon appears 10° above the planet and 8° below on the following evening (see sky view).

SATURN, in Aquarius, is visible in the western evening twilight until about mid-month when it will be too close to the Sun for observation. It is not visible in dark skies at all during February, for it sets before the end of twilight. On the 2nd, the 3 day old Moon will be about 8° north of the planet (see sky view).

URANUS rises around 3am mid-month in Sagittarius. On the 27th, the 27 day old Moon will be 9° below (east) of the planet.

NEPTUNE ahead of Uranus by 4°, has a close encounter with Venus on the 26th and 27th (see detail in Venus section). On the 26th, the 26 day old Moon appears 6° north of Neptune and Venus and on the following evening 10° below the pair.

PLUTO remains in Ophiuchus until early May when it crosses back into Libra. The planet rises around midnight.

MINOR PLANETS. Ceres is at opposition on 6th February at 6.9 magnitude in Leo.

METEOR SHOWERS

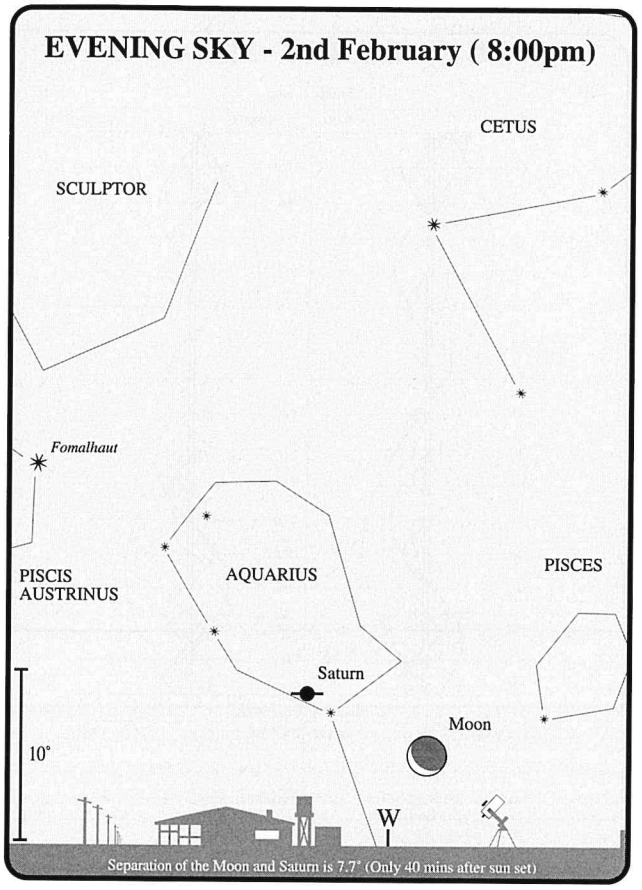
The **ALPHA CARINIDS** are active from 24th January through to 9th February, with maximum last month on the 30th. See January notes for details.

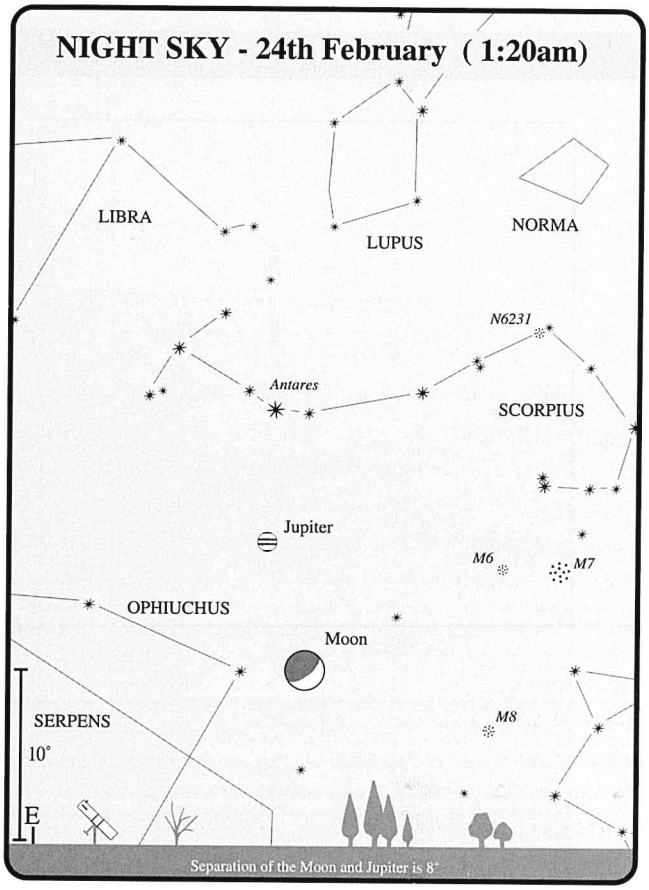
The **THETA CENTAURIDS** are another minor southern shower. They are active from 23rd January to 12th March, with maximum this month on the 1st. Again, little is known about this shower. Its radiant is near 2nd magnitude Theta Centauri and it is visible from late evening through until dawn.

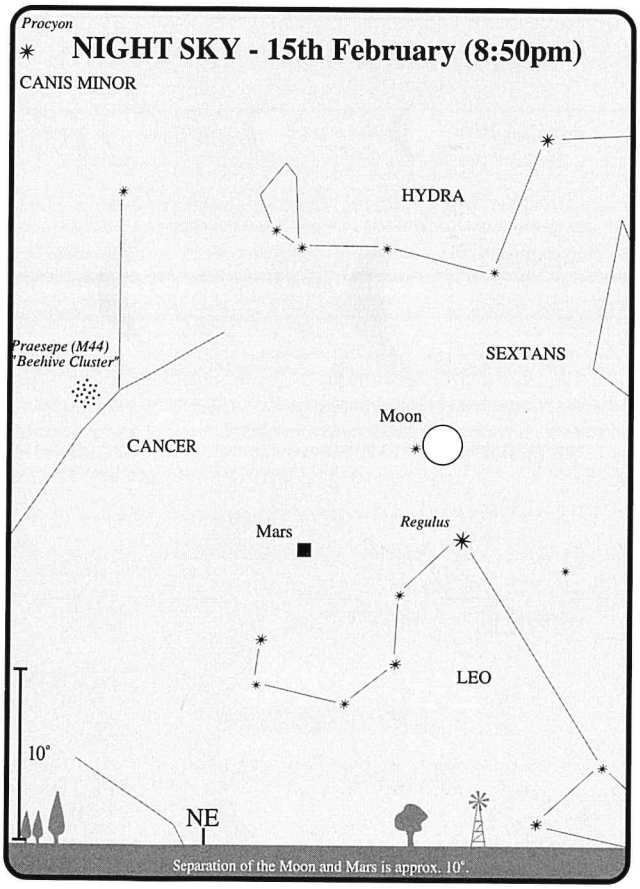
DIARY OF EVENTS

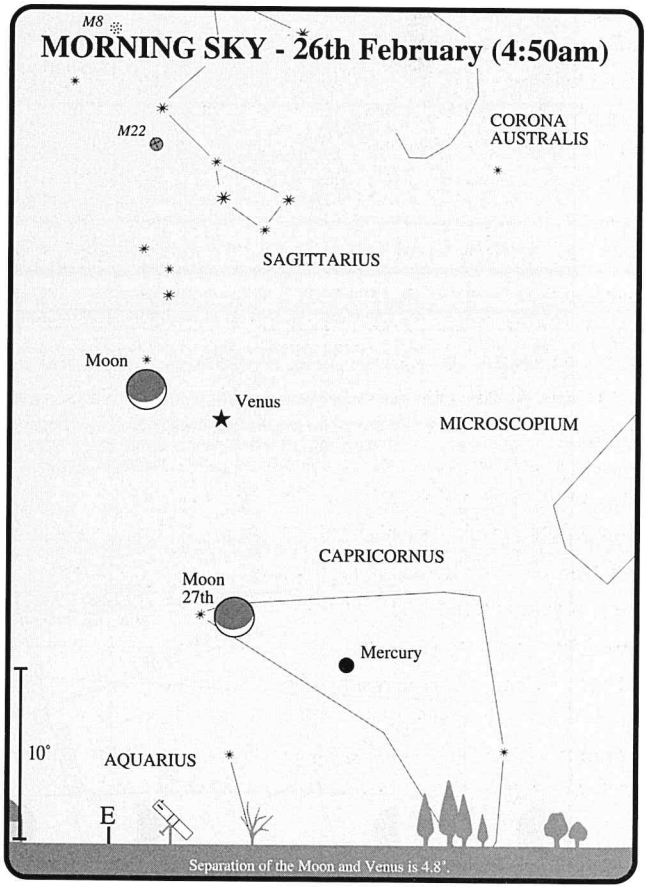
2nd		Venus 0.3° South of NGC 6440 (GC) in Sgr
2nd	4 PM	Saturn 6° South of the Moon
3rd	9 AM	m.p. 1 Ceres at opposition
4th		m.p. 654 Zelinda 0.7° East of NGC 2194 (OC) in Ori
4th		Mars at Greatest Latitude North (Heliocentric).
4th		Mercury at Greatest Latitude North (Heliocentric).
4th	7 AM	Mercury at inferior conjunction
7th		m.p. 10 Hygiea 0.3° South of M22 (GC) in Sgr
7th		m.p. 88 Thisbe 0.1° South of NGC 6544 (GC) in Oph
7th	8:54 PM	First Quarter Moon
9th		m.p. 18 Melpomene 0.3° North of NGC 6774 (OC) in Sgr
9th	2 AM	Moon at apogee
11th	10 PM	Mars closest approach
12th	4 AM	m.p. 4 Vesta stationary
12th	11 AM	Mars at opposition
14th		Comet d'Arrest 0.5° North of M10 (GC) in Oph
14th		m.p. 2 Pallas 0.1° East of IC 343 (G) in Eri
15th		Mercury 1.4° South of m.p. 6 Hebe
15th	6 PM	Mars 10° North of the Moon
15th	8:15 PM	Full Moon
16th		m.p. 88 Thisbe 0.1° North of M28 (GC) in Sgr
16th	3 AM	Mercury stationary
20th	1 AM	Spica 0.9° South of the Moon *Occ
22nd	9:04 PM	Last Quarter Moon
23rd	10 AM	Moon at perigee
23rd	1 PM	Jupiter 2° South of the Moon
24th		m.p. 18 Melpomene 0.2° South of IC 4895 (G) in Sgr
26th	1 PM	Neptune 4° South of the Moon
26th	1 PM	Venus 4° South of the Moon
26th	6 PM	Venus 0.7° North of Neptune
26th	9 PM	Uranus 6° South of the Moon
27th	7 PM	Mercury 5° South of the Moon
28th		Mercury at descending node.

FEBRUARY


EVENING SKY - 2nd February (8:00pm)
CETUS
SCULPTOR
Fomalhaut
PISCIS AUSTRINUS
AQUARIUS
PISCES
Saturn
Moon
10°
W
Separation of the Moon and Saturn is 7.7° (Only 40 mins after sun set)

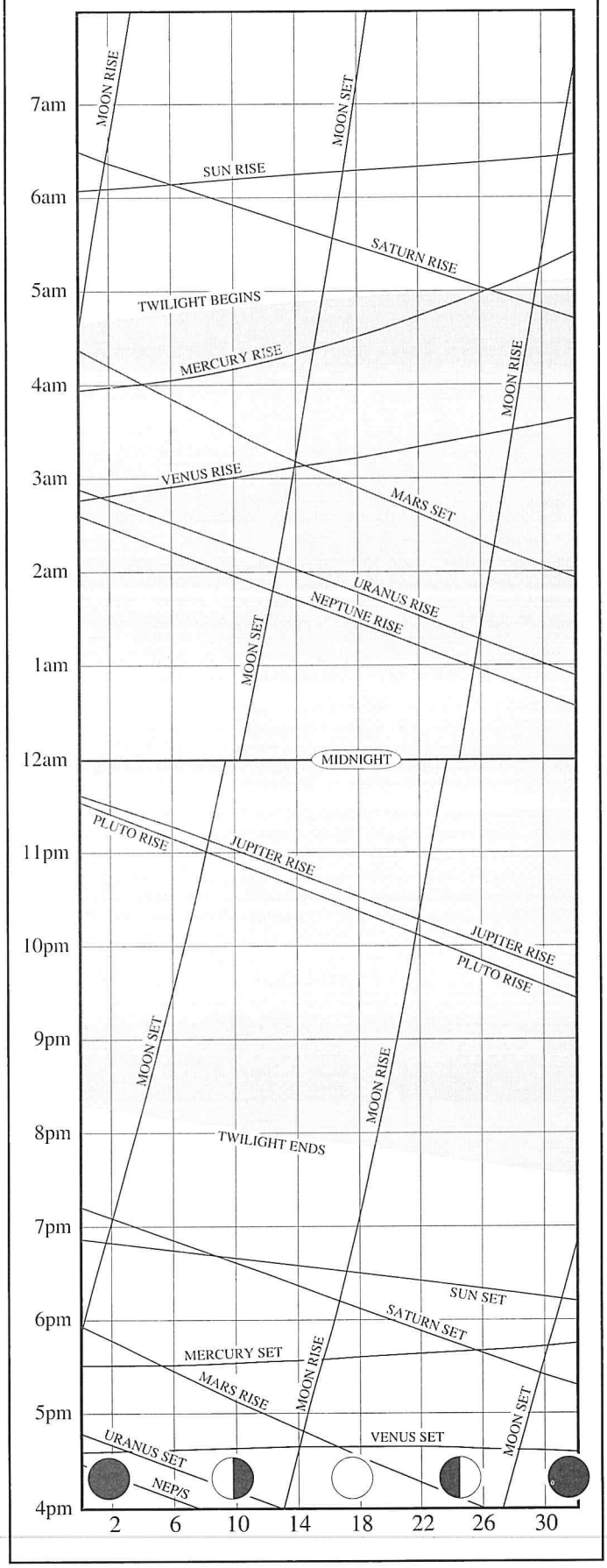

NIGHT SKY - 24th February (1:20am)
LIBRA
LUPUS
NORMA
N6231
Antares
SCORPIUS
Jupiter
M6
M7
OPHIUCHUS
Moon
SERPENS
M8
10°
E
Separation of the Moon and Jupiter is 8°


Procyon
NIGHT SKY - 15th February (8:50pm)
CANIS MINOR
HYDRA
Praesepe (M44) "Beehive Cluster"
SEXTANS
Moon
CANCER
Mars
Regulus
LEO
10°
NE
Separation of the Moon and Mars is approx. 10°.

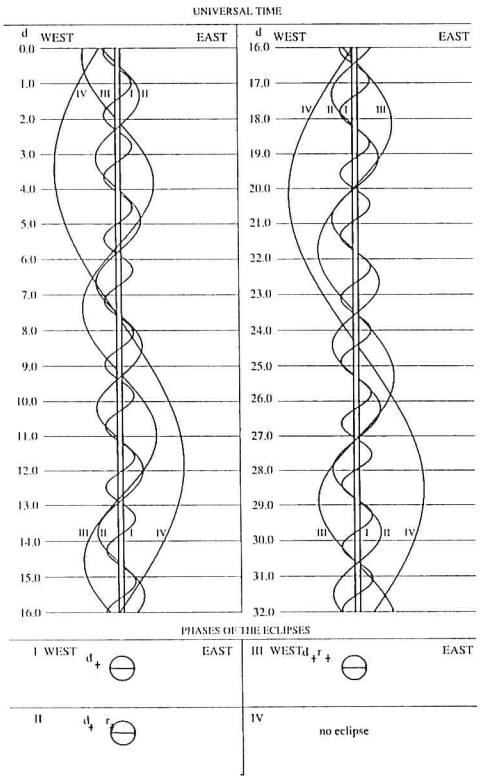

M8
MORNING SKY - 26th February (4:50am)
M22
CORONA AUSTRALIS
SAGITTARIUS
Moon
Venus
MICROSCOPIUM
CAPRICORNUS
Moon 27th
Mercury
10°
AQUARIUS
E
Separation of the Moon and Venus is 4.8°.

MARCH

RISE/SET CHART

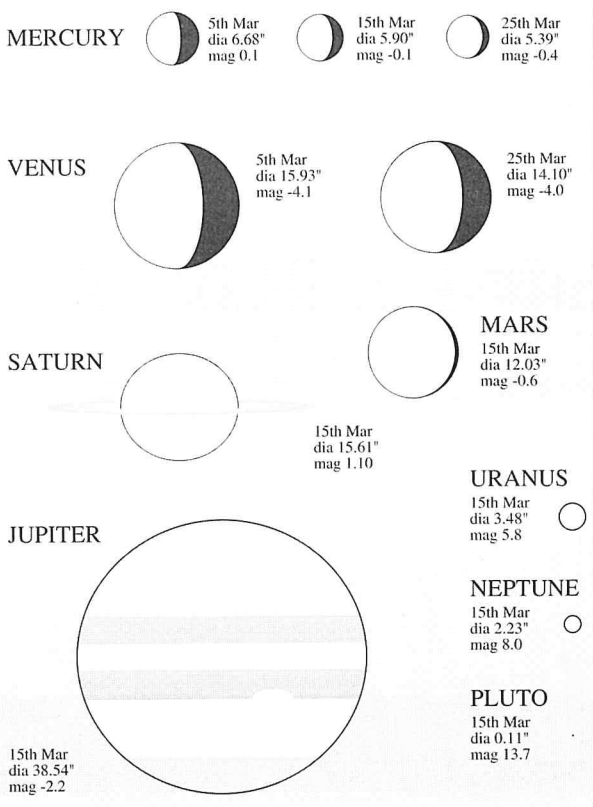


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



MARCH

HIGHLIGHTS FOR THE MONTH

- Mercury and Saturn are close together late in March (26th only 0.8° !).
- In early March, Mercury is still well placed in the morning sky.
- On the 22nd/23rd the Moon and Jupiter make a close approach.

THE MOON

1st New Moon, 7:48pm.
9th First Quarter, 6:14pm.
9th Moon at apogee (furthest from Earth - 407500 kms, size 29.3').
17th Full Moon, 9:26am.
19th Occultation of Spica by the Moon (occultation not visible from Australia, the closest Spica appears from our latitudes is about 3° above the Moon in the morning sky just before dawn).
20th Moon at perigee (closest to Earth - 363370 kms, size 32.9').
24th Last Quarter, 4:10am.
31st New Moon, 10:09am.

THE PLANETS

MERCURY is at greatest elongation (27°) west of the Sun on the 1st , and can be seen in the early morning sky before the beginning of twilight. Each morning as Mercury gradually moves back toward the Sun, Saturn gains altitude in the eastern dawn sky. They continue to get closer until the 26th when their separation is only 0.8°(see sky view). On the 30th, around 6am, as the sky begins to brighten, the thin crescent Moon appears 6° to the left (north) of Mercury and 10° below Saturn, the trio forming a triangle. A clear eastern outlook and binoculars will help as the Moon (30 hours from New Moon) is only 5° above the horizon, with Mercury and Saturn's altitude being 7° and 13° respectively.

VENUS moves from Sagittarius into Capricornus in the first week of the month; then into Aquarius in the last week of the month. On the 1st, in the morning sky, Venus will be midway between Uranus and Neptune (2° and 3° away respectively). On the following day Venus comes to within 1.5° of Uranus. On the 28th, Venus will be seen 6° south of the 26 day old Moon (see sky view).

MARS, now well past opposition begins to fade (-0.5 magnitude at mid month). In the first week of the month the planet moves from Leo into the constellation of Cancer. Observers with telescopes may detect a slight gibbous phase. This becomes more noticeable over the coming weeks as Mars reaches quadrature (late May). At opposition Mars displays a 100% illuminated disk. Three months after opposition, when at quadrature (see diagram on page 53), the disk will only be 89.4% illuminated. The Moon will be 11° from Mars on two consecutive nights during the month; on the 13th with an 11 day old Moon to the southwest and on the following evening to the south (see sky view).

JUPITER at magnitude -2.2, rises in the east around 10:30pm mid month, with 1st magnitude Antares (Alpha Scorpii) a few degrees directly above. Spending the month in Ophiuchus, Jupiter has one close encounter with the 21 day old Moon on the 22nd, when the planet will be 3° south of Earth's satellite (see sky view).

SATURN, after moving west of the Sun last month, can be found mid month in the early morning twilight in Aquarius (the constellation in which it remains throughout the year). On the 29th, the 27 day old thin crescent Moon will be 8° north of Saturn (see sky view for 28th). Saturn gains altitude each evening as Mercury gradually moves back (lower in the sky) toward the Sun. The pair appear very close over a four day period, on the 25th a little over 2°, 26th just 0.8° (see sky view), 27th about 1° and 28th around 2.5.°

URANUS begins the month situated 2° south (right) of Venus in the early morning sky. On the 2nd the separation decreases to 1.5°. There after Venus drops away to the horizon as Uranus (and Neptune) gain altitude in the east, rising around 2am mid month. On the 26th, the 24 day old Moon appears 6° north of both Uranus and Neptune. Around the middle of the month Uranus moves from Sagittarius into Capricornus, where it remains until early July.

NEPTUNE, in Sagittarius (where it remains for the entire year), is situated 3° above Venus and 5° above Uranus on the 1st in the early morning sky. On the 26th, there is a conjunction with the Moon (see note above).

PLUTO rises around 10pm mid month, transiting the meridian at 3am.

MINOR PLANETS. Metis reaches opposition on 14th March at 9.3 magnitude in Leo.

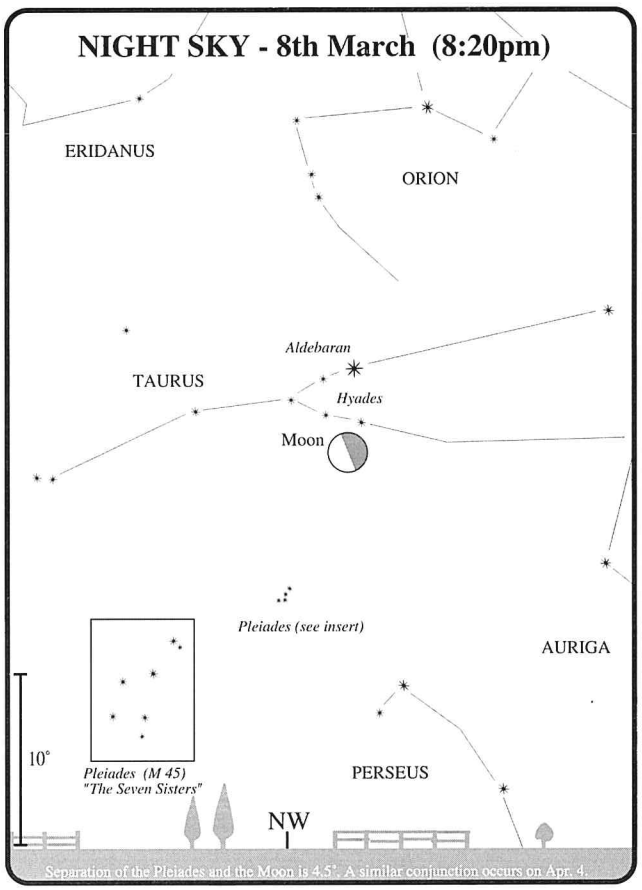
METEOR SHOWERS

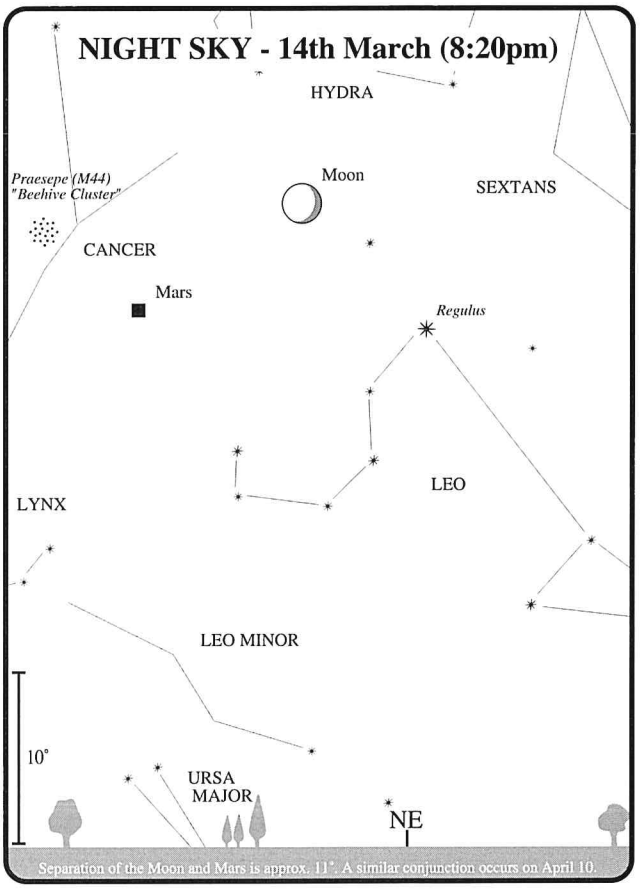
The **THETA CENTAURIDS** are active from 23rd January to 12th March, with maximum last month on the 1st. See February notes for details.

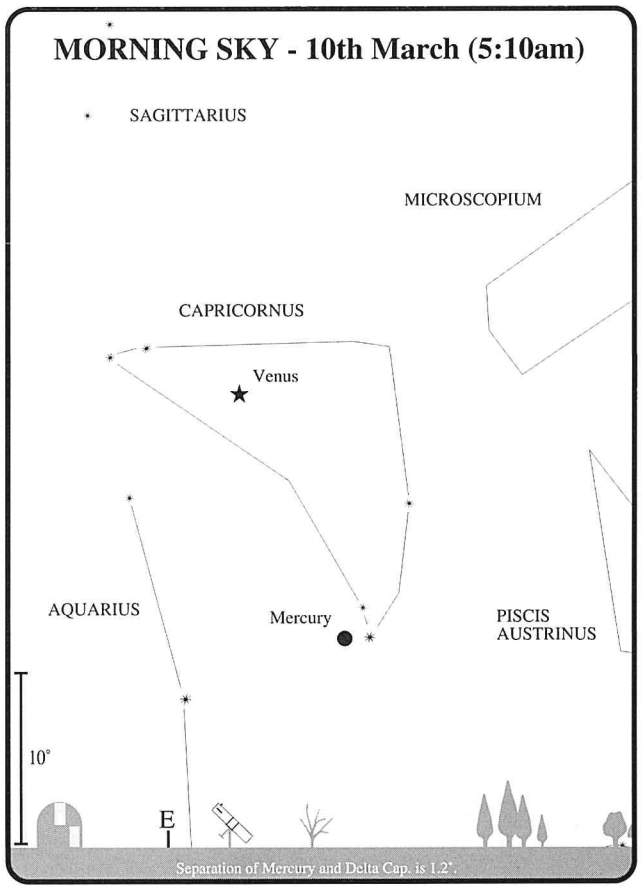
DIARY OF EVENTS

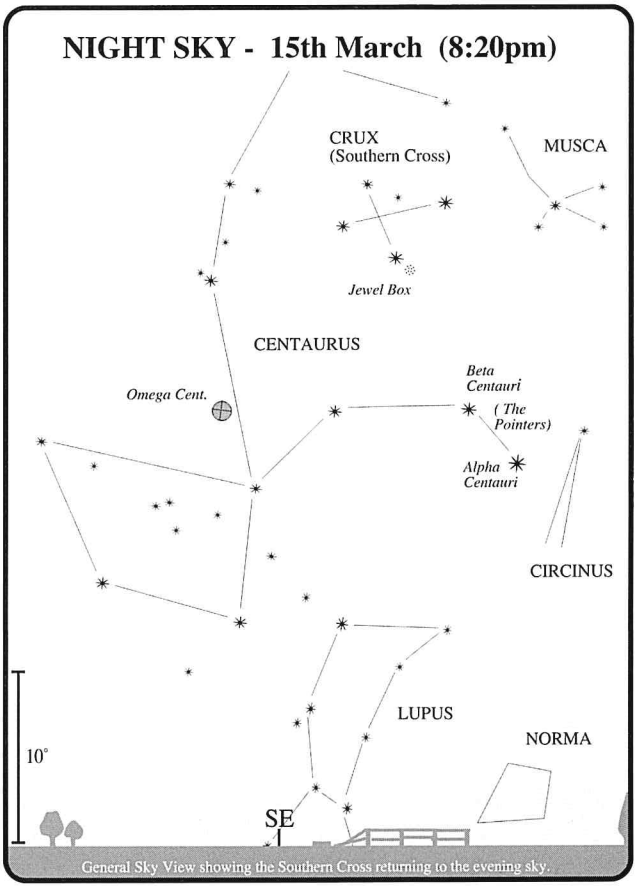
1st	7 PM	Mercury greatest elongation West (27°)
1st	7:48 PM	New Moon
2nd	1 PM	Venus 1.5° North of Uranus
6th	10 AM	Saturn in conjunction with the Sun
6th	6 PM	Pluto stationary
8th		Jupiter 0.5° North of NGC 6235 (GC) in Oph
8th	11 PM	Moon at apogee
9th	6:14 PM	First Quarter Moon
10th		Uranus 1.2° North of M75 (GC) in Sgr
10th		Mercury at aphelion.
13th		m.p. 654 Zelinda 0.3° South of NGC 2251 (OC) in Mon
14th		Mars at aphelion.
14th	Noon	Mars 9° North of the Moon
15th		Neptune 1° North of m.p. 704 Interamnia
17th		Venus at descending node.
17th	9:26 AM	Full Moon
19th	8 AM	Spica 1.0° South of the Moon *Occ
20th	9 PM	Moon at perigee
21st	10 AM	Equinox
22nd	10 PM	Jupiter 2° South of the Moon
23rd	9 PM	m.p. 1 Ceres stationary
24th	4:10 AM	Last Quarter Moon
25th		Neptune 1° North of m.p. 10 Hygiea
25th	8 PM	Neptune 5° South of the Moon
26th	1 AM	Mars stationary
26th	5 AM	Uranus 6° South of the Moon
26th	8 AM	Mercury 0.6° South of Saturn
27th		Comet Borrelly 1° East of NGC 2768 (G) in UMa
27th		m.p. 19 Fortuna 1.8° North of m.p. 60 Echo
27th		m.p. 4 Vesta 0.8° North of IC 2157 (OC) in Gem
28th	Noon	Venus 6° South of the Moon
29th	9 PM	Saturn 6° South of the Moon
30th		Mercury at Greatest Latitude South (Heliocentric).
30th	9 AM	Mercury 6° South of the Moon
31st		m.p. 18 Melpomene 1° North of M72 (GC) in Aqr
31st	10:09 AM	New Moon

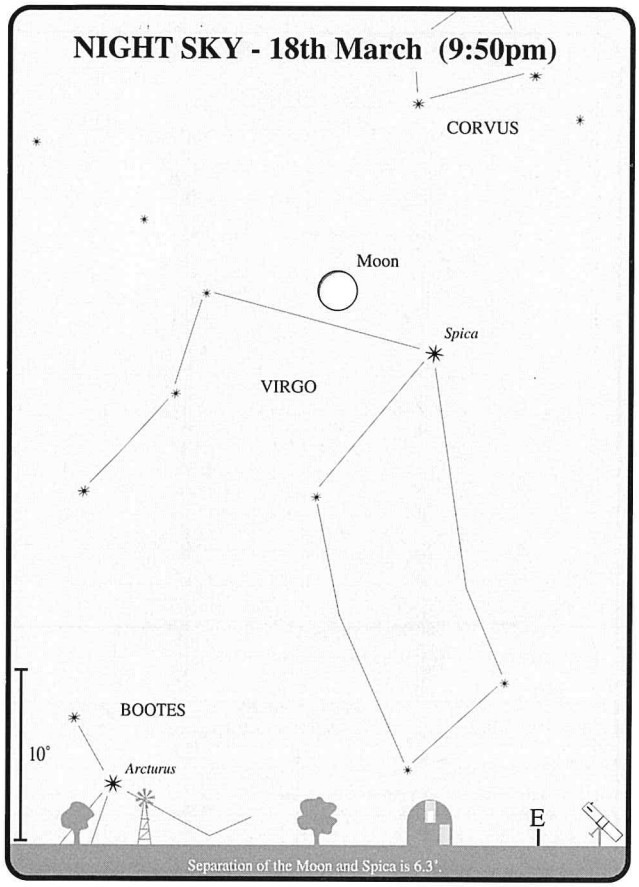
MARCH

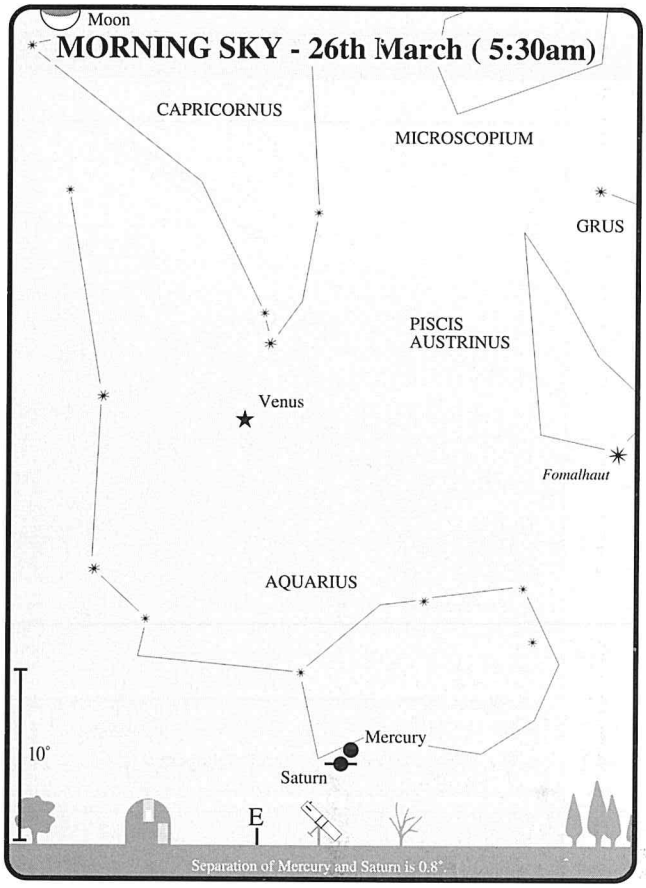

NIGHT SKY - 8th March (8:20pm)
ERIDANUS
ORION
Aldebaran
TAURUS
Hyades
Moon
Pleiades (see insert)
AURIGA
10°
Pleiades (M 45)
"The Seven Sisters"
PERSEUS
NW
Separation of the Pleiades and the Moon is 4.5°. A similar conjunction occurs on Apr. 4.

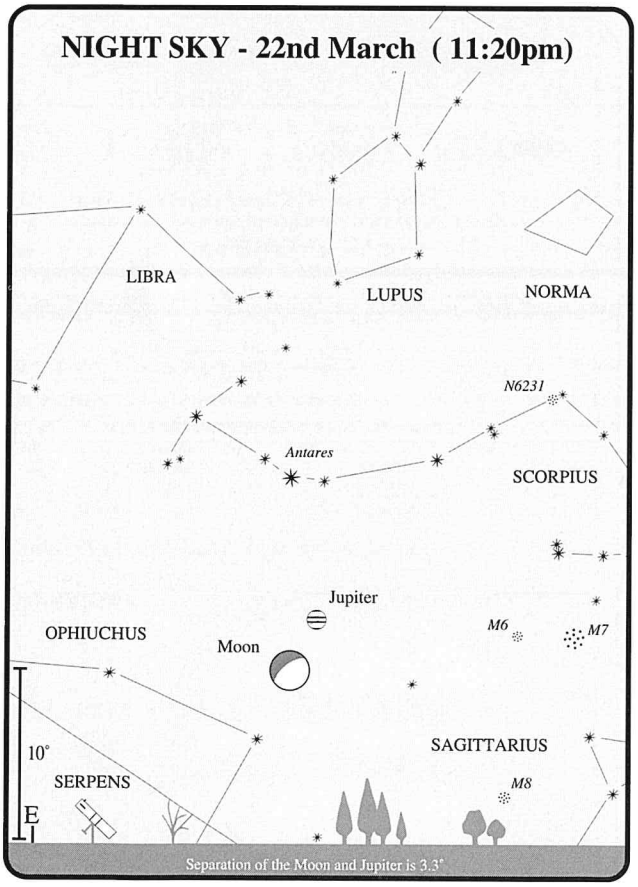

NIGHT SKY - 14th March (8:20pm)
HYDRA
Praesepe (M44)
"Beehive Cluster"
Moon
SEXTANS
CANCER
Mars
Regulus
LEO
LYNX
LEO MINOR
10°
URSA
MAJOR
NE
Separation of the Moon and Mars is approx. 11°. A similar conjunction occurs on April 10.

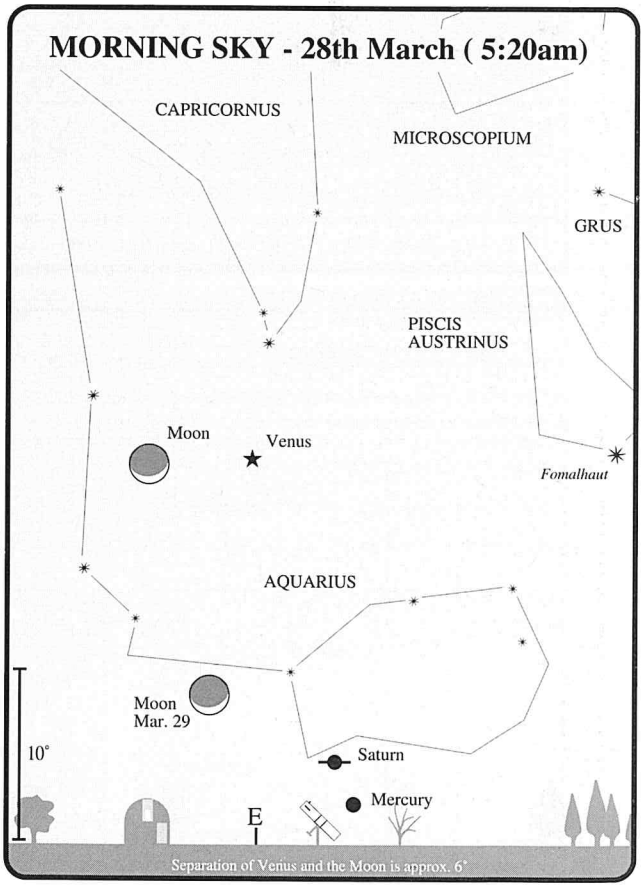

MORNING SKY - 10th March (5:10am)
SAGITTARIUS
MICROSCOPIUM
CAPRICORNUS
Venus
AQUARIUS
Mercury
PISCIS
AUSTRINUS
10°
E
Separation of Mercury and Delta Cap. is 1.2°.


NIGHT SKY - 15th March (8:20pm)
CRUX
(Southern Cross)
MUSCA
Jewel Box
CENTAURUS
Omega Cent.
Beta
Centauri
(The
Pointers)
Alpha
Centauri
CIRCINUS
LUPUS
NORMA
10°
SE
General Sky View showing the Southern Cross returning to the evening sky.


NIGHT SKY - 18th March (9:50pm)
CORVUS
Moon
Spica
VIRGO
BOOTES
10°
Arcturus
E
Separation of the Moon and Spica is 6.3°.

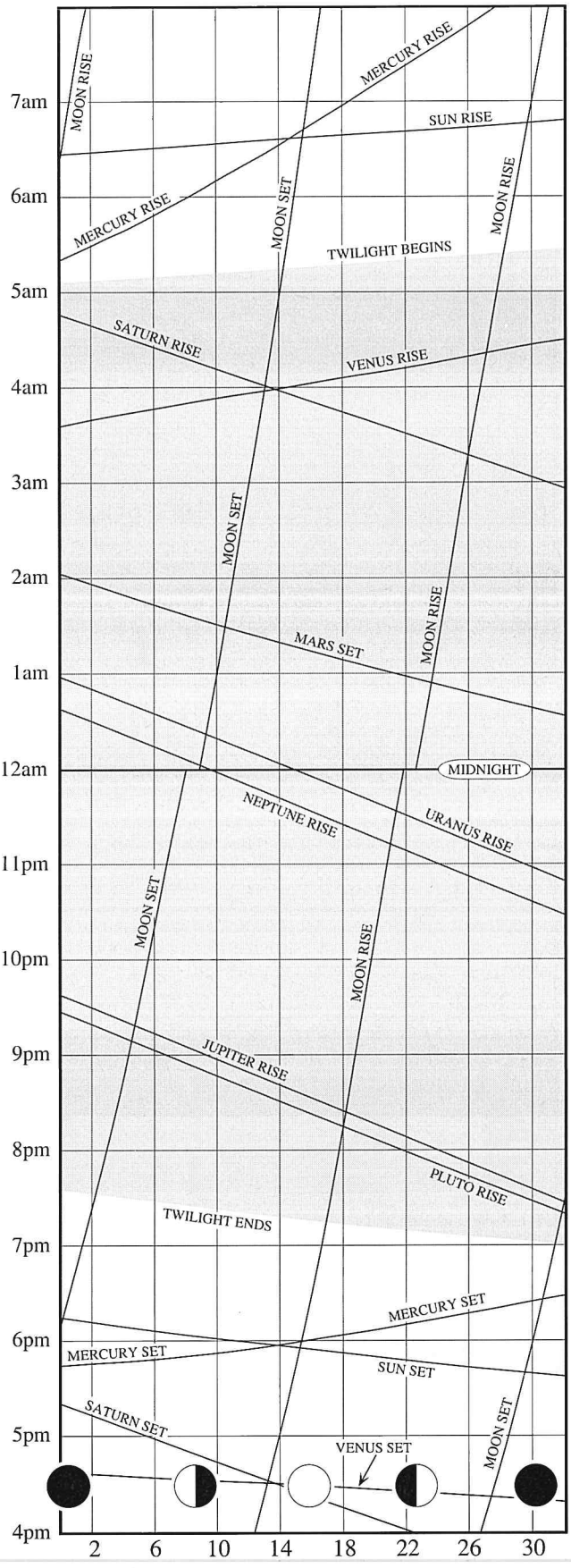

Moon
MORNING SKY - 26th March (5:30am)
CAPRICORNUS
MICROSCOPIUM
GRUS
PISCIS AUSTRINUS
Venus
Fomalhaut
AQUARIUS
Mercury
Saturn
10°
E
Separation of Mercury and Saturn is 0.8°.


NIGHT SKY - 22nd March (11:20pm)
LIBRA
LUPUS
NORMA
N6231
Antares
SCORPIUS
Jupiter
OPHIUCHUS
Moon
M6
M7
M8
SAGITTARIUS
SERPENS
10°
E
Separation of the Moon and Jupiter is 3.3°

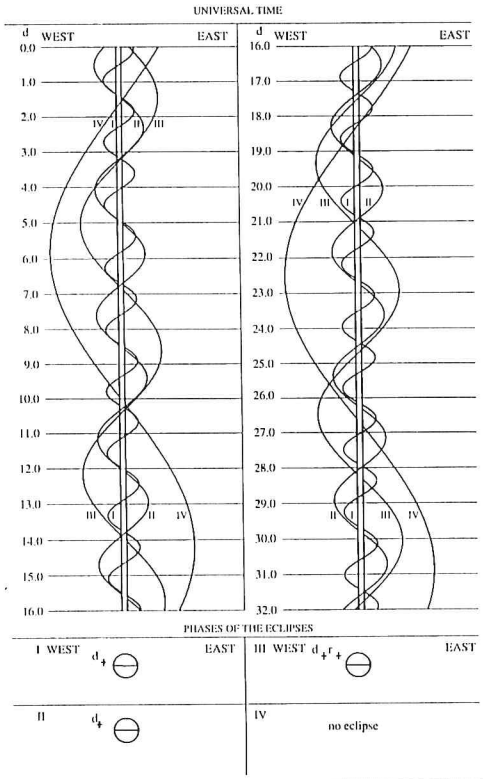

MORNING SKY - 28th March (5:20am)
CAPRICORNUS
MICROSCOPIUM
GRUS
PISCIS AUSTRINUS
Moon
Venus
Fomalhaut
AQUARIUS
Moon
Mar. 29
Saturn
Mercury
10°
E
Separation of Venus and the Moon is approx. 6°

APRIL

RISE/SET CHART

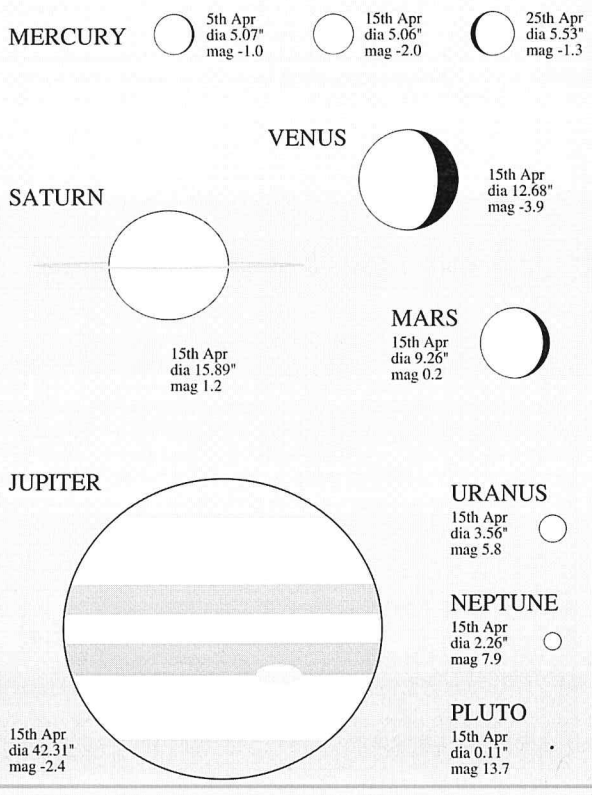


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



HIGHLIGHTS FOR THE MONTH

- Venus and Saturn make a close approach mid-month (Only 0.6° on the 14th!).
- 15th, a partial Eclipse of the Moon.
- Try looking for the Lyrid meteors.

THE MOON

5th Moon at apogee (furthest from Earth - 403610 kms, size 29.6').

8th First Quarter, 1:35pm.

15th Full Moon, 8:08pm.

15th Occultation of Spica by the Moon (occultation not visible from Australia, but Spica will be 2° from the Moon around 8pm, during the lunar eclipse, see sky view).

15th Partial eclipse of the Moon, visible from Australia. The Moon will be totally immersed in the penumbra of the Earth's shadow, with only slight contact by the umbra (see pages 63 to 64 for full details).

17th Moon at perigee (closest to Earth - 362630 kms, size 32.9').

22nd Last Quarter, 11:18am.

30th New Moon, 1:36am.

30th Annular eclipse of the Sun, visible only from the Pacific Ocean, Central America, South America, Atlantic Ocean and West Africa.

THE PLANETS

MERCURY is in an unfavourable position for observation this month. The first two weeks the planet spends in the morning twilight, before superior conjunction (on the opposite side of the Sun to the Earth) on the 14th. In the remaining two weeks of the month the planet reappears east of the Sun to become an evening object setting soon after the Sun in the west.

VENUS, in Aquarius moves into Pisces, mid month, and visits Cetus briefly during the last few days of April. During the month, a spectacular conjunction occurs between Venus and Saturn in the early morning eastern sky. The pair will be within 2° of each other from the 12th to the 16th. On the 14th, Venus (at gibbous phase and mag. -3.9) and Saturn (with rings nearly edge-on at magnitude 1.2) approach within 0.6° of each other (see sky view). On the 27th, the thin crescent Moon will be 5° north (left) of Venus (see sky view).

MARS in Cancer, at 0 magnitude, moves into Leo late in the month. On the 10th, the 9 day old Moon will be about 7° above Mars in the northern evening sky. With only 91% of the disk being illuminated by the Sun, the planet now has a definite gibbous phase for telescope users (see March).

JUPITER, being only two months away from opposition, shines brightly at -2.4 magnitude in the late eastern evening sky. On the 18th, the 18 day old Moon will appear 5° north of the planet, forming a triangle with 1st magnitude Antares (see sky view).

SATURN makes a splendid sight with Venus for a few days during the middle of the month (see Venus notes for details). Of interest to telescope users will be the closing ring system. On 22nd May, the rings will be edge-on and for a short period will be very difficult to see in small telescopes. Even during April the rings may present a test to the amateur. On the 26th, the 26 day old Moon will be 6° north (left) of Saturn in the morning eastern sky (see sky view).

URANUS and **NEPTUNE** rise around midnight early in the month and observers will have to wait until the early hours of the morning to observe these faint worlds. Only 5° apart, Uranus is in Capricornus and Neptune in Sagittarius.

PLUTO, at magnitude 13.7 is located in Ophiuchus near the border with Libra. Rising around 8:30pm mid month, Pluto transits the meridian at 3am.

MINOR PLANETS. Euterpe is at opposition on 9th April at 9.9 magnitude in Virgo.

METEOR SHOWERS

The **LYRIDS** are best from northern latitudes but are still visible to southern observers. Historically the Lyrids are the oldest recorded shower, being noted by the Chinese in 687 B.C. The shower is active from the 16th to 25th April, with maximum rates on the 22nd (maximum rates usually occur for only an hour or two). The period leading up to and after the peak has only minor activity. The zenith hourly rate (ZHR) at maxima is normally around 15-25 meteors per hour, however much higher rates have been seen (90 per hour in 1982). Best viewed in the morning hours.

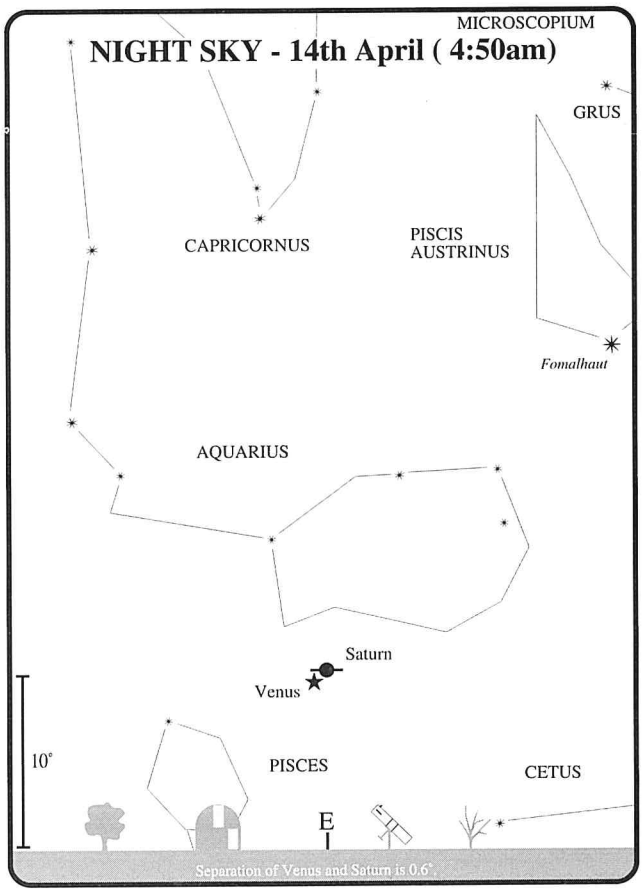
The **PI PUPPIDS** or Grigg-Skjellerupids (after the short period comet that produced the stream), is a very young southern shower first observed in 1972. It is best seen in the evening sky from 15th to 28th April, with maximum activity on the 23rd. Just before and after maximum the rates are low and difficult to separate from sporadic meteors. The peak can vary greatly in intensity, sometimes nil, occasionally 3 to 4 per hour or more (13 in 1983, 40 in 1982 and 1977). The Pi Puppids are noted for their very slow speed, brightness, persistent trains, large proportion of yellow meteors and occasional fireballs.

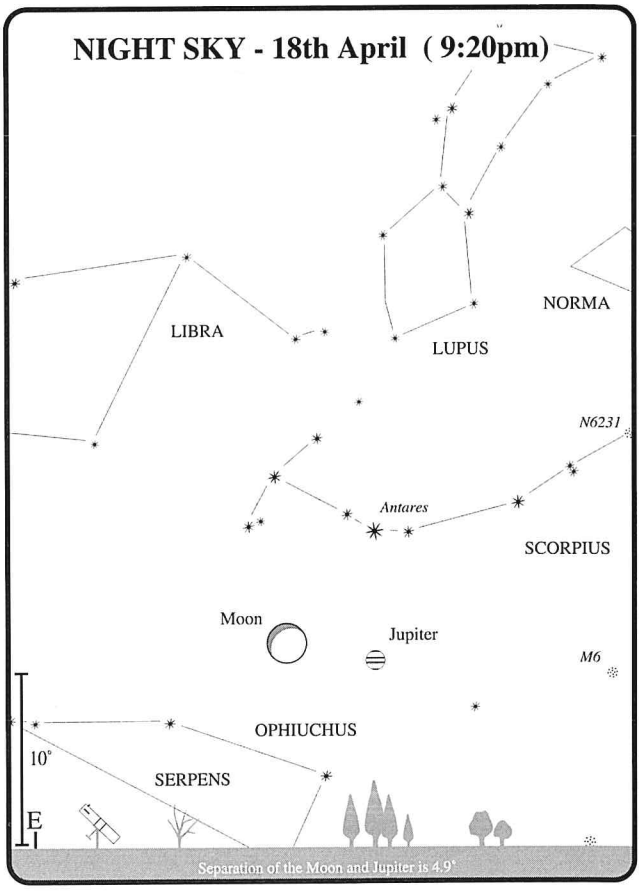
The **ETA AQUARIDS** are visible from 19th April to 28th May in the morning sky before dawn. Maximum activity occurs next month on the 4th. See May notes for further details.

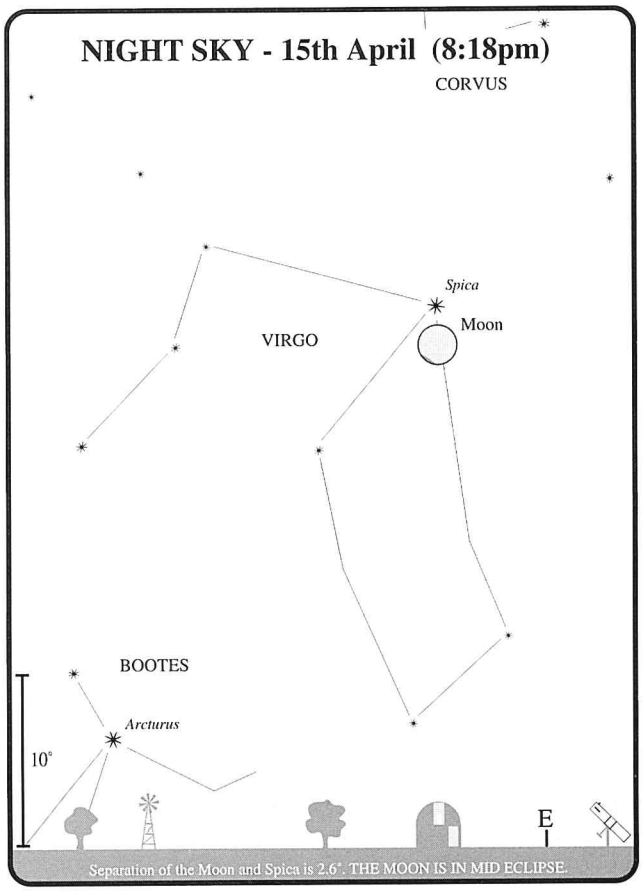
DIARY OF EVENTS

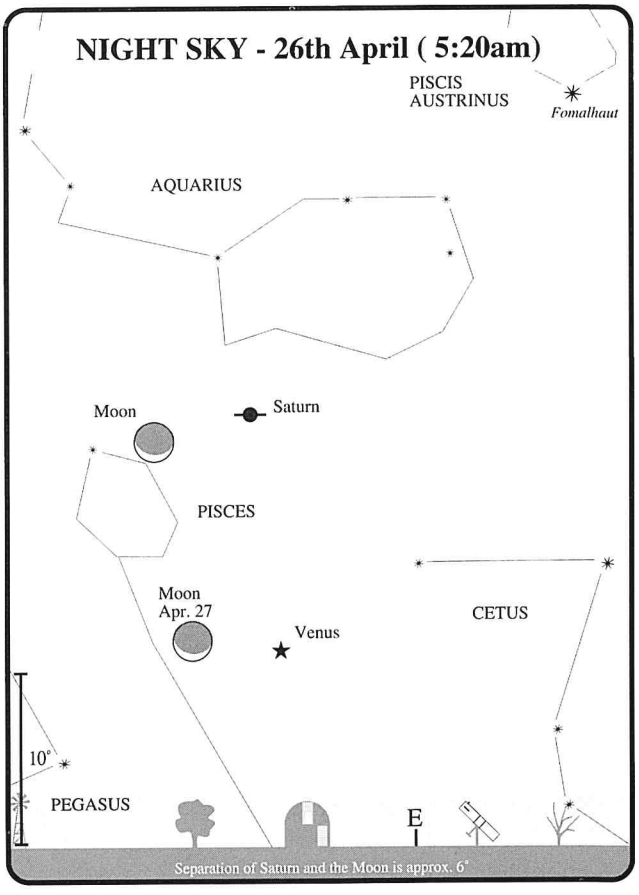
1st	9 PM	Jupiter stationary
2nd		Uranus 1° South of m.p. 704 Interamnia
3rd		m.p. 9 Metis 0.1° North of NGC 3628 (G) in Leo
5th	6 PM	Moon at apogee
8th	1:35 PM	First Quarter Moon
10th	10 PM	Mars 8° North of the Moon
14th		Uranus 0.2° South of m.p. 10 Hygiea
14th	1 AM	Venus 0.6° North of Saturn
14th	9 PM	Mercury in superior conjunction
15th	5 PM	Spica 1.0° South of the Moon *Occ
15th	8:08 PM	Full Moon - Eclipse
17th	4 PM	Moon at perigee
18th		Mercury at ascending node.
18th		Comet Clark 0.2° East of M22 (GC) in Sgr.
19th	5 AM	Jupiter 3° South of the Moon
20th		Venus at aphelion.
22nd	2 AM	Neptune 5° South of the Moon
22nd	11:18 AM	Last Quarter Moon
22nd	Noon	Uranus 6° South of the Moon
23rd		m.p. 654 Zelinda 0.3° South of Procyon
23rd		Uranus 0.4° South of m.p. 88 Thisbe
23rd		Mercury at perihelion.
24th	5 PM	m.p. 3 Juno stationary
25th		Jupiter 0.5° North of NGC 6235 (GC) in Oph
25th		m.p. 4 Vesta 0.2° South of Epsilon Gem
26th	9 AM	Saturn 6° South of the Moon
27th	1 PM	Venus 4° South of the Moon
28th		m.p. 2 Pallas 0.2° South of the Horsehead Neb. in Orion
28th	5 AM	Neptune stationary
30th	1:36 AM	New Moon - Eclipse

APRIL


NIGHT SKY - 14th April (4:50am)
MICROSCOPIUM
GRUS
CAPRICORNUS
PISCIS AUSTRINUS
Fomalhaut
AQUARIUS
Saturn
Venus
10°
PISCES
CETUS
E
Separation of Venus and Saturn is 0.6°.

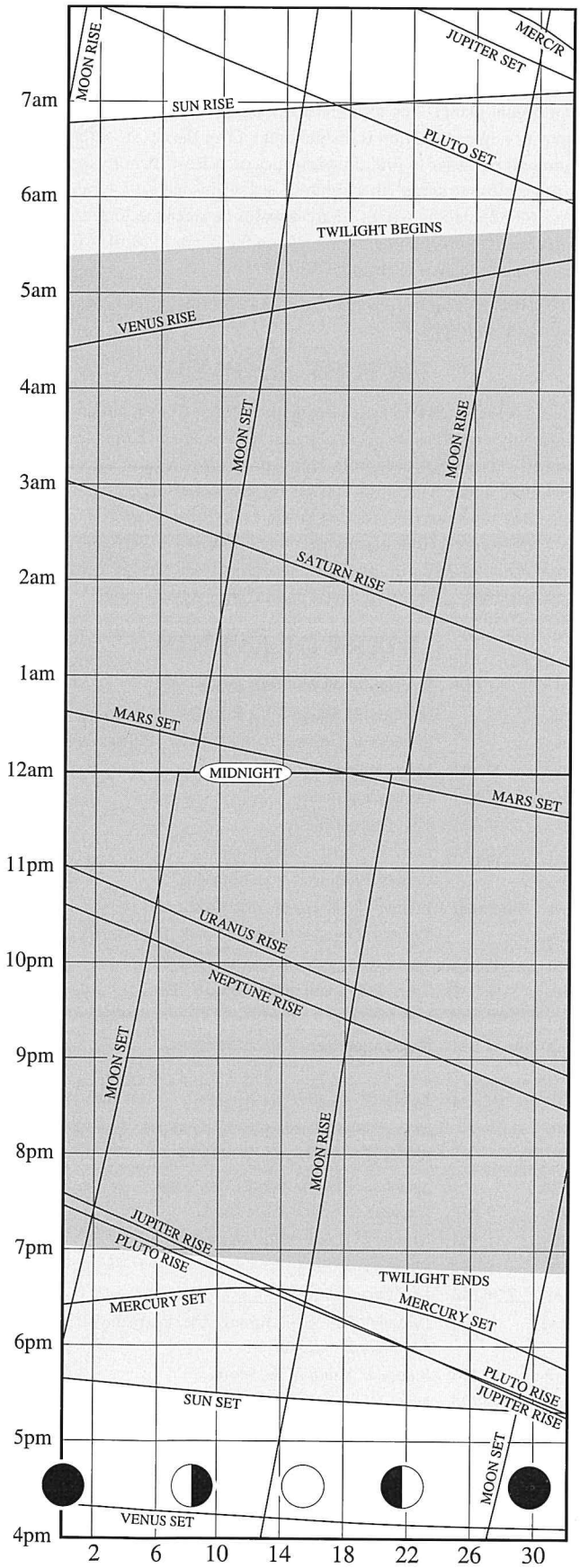

NIGHT SKY - 18th April (9:20pm)
NORMA
LIBRA
LUPUS
N6231
Antares
SCORPIUS
Moon
Jupiter
M6
OPHIUCHUS
10°
SERPENS
E
Separation of the Moon and Jupiter is 4.9°


NIGHT SKY - 15th April (8:18pm)
CORVUS
Spica
Moon
VIRGO
BOOTES
Arcturus
10°
E
Separation of the Moon and Spica is 2.6°. THE MOON IS IN MID ECLIPSE.

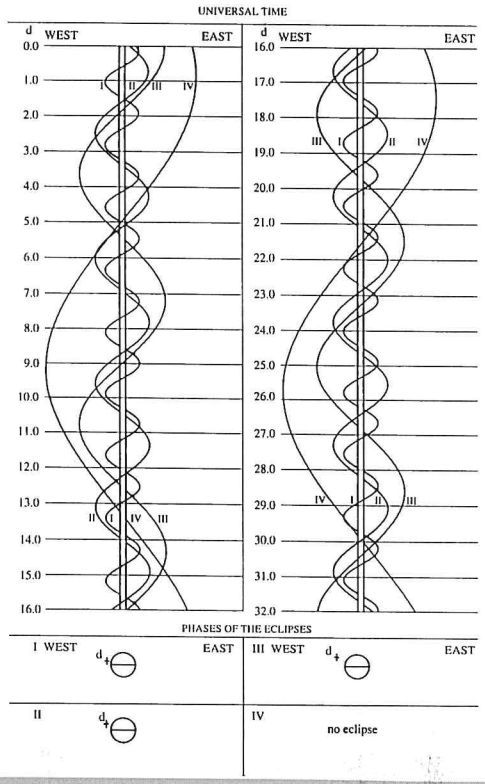

NIGHT SKY - 26th April (5:20am)
PISCIS AUSTRINUS
Fomalhaut
AQUARIUS
Moon
Saturn
PISCES
Moon Apr. 27
Venus
CETUS
10°
PEGASUS
E
Separation of Saturn and the Moon is approx. 6°

MAY

RISE/SET CHART

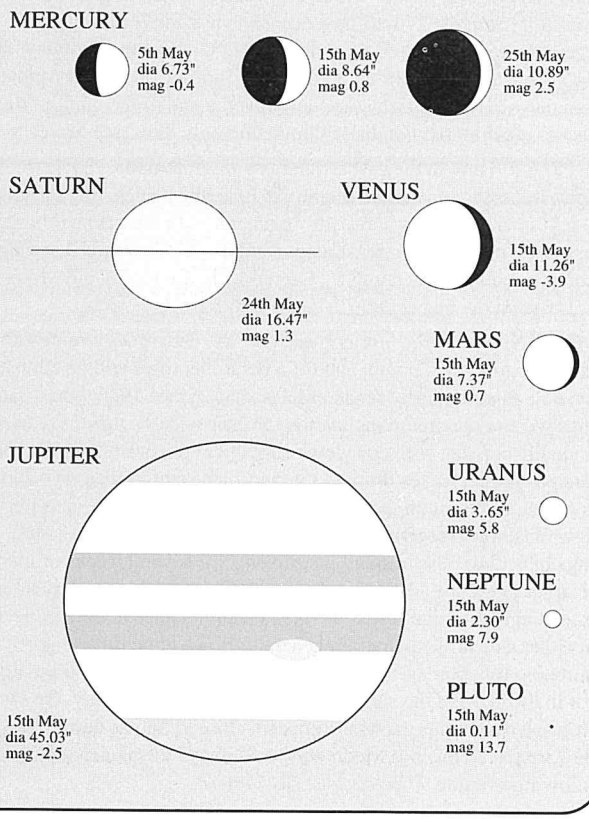


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



MAY

HIGHLIGHTS FOR THE MONTH

- Saturn's rings edge-on.
- Close approach of Mars to Regulus in the western evening sky (On the 24th/25th, only 1°!)
- The Eta Aquarid meteor shower.

THE MOON

3rd Moon at apogee (furthest from Earth - 403920 kms, size 29.6').
8th First Quarter, 5:44am.
13th Occultation of Spica by the Moon (not visible from Australia). The closest Spica appears here is about 1.5° above the 12 day old Moon in the morning western sky, just before Moon set).
15th Full Moon, 4:48am.
16th Moon at perigee (closest to Earth - 351850 kms, size 34.0').
21st Last Quarter, 7:36pm
27th Occultation of Venus by the Moon (occultation not visible from Australia, but Venus will be 4° east of the thin crescent Moon in the morning eastern sky - see sky view).
29th New Moon, 5:27pm.
30th Moon at apogee (furthest from Earth - 406900 kms, size 29.4').

THE PLANETS

MERCURY in the western evening sky, reaches greatest elongation east of the Sun (22°) on the 12th. The closeness to the Sun means that Mercury remains in twilight during the month. The best time to try and glimpse the planet is from about 10th to 22nd when the elongation is greatest. Difficult, but worth trying to see, is the conjunction of the 30 hour old Moon and Mercury on the 1st when the two are 3° apart. In this case a good western horizon is essential and binoculars may help in this twilight sky only 30 minutes after sunset (see sky view).

VENUS, in the morning sky, moves from Cetus into Pisces early in May; then into Aries in the last third of the month. The 27 day old thin crescent Moon appears 4° north of Venus on the 27th (see sky view).

MARS. Throughout May, Mars sets around midnight and is at magnitude 0.8. It spends the month in Leo, progressively moving towards the 1st magnitude star Regulus (Alpha Leonis). By the 18th, Mars and Regulus appear within 3° of each other, and gradually close to around 1° from the 24th to 26th (see sky view for 25th); then the separation increases to 3° by month's end. On the 8th, the 8 day old Moon appears 6.5° from the Red Planet, forming an almost equilateral triangle with Regulus (see sky view). At the end of the month, Mars reaches quadrature with disk illumination only 89% (see March notes).

JUPITER rising in the east soon after sunset, remains visible the entire night. Reaching opposition on the 1st June, the planet shines brightly at mag. -2.6 and presents a disc 45" in diameter. In Ophiuchus, Jupiter begins the month 7° from 1st mag. Antares (Alpha Scorpii) and by month's end has closed to 5.5°. On the 15th, the 16 day old Moon will be 11° from the planet and 7.6° on the 16th (see sky view).

SATURN, high in the morning eastern sky, undergoes a remarkable transformation this month, and for a period its rings will be almost invisible in all but large amateur telescopes. Since 1988, when Saturn's rings were at maximum inclination (at their widest), they have been gradually closing, with our view restricted to the north face. On the 22nd, the Earth passes through the ring-plane (rings edge-on), allowing us a view of the south face. In August we again cross the ring-plane to view the north face. During these periods of ring plane crossings, the rings may disappear in small instruments for several weeks or months. In larger telescopes they may disappear for a few days or appear as an exceedingly thin line across the globe and/or as needle-like projections on either side of the planet. In general this is a good time to go searching for some of Saturn's inner moons which would normally be lost in the glare of the rings. Back to naked eye astronomy. On two successive evenings the Moon appears close to Saturn during May, on the 23rd the 23 day old Moon will be 8° above the planet and on the following evening 9° below (see sky view).

URANUS in Capricornus at magnitude 5.7, rises around 9.30pm mid month. On the 19th (11pm), the 20 day old Moon will be 9° from the planet.

NEPTUNE in Sagittarius at magnitude 7.9, rises around 9.00pm mid month. On the 18th (11pm), the 19 day old Moon will be 6° from the planet.

PLUTO moves from Ophiuchus into Libra during the 1st week of May. On the 21st Pluto will be at opposition, which means little with this tiny, faint distant planet. Any difference in magnitude and size from opposition to conjunction is insignificant. Over the next month or two Pluto will be easier to find (in telescopes of at least 20cm in aperture) as it passes close to some 7th magnitude stars. This month 7.4 magnitude SAO 140885 will be within 12 arc minutes between the 17th and 27th, with closest approach (9 arc minutes) on the 22nd. A detailed finder chart is still required (See pages 88 - 89).

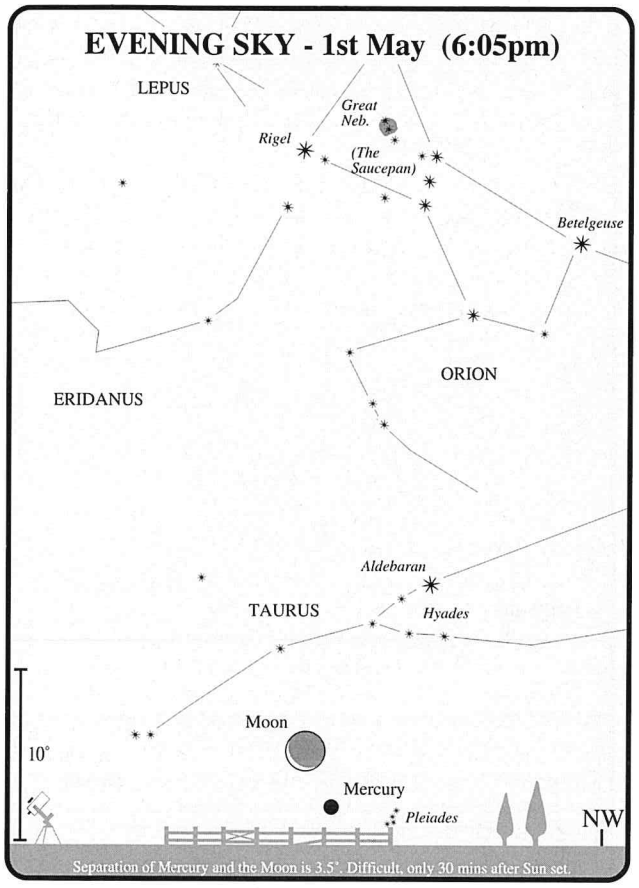
MINOR PLANETS Ausonia reaches opposition on 24th May at 9.8 magnitude in Lupus.

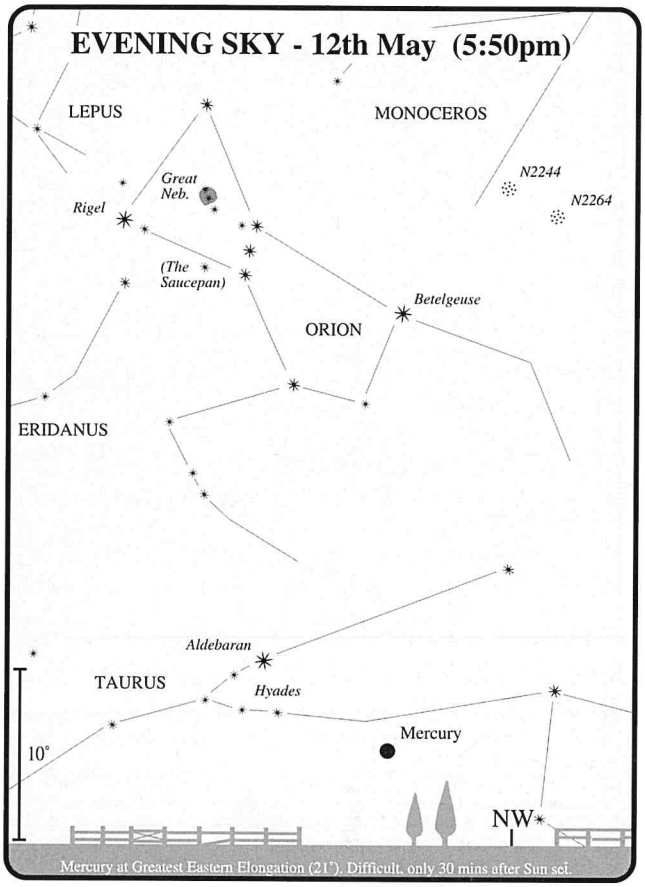
METEOR SHOWERS

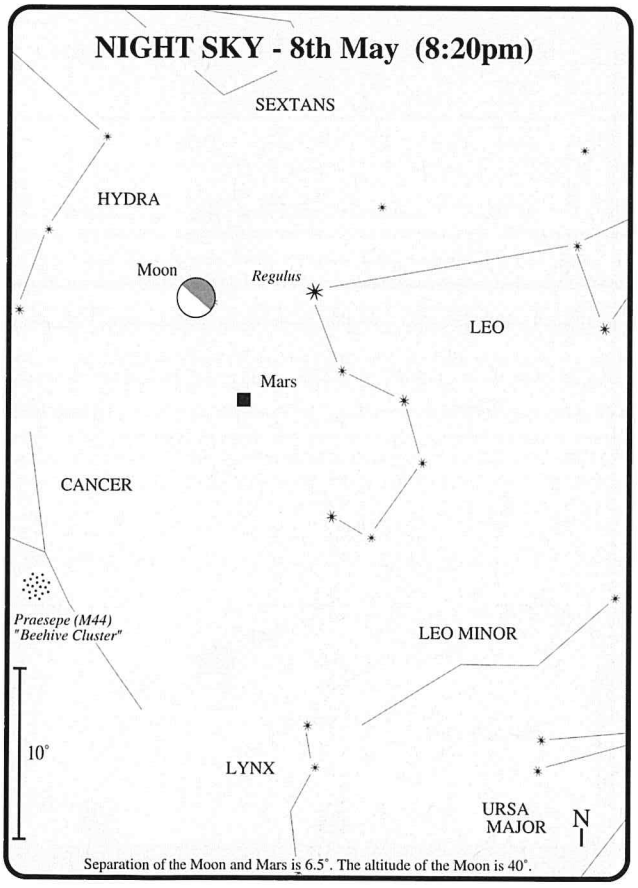
The **ETA AQUARIDS** are linked with Halley's Comet and are commonly ranked as the most popular of the southern hemisphere showers. They are visible from 19th April to 28th May in the morning sky before dawn. Maximum activity occurs this month on the 4th, but high rates have been recorded from the 1st to 8th of May. It's usual for the ZHR to reach 50 or more meteors per hour (95 in 1975 and 110 in 1980). The Eta Aquarids are characterised by their high percentage of persistent trains, very swift speed and striking yellow colour.

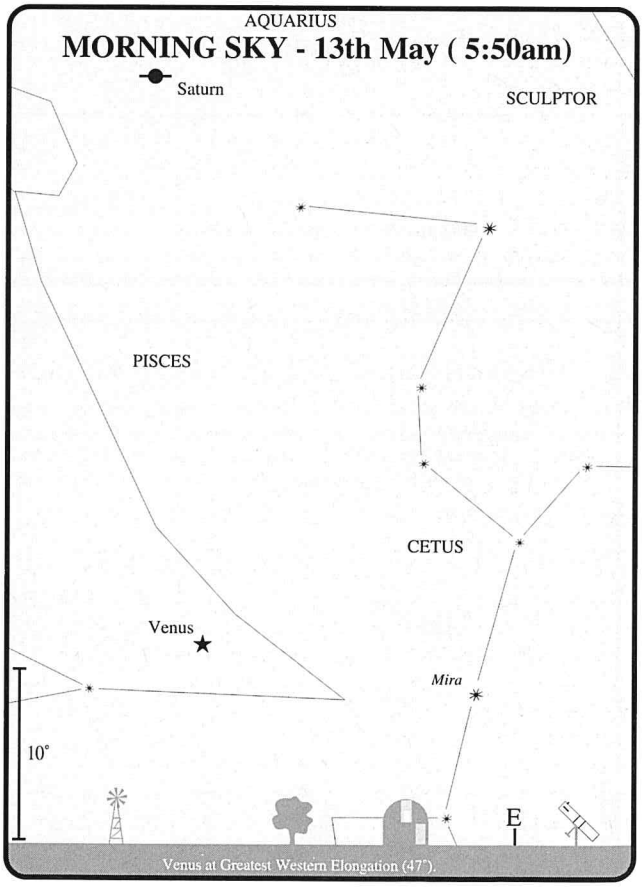
DIARY OF EVENTS

1st	1 PM	Mercury 4° North of the Moon
2nd		Mercury 2° South of the Pleiades
3rd		Mercury at Greatest Latitude North (Heliocentric).
3rd	9 AM	Moon at apogee
5th	7 PM	Uranus stationary
8th	5:44 AM	First Quarter Moon
8th	10 PM	Mars 7° North of the Moon
9th		Comet d'Arrest 3° South of Altair
10th	Midnight	Mercury 8° North of Aldebaran
12th		Venus at Greatest Latitude South (Heliocentric).
12th	10 AM	Mercury greatest elongation East (22°)
13th	4 AM	Spica 1.0° South of the Moon *Occ
15th	4:48 AM	Full Moon
15th	11 PM	Moon at perigee
16th		m.p. 10 Hygiea 0.4° South of m.p. 88 Thisbe
16th	10 AM	Jupiter 2° South of the Moon
19th		Mercury 0.8° North of NGC 1746 (OC) in Tau
19th		Saturn 0.1° South of m.p. 6 Hebe
19th		Venus 0.3° North of m.p. 16 Psyche
19th	9 AM	Neptune 5° South of the Moon
19th	6 PM	Uranus 6° South of the Moon
21st	1 AM	Pluto at opposition
21st	7:36 PM	Last Quarter Moon
22nd	4 PM	Passage of the Earth through the ring-plane of Saturn from North to South
23rd	7 PM	Saturn 6° South of the Moon
24th	3 PM	Mars 1.1° North of Regulus
24th	Midnight	Mercury stationary
27th		Mercury at descending node.
27th	3 PM	Venus 0.8° South of the Moon *Occ
29th	5:27 PM	New Moon
30th		m.p. 1 Ceres 0.4° North of Epsilon Leo.
30th	4 PM	Moon at apogee

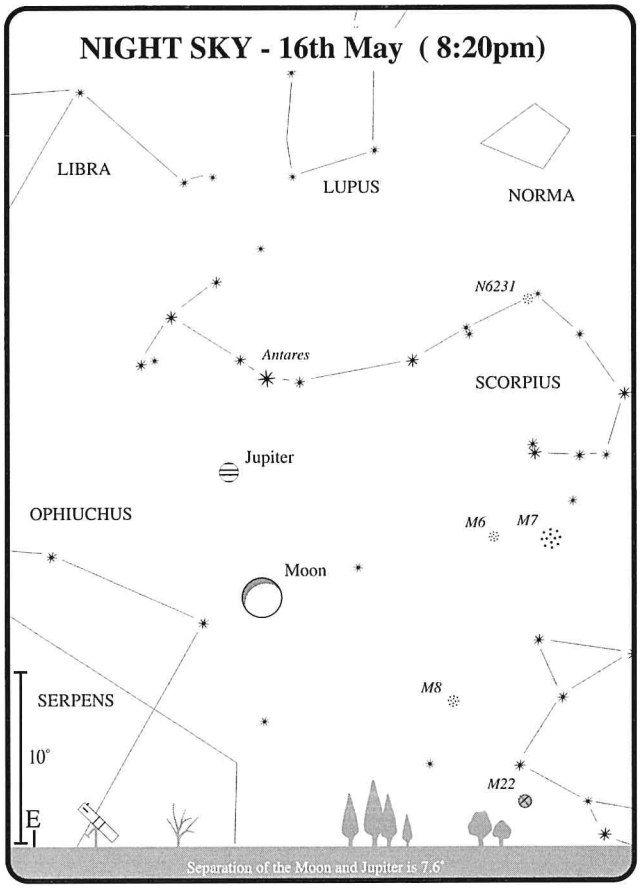

EVENING SKY - 1st May (6:05pm)
LEPUS
Great Neb.
Rigel
(The Saucepan)
Betelgeuse
ORION
ERIDANUS
Aldebaran
TAURUS
Hyades
Moon
10°
Mercury
Pleiades
NW
Separation of Mercury and the Moon is 3.5°. Difficult, only 30 mins after Sun set.

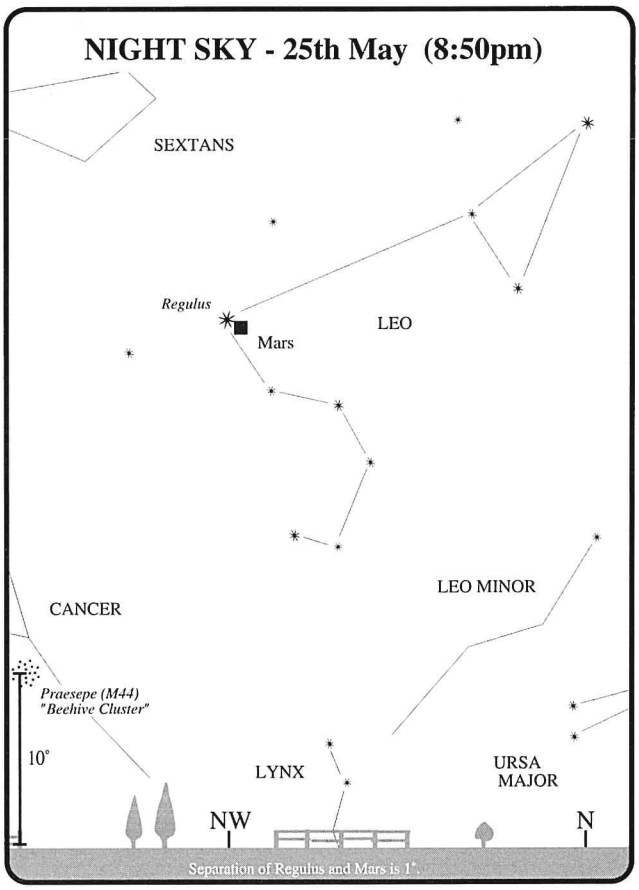

EVENING SKY - 12th May (5:50pm)
LEPUS
MONOCEROS
N2244
N2264
Great Neb.
Rigel
(The Saucepan)
Betelgeuse
ORION
ERIDANUS
Aldebaran
TAURUS
Hyades
Mercury
10°
NW
Mercury at Greatest Eastern Elongation (21°). Difficult, only 30 mins after Sun set.

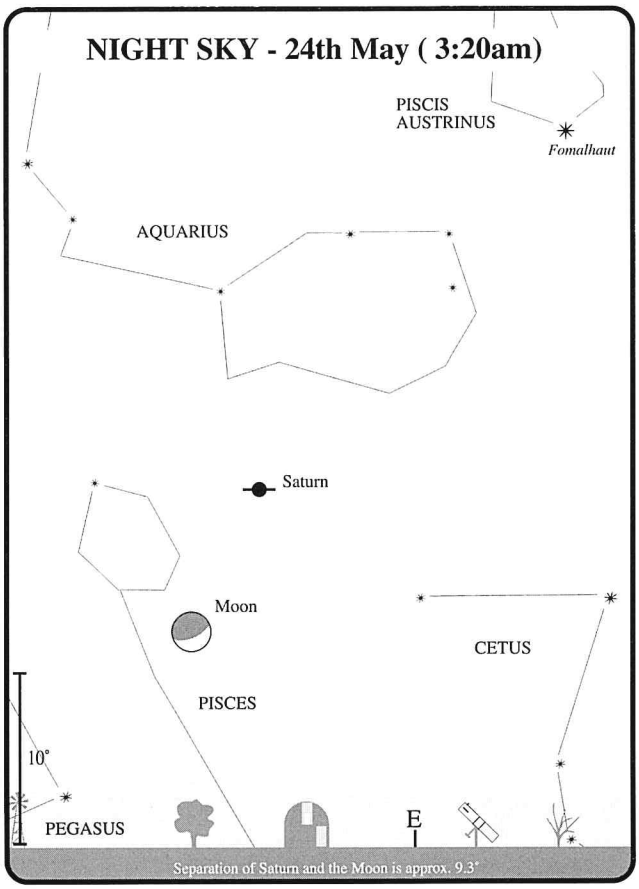

NIGHT SKY - 8th May (8:20pm)
SEXTANS
HYDRA
Moon
Regulus
LEO
Mars
CANCER
Praesepe (M44)
"Beehive Cluster"
LEO MINOR
10°
LYNX
URSA MAJOR
N
Separation of the Moon and Mars is 6.5°. The altitude of the Moon is 40°.

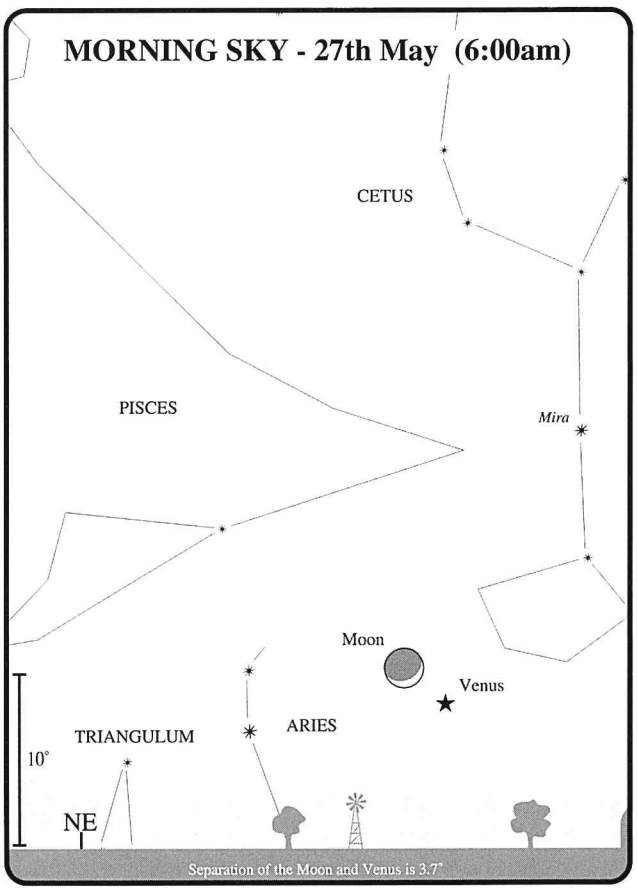

AQUARIUS
MORNING SKY - 13th May (5:50am)
Saturn
SCULPTOR
PISCES
CETUS
Venus
Mira
10°
E
Venus at Greatest Western Elongation (47°).

MAY


NIGHT SKY - 16th May (8:20pm)
LIBRA
LUPUS
NORMA
N6231
Antares
SCORPIUS
Jupiter
OPHIUCHUS
M6
M7
Moon
SERPENS
M8
10°
M22
E
Separation of the Moon and Jupiter is 7.6°

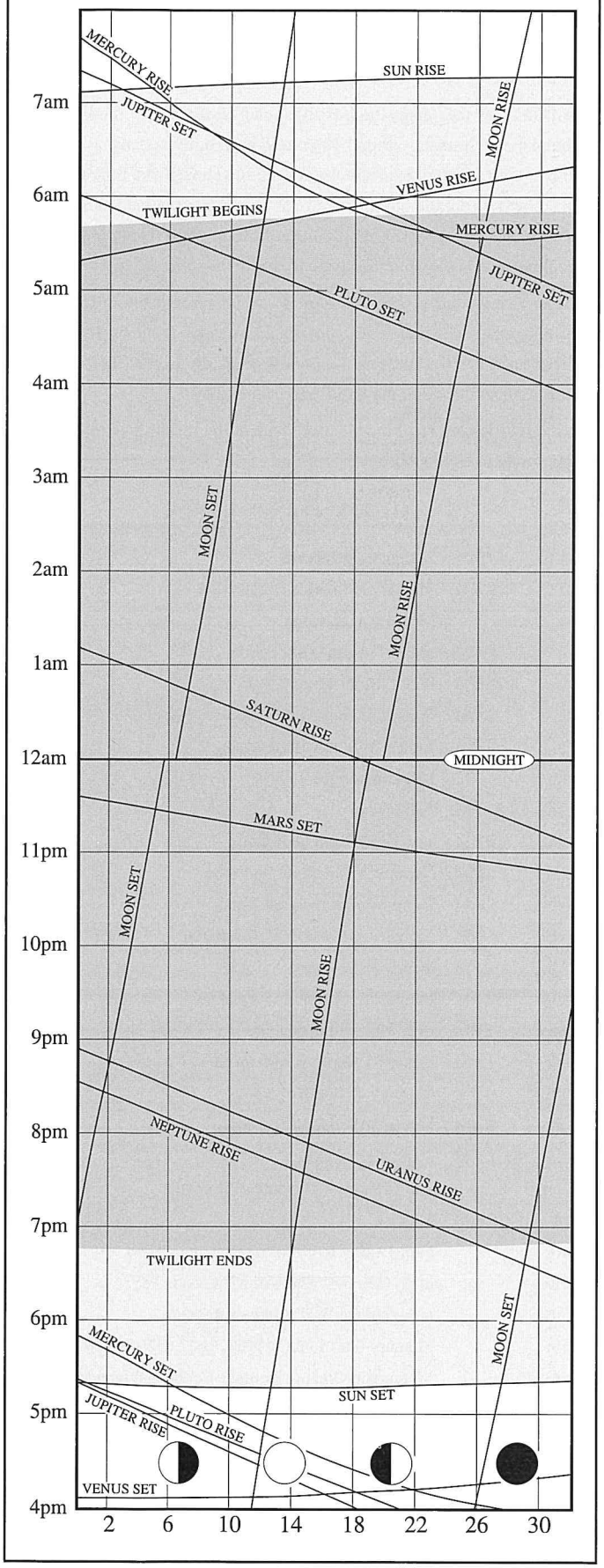

NIGHT SKY - 25th May (8:50pm)
SEXTANS
Regulus
LEO
Mars
LEO MINOR
CANCER
Praesepe (M44)
"Beehive Cluster"
10°
LYNX
URSA
MAJOR
NW
N
Separation of Regulus and Mars is 1°.


NIGHT SKY - 24th May (3:20am)
PISCIS
AUSTRINUS
Fomalhaut
AQUARIUS
Saturn
Moon
CETUS
PISCES
10°
PEGASUS
E
Separation of Saturn and the Moon is approx. 9.3°

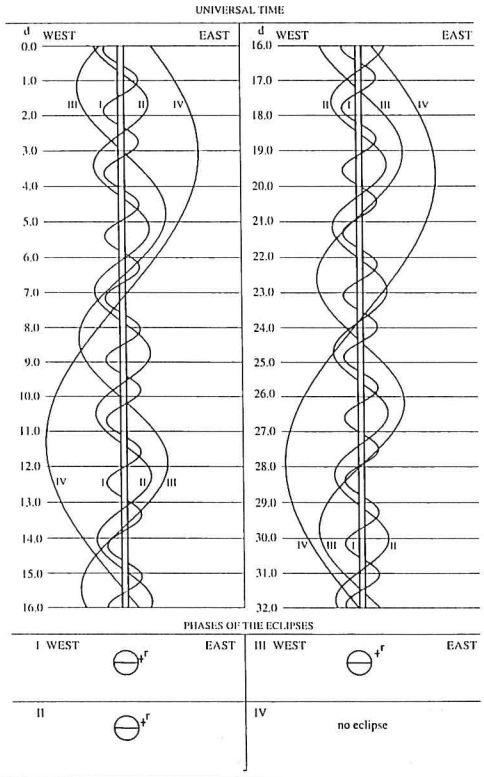

MORNING SKY - 27th May (6:00am)
CETUS
PISCES
Mira
Moon
Venus
TRIANGULUM
ARIES
10°
NE
Separation of the Moon and Venus is 3.7°

JUNE

RISE/SET CHART

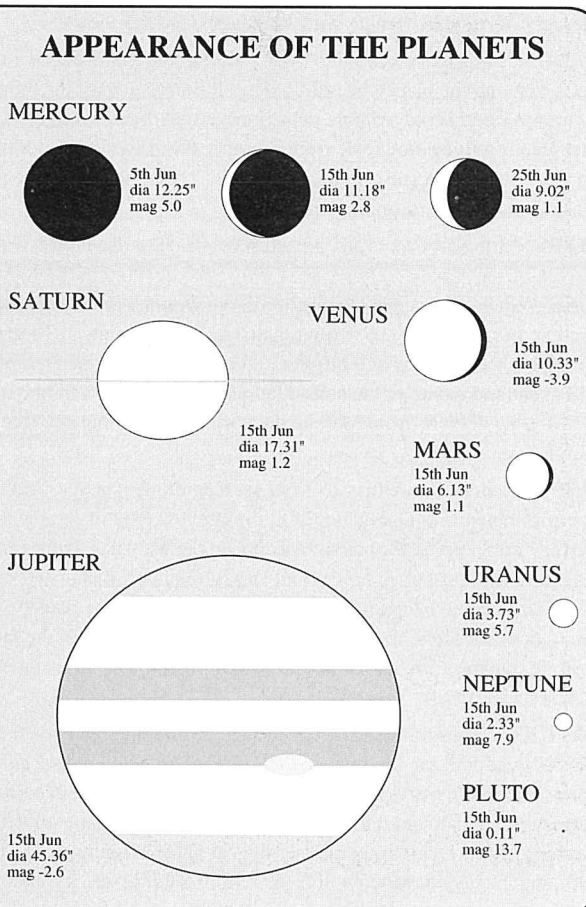


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



JUNE

HIGHLIGHTS FOR THE MONTH

- Jupiter visible for the whole night with opposition on the 1st.
- In late June, Mercury returns to the morning sky (with nearby Aldebaran)
- Venus is lost from the "dark" morning sky.
- Saturn's rings re-open.

THE MOON

6th First Quarter, 6:26pm.

9th Occultation of Spica by the Moon (occultation not visible from Australia. The closest Spica appears, from our latitudes, is about 2° in the early evening).

13th Full Moon, 12:03pm.

13th Moon at perigee (closest to Earth - 360680 kms, size 33.1').

20th Last Quarter, 6:01am.

26th Occultation of Mercury by the Moon (occultation not visible from Australia, however Mercury will be about 1° south (right) of the Moon in the morning twilight sky).

26th Moon at apogee (furthest from Earth - 411990 kms, size 29.0').

28th New Moon, 8:50am.

THE PLANETS

MERCURY is in inferior conjunction (between the Earth and the Sun) on the 5th, and is not visible again until the latter part of the month when the planet returns to the morning twilight. The best time to observe Mercury is from the 18th to month's end, with the planet's greatest elongation west of the Sun (22°) occurring on the 30th. Mercury's constant companion, over most of the observable period, is the first magnitude star Aldebaran (Alpha Tauri). From the 16th to 20th (see sky view) the pair will be separated by about 1°. For a few days Venus also comes into the picture and will be 4° from Mercury from the 17th to 21st. On the 26th, the 28 day old Moon appears 2° from Mercury, forming a triangle with Aldebaran.(see sky view)

VENUS moves from Aries into Taurus during the first week of June. Each morning the planet loses altitude as it moves toward the Sun and by month's end is only visible in the morning twilight. From the 17th to 21st Venus will be around 4° from Mercury (see sky view for 20th), and on the 27th the thin crescent Moon will be 5° south (right) of the planet (only visible in the morning twilight).

MARS, setting around 11pm, presents a poor telescope target, with a disc diameter of only 6 arc seconds. Now past quadrature (see diagram page 53) the tiny disc now begins to fill out from its gibbous phase to become full (or at least 99% illuminated in late December). To the naked eye the planet is still bright at 1st magnitude and the "red planet" will spend the month in the constellation of Leo. On the 5th, the 6 day old Moon will be 6° from Mars in the north west evening sky (see sky view).

JUPITER, never more than 6° from 1st magnitude Antares (Alpha Scorpii), remains in Ophiuchus until the last few days of June when it moves into Scorpius. Opposition occurs on the 1st when Jupiter will be at its brightest (-2.6 magnitude) and largest (equatorial diameter of 45.59 arc seconds). Opposition allows observation of the planet throughout the night, rising just before sunset and setting in the morning twilight. On the 12th, the 14 day old Moon will be 3.6° from Jupiter (see sky view).

SATURN's rings re-open slightly in June, displaying their south face. Month's end will see the rings at their maximum width before closing again; with the Earth again passing through the ring-plane in early August. Rising around midnight the planet is only available to the morning observer, crossing the meridian at 6am (in twilight). On the 20th, the 22 day old Moon will be 5.8° from Saturn (see sky view).

URANUS returns to Sagittarius at the end of June, after spending four months in Capricornus. With opposition occurring next month, the planet is high in the late eastern evening sky. On the 15th (10pm), the 17 day old Moon will be 6° north of Uranus.

NEPTUNE is in Sagittarius and 5° ahead (west) of Uranus. Like Uranus, it is also high in the late eastern evening sky. On the 15th (10pm), the 17 day old Moon will be 6° from Neptune.

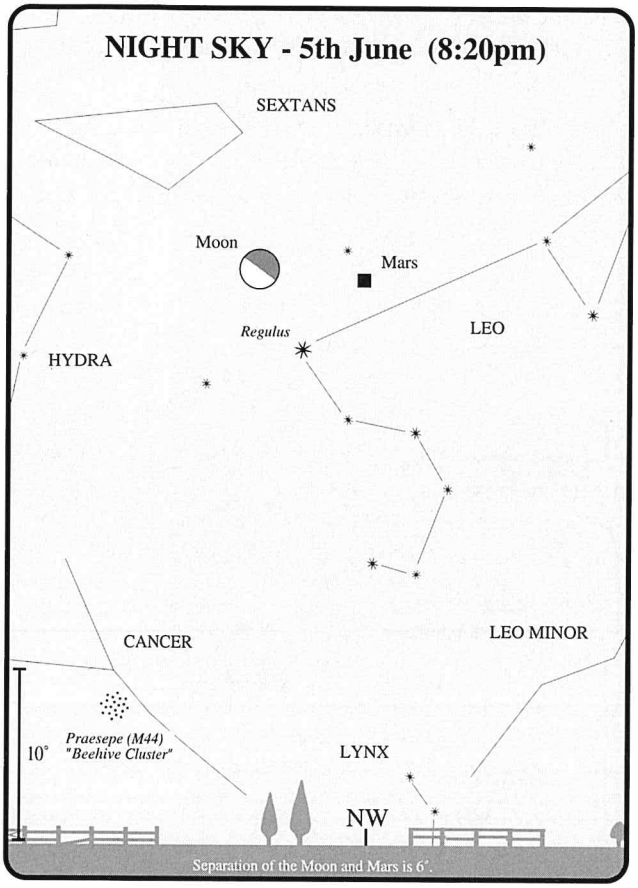
PLUTO now past opposition, (still) shines faintly at 13.7 magnitude. The planet culminates around 10pm mid month. If you have a telescope with at least 20cm of aperture, locating Pluto should be a little easier this month. From the 6th to 26th, a 7th magnitude star named SAO 140853 will be within 15 arc minutes of Pluto, with closest approach (5 arc minutes) on the 16th. See page 89 for detailed finder chart.

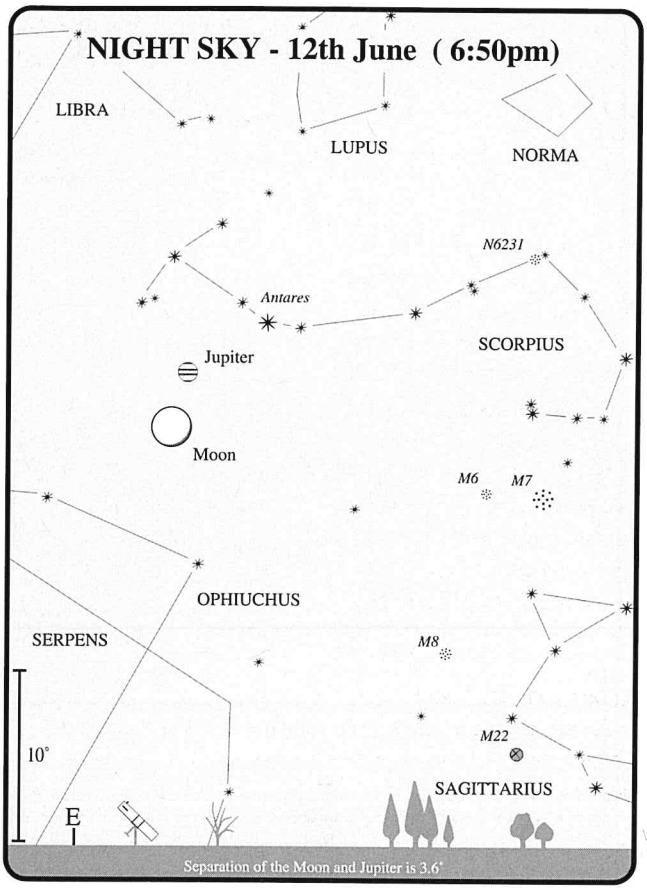
Because of its highly elliptical orbit, Pluto is presently closer to the Sun than Neptune. The planet does not regain its status as the outermost planet until 1999. At present the Sun/Neptune distance is 30.2 astronomical units and the Sun/Pluto is only 29.9.

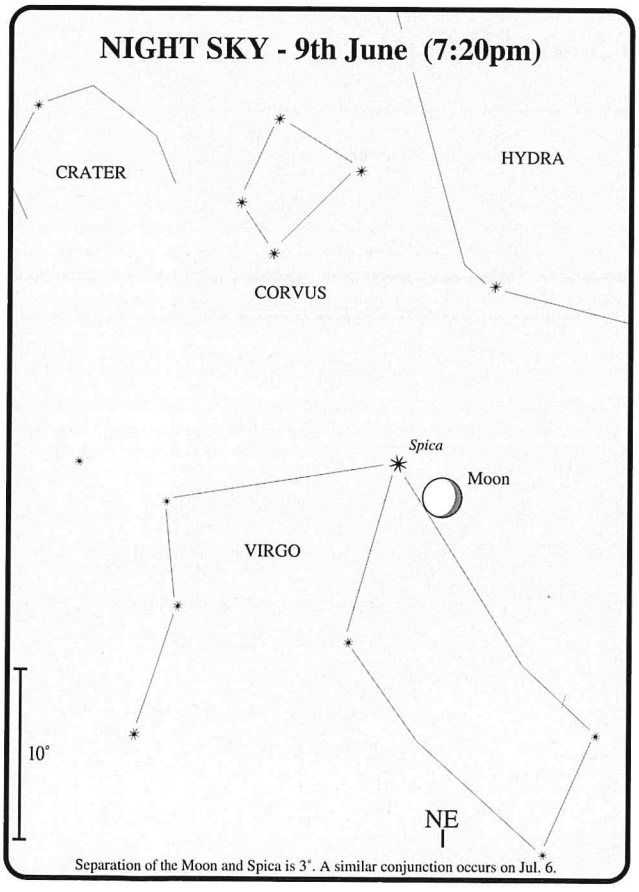
MINOR PLANETS. Juno reaches opposition on 18th June at 10.0 magnitude in Ophiuchus.

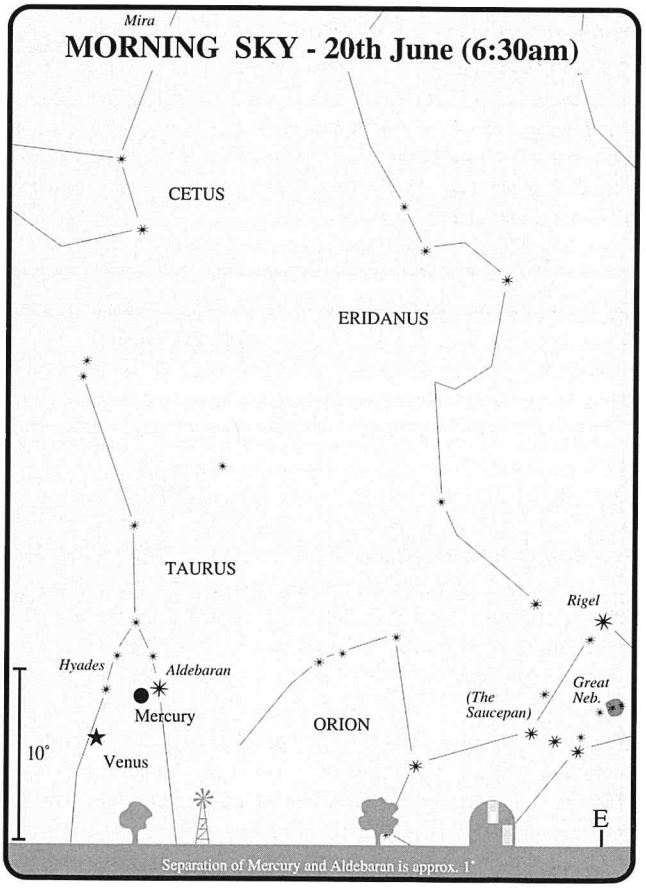
DIARY OF EVENTS

1st	7 PM	Jupiter at opposition
5th	2 PM	Mercury in inferior conjunction
6th		Mercury at aphelion.
6th	4 AM	Mars 6° North of the Moon
6th	6:26 PM	First Quarter Moon
9th	2 PM	Spica 1.1° South of the Moon *Occ
12th	4 PM	Jupiter 2° South of the Moon
13th	9 AM	Moon at perigee
13th	12:03 PM	Full Moon
14th	10 PM	Jupiter 5° North of Antares
15th	6 PM	Neptune 5° South of the Moon
16th	3 AM	Uranus 6° South of the Moon
16th	5 AM	Mercury 1.2° North of Aldebaran
17th	2 PM	Mercury stationary
18th	10 PM	Mercury 1.1° North of Aldebaran
18th	11 PM	m.p. 3 Juno at opposition
19th	1 PM	Venus 5° North of Aldebaran
19th	3 PM	Mercury 4° South of Venus
20th	3 AM	Saturn 6° South of the Moon
20th	6:01 AM	Last Quarter Moon
22nd		m.p. 2 Pallas 2.4° South of Procyon
22nd	5 AM	Solstice
24th		m.p. 1 Ceres 0.4° North of Gamma 1 Leo
24th		m.p. 7 Iris 0.3° South of M74 (G) in Peg
25th		m.p. 60 Echo 1.5° South of Regulus
25th		Mercury 0.6° South of NGC 1647 (OC) in Tau
26th		Mercury at Greatest Latitude South (Heliocentric).
26th	10 AM	Mercury 0.6° South of the Moon *Occ
26th	7 PM	Moon at apogee
26th	11 PM	Venus 3° North of the Moon
28th	8:50 AM	New Moon
29th	Midnight	Mercury greatest elongation West (22°)

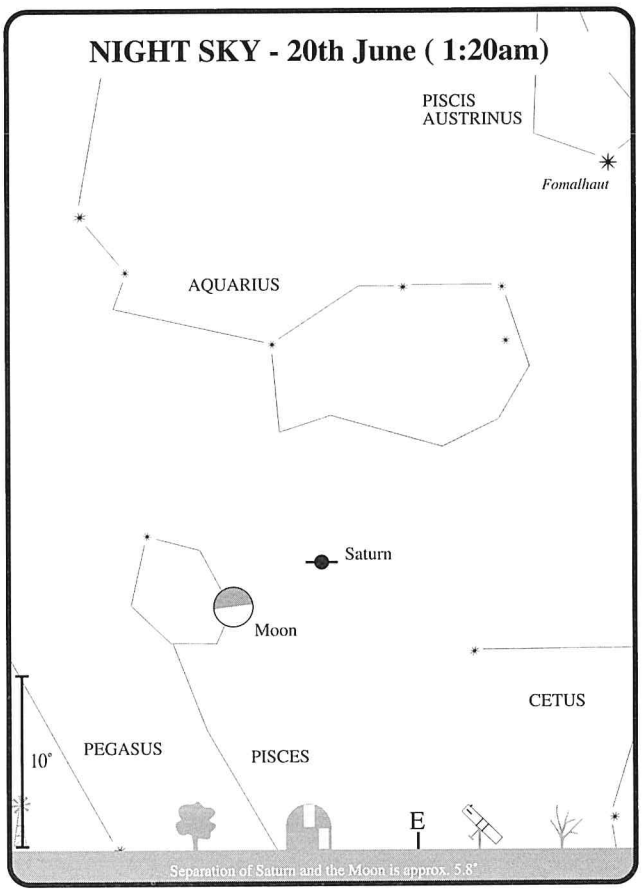

NIGHT SKY - 5th June (8:20pm)
SEXTANS
Moon
Mars
Regulus
LEO
HYDRA
CANCER
LEO MINOR
Praesepe (M44)
"Beehive Cluster"
LYNX
10°
NW
Separation of the Moon and Mars is 6°.

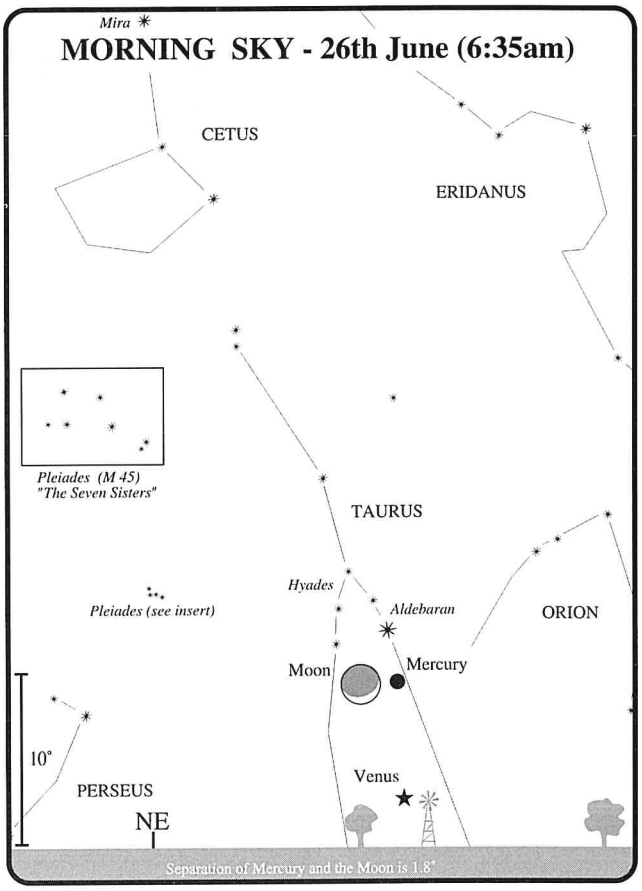

NIGHT SKY - 12th June (6:50pm)
LIBRA
LUPUS
NORMA
N6231
Antares
SCORPIUS
Jupiter
Moon
M6
M7
OPHIUCHUS
SERPENS
M8
M22
SAGITTARIUS
10°
E
Separation of the Moon and Jupiter is 3.6°

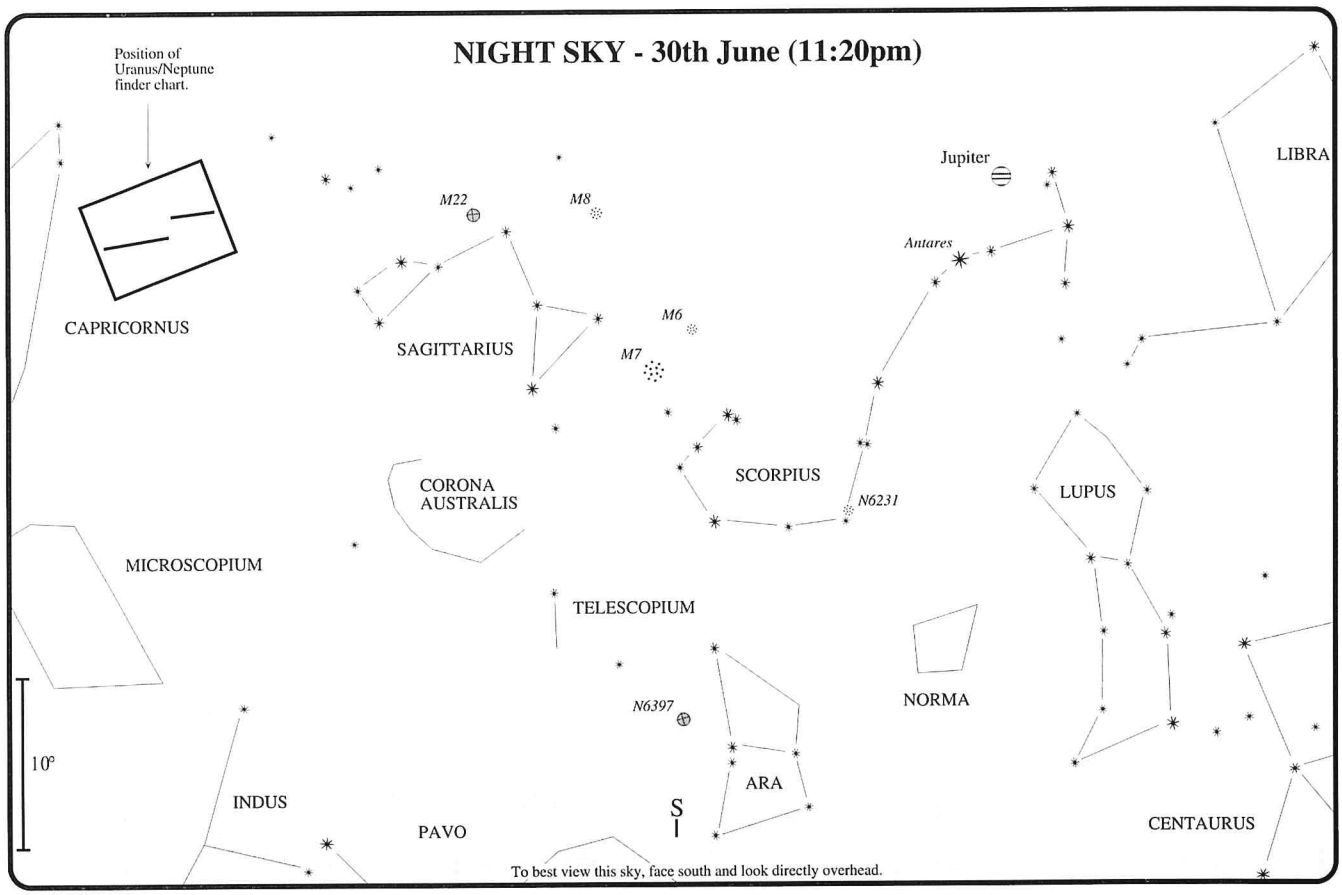

NIGHT SKY - 9th June (7:20pm)
CRATER
HYDRA
CORVUS
Spica
Moon
VIRGO
10°
NE
Separation of the Moon and Spica is 3°. A similar conjunction occurs on Jul. 6.


Mira
MORNING SKY - 20th June (6:30am)
CETUS
ERIDANUS
TAURUS
Rigel
Hyades
Aldebaran
Mercury
Venus
ORION
(The
Saucepan)
Great
Neb.
10°
E
Separation of Mercury and Aldebaran is approx. 1°

JUNE

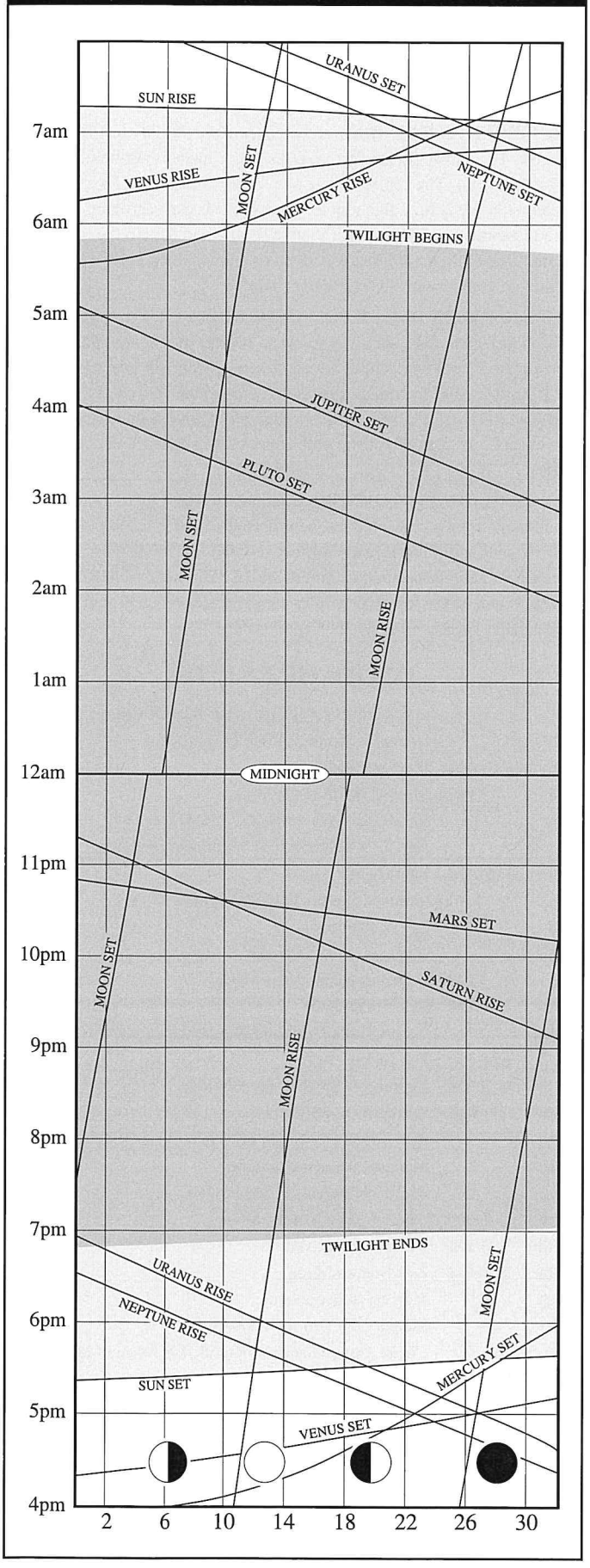

NIGHT SKY - 20th June (1:20am)
PISCIS AUSTRINUS
Fomalhaut
AQUARIUS
Saturn
Moon
CETUS
10°
PEGASUS
PISCES
E
Separation of Saturn and the Moon is approx. 5.8°


Mira
MORNING SKY - 26th June (6:35am)
CETUS
ERIDANUS
Pleiades (M 45)
"The Seven Sisters"
TAURUS
Hyades
Pleiades (see insert)
Aldebaran
ORION
Moon
Mercury
10°
PERSEUS
Venus
NE
Separation of Mercury and the Moon is 1.8°

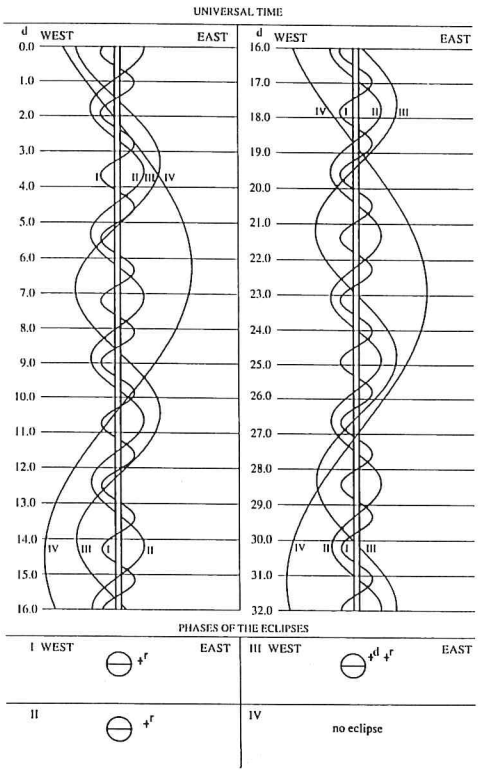

NIGHT SKY - 30th June (11:20pm)
Position of Uranus/Neptune finder chart.
Jupiter
LIBRA
M22
M8
Antares
CAPRICORNUS
SAGITTARIUS
M6
M7
SCORPIUS
N6231
CORONA AUSTRALIS
LUPUS
MICROSCOPIUM
TELESCOPIUM
N6397
NORMA
10°
INDUS
ARA
S
PAVO
CENTAURUS
To best view this sky, face south and look directly overhead.

JULY

RISE/SET CHART

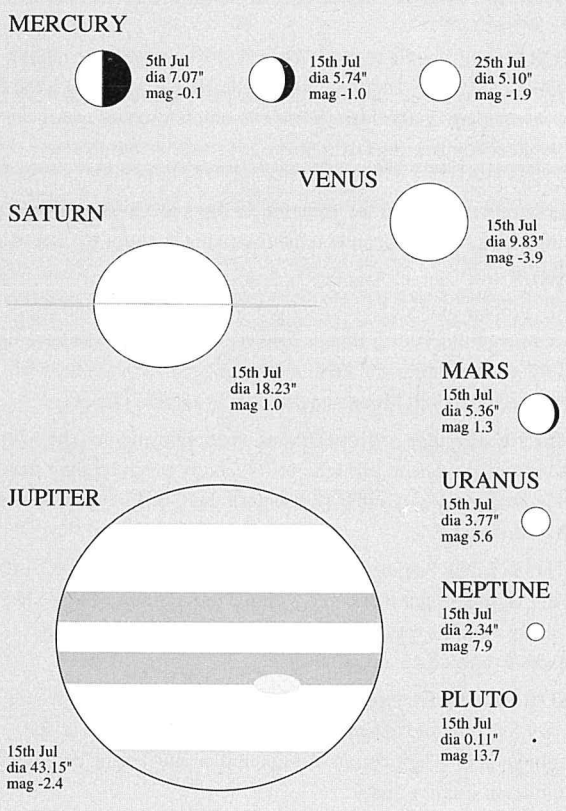


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



JULY

HIGHLIGHTS FOR THE MONTH

- Comet d'Arrest is at maximum brightness and is visible from late evening until dawn.
- Mercury is well placed in the late morning sky.
- Saturn's rings start to close (again).
- The Southern Delta Aquarids are at maximum activity at the end of July.

THE MOON

6th First Quarter, 4:02am.
11th Moon at perigee (closest to Earth - 353950 kms, size 33.8').
12th Full Moon, 6:49pm.
19th Last Quarter, 7:10pm.
24th Moon at apogee (furthest from Earth - 403320 kms, size 29.6').
27th New Moon, 11:13pm.

THE PLANETS

MERCURY is in a favourable position for observation during the first two weeks of July, in the morning sky. The planet then becomes lost in the twilight as it nears the Sun with superior conjunction on the 28th. After conjunction, Mercury again becomes an evening object and returns to the twilight early in August.

VENUS becomes lost in the Sun's glare by mid month. With superior conjunction in August, Venus will be unobservable until late September or early October when it reappears in the evening sky.

MARS. Early in the month, Mars moves from Leo into Virgo, setting around 10:30pm. On the 3rd, the 5 day old Moon appears 9° south and below Mars, and on the following evening 6° above (see sky view).

JUPITER, now four weeks past opposition, presents a 43 arc second diameter globe shinning at -2.4 magnitude. In Scorpius, Jupiter remains within 7° of 1st magnitude Antares (Alpha Scorpii) throughout the month. Jupiter is in an ideal position for observation this month, its southerly declination (-20°) places it high in the sky as it culminates around 8.30pm. On the 9th, the 11 day old Moon will be 2.5° from the planet (see sky view).

SATURN's rings begin to close from the beginning of the month, becoming completely edge-on when the Earth passes through the ring-plane next month on the 11th. Users of small telescopes may have trouble detecting the rings over the coming weeks, but the 1st magnitude planet is visually unmistakable, rising in the east around 10:30pm mid month. On the 16th, the 19 day old Moon will be 7° north of Saturn (see sky view), and on the following evening 10° below (east).

URANUS now back in Sagittarius, is at opposition on the 21st, rising in the east around sunset and remaining visible throughout the night. The planet's magnitude at this time is 5.6 (visible to the unaided eye under good skies, or with binoculars in metropolitan areas). On the 12th (9pm), the 16 day old Moon appears 9° north of the planet.

NEPTUNE, less than 5° from Uranus, is at opposition on the 17th. Neptune's magnitude at this time is 7.9, barely much brighter than at less favourable times. On the 12th (9pm), the Full Moon is less than 6° north of the planet.

PLUTO in Libra, begins the month 20 arc minutes from SAO 140853, the 7th magnitude star that came within 5 arc minutes of Pluto last month. By month's end the separation between the two objects increases to around 45 arc minutes.

MINOR PLANETS at opposition this month include: Hygiea on 24th July at 9.3 magnitude in Capricornus, Interamnia on 25th at 10.0 magnitude on the Capricornus/Aquila border and Thisbe on 26th at 9.8 magnitude in Capricornus.

COMETS

P/ D'ARREST. During July, the comet rises around 9:30pm and is visible for the remainder of the night. It commences the month in Pegasus. On the 27th, d'Arrest reaches perihelion, at magnitude 10.8, in the constellation of Pisces. On July 31, the comet is 3° west of Saturn.

METEOR SHOWERS

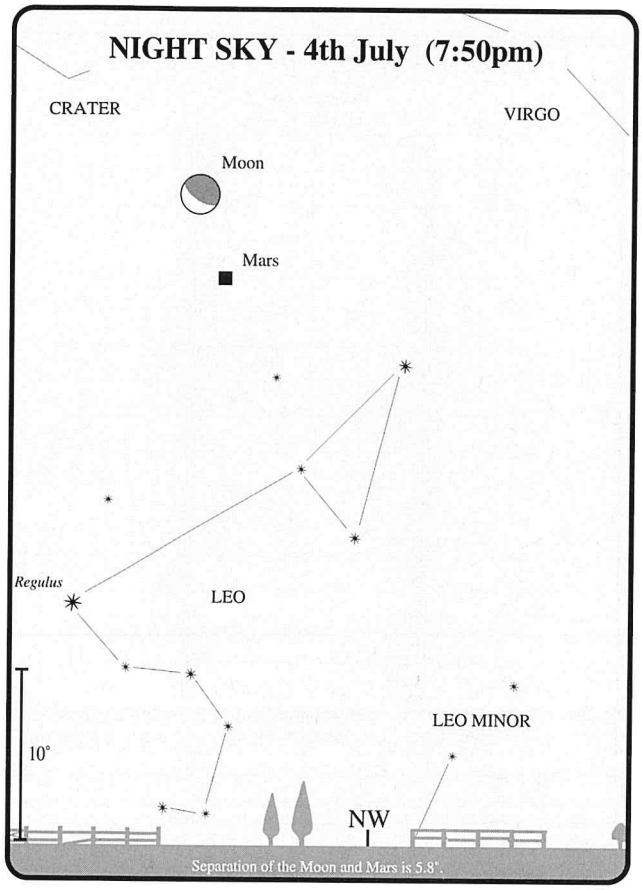
The **PISCIS AUSTRINIDS** are visible from the 9th July to 17th August. The shower generally provides 1 or 2 meteors per hour and on occasion 3 or 4. The zenith hourly rate (ZHR) increases to 8 or 10 meteors on the 28th of this month. However this can vary from as little as 5 to as many as 15 per hour. Visible from about 8pm to the beginning of morning twilight, the Piscis Austrinids are generally blue, white or yellow in colour, with some leaving trains.

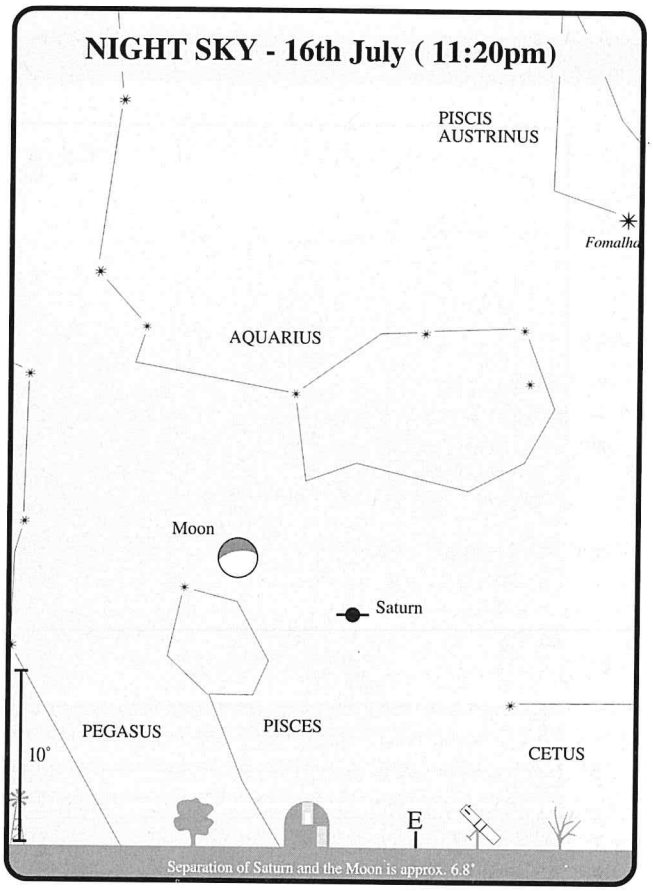
The **SOUTHERN DELTA AQUARIDS** are one of the strongest and most consistent of the southern showers, visible late evening until dawn. The range of activity of these meteors extends from 8th July through to 19th August, with maximum this month around the 28th or 29th, with a ZHR of 20. The Delta Aquarids are generally faint (bright meteors are the exception), typically white with some blue members and occasional trains.

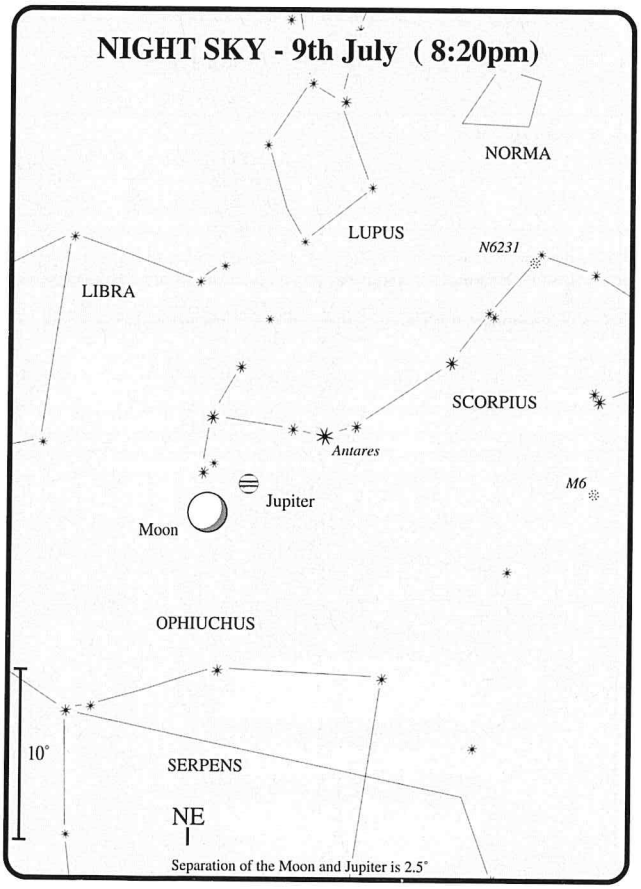
The **ALPHA CAPRICORNIDS** are noted for their bright, slow meteors with long paths and frequent fireballs. The shower is visible late evening until dawn, from 3rd July through to 25th August. Maximum activity occurs this month on the 30th, when a ZHR of 8 can be expected. These low hourly rates are generally compensated by the spectacular nature of the Alpha Capricornids.

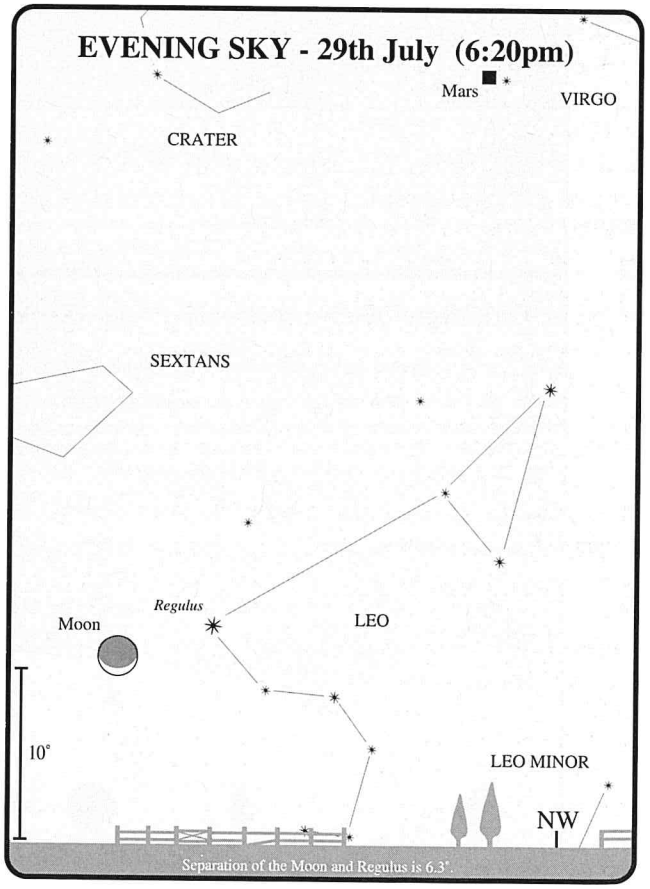
DIARY OF EVENTS

1st		m.p. 4 Vesta 1.4° North of the Beehive Cluster in Cnc
4th		Uranus 1° North of M75 (GC) in Sgr
4th	10 AM	Earth at aphelion
4th	1 PM	Mars 4° North of the Moon
5th		Venus 0.5° West of NGC 2126 (OC) in Gem
6th		m.p. 29 Amphitrite 0.6° South of the Pleiades
6th	4:02 AM	First Quarter Moon
7th		Venus 1° South of M35 (OC) in Gem
7th	7 PM	Saturn stationary
8th		Venus at ascending node.
9th	9 PM	Jupiter 2° South of the Moon
11th	6 PM	Moon at perigee
12th		Comet Tuttle-Giacobini-Kresak 0.8° South of Eta Leo
12th	6:49 PM	Full Moon
13th	3 AM	Neptune 4° South of the Moon
13th	11 AM	Uranus 6° South of the Moon
14th		m.p. 3 Juno 0.3° South of NGC 6366 (GC) in Oph
15th		Mercury at ascending node.
17th		m.p. 19 Fortuna 1.4° South of Regulus
17th	Noon	Saturn 6° South of the Moon
17th	1 PM	Neptune at opposition
19th	7:10 PM	Last Quarter Moon
20th		Mercury at perihelion.
21st		Mercury 0.5° North of Venus
22nd		Comet Tuttle-Giacobini-Kresak 0.4° North of M105 (G) in Leo
22nd	2 AM	Uranus at opposition
24th	4 AM	Moon at apogee
27th	11:13 PM	New Moon
28th	10 AM	Mercury in superior conjunction
30th		Mercury at Greatest Latitude North (Heliocentric).


NIGHT SKY - 4th July (7:50pm)
CRATER
VIRGO
Moon
Mars
Regulus
LEO
LEO MINOR
10°
NW
Separation of the Moon and Mars is 5.8°.

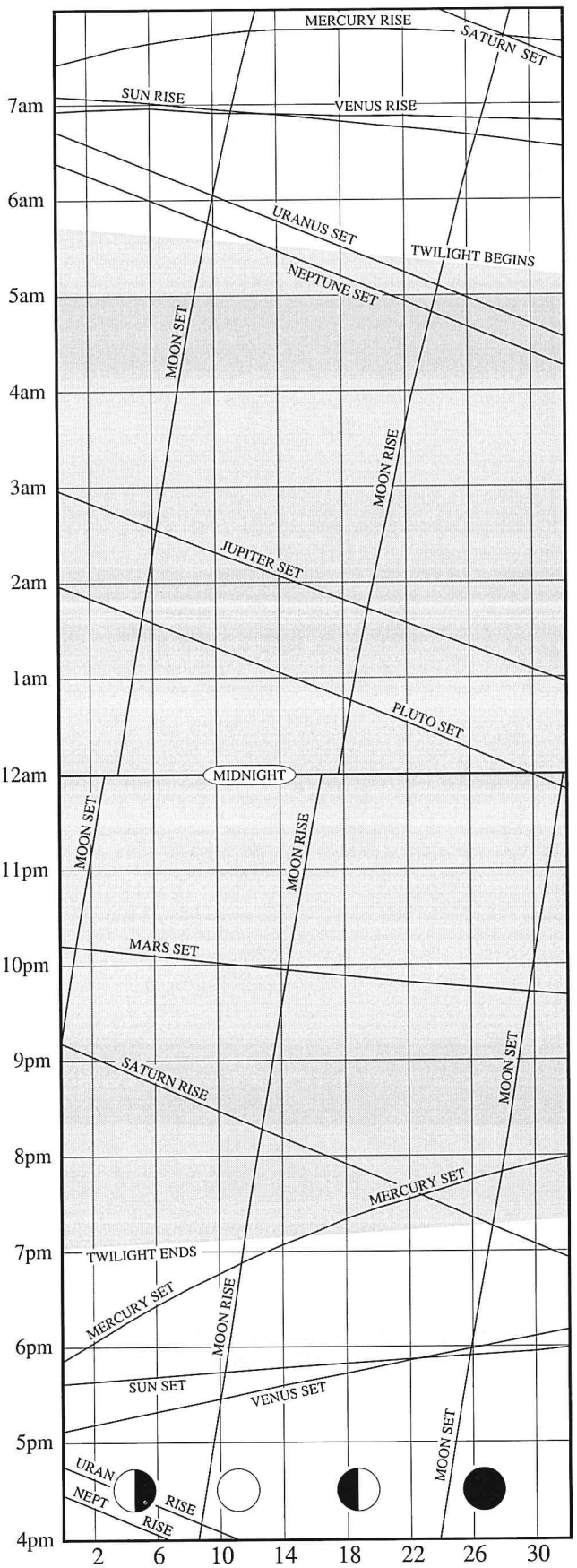

NIGHT SKY - 16th July (11:20pm)
PISCIS AUSTRINUS
Fomalha
AQUARIUS
Moon
Saturn
PEGASUS
PISCES
CETUS
10°
E
Separation of Saturn and the Moon is approx. 6.8°


NIGHT SKY - 9th July (8:20pm)
NORMA
LUPUS
N6231
LIBRA
SCORPIUS
Antares
M6
Jupiter
Moon
OPHIUCHUS
10°
SERPENS
NE
Separation of the Moon and Jupiter is 2.5°

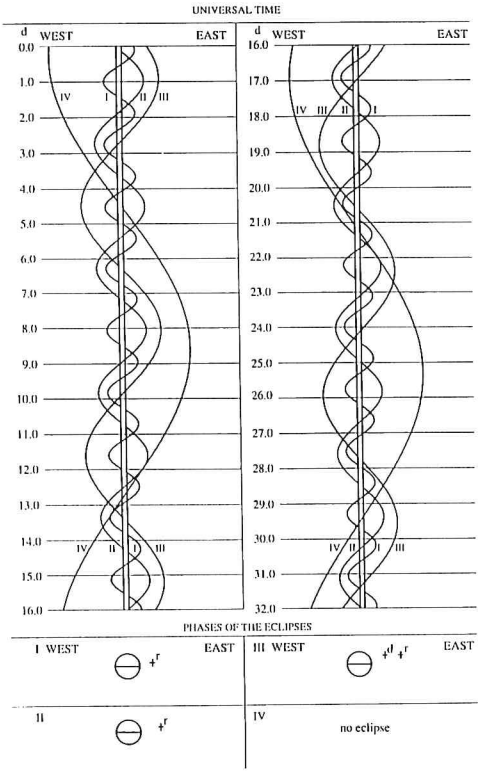

EVENING SKY - 29th July (6:20pm)
Mars
VIRGO
CRATER
SEXTANS
Regulus
Moon
LEO
10°
LEO MINOR
NW
Separation of the Moon and Regulus is 6.3°.

AUGUST

RISE/SET CHART

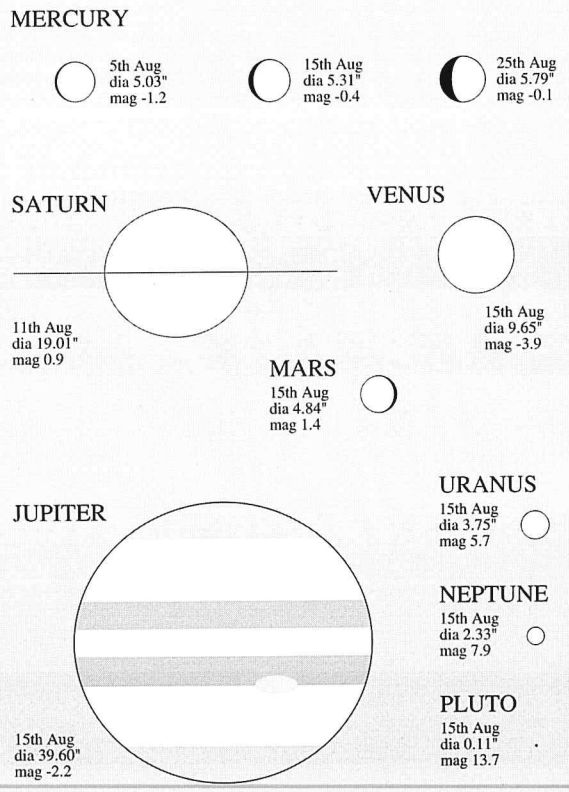


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



AUGUST

HIGHLIGHTS FOR THE MONTH

- The Moon makes a close approach to Mars, on the 1st, in the early evening western sky.
- Late in August, Mars and Spica move close together
- Saturn's rings are edge-on. The planet is visible most of the night.
- Comet d'Arrest, at the start of August, is only 2° from Saturn. Comet is still at maximum brightness and by month's end it will be visible the whole night.
- Mercury moves into the western evening sky in late August. On 9th, Mercury is only 1.4° from Regulus; the 28th sees the Moon only 2° away.

THE MOON

4th First Quarter, 11:16am.
9th Moon at perigee (closest to Earth - 357390 kms, size 33.4').
11th Full Moon, 2:15am.
18th Last Quarter, 11:04am
20th Moon at apogee (furthest from Earth - 409900 kms, size 29.1')
26th New Moon, 12:31pm.
30th Occultation of Mars by the Moon. Although the event is visible from the northern regions of Australia and New Zealand, it occurs during daylight. However, during the early evening the 4 day old Moon will be about 4° from Mars (see sky view).

THE PLANETS

MERCURY, now past superior conjunction, becomes an evening object this month. During August it moves from Cancer into Leo then finally Virgo. Although it is resident in the western evening twilight for the first half of the month, observers may try to locate the planet when 1° from Regulus (Alpha Leonis) on the 9th (see sky view). Since the pair are low to the horizon (about 4° at 6:30pm) 40 minutes after sunset, a good western outlook (low horizon) will be necessary. Binoculars will help; at -0.8 magnitude Mercury will be brighter than 1st magnitude Regulus. On the 28th, the 2 day old Moon will be 2° from Mercury (see sky view).

VENUS is in superior conjunction on the 21st. The planet's closeness to the Sun effectively excludes observations until late September.

MARS in Virgo, sets around 10pm. The planet begins and ends the month near the waxing Moon. On the 1st, a 5 day Moon will be 3° from Mars, and on the 30th, 4° from a 4 day old Moon (see sky views). It is also worthwhile watching the slow approach of Mars to 1st magnitude Spica (Alpha Virginis) towards the end of the month. At magnitude 1.4 the red planet will be slightly fainter than Spica, but its distinctive orange colour should lead no doubt to its identity.

JUPITER, shining brightly at magnitude -2.2, again remains close (within 7°) of Antares during the month. Culminating in the northern sky by the end of astronomical twilight, the giant planet makes for easy evening viewing. On the 5th, the 9 day old Moon appears within 6° of the planet (see sky view), and on the following evening 9°.

SATURN's rings continue to close until the 11th when we again see them edge-on. Since 1980 (last edge-on occurrence) we have viewed the northern face of the rings, in May this year the Earth crossed the ring plane to afford us a view of the southern face. This month the view changes back to the north orientation, as the Earth again traverses the ring-plane. This northern aspect is only transitory, and we move across the ring-plane for the third time in February 1996. This final passage leaves us with a view of the southern face of the rings, a view that remains for the next 14 years (see also discussion in May notes). With opposition next month, the planet is ideally suited for observations in the late evening. On the 13th, the 18 day old Moon appears 7° north of Saturn (see sky view).

URANUS and **NEPTUNE,** rise in Sagittarius in the early afternoon. With both planets past opposition they now culminate around 10pm, providing easy evening viewing. On the 9th (8pm), the 13 day old Moon forms a triangle with the pair, 6° from Uranus and 8° from Neptune (the planets themselves being 4° apart).

PLUTO culminating in the afternoon, setting around midnight. During the month the brightest reference star, near Pluto, is 7th magnitude SAO 140853; the planet remaining within 45 arc minutes of this star.

MINOR PLANETS. Aquitania reaches opposition on 11th August at 9.6 magnitude in Capricornus.

COMETS

P/ D'ARREST. Commences the month 2° west of Saturn, in Aquarius at magnitude 10.8 (rising at 9pm). The comet heads south, completing the month in Cetus (31st, 8° south of Beta Ceti). By this time, d'Arrest rises at 7pm and is visible the whole night.

METEOR SHOWERS

The **PISCIS AUSTRINIDS** are visible from the 9th July to 17th August, with maximum activity last month on the 28th (see July notes).

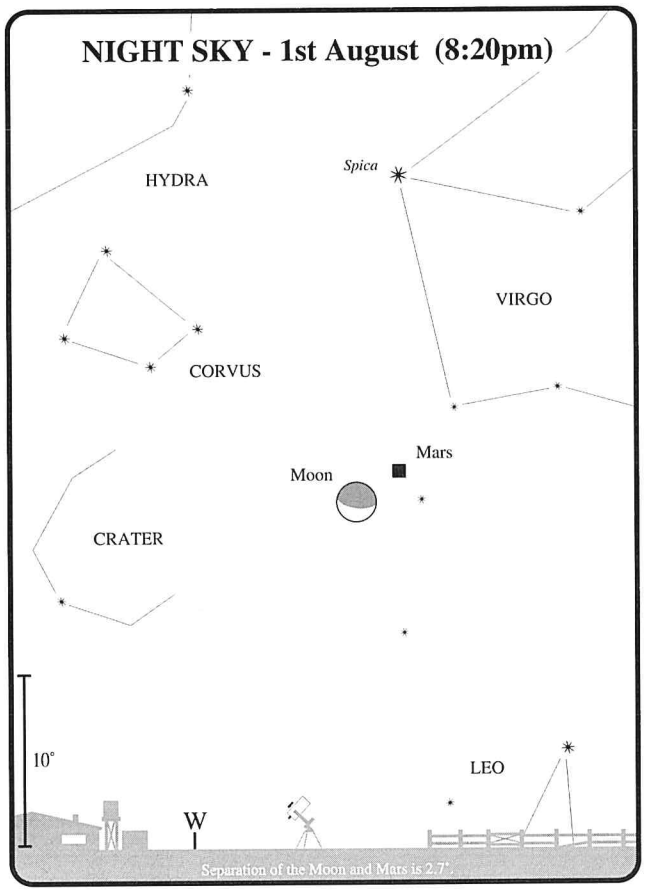
The **SOUTHERN DELTA AQUARIDS** are visible from 8th July through to 19th August, with maximum at the end of last month (see July notes).

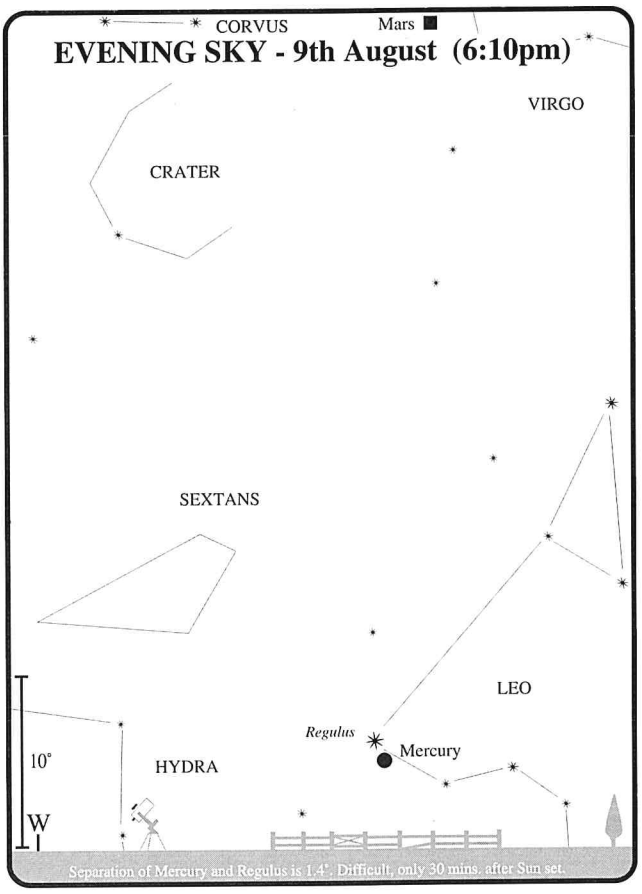
The **ALPHA CAPRICORNIDS** are visible from 3rd July through to 25th Maximum activity was last month on the 30th (see July notes).

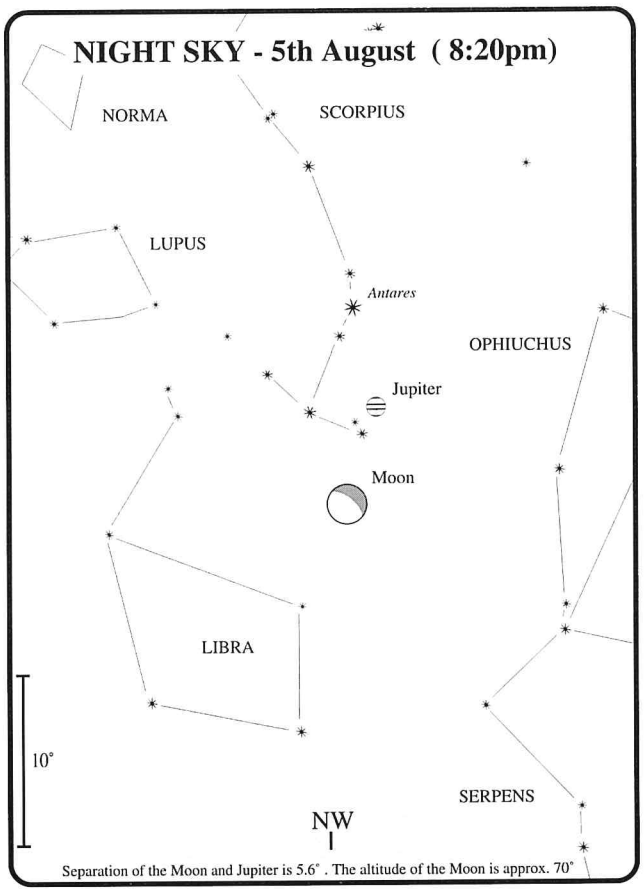
DIARY OF EVENTS

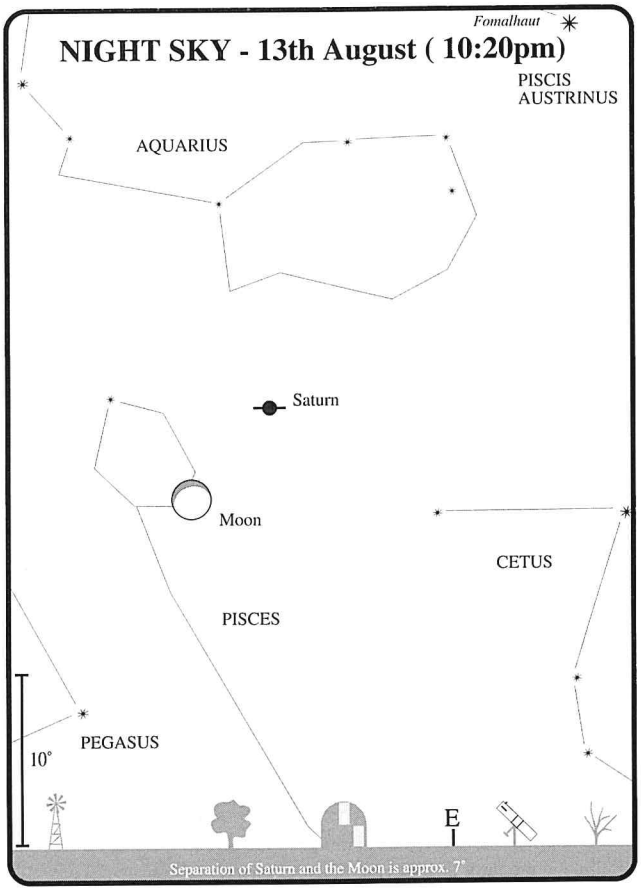
1st		m.p. 1 Ceres 0.2° North of M65 (G) in Leo
1st	11 PM	Mars 2° North of the Moon
2nd		Comet d'Arrest 2° South West of Saturn
2nd		m.p. 1 Ceres 0.2° North of M66 (G) in Leo
3rd	6 AM	Jupiter stationary
4th	11:16 AM	First Quarter Moon
5th		Mars 3° South of m.p. 9 Metis
6th	4 AM	Jupiter 2° South of the Moon
8th	10 PM	Moon at perigee
9th	Noon	Neptune 5° South of the Moon
9th	8 PM	Uranus 6° South of the Moon
9th	Midnight	Mercury 1.1° North of Regulus
11th		Venus at perihelion.
11th	2:15 AM	Full Moon
11th	5 AM	Passage of the Earth through the ring-plane of Saturn from South to North
12th	Noon	Pluto stationary
13th	7 PM	Saturn 5° South of the Moon
14th		Comet Jackson-Neujmin 0.5° SW of M2 in Aqu.
14th		Comet Tuttle-Giacobini-Kresak 0.2° West of M61 (G) in Virgo
15th	2 PM	m.p. 3 Juno stationary
18th	11:04 AM	Last Quarter Moon
20th	8 PM	Moon at apogee
21st		Mars at descending node.
21st	8 AM	Venus in superior conjunction
22nd		Mercury at descending node.
23rd	11 PM	m.p. 2 Pallas in conjunction with the Sun
26th	9 AM	Vesta in conjunction with the Sun
26th	12:31 PM	New Moon
27th	9 PM	Mars 2° North of Spica
28th	3 PM	Mercury 1.8° North of the Moon
30th		m.p. 16 Psyche 0.1° North of NGC 1647 (OC) in Tau
30th		m.p. 63 Ausonia 1° South of M4 (GC) in Sco
30th		m.p. 7 Iris 1.5° North of the Pleiades
30th	Noon	Mars 0.2° North of the Moon *Occ
31st		m.p. 29 Amphitrite 0.2° East of Beta Tau
31st		Mercury 1.3° South of m.p. 60 Echo

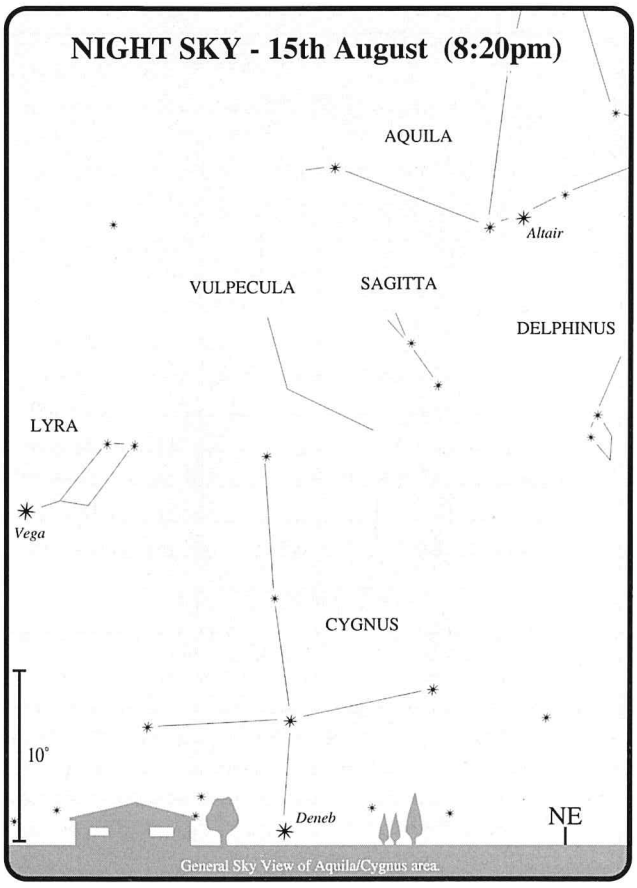
AUGUST

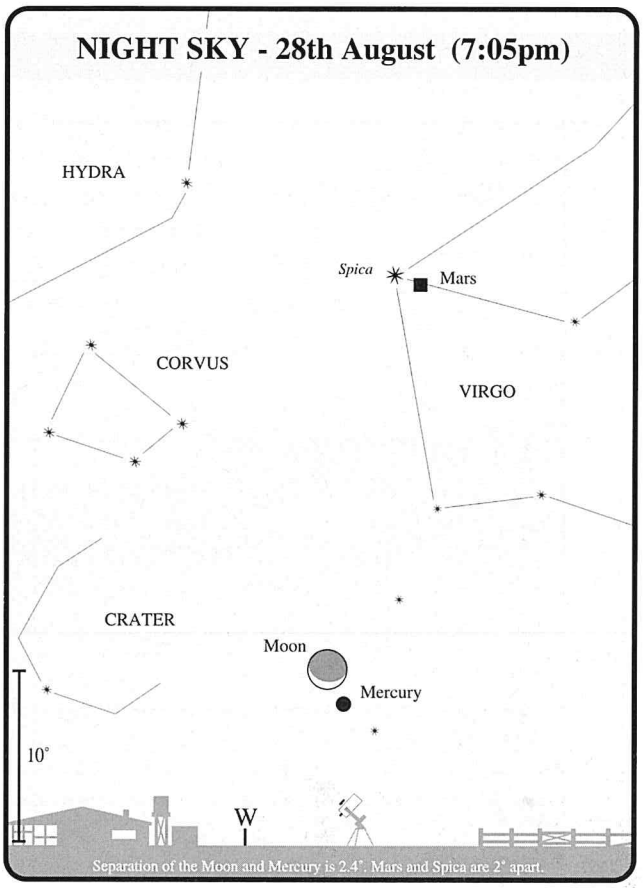

NIGHT SKY - 1st August (8:20pm)
HYDRA
Spica
VIRGO
CORVUS
Moon
Mars
CRATER
10°
LEO
W
Separation of the Moon and Mars is 2.7°.

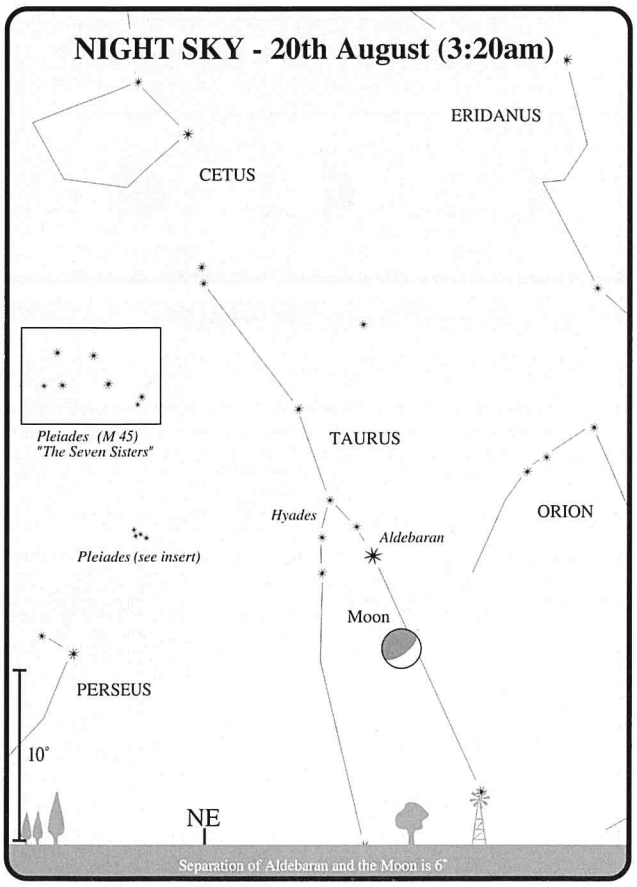

CORVUS
Mars
EVENING SKY - 9th August (6:10pm)
VIRGO
CRATER
SEXTANS
LEO
Regulus
Mercury
10°
HYDRA
W
Separation of Mercury and Regulus is 1.4°. Difficult, only 30 mins. after Sun set.

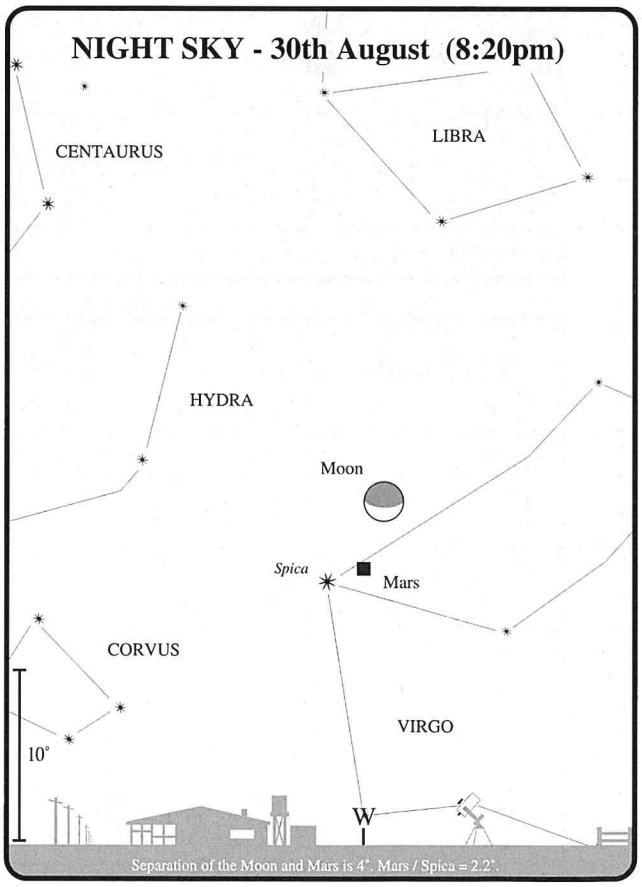

NIGHT SKY - 5th August (8:20pm)
NORMA
SCORPIUS
LUPUS
Antares
OPHIUCHUS
Jupiter
Moon
LIBRA
10°
SERPENS
NW
Separation of the Moon and Jupiter is 5.6° . The altitude of the Moon is approx. 70°


Fomalhaut
NIGHT SKY - 13th August (10:20pm)
PISCIS AUSTRINUS
AQUARIUS
Saturn
Moon
CETUS
PISCES
PEGASUS
10°
E
Separation of Saturn and the Moon is approx. 7°


NIGHT SKY - 15th August (8:20pm)
AQUILA
Altair
VULPECULA
SAGITTA
DELPHINUS
LYRA
Vega
CYGNUS
Deneb
10°
NE
General Sky View of Aquila/Cygnus area.

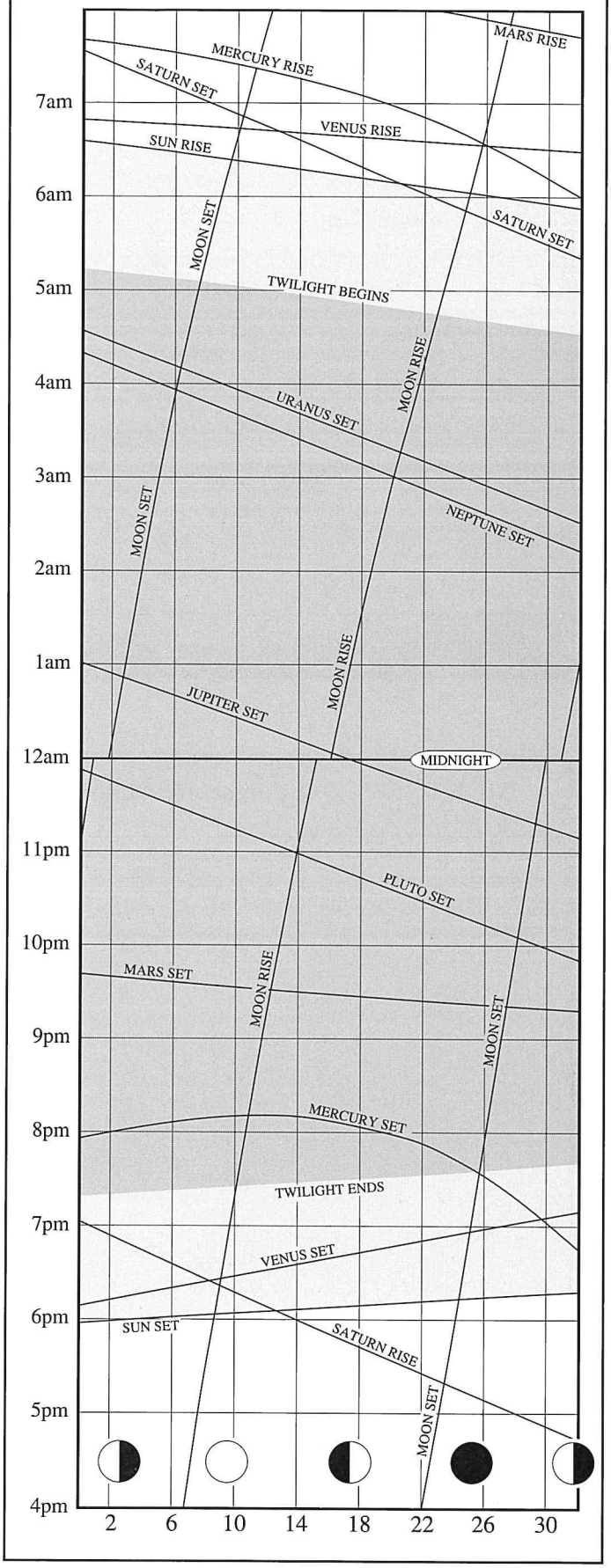

NIGHT SKY - 28th August (7:05pm)
HYDRA
Spica
Mars
CORVUS
VIRGO
CRATER
Moon
Mercury
10°
W
Separation of the Moon and Mercury is 2.4°. Mars and Spica are 2° apart.


NIGHT SKY - 20th August (3:20am)
ERIDANUS
CETUS
Pleiades (M 45)
"The Seven Sisters"
TAURUS
Hyades
Aldebaran
ORION
Pleiades (see insert)
Moon
PERSEUS
10°
NE
Separation of Aldebaran and the Moon is 6°

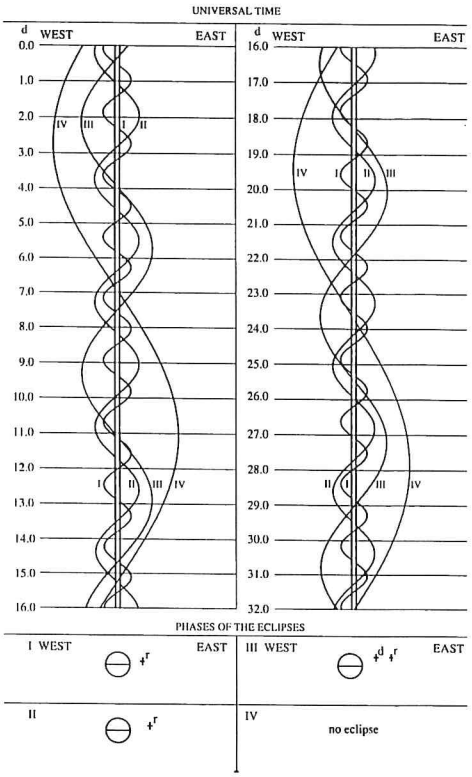

NIGHT SKY - 30th August (8:20pm)
CENTAURUS
LIBRA
HYDRA
Moon
Spica
Mars
CORVUS
VIRGO
10°
W
Separation of the Moon and Mars is 4°. Mars / Spica = 2.2°.

SEPTEMBER

RISE/SET CHART

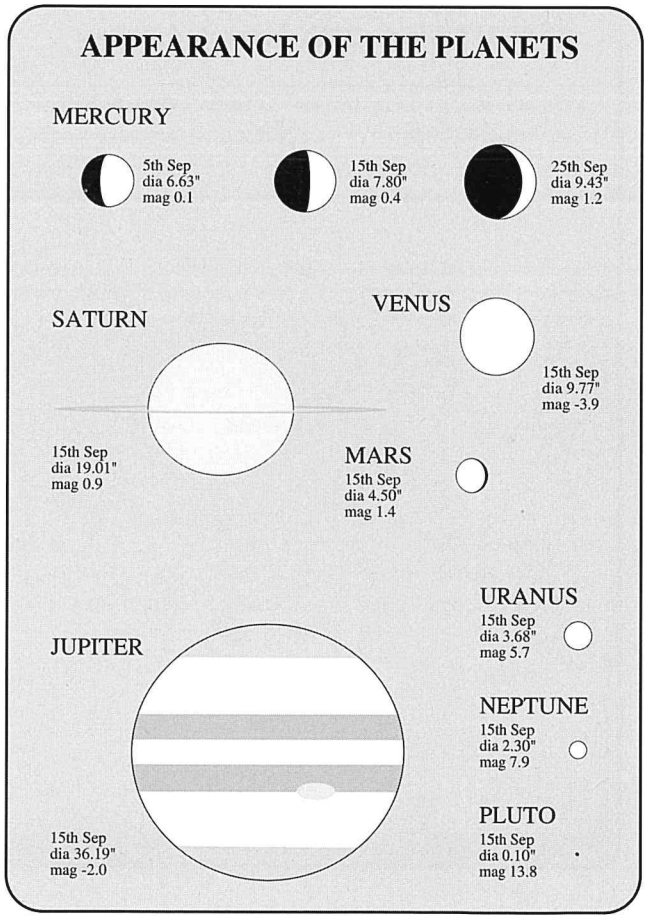


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



SEPTEMBER

HIGHLIGHTS FOR THE MONTH

- Saturn is at its brightest and visible the whole night (opposition on 15th).
- Close approach of Jupiter to the star Omega Ophiuchi (from 21st to 28th).
- Best chance to observe Mercury in the evening sky for 1995.
- The Moon and Spica are only 2° apart in the early western evening sky on the 26th.

THE MOON

2nd First Quarter, 5:03pm.
5th Moon at perigee (closest to Earth - 370550 kms, size 32.2').
9th Full Moon, 11:37am.
17th Last Quarter, 5:09am.
17th Moon at apogee (furthest from Earth - 409600 kms, size 29.2').
25th New Moon, 12:55am.
30th Moon at perigee (closest to Earth - 364270 kms, size 32.8').

THE PLANETS

MERCURY is at its greatest elongation east of the Sun (27°) on the 9th. This elongation is the best in the evening sky this year (see also Appendix J, page 105), providing a good observing window with dark sky for almost three weeks either side of the 9th. Do not confuse Mercury with 1st magnitude Spica (Alpha Virginis) from the 18th to 26th when the two will be within 5° of each other. Identification should not be too difficult. Mercury at magnitude -0.2, is the brighter and lower of the two. On the 26th, the 2 day old Moon will be 6° north (right) of the planet, with Spica 2° from the Moon (see sky view). Mercury and Venus approach each other towards the end of the month, and on the 29th appear 4° apart in the early evening twilight.

VENUS, now past superior conjunction (21st August), becomes an evening object, and moves from Leo into Virgo. Its closeness to the Sun excludes observation until late in the month. On the 26th, the planet will be 11° below the Moon (see sky view). A good western outlook and binoculars will help in finding Venus, near the horizon in the twilight.

MARS will be 3° from Spica at the beginning of the month. On the 20th, the planet moves from Virgo into Libra. On two successive evenings the Moon appears near Mars: on the 27th the 3 day old Moon is 7° below the planet (see sky view, 26th), and on the 28th, 9° above. At magnitude 1.4, the tiny disc (less than 5 arc seconds diameter) appears slightly gibbous and is now 95% illuminated. Between the 28th and 30th Mars will be within 1° of 3rd magnitude Alpha Librae.

JUPITER observers will be in for a real treat this month, when 4th magnitude Omega Ophiuchi moves along the satellite plane. On the 21st, the star will be 0°28' east of the planet, and on the 28th 0°31' west. Between these dates the star moves amongst the satellites, becoming a temporary fifth moon. The diagram on page 41, illustrates the interesting star/planet/satellite patterns. Since Omega is only slightly brighter than the Jovian satellites, casual observers may have difficulty in identifying which is the real star. On the 24th, Omega will be 3 arc minutes East of Jupiter (the distance between planet and star decreasing before Jupiter sets). On the following evening, Omega is now west of Jupiter.

Jupiter again spends the month within 6° of Antares, moving out of Scorpius into Ophiuchus by the 10th. On two occasions the Moon will be close to Jupiter. On the 2nd, the First Quarter Moon will be 5° distant (see sky view), and on the 29th the 5 day old Moon will be 4.4° away (see sky view). On both occasions the view will be aesthetically pleasing, with 1st magnitude Antares near both objects.

SATURN is at opposition on the 15th, rising in the east as the Sun sets, and visible throughout the night. Opposition is an ideal time for telescopic observation of the planet, not only is it at its brightest (0.9) and largest angular size (19 arc seconds equatorial diameter), but with the rings only slightly tilted, the planet's disc is relatively unobscured. On the 9th, the Full Moon will be 5.6° north of Saturn (see sky view).

URANUS and **NEPTUNE** in Sagittarius, spend the month 4° from each other, and culminate around 8pm. On the 5th (8pm), the 11 day old Moon appears 6° from Uranus and 5° from Neptune.

PLUTO, moving towards conjunction in November, sets around 11pm.

MINOR PLANETS. Melpomene is at opposition on 18th September at 7.8 magnitude in Aquarius.

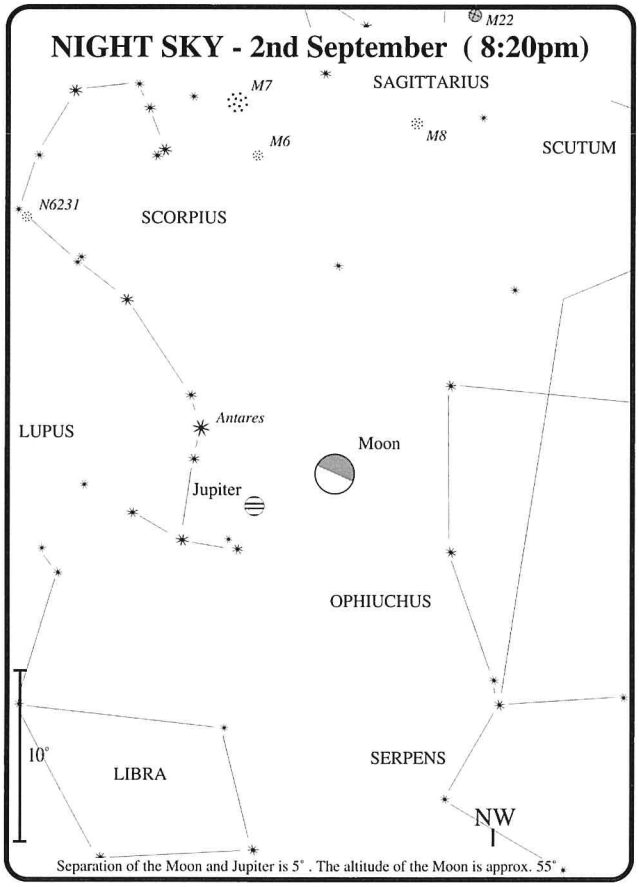
METEOR SHOWERS

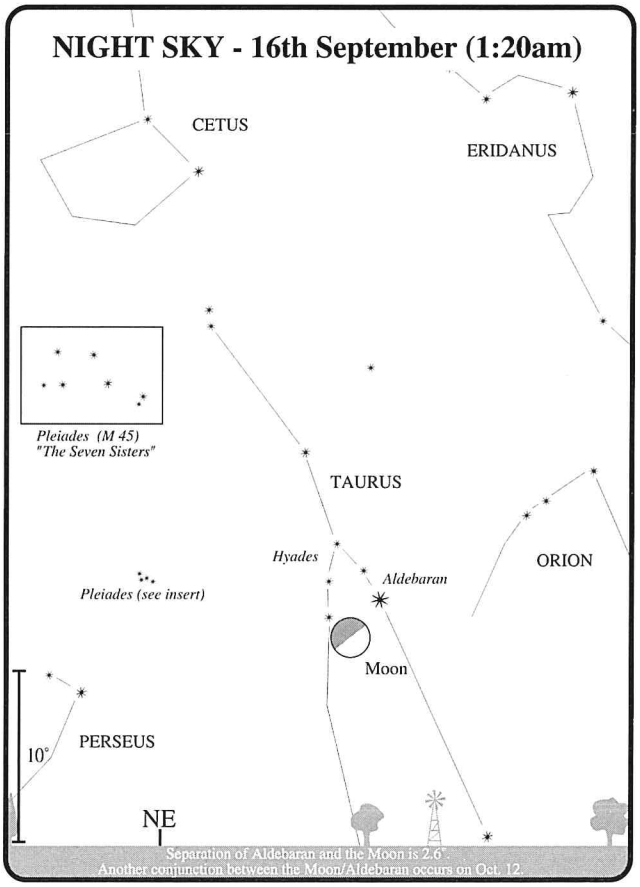
The **KAPPA AQUARIDS,** a minor shower, is active from September 8th to 30th. The meteors are slow and faint, with a maximum zenith hourly rate of 3 on the 21st. On this peak day, the radiant culminates in the northern sky around 11pm.

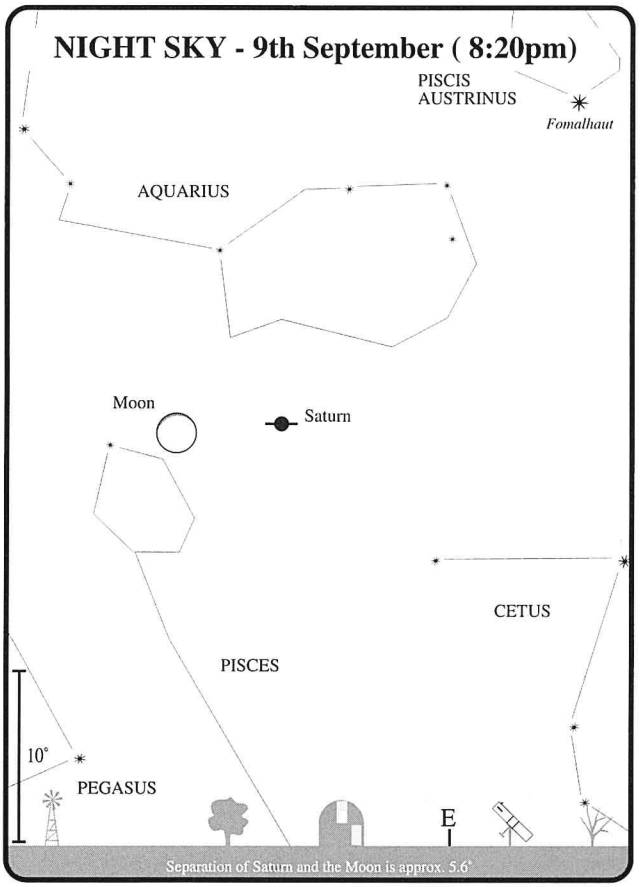
DIARY OF EVENTS

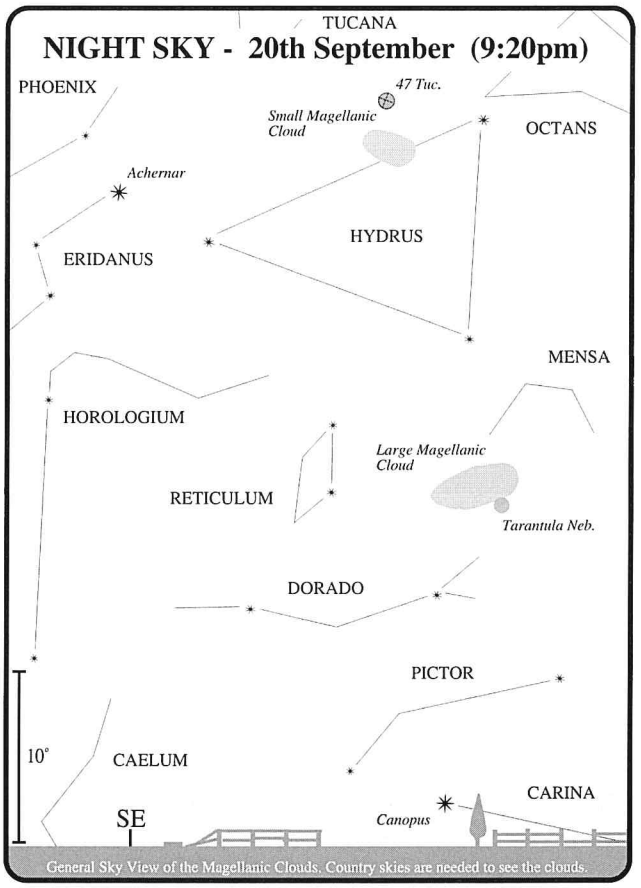
1st		m.p. 19 Fortuna 0.1° South of NGC 4697 (G) in Vir
1st		Venus at Greatest Latitude North (Heliocentric).
2nd		Mercury at aphelion.
2nd	Noon	Jupiter 3° South of the Moon
2nd	5:03 PM	First Quarter Moon
3rd		m.p. 63 Ausonia 1.3° South of Antares
5th	9 AM	Moon at perigee
5th	7 PM	Neptune 5° South of the Moon
6th	3 AM	Uranus 6° South of the Moon
7th		Comet Schwassmann-Wachmann-3 is 2° NE of Spica
9th	11:37 AM	Full Moon
9th	Noon	Mercury at greatest elongation East (27°)
10th	1 AM	Saturn 6° South of the Moon
14th	11 PM	Saturn at opposition
17th		Comet Schwassmann-Wachmann-3 is 2° SW of Mars
17th	5:09 AM	Last Quarter Moon
17th	2 PM	Moon at apogee
20th	3 PM	Jupiter 5° North of Antares
22nd		Mercury at Greatest Latitude South (Heliocentric).
22nd	2 PM	Mercury stationary
23rd		m.p. 1 Ceres 0.5° North of NGC 4636 in Vir
23rd	8 PM	Equinox
25th	12:55 AM	New Moon
25th	5 AM	Jupiter 0.1° North of Omega Oph (possible occultation)
26th		Comet Clark 0.2° East of Alpha Mic.
26th	7 AM	Mercury 3° South of the Moon
28th	2 AM	Mars 2° South of the Moon
29th		m.p. 63 Ausonia 0.6° North of NGC 6316 (GC) in Oph
29th		Mars 1.2° South of m.p. 27 Euterpe
29th		Venus 0.8° North of m.p. 60 Echo
29th	5 AM	Mercury 5° South of Venus
29th	11 PM	Jupiter 3° South of the Moon
30th		Comet Jackson-Neujmin 1.5°SE of Beta Cet.
30th	Noon	Moon at perigee

SEPTEMBER


NIGHT SKY - 2nd September (8:20pm)
M22
SAGITTARIUS
M7
M8
M6
SCUTUM
N6231
SCORPIUS
LUPUS
Antares
Moon
Jupiter
OPHIUCHUS
10°
LIBRA
SERPENS
NW
Separation of the Moon and Jupiter is 5° . The altitude of the Moon is approx. 55°


NIGHT SKY - 16th September (1:20am)
CETUS
ERIDANUS
Pleiades (M 45)
"The Seven Sisters"
TAURUS
Hyades
ORION
Aldebaran
Pleiades (see insert)
Moon
10°
PERSEUS
NE
Separation of Aldebaran and the Moon is 2.6
Another conjunction between the Moon/Aldebaran occurs on Oct. 12.


NIGHT SKY - 9th September (8:20pm)
PISCIS
AUSTRINUS
Fomalhaut
AQUARIUS
Moon
Saturn
CETUS
PISCES
10°
PEGASUS
E
Separation of Saturn and the Moon is approx. 5.6°

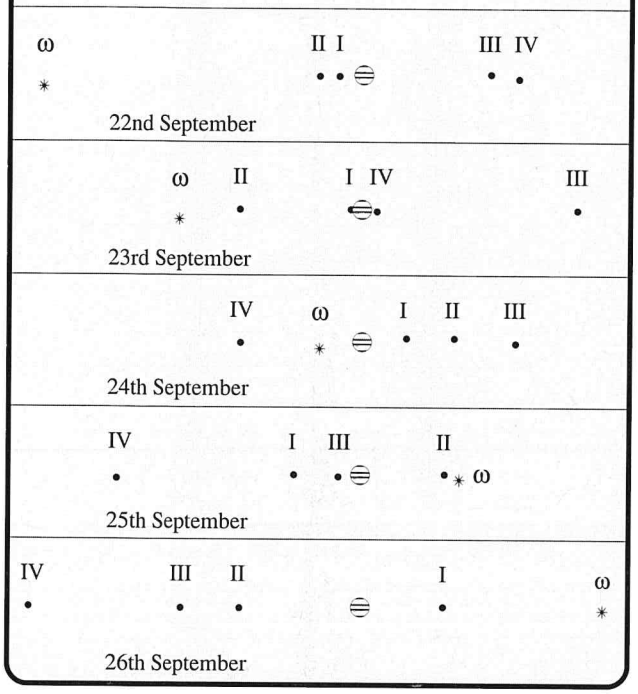

TUCANA
NIGHT SKY - 20th September (9:20pm)
PHOENIX
47 Tuc.
Small Magellanic
Cloud
OCTANS
Achernar
HYDRUS
ERIDANUS
MENSA
HOROLOGIUM
Large Magellanic
Cloud
RETICULUM
Tarantula Neb.
DORADO
PICTOR
10°
CAELUM
CARINA
Canopus
SE
General Sky View of the Magellanic Clouds. Country skies are needed to see the clouds.

JUPITER'S SATELLITES and OMEGA OPHIUCHI

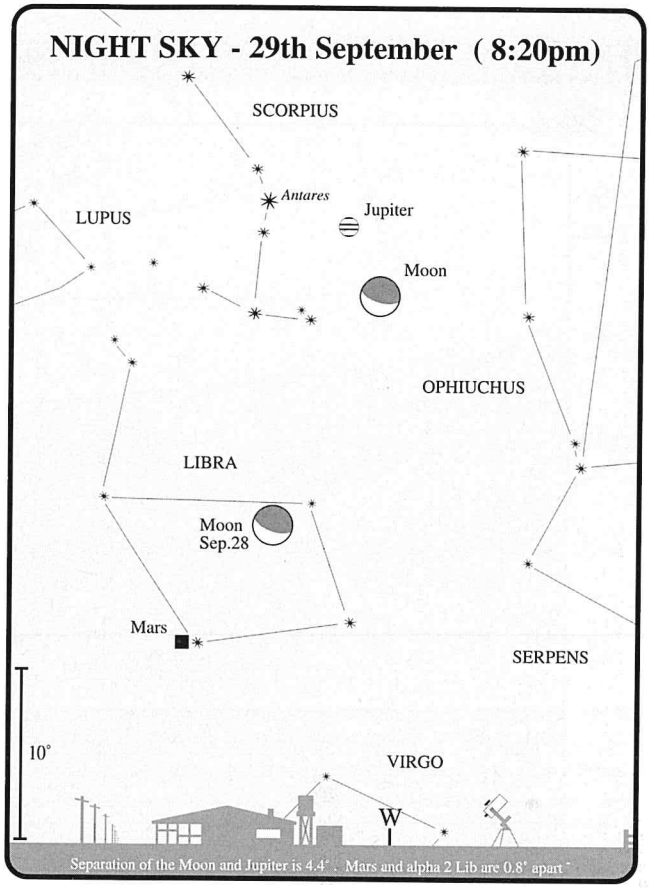
22nd to 26th September, 9.00pm (WAST)

I = Io II = Europa III = Ganymede IV = Callisto

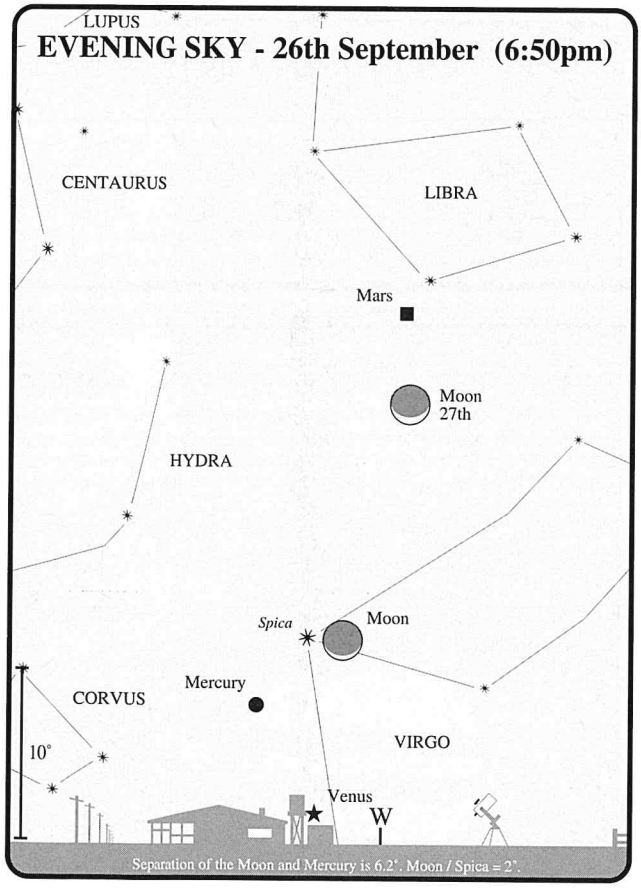
ω = Omega Ophiuchi



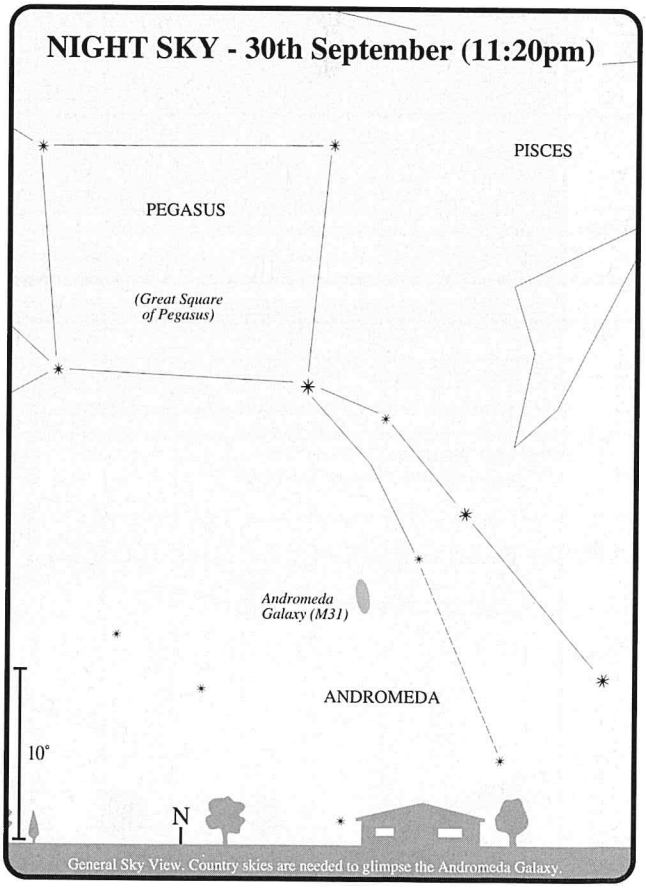
NIGHT SKY - 29th September (8:20pm)



EVENING SKY - 26th September (6:50pm)

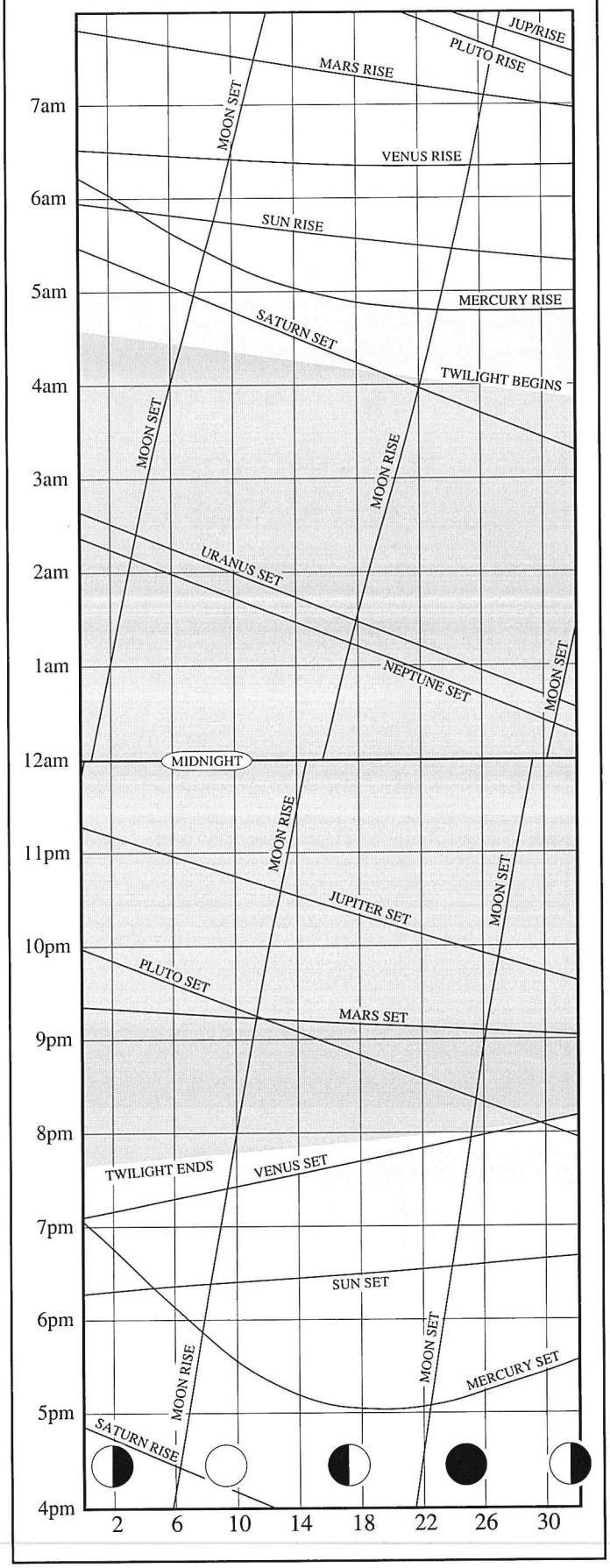


NIGHT SKY - 30th September (11:20pm)

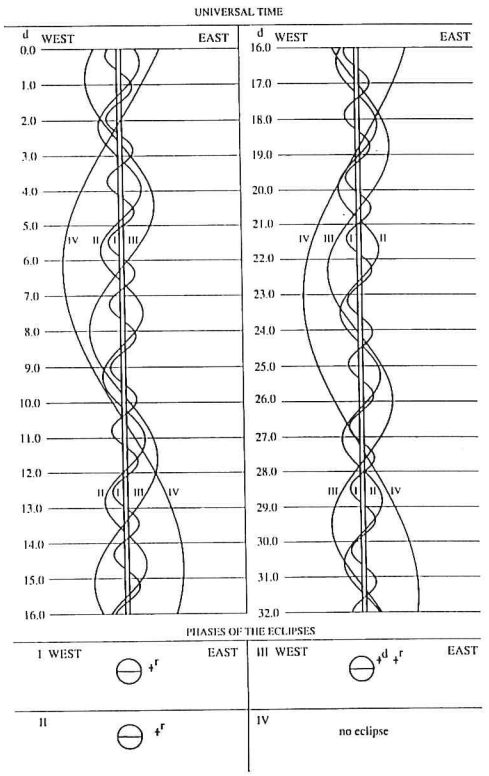


OCTOBER

RISE/SET CHART

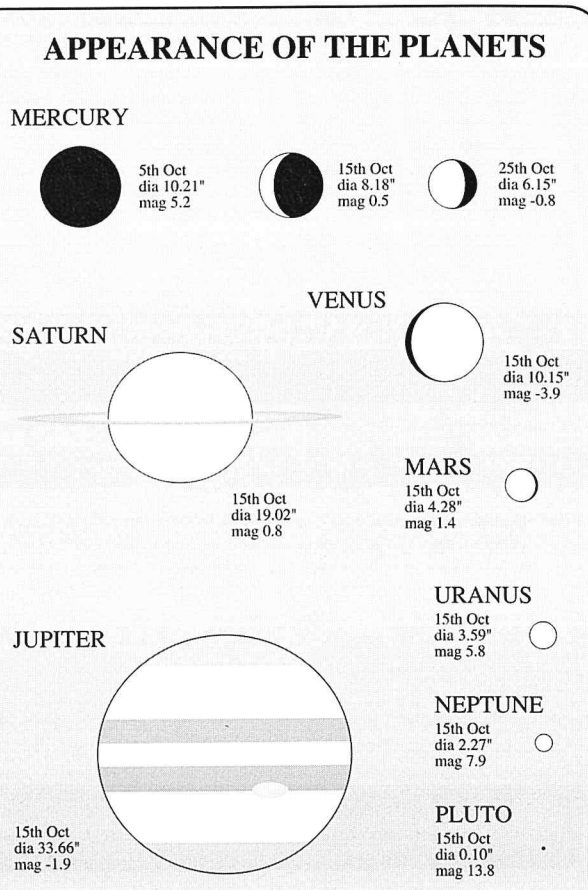


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



OCTOBER

HIGHLIGHTS FOR THE MONTH

- Conjunctions between the Moon and Venus, Mars and Jupiter are seen on three consecutive evenings, commencing on 25th.
- A penumbral eclipse of the Moon is seen on the 9th.
- A partial eclipse of the Sun is visible from northern Australia on 24th.

THE MOON

1st First Quarter, 10:36pm.

8th Full Moon, 11:52pm.

9th Penumbral eclipse of the Moon, visible from Australia (see pages 63 & 64 for more details).

15th Moon at apogee (furthest from Earth - 407500 kms, size 29.3').

17th Last Quarter, 12:26am.

24th New Moon, 12:36pm.

24th Total eclipse of the Sun, partial phases only visible from northern half of Australia (see Solar & Lunar Eclipses pages 63 & 64).

27th Moon at perigee (closest to Earth - 365170 kms, size 32.7').

31st First Quarter, 5:17am.

THE PLANETS

MERCURY rapidly moves towards the Sun early in the month, and is in inferior conjunction (between the Earth and Sun) on the 5th. The planet then reappears in the morning sky, reaching its greatest western elongation (18°) on the 21st. This poor elongation, with the planet low on the horizon in twilight, makes observation extremely difficult. For a challenge, readers may like to try to locate Mercury 3° from the thin crescent Moon (30 hours from New Moon) on the 23rd (see sky view). Mercury spends the entire month in Virgo. The best elongation this year in the morning sky, occurred in March.

VENUS commences the month in Virgo, moving into Libra mid-month. Each evening the planet gains a little altitude, gradually becoming prominent in the early western twilight sky. On the 4th (see sky view) to 6th Venus will be 3° north (right) of 1st magnitude Spica. There will be no confusion over which object is which, with Venus shinning at -3.9 magnitude! On the 22nd, Venus will be a close 6 arc minutes from Alpha Librae. As the star is a wide double, of magnitudes 3rd and 5th, Venus/Alpha Librae will make an interesting telescope field. On the 25th, an 18 hour thin crescent Moon will be 2.5° from Venus (see sky view for 26th).

MARS, at 1.4 magnitude, begins the month within 2° of Alpha Librae (the same star mentioned in Venus above). The planet spends the month low in the western evening sky. On the 20th, the planet moves into Scorpius. Mars will be within 5° of the 2 day old Moon on the 26th (see sky view). The red planet finishes the month on the Scorpius/Ophiuchus border, below Jupiter (8.5° away), and Regulus (4.5° away).

JUPITER, after months of upsetting the familiar tail pattern of the Scorpion, begins to distance itself from 1st magnitude Antares, ending 8° away by month's end. Setting by 10pm (mid-month) there is little time left for observation as Jupiter heads toward conjunction in December. On the 27th, the 4 day old Moon will be 4.5° from the planet (see sky view for 26th).

SATURN is now high in the eastern sky at the end of evening twilight and visible the entire night. On the 6th, the 12 day old Moon appears 6.6° north of Saturn (see sky view). With the rings gradually widening, small telescopes should have no difficulty in seeing them this month. However, by mid-November the rings begin to close again, as the Earth again moves towards another (and final, at least for the next 13.75 years) passage through the ring-plane in February 1996.

URANUS and **NEPTUNE** transit the meridian around 7pm, placing them high in the north western sky by 8pm. On two occasions the Moon will be close to the planets. The first encounter is on the 2nd (8pm) when the 8 day old Moon will be 8° from Uranus and 6° from Neptune. The next meeting is on the 30th (9pm) when the First Quarter Moon will be 8° from Uranus and 10° from Neptune.

PLUTO will be difficult to observe by the end of the month, when it will be setting during evening twilight.

MINOR PLANETS. Hebe reaches opposition on 27th October, at 7.8 magnitude, in Cetus.

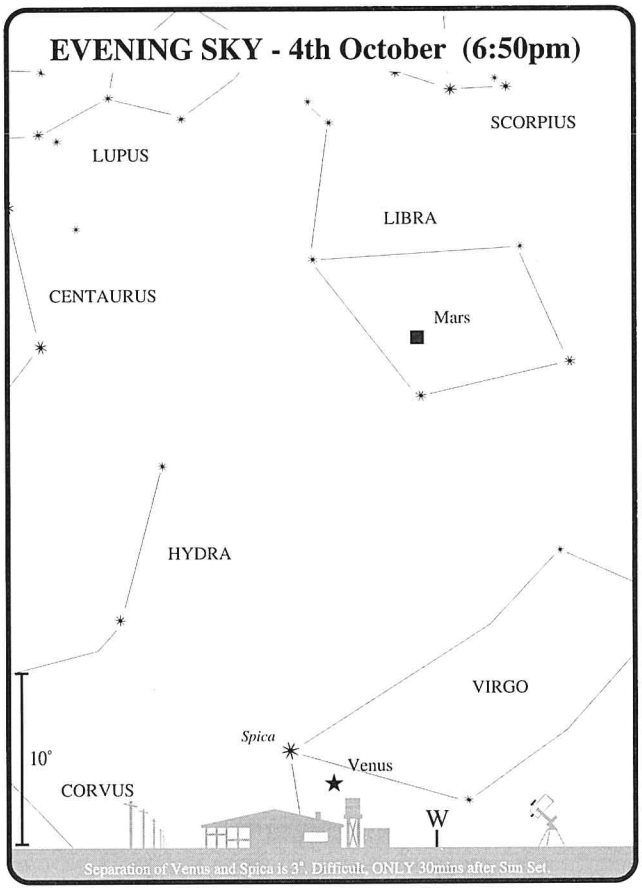
METEOR SHOWERS

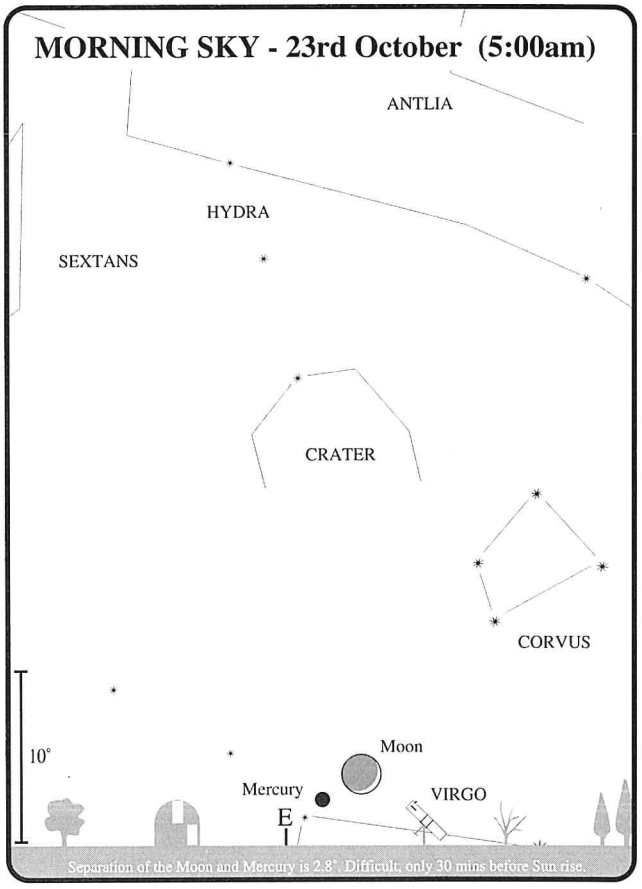
The **ORIONIDS** are best seen from late evening until dawn and are visible from 2nd October through to 7th November. Maximum activity is on the 22nd, but with many sub-maxima good rates are observable between 20th to 24th October. In 1993, high rates were recorded on the 17/18th (4 days before the predicted peak, which came on the 21st). The Orionids provide a prominent display that generally reach an intensity of 25 meteors per hour. They are typically very swift and often bright with some leaving trains. The shower was first recorded by Chinese observers in 288AD, and is associated with Halley's Comet.

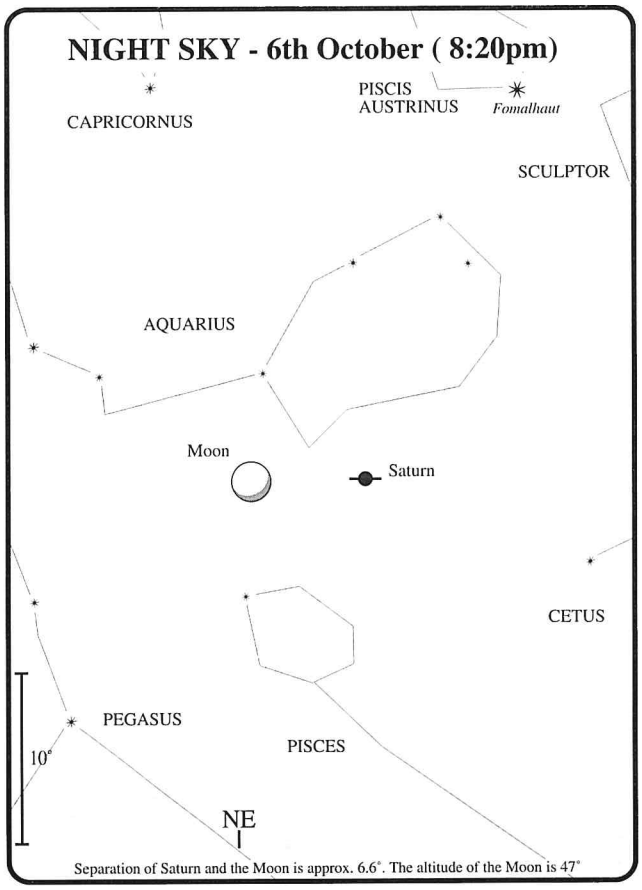
DIARY OF EVENTS

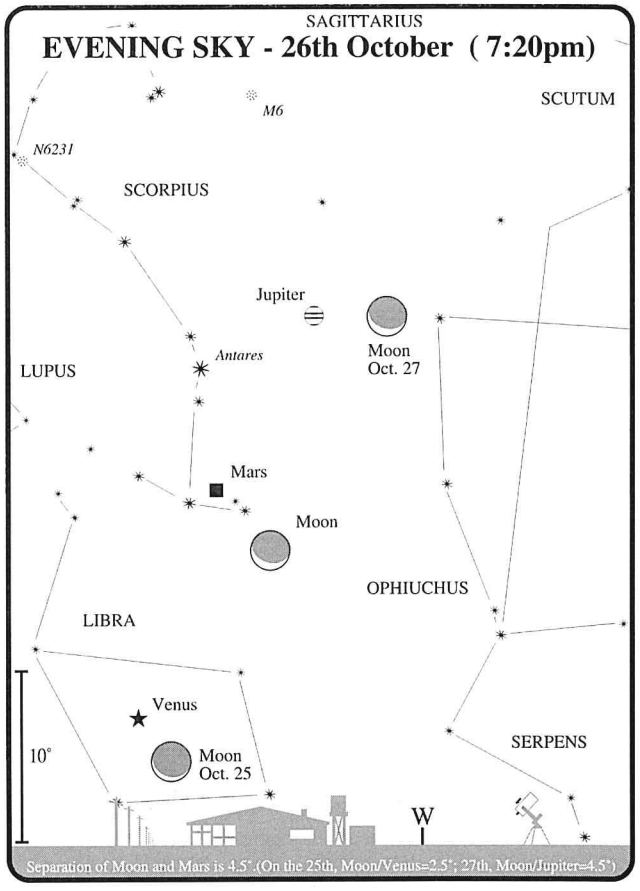
1st	10:36 PM	First Quarter Moon
3rd	1 AM	Neptune 5° South of the Moon
3rd	8 AM	Uranus 6° South of the Moon
4th	5 PM	Venus 3° North of Spica
5th	8 AM	Neptune stationary
5th	9 AM	Mercury in inferior conjunction
6th	11 PM	Uranus stationary
7th	6 AM	Saturn 6° South of the Moon
8th	11:52 PM	Full Moon - Penumbral Eclipse
10th	7 AM	m.p. 1 Ceres in conjunction with the Sun
11th		Mercury 0.7° West of m.p. 19 Fortuna
11th		Mercury at ascending node.
13th	5 PM	Mercury stationary
15th		Comet Schwassmann-Wachmann-3 is 2° South of Antares
15th	10 AM	Moon at apogee
16th		Venus 1.3° South of m.p. 9 Metis
16th		Mercury at perihelion.
17th	12:26 AM	Last Quarter Moon
20th	10 PM	Mercury greatest elongation West (18°)
22nd		m.p. 13 Egeria 2° West of m.p. 7 Iris
22nd	6 AM	m.p. 2 Pallas 0.9° South of the Moon *Occ
23rd	6 AM	Mercury 4° North of the Moon
24th		Jupiter 0.1° South of NGC 6235 (GC) in Oph
24th	12:36 PM	New Moon - Eclipse
25th	7 PM	Venus 1.9° South of the Moon
26th		Mercury at Greatest Latitude North (Heliocentric).
26th	7 PM	Mars 4° South of the Moon
27th		Venus at descending node.
27th	5 AM	Moon at perigee
27th	2 PM	Jupiter 4° South of the Moon
29th		Mars 1° North of M80 (GC) in Sco
30th	7 AM	Neptune 5° South of the Moon
30th	2 PM	Uranus 6° South of the Moon
30th	9 PM	Mercury 4° North of Spica
31st	5:17 AM	First Quarter Moon

OCTOBER


EVENING SKY - 4th October (6:50pm)
SCORPIUS
LUPUS
LIBRA
CENTAURUS
Mars
HYDRA
VIRGO
Spica
Venus
10°
CORVUS
W
Separation of Venus and Spica is 3°. Difficult, ONLY 30mins after Sun Set.

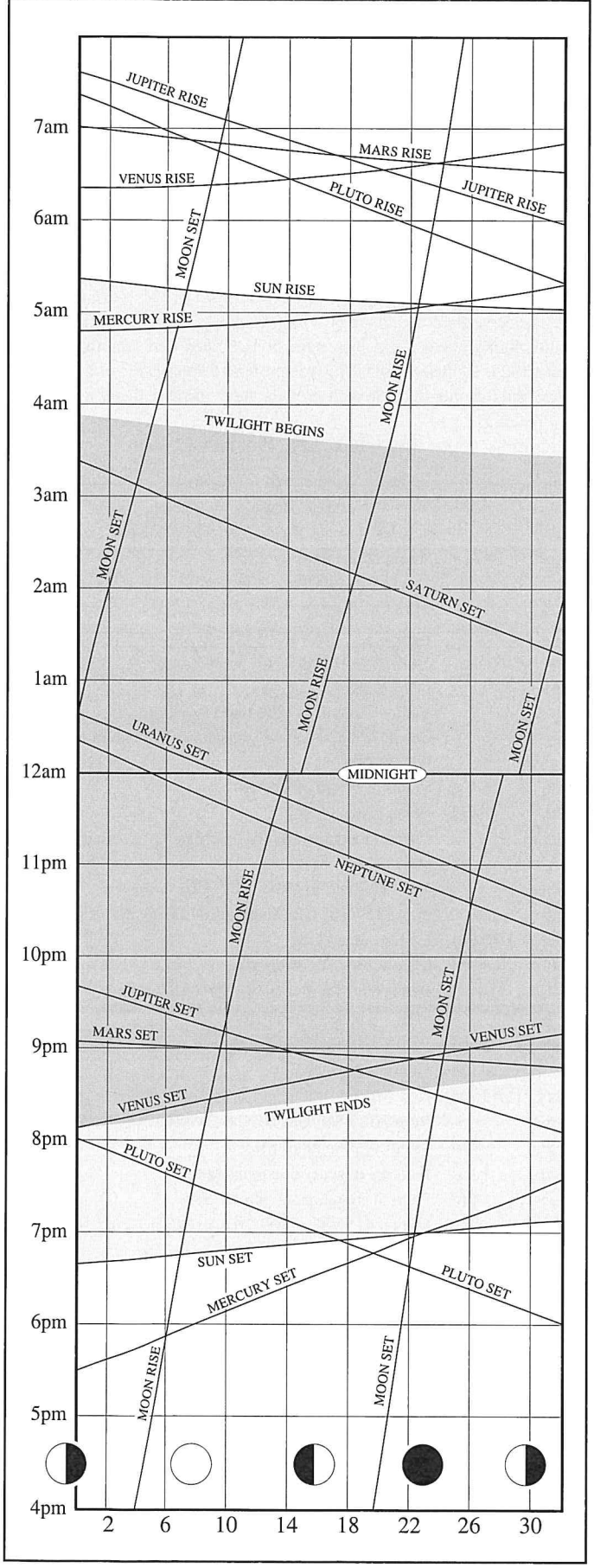

MORNING SKY - 23rd October (5:00am)
ANTLIA
HYDRA
SEXTANS
CRATER
CORVUS
10°
Moon
Mercury
VIRGO
E
Separation of the Moon and Mercury is 2.8°. Difficult, only 30 mins before Sun rise.


NIGHT SKY - 6th October (8:20pm)
CAPRICORNUS
PISCIS AUSTRINUS
Fomalhaut
SCULPTOR
AQUARIUS
Moon
Saturn
CETUS
PEGASUS
10°
PISCES
NE
Separation of Saturn and the Moon is approx. 6.6°. The altitude of the Moon is 47°

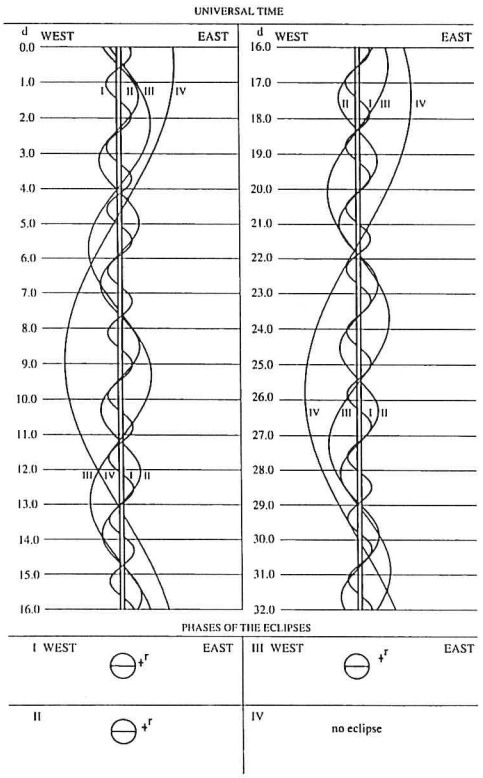

SAGITTARIUS
EVENING SKY - 26th October (7:20pm)
SCUTUM
M6
N6231
SCORPIUS
Jupiter
Antares
Moon
Oct. 27
LUPUS
Mars
Moon
OPHIUCHUS
LIBRA
Venus
10°
Moon
Oct. 25
SERPENS
W
Separation of Moon and Mars is 4.5°.(On the 25th, Moon/Venus=2.5°; 27th, Moon/Jupiter=4.5°)

NOVEMBER

RISE/SET CHART

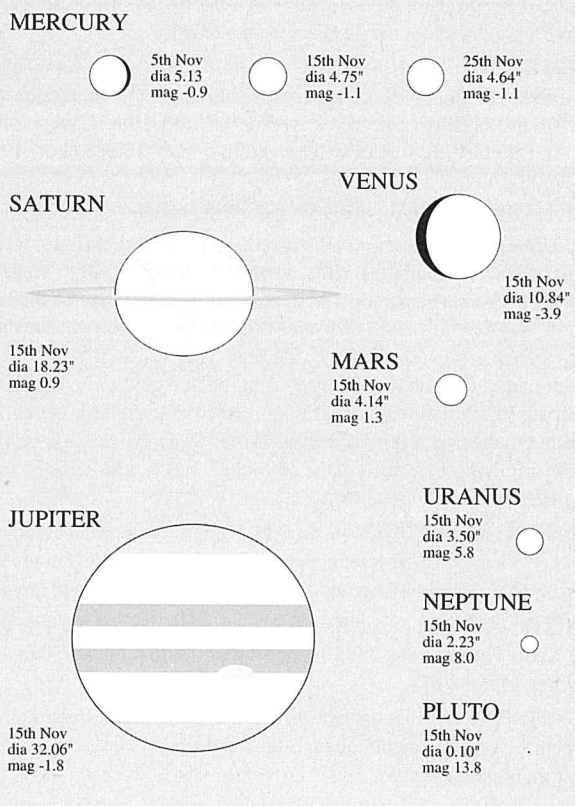


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



NOVEMBER

HIGHLIGHTS FOR THE MONTH

○ Jupiter, Mars and Venus have spectacular conjunctions in the early western evening sky (the Moon joins in on the 24th)

THE MOON

7th Full Moon, 3:20pm.
12th Moon at apogee (furthest from Earth - 403910 kms, size 29.6').
15th Last Quarter, 7.40pm.
22nd New Moon, 11:43pm.
24th Moon at perigee (closest to Earth - 356040 kms, size 33.6').
29th First Quarter, 2:28pm.

THE PLANETS

MERCURY will be virtually impossible to see in November because of its closeness to the Sun. Beginning the month in the morning twilight, the planet is in superior conjunction (on the opposite side of the Sun to the Earth) on the 23rd, and then returns to the evening twilight for the rest of the year.

VENUS is now prominent in the early western evening sky setting soon after the end of astronomical twilight. Throughout November, Venus has some spectacular conjunctions with other celestial bodies: Antares, Mars, Jupiter and the Moon. The following are some of the close approaches by the five objects. The interaction between all objects makes some fascinating and impressive sights, and a full description would be to difficult to include here. From the 10th to 12th Venus will be seen within 4° of Antares. On the 19th, Venus and Jupiter will be within 1.3° of each other. Between the 21st and 24th, Venus will be within 1° of Mars, with closest approach of 0.3° on the 22nd. On the 24th, the 2 day old Moon will be 6° from Venus (also the same distance from Mars and Jupiter). See also sky views for the 16th, 19th, 22nd & 24th as well as the "Evening Sky for Oct. to Jan. 96", page 8.

MARS in Ophiuchus, moves into Sagittarius in the later part of the month. Mars figures prominently in the western evening "sky show" mentioned in Venus (see sky views for the 16th, 19th, 22nd & 24th). On the 15th to 17th, Mars will be within 1.3° of Jupiter. Between the 21st and 24th, Mars will be within 1° of Venus, with closest approach of 0.3° on the 22nd. On the 24th, the 2 day old thin crescent Moon appears 6° from Mars (also the same distance from Venus).

JUPITER also plays a part in the western evening sky "spectacular" this month, its final performance before moving into conjunction with the Sun in December (see sky views for the 16th, 19th, 22nd & 24th). On the 15th to 17th, Jupiter will be within 1.3° of Mars. On the 19th, Jupiter and Venus will be within 1.3° of each other. On the 24th, the 2 day old thin crescent Moon appears 7° from Jupiter.

SATURN culminates around the end of astronomical twilight, well placed for observing in the early evening. Although Saturn's rings are at their widest since being edge-on in August, they may still be difficult to see, or very faint, in small apertures this month. This is because the rings are edge-on with respect to the Sun. This Sun and "edge-on" aspect means that the illumination from the Sun on the rings will be minimal. The Moon will appear within 10° of Saturn three times this month. On the 2nd, the 10 day old Moon is 8° away (see sky view), and 9° the following evening. On the 30th, the 9 day old Moon is 8° from the planet (see sky view).

URANUS and **NEPTUNE** set around 11pm mid-month, leaving only the early evening to capture them at a reasonable altitude. On the 26th (9pm), the 4 day old Moon appears 6° from both Uranus and Neptune.

PLUTO now lost in the twilight is in conjunction (opposite side of the Sun to the Earth) on the 23rd. In December, Pluto returns to the morning twilight sky.

MINOR PLANETS at opposition this month includes, Egeria on 25th November at 10.0 magnitude in Taurus and Iris on 29th at 6.8 magnitude in Taurus.

METEOR SHOWERS

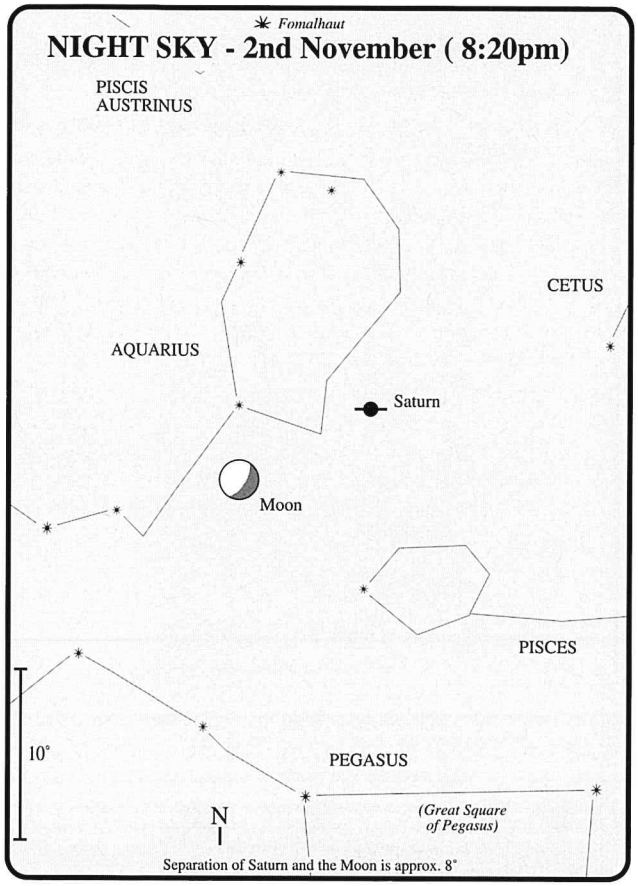
The **ORIONIDS** are visible from 2nd October through to 7th November. Maximum activity was last month on the 22nd (see October notes for further information).

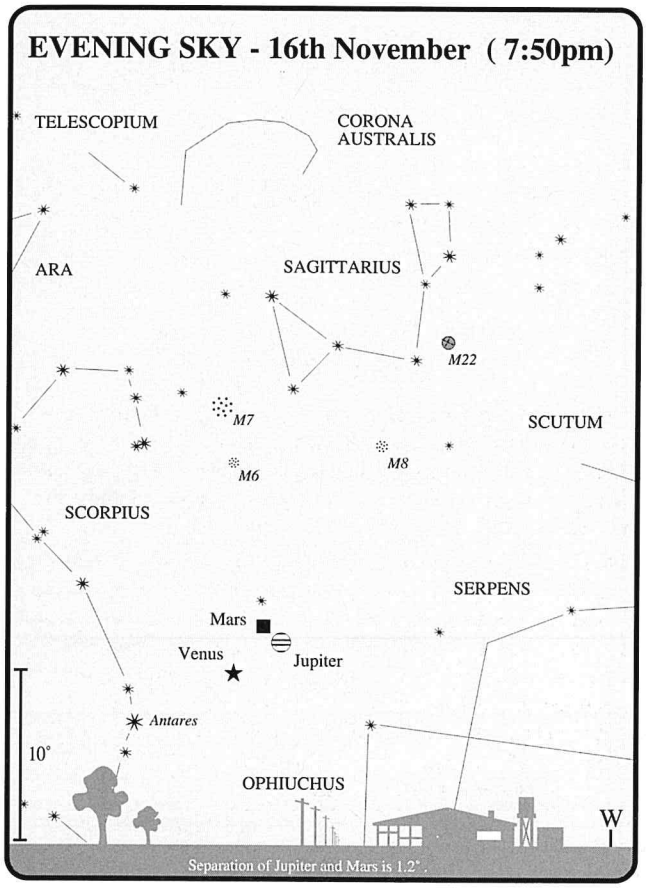
The **LEONIDS,** after a storm of unbelievable intensity in 1833, were responsible for the change in scientist's attitudes that meteors were not purely an atmospheric event. The shower is associated with the periodic comet Tempel-Tuttle and is best about every 33 years when the comet returns to perihelion. The Leonids generally provide showers of low to moderate activity each year (10 to 20 meteors per hour), and are active from 14th to 21st November, with maximum on the 17th. Following a storm in 1966, the years leading up to 1998-2000 are expected to show an increase in activity as the comet returns to perihelion.

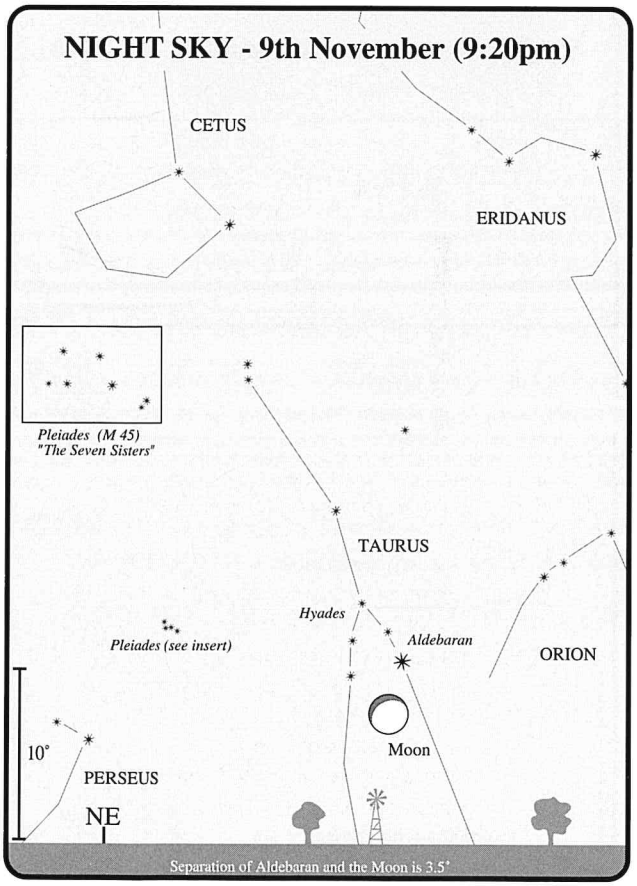
The **ALPHA MONOCEROTIDS** are a minor shower, with unusual short lived bursts of high rates. Active from 15th to 25th November, they peak on the 21st and are best seen from late evening. While the zenith hourly rate is normally around 5, high rates were seen in the years 1925, 1935 and 1985. This has prompted speculation of a 10 year cycle and this month could well provide the evidence either way!

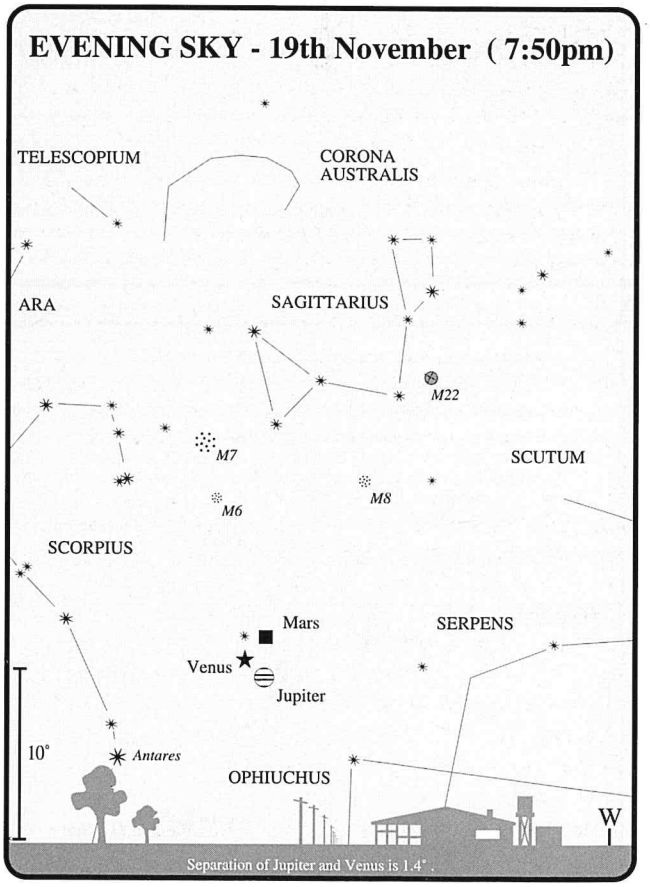
DIARY OF EVENTS

2nd		Venus 1° South of m.p. 27 Euterpe
2nd	8 PM	Mars 4° North of Antares
3rd		m.p. 63 Ausonia 1° South of NGC 6638 (GC) in Sgr
3rd	10 AM	Saturn 6° South of the Moon
4th		Comet Honda-Mrkos-Pajdusakova 0.2° North of NGC 6553 (GC) in Sgr
7th		Jupiter 0.3° North of NGC 6287 (GC) in Oph
7th		Mercury 0.5° North of 60Echo
7th	3:20 PM	Full Moon
8th		Venus 1° North of M80 (GC) in Sco
10th		Comet Honda-Mrkos-Pajdusakova 1° South of M28 (GC) in Sgr
11th	2 AM	Venus 4° North of Antares
12th	5 AM	Moon at apogee
13th		Comet Honda-Mrkos-Pajdusakova 0.3° South of NGC 6638 (GC) in Sgr
14th		Mars 1° South of NGC 6287 (GC) in Oph
15th		m.p. 88 Thisbe 0.2° South of M72 (GC) in Aqr
15th	7:40 PM	Last Quarter Moon
16th	4 PM	Mars 1.2° South of Jupiter
17th		Venus 0.8° South of NGC 6287 (GC) in Oph
18th		Mercury at descending node.
19th	8 PM	Venus 1.3° South of Jupiter
22nd	10 PM	Saturn stationary
22nd	11:43 PM	New Moon
23rd		Venus 0.5° South of NGC 6401 (GC) in Oph
23rd	6 AM	Venus 0.2° South of Mars
23rd	1 PM	Mercury in superior conjunction
23rd	3 PM	Pluto in conjunction with the Sun
24th		Mars 0.4° South of NGC 6401 (GC) in Oph
24th	7 AM	Moon at perigee
24th	9 AM	Jupiter 4° South of the Moon
24th	4 PM	Mars 5° South of the Moon
24th	5 PM	Venus 6° South of the Moon
26th		m.p. 19 Fortuna 1.8° North of Spica
26th	3 PM	Neptune 5° South of the Moon
26th	10 PM	Uranus 6° South of the Moon
27th		Comet Jackson-Neujmin 1.5° South of Beta Cet.
29th		Venus 0.5° North of NGC 6544 (GC) in Sgr
29th		Mercury at aphelion.
29th	2:28 PM	First Quarter Moon
30th	3 PM	Saturn 6° South of the Moon


Fomalhaut
NIGHT SKY - 2nd November (8:20pm)
PISCIS AUSTRINUS
CETUS
AQUARIUS
Saturn
Moon
PISCES
10°
PEGASUS
N
(Great Square of Pegasus)
Separation of Saturn and the Moon is approx. 8°

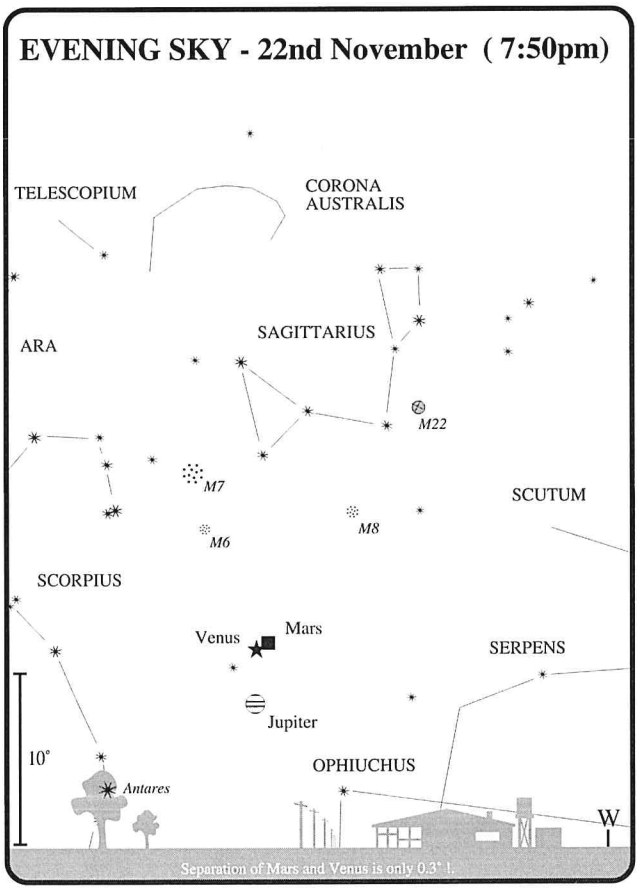

EVENING SKY - 16th November (7:50pm)
TELESCOPIUM
CORONA AUSTRALIS
ARA
SAGITTARIUS
M22
M7
SCUTUM
M6
M8
SCORPIUS
SERPENS
Mars
Venus
Jupiter
Antares
10°
OPHIUCHUS
W
Separation of Jupiter and Mars is 1.2°.


NIGHT SKY - 9th November (9:20pm)
CETUS
ERIDANUS
Pleiades (M 45)
"The Seven Sisters"
TAURUS
Hyades
Aldebaran
Pleiades (see insert)
ORION
Moon
10°
PERSEUS
NE
Separation of Aldebaran and the Moon is 3.5°

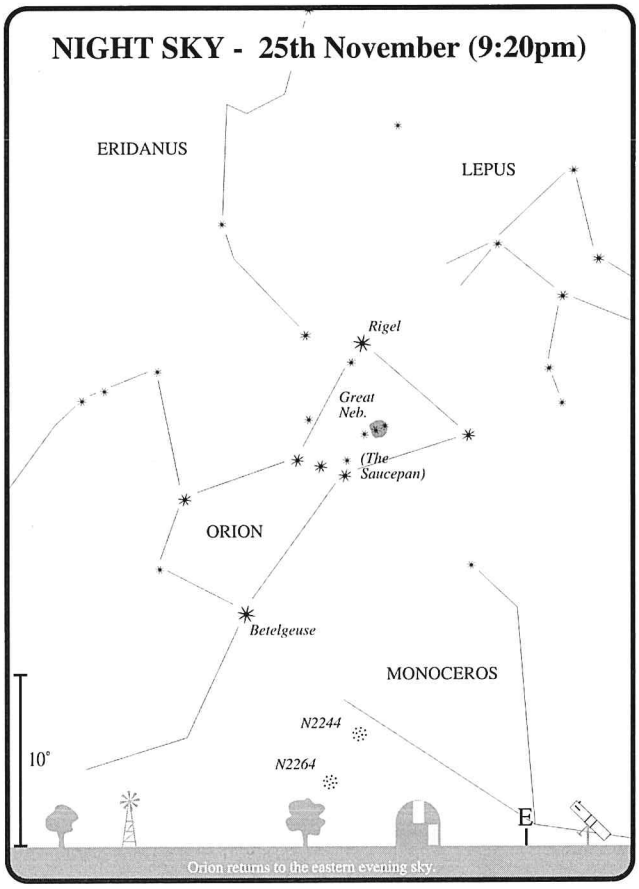

EVENING SKY - 19th November (7:50pm)
TELESCOPIUM
CORONA AUSTRALIS
ARA
SAGITTARIUS
M22
M7
SCUTUM
M6
M8
SCORPIUS
Mars
SERPENS
Venus
Jupiter
10°
Antares
OPHIUCHUS
W
Separation of Jupiter and Venus is 1.4°.

NOVEMBER

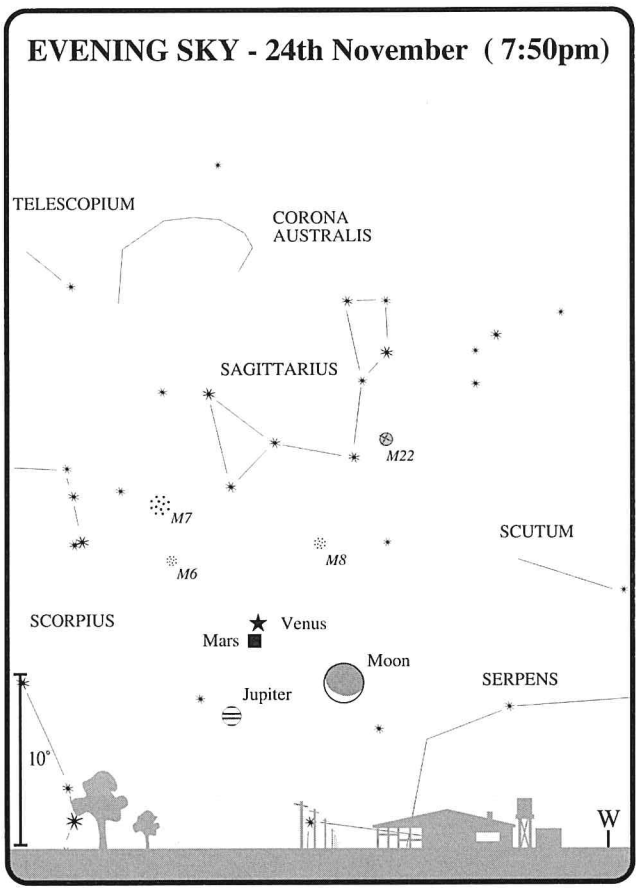
EVENING SKY - 22nd November (7:50pm)



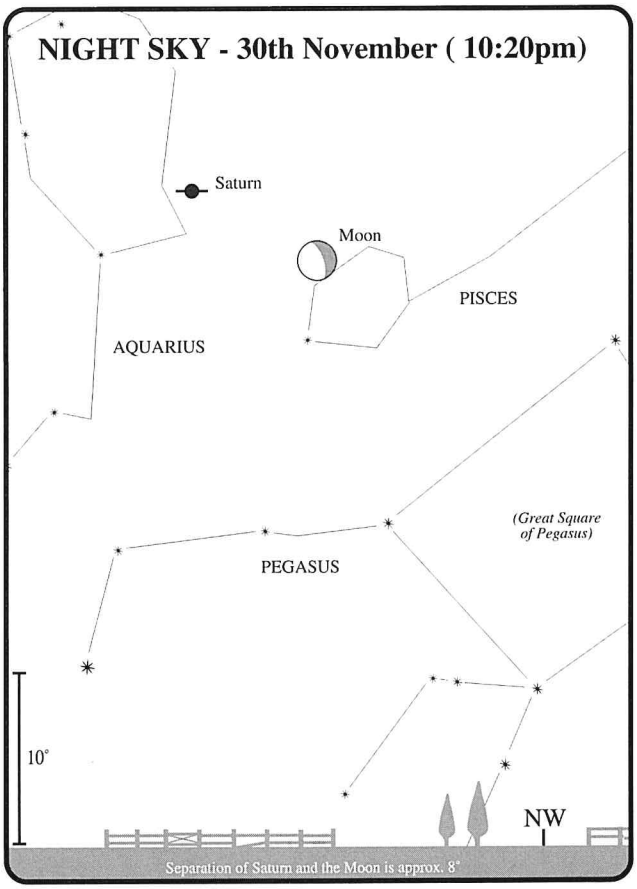
NIGHT SKY - 25th November (9:20pm)



EVENING SKY - 24th November (7:50pm)

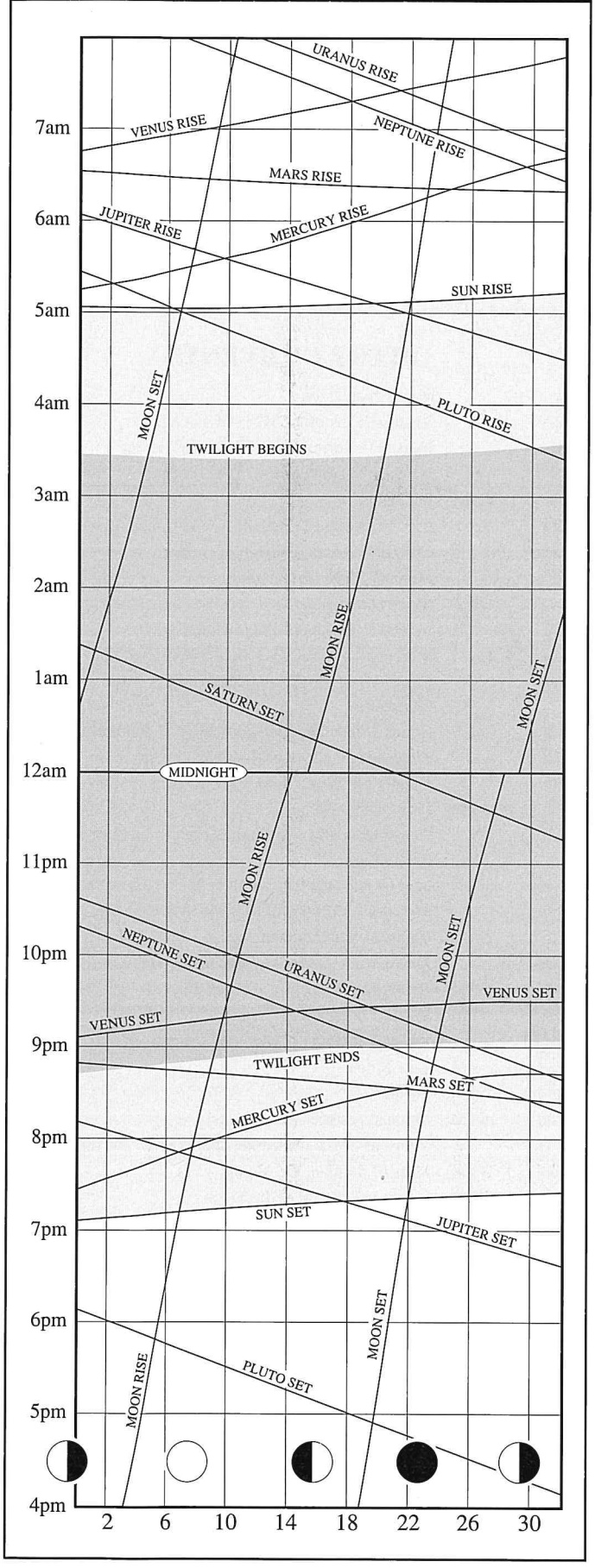


NIGHT SKY - 30th November (10:20pm)

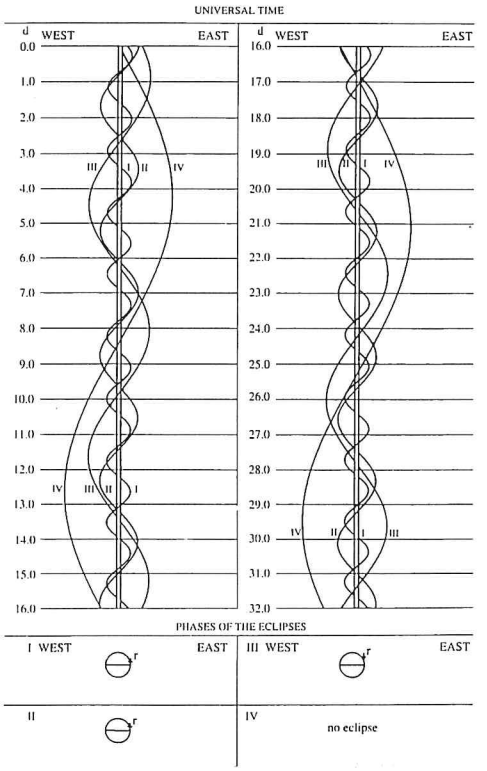


DECEMBER

RISE/SET CHART

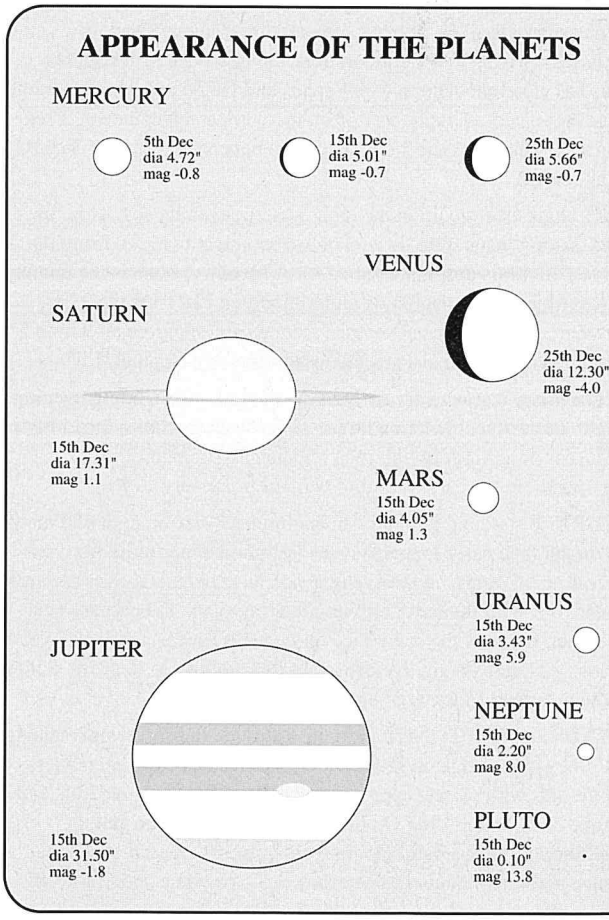


JUPITER'S MOONS



I = Io, II = Europa, III = Ganymede, IV = Callisto

APPEARANCE OF THE PLANETS



DECEMBER

HIGHLIGHTS FOR THE MONTH

- Jupiter, Mars and Venus continue to be prominent in the early western evening sky.
- Comet Honda-Mrkos-Pajdusakova brightens rapidly until perihelion on 25th. It remains an early evening object. Also take note of the conjunctions on the 20th (see below).
- Towards the end of the month, Jupiter has been replaced by Mercury in the trio of planets in the early western evening sky. On 23rd, Mars and Mercury are only 1° apart.

THE MOON

7th Full Moon, 9:27am.
9th Moon at apogee (furthest from Earth - 406910 kms, size 29.4').
15th Last Quarter, 1:31pm.
22nd New Moon, 10:22am.
22nd Moon at perigee (closest to Earth - 357840 kms, size 33.4').
29th First Quarter, 3:06am.

THE PLANETS

MERCURY, moving from Ophiuchus into Sagittarius early in the month, reaches maximum eastern elongation (19.5°) on the 2nd January 1996. Visible only in the evening twilight, the planet forms some interesting configurations and conjunctions with Venus, Mars (see sky views), Uranus, Neptune and the Moon. With five planets and the Moon within 15° of each other (on the 23rd), it is a shame that all are not visible to the naked eye. However, some highlights include: from the 22nd to 24th Mars appears within 1.4° of Mercury, on the 23rd the 2 day old Moon is 8° from Mercury with Mars between the two, the 28th Mercury and Neptune 2° apart and the 31st, Mercury and Uranus 1.2° apart. On the 31st, Mercury/Mars and Uranus/Neptune form a neat parallelogram all within 5° of each other.

VENUS during December remains in the early evening sky, setting just after the end of twilight. It begins the month 4° above Mars in Sagittarius, moving into Capricornus in the last week of December. Venus has close encounters with Uranus and Neptune during the month: closest approach to Uranus of 1.3° on the 20th, and Neptune of 2° on the 17th. On the 24th, the 3 day old Moon appears 8° north of Venus (a twilight event).

MARS begins the month in the early western evening sky, 4° below Venus, setting just before the end of astronomical twilight. From the 22nd to 24th Mars appears within 1.4° of Mercury; Mars is the fainter of the two (Mars at 1.2 magnitude and Mercury at -0.7). On the 31st, Mars/Mercury and Uranus/Neptune form a parallelogram all within 5° of each other, with the distance between Mars and Neptune 1.8°.

JUPITER can be seen very early in the month in the western evening twilight, but with conjunction on the 19th it soon becomes too close to the Sun for observing. Jupiter then remains invisible until its reappearance in the early morning twilight in January 1996.

SATURN sets around midnight and culminates around 6pm mid month. This month (and early January) is the last good opportunity for observation of Saturn, in the evening sky, as the planet moves towards conjunction. With the Earth crossing the ring-plane in February next year (when we view the south face of the rings for the next 13.75 years), the rings gradually begin to close again this month. On the 27th, Saturn and the 6 day old Moon is 6° apart (see sky view).

URANUS and **NEPTUNE** rapidly lose altitude in the western evening sky as they near conjunction in January. Venus has close encounters with the pair with closest approach to Uranus of 1.3° on the 20th, and Neptune of 2° on the 17th. On the 31st, Uranus/Neptune and Mars/Mercury form a parallelogram all within 5° of each other: the distance between Uranus and Mercury 1.3°, Neptune and Mars 1.8°.

PLUTO remains low in the eastern morning twilight sky throughout December.

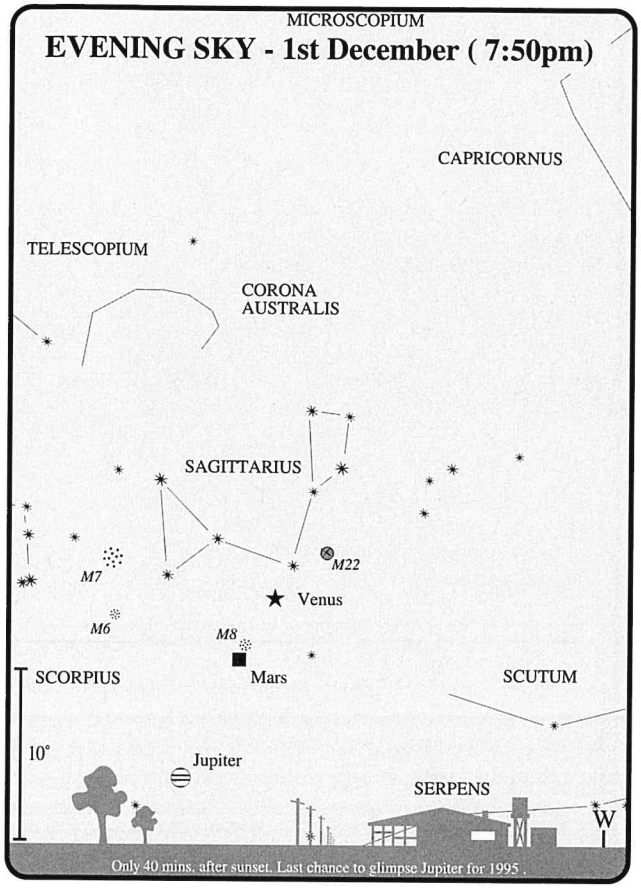
MINOR PLANETS at opposition this month include: Psyche on 6th December at 9.5 magnitude in Taurus and Amphitrite on 22nd at 8.9 magnitude in Auriga.

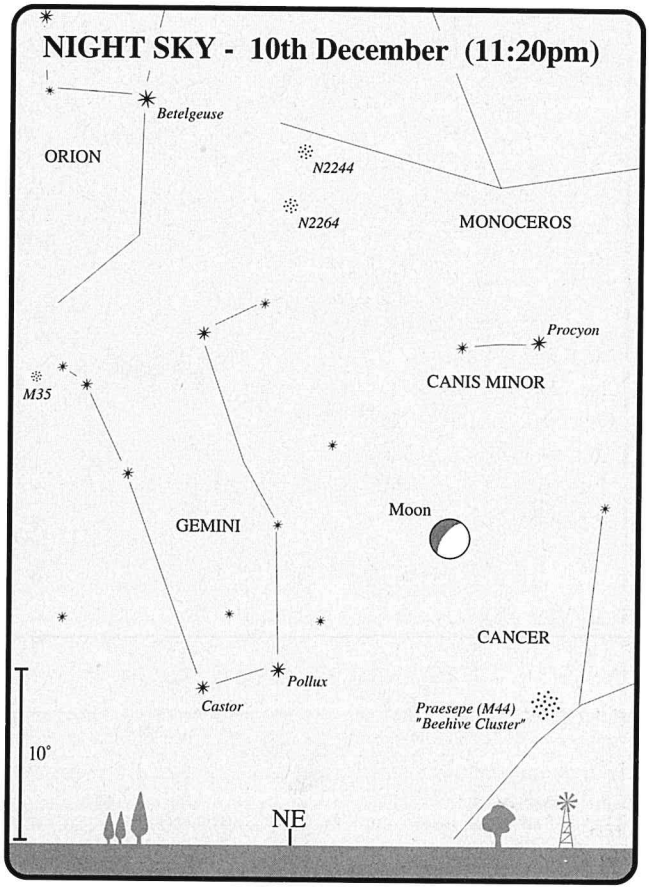
COMETS

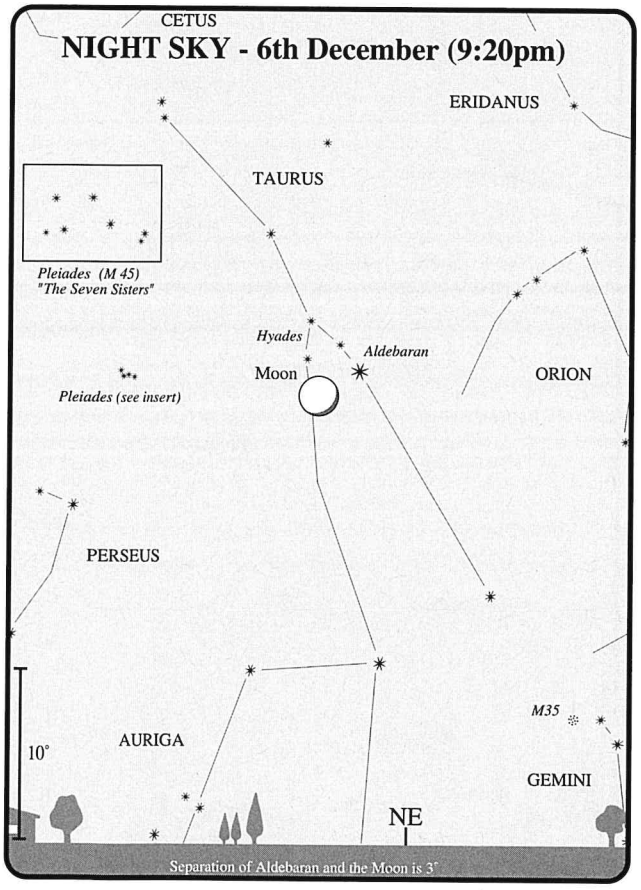
P/ HONDA-MRKOS-PAJDUSAKOVA. During December this comet is an early evening object (1st, setting 10pm), disappearing into the twilight at the end of the month. It commences the month in Sagittarius at magnitude 11 but brightens rapidly as it approaches perihelion on Christmas Day (7th magn.). At the end of December it is in Capricornus, setting at 9pm (the end of twilight). The comet has some interesting conjunctions. On the 20th, the comet, Venus, Uranus, minor planet Ausonia and M75 fit into a 3 degree circle (a little challenging due to twilight).

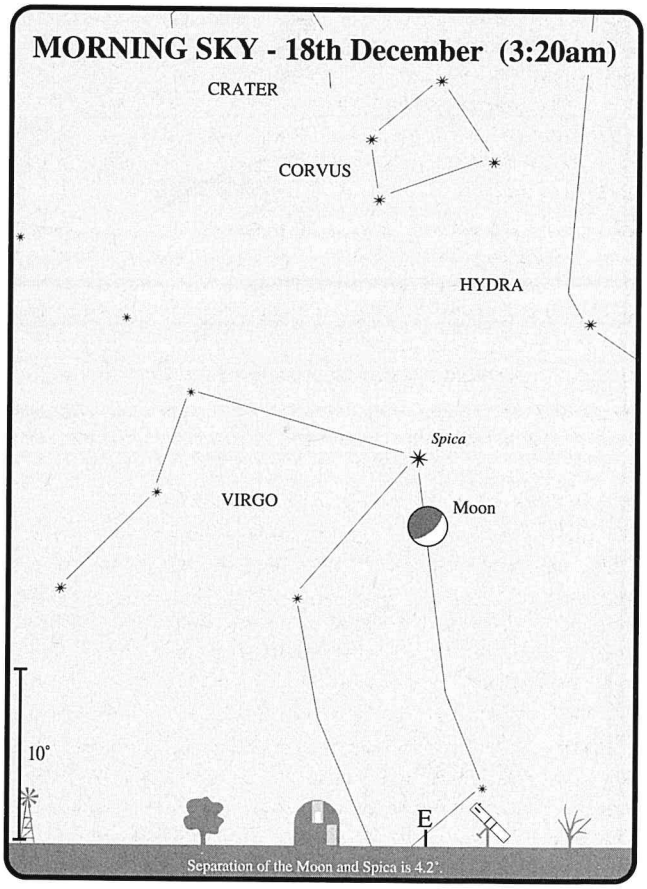
DIARY OF EVENTS

1st		Venus at aphelion.
2nd		Venus 0.3° North of M28 (GC) in Sgr
3rd		Mars 0.7° North of NGC 6544 (GC) in Sgr
4th		Venus 0.7° South of M22 (GC) in Sgr
7th	9:27 AM	Full Moon
8th		m.p. 13 Egeria 1° South of IC 348 (OC) in Peg
8th		Mars 0.7° North of M28 (GC) in Sgr
8th		Mercury 2° South of Jupiter
9th	6 PM	Moon at apogee
11th		Mars 0.3° South of M22 (GC) in Sgr
13th		Mercury 0.4° South of NGC 6544 (GC) in Sgr
14th		Comet Honda-Mrkos-Pajdusakova 0.8° South of m.p. 63 Ausonia
15th		Comet Honda-Mrkos-Pajdusakova 2° South of Uranus
15th		Mercury 0.5° South of M28 (GC) in Sgr
15th		Uranus 1.3° North of m.p. 63 Ausonia
15th	1:31 PM	Last Quarter Moon
16th		Comet Honda-Mrkos-Pajdusakova 1° South of M75 (GC) in Sgr
16th		m.p. 63 Ausonia 0.3° South of M75 (GC) in Sgr
16th		Mercury 0.1° North of NGC 6638 (GC) in Sgr
17th	1 AM	Venus 2° South of Neptune
19th		Mercury at Greatest Latitude South (Heliocentric).
19th	6 AM	Jupiter in conjunction with the Sun
20th	9 PM	Venus 1.3° South of Uranus
21st		Venus 0.2° South of M75 (GC) in Sgr
22nd	10:22 AM	New Moon
22nd	4 PM	Solstice
22nd	6 PM	Moon at perigee
23rd		Venus at Greatest Latitude South (Heliocentric).
23rd	3 PM	Mars 6° South of the Moon
23rd	3 PM	Mercury 7° South of the Moon
23rd	5 PM	Mercury 1.1° South of Mars
24th		m.p. 16 Psyche 1° North of Aldebaran
24th		Venus 0.2° South of m.p. 63 Ausonia
24th	2 AM	Neptune 5° South of the Moon
24th	10 AM	Uranus 6° South of the Moon
24th	6 PM	Venus 7° South of the Moon
25th		Comet Honda-Mrkos-Pajdusakova 0.3° South of Venus
26th		Comet Honda-Mrkos-Pajdusakova 0.4° South of m.p. 63 Ausonia
27th	11 PM	Saturn 5° South of the Moon
28th	10 AM	Mercury 2° South of Neptune
29th		Uranus 1° North of M75 (GC) in Sgr
29th	3:06 AM	First Quarter Moon

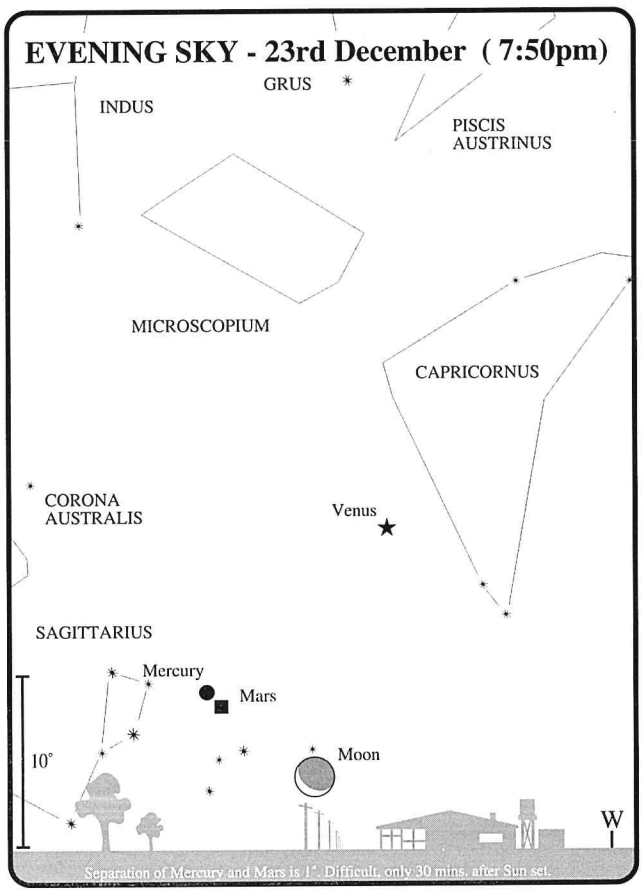

MICROSCOPIUM
EVENING SKY - 1st December (7:50pm)
CAPRICORNUS
TELESCOPIUM
CORONA AUSTRALIS
SAGITTARIUS
M7
M22
Venus
M6
M8
SCORPIUS
Mars
SCUTUM
10°
Jupiter
SERPENS
W
Only 40 mins. after sunset. Last chance to glimpse Jupiter for 1995 .

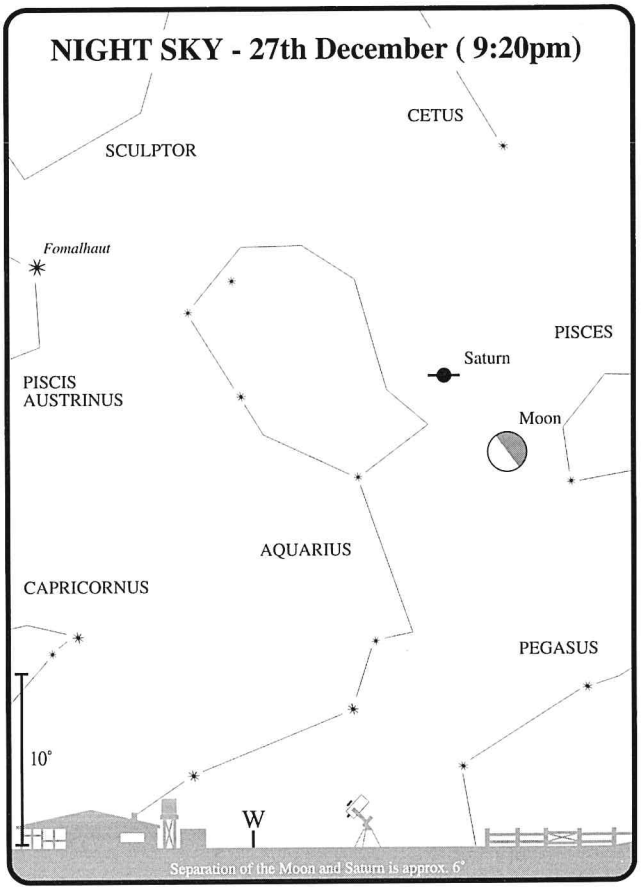

NIGHT SKY - 10th December (11:20pm)
Betelgeuse
ORION
N2244
N2264
MONOCEROS
Procyon
M35
CANIS MINOR
Moon
GEMINI
CANCER
Pollux
Castor
Praesepe (M44)
"Beehive Cluster"
10°
NE

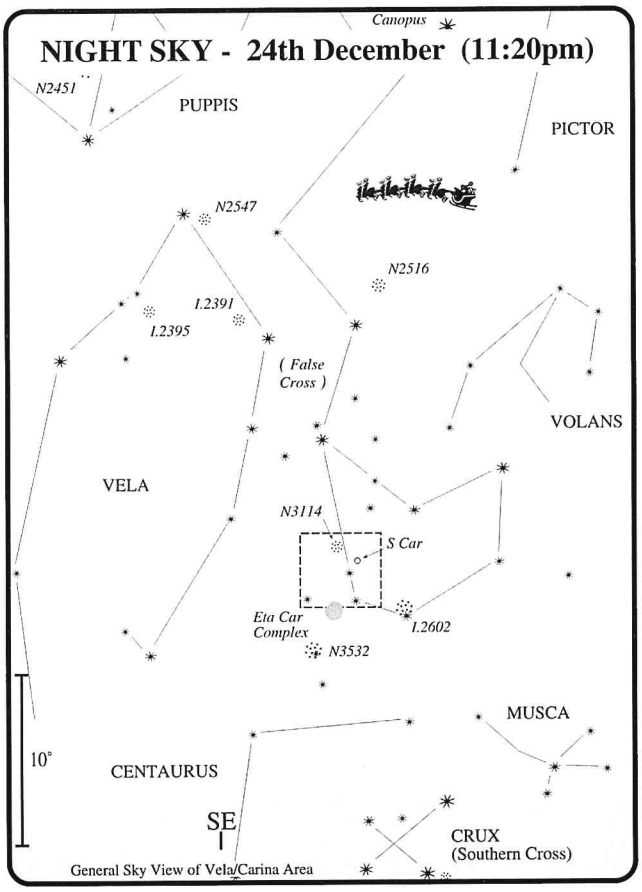

CETUS
NIGHT SKY - 6th December (9:20pm)
ERIDANUS
TAURUS
Pleiades (M 45)
"The Seven Sisters"
Hyades
Aldebaran
Moon
ORION
Pleiades (see insert)
PERSEUS
M35
10°
AURIGA
GEMINI
NE
Separation of Aldebaran and the Moon is 3°

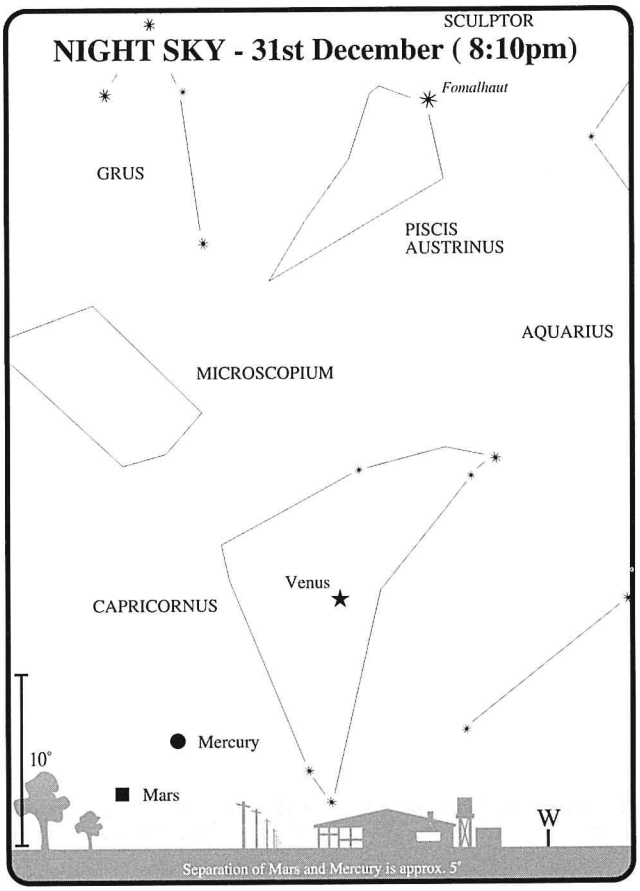

MORNING SKY - 18th December (3:20am)
CRATER
CORVUS
HYDRA
Spica
VIRGO
Moon
10°
E
Separation of the Moon and Spica is 4.2°.

DECEMBER


EVENING SKY - 23rd December (7:50pm)
GRUS
INDUS
PISCIS AUSTRINUS
MICROSCOPIUM
CAPRICORNUS
CORONA AUSTRALIS
Venus
SAGITTARIUS
Mercury
Mars
Moon
10°
W
Separation of Mercury and Mars is 1°. Difficult, only 30 mins. after Sun set.


NIGHT SKY - 27th December (9:20pm)
CETUS
SCULPTOR
Fomalhaut
PISCES
Saturn
PISCIS AUSTRINUS
Moon
AQUARIUS
CAPRICORNUS
PEGASUS
10°
W
Separation of the Moon and Saturn is approx. 6°


NIGHT SKY - 24th December (11:20pm)
Canopus
N2451
PUPPIS
PICTOR
N2547
N2516
I.2391
I.2395
(False Cross)
VOLANS
VELA
N3114
S Car
Eta Car Complex
I.2602
N3532
MUSCA
10°
CENTAURUS
SE
CRUX (Southern Cross)
General Sky View of Vela/Carina Area


NIGHT SKY - 31st December (8:10pm)
SCULPTOR
Fomalhaut
GRUS
PISCIS AUSTRINUS
AQUARIUS
MICROSCOPIUM
Venus
CAPRICORNUS
Mercury
Mars
10°
W
Separation of Mars and Mercury is approx. 5°

PART 2 - THE SOLAR SYSTEM

EXPLANATION

GENERAL COMMENTS

Astronomical Terms. Words, used in this introduction ,that are in *italics* have an expanded explanation in the Glossary.

TIME There are two time zones used in part 2 of this book. They are Western Australian Standard Time (WAST) ie. as used in part 1, and Universal Time (UT). The 24 hr clock is often used in astronomy eg. 16:00 hr is equal to 4:00pm. This avoids having to distinguish between "am" and "pm". The 24hr approach is used a lot in Part 2 of this book, eg. for rise/set times. In some areas, it is convenient to use decimal hours. eg. 5.3hr is the same as 5hr 18 min or 5:18hr.

UNIVERSAL TIME, or UT, is the mean time for the meridian of Greenwich, England reckoned from midnight. WAST is 8 hours ahead of UT . For example, midnight UT, or 0 hr, is equal to 8:00hr or 8:00am WAST.

ASTRONOMICAL CO-ORDINATES OR POSITIONS. The astronomical positions are given as equatorial co-ordinates. These are Right Ascension (RA) and Declination (Dec) which are analogous to longitude and latitude for finding places on the Earth. RA is the longitude component but unlike its terrestrial counterpart it is not measured in degrees, but in hours. The 360 degrees, for once around the sky, are broken up into 24 hour divisions. Each hour is further divided, like a clock, into minutes and seconds. Declination is the counterpart to latitude but does not use north or south. Objects north of the celestial equator have positive(+) declinations, south are negative(-).

The Earth's daily rotation on its polar axis causes the stars to appear to rotate around a point in the sky. From southern latitudes, as is the case of Australia, this point is called the "South Celestial Pole" and is at declination -90°. The "Northern Celestial Pole", not visible from the southern hemisphere, is at +90°. The celestial equator and poles can be described as projections on the sky of their terrestrial partners.

THE "POSITION" TABLES. All Right Ascensions and Declinations have been calculated for 0 hr UT of date listed, *Epoch* 2000. All positions are "geocentric". This means they have been calculated for the position of the centre of the Earth. There is no taking into account the parallax effect of the observer being located on the surface of the Earth. With the exception of the Moon, this slight shift is certainly insignificant. Ephemerides for the outer planets are given in weekly intervals and correspond to Saturdays. The Sun, Moon, Venus and Mercury are daily.

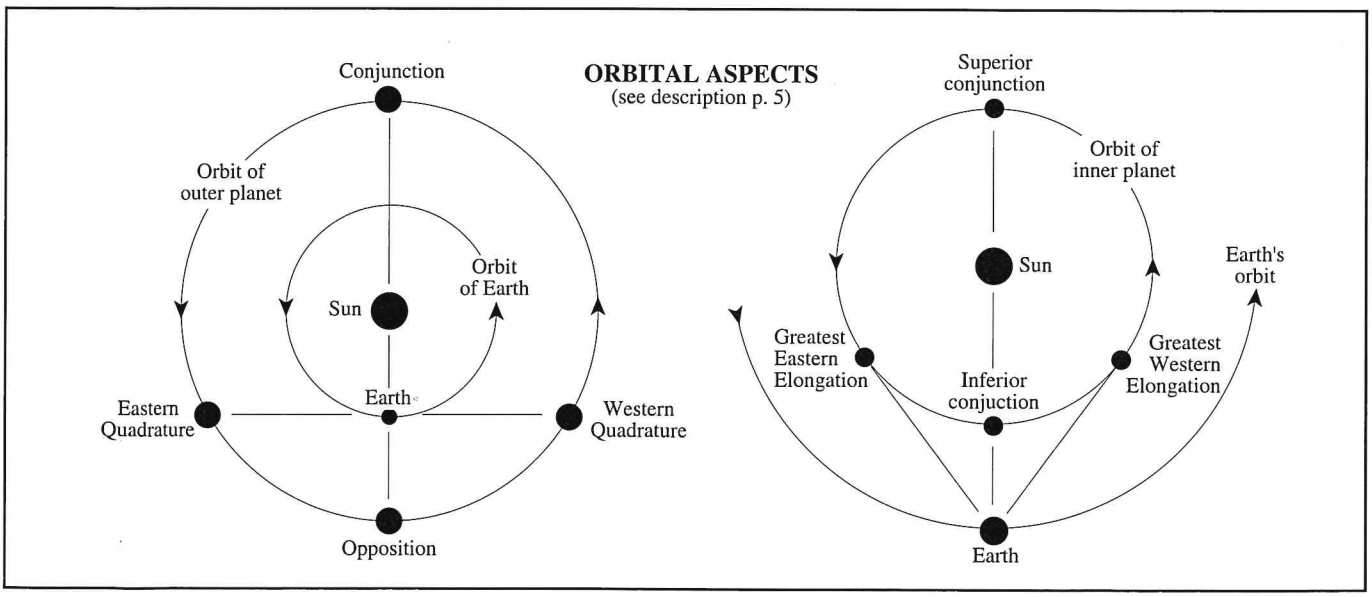
RISE AND SET TIMES. The rise and set times for various objects are given in WAST. The times given are when the upper limb of the object is coincident with the theoretical "true" horizon. Atmospheric refraction is taken into account. The intervals used for rise/sets are weekly and the dates correspond to Saturdays. The only exception is the Moon which is daily.

USE OF STAR ATLASES. Over many years, the stars appear to move in the sky relative to the celestial poles. This is called "precession" and is caused by the Earth's axis slowly wobbling like a spinning top over thousands of years. "Epoch 2000.0" refers to an object's position in relation to where the celestial poles (+ and -90° in declination) will be in the year 2000. This epoch has now been adopted by most modern star atlases. There are still atlases around which use epoch 1950.0 and it is important to check your atlas before using (or buying) it to ensure it is epoch 2000.0. The precession over this 50 year period can cause a shift of up to one degree in the apparent position of a solar system object relative to the background stars. This may not be a problem when looking for the brighter planets, but high precision may be necessary to track down a 12th magnitude comet. The calculations required to convert (or "precess") positions from one epoch to another, are not complicated considering the power of the calculators/ computers that are available today. Suggested references are "Practical Astronomy with a Calculator" (Duffett-Smith) or "Astronomical Formulae for Calculators" (Meeus).

FIELD OF VIEW IN A TELESCOPE. All the satellite diagrams and finder charts in this book are drawn to correct or normal sky orientation, ie. East to the left of North (in the sky East and West are opposite to what is seen on terrestrial maps). Telescope systems that use odd numbers of reflecting surfaces will "mirror" (or reverse) the image. The common use of "star diagonals" in Schmidt-Cassegrains or traditional refractors causes this reversal. Binoculars or straight Newtonians show "normal" sky images.

FINDER CHARTS FOR THE PLANETS. No finder charts are presented for the Moon, Venus or Mercury. Their rapid motion during the year causes them to cover a very large section of the sky which is difficult to cater for adequately in the space available. Considering the brilliance of these objects, the sky view diagrams (see part 1) should be sufficient to act as "finders".

RETROGRADE MOTION. The finder charts, for the outer planets, have one thing in common - an apparent motion with a "loop" shape. This puzzled astronomers for centuries until it was finally recognised that the Earth orbited the Sun just like any of the other "wanderers" (planets). Unfortunately the Earth was no longer the centre of the Universe. The diagram (p.55) illustrates the combined effects of the orbital motions of Earth and an outer planet (in this case, Mars) to explain this "loop". This only applies to the period during opposition. All the outer planets reach opposition each year with the exception of Mars which is every 26 months (its next opposition is this year in February). The shaded area represents the path of an outer planet against the celestial sphere. As the Earth moves around the Sun faster than Mars (and the other outer planets), it overtakes them; the effect is this loop or "S-bend" in the apparent path against the celestial sphere. This apparent reversal in the planet's movement is known as retrograde motion, and at this time the planet moves from east to west instead of from west to east. At position 1 and 2, Mars continues on its west to east path and begins to slow up to position 3 as the Earth catches up. Between 3 and 5, Mars is in retrograde motion, moving east to west and is at opposition (in line with the Earth and the Sun) at 4. At points 3 and 5 the planet is said to be stationary. After 5, as the Earth passes the slower planet, Mars continues on its west to east direction.



Because of the inclination of Mars' orbit to the Earth's (1°51'), the apparent path of Mars can never be a straight line. A planet's motion will appear as an "S-bend" if it is near one of its *nodes* (the points where a planet crosses the plane of the Earth's orbit), or as a loop when distant from the nodes. During 1995, none of the outer planets will pass through one of their *nodes*; hence "loops" are seen.

The following is a brief explanation of the data in part 2 of this book. Some sections are not mentioned, or only briefly described, when there are more detailed discussions present on the relevant pages.

"PLANETARY ANGULAR SIZE" DIAGRAM (p. 58) The "Y" axis of this diagram is arc seconds. When Venus is near inferior conjunction (closest to Earth) it grows in size to around 1 min. of arc (60".). Unfortunately, Venus does not reach inferior conjunction this year hence its maximum size of approx. 30". It is interesting to note that there are rare reports of people having the ability to see the crescent of Venus, with the naked eye, around the time of inferior conjunction. Early in the year it would be worthwhile trying to observe Venus' crescent in binoculars (it helps to keep the binoculars steady by mounting them on a tripod). See part 1 for the expected crescent shape. Looking during twilight may also help, for there is less glare.

"MERIDIAN PASSAGE OF THE SUN AND PLANETS" DIAGRAM (p. 59). In this diagram, the "Y" axis represents the local mean time. It shows the time the Sun and planets cross the meridian (or *culminates*) for the year. When a planet culminates around midnight (0 or 24 hours), it is at opposition and visible the whole night.

MOON -RISE/SET DATA (p 67). Looking at this data you will see there are some days where the Moon appears not to rise or set (represented by "DNR" for Does Not Rise or "DNS", Does Not Set). The reason for this lies in its rapid daily motion from west to east. Consecutive days show the Moon to rise (or set) more than 24 hours later. Hence, if the Moon rises just before midnight on the 1st of the month, it may not rise again until after midnight on the 2nd (making it an event for the 3rd) with no rise on the 2nd.

OPPOSITION OF MARS

Mars reaches opposition during 1995 and once again shows the classic retrograde loop in its movement through the heavens (see page 74). There is also a description and diagram of retrograde motion elsewhere in this introduction. Relating this diagram to the current opposition of Mars; position 1 corresponds to around mid Oct. 94, position 2 - end of Nov. 94, position 3 - Jan. 4 (stationary), position 4 - Feb. 12 (opposition), position 5 - Mar. 26 (stationary), position 6 - end of Apr. and position 7 - mid Jun.

Page 74 presents the data, needed by the serious amateur, to make observations/ drawings of the planet during opposition (when the planet is not in opposition it is too distant to see any features).

When monitoring Mars, the determination of Central Meridian, at the time of your observation (sketch?) of the planet, is important (use the same technique as described below for Jupiter/Saturn). Knowing the longitude allows you to relate your observations to known surface features. Changes in shape or intensity of a feature can be indicative of the Martian weather patterns. It is fascinating to track the movement and development of white and yellow clouds (dust storms) as they grow and move across the surface. Such observations are mainly restricted to the time around opposition.

When making observations of Mars the use of coloured filters is highly recommended. Different coloured filters will present different aspects of the planet. The following is a rough guide.

* Orange or Red (Wratten 21 or 25a), reduces the red glare and helps in observing fine detail in the red plains.
* Green (Wratten 58), useful for observations of white clouds and the edge of the polar caps.
* Yellow (Wratten 12), good for yellow clouds (dust storms).

JUPITER and SATURN

Longitudes of Central Meridian. (pages 78 and 84) Unlike Mars, Jupiter and Saturn are "Gas Giants" and they only allow us to view their upper atmospheric features. There is no one correct rotation period. The speed of movement of any feature on the surface depends on its latitude, hence the multiple rotation systems used. For Saturn, only the equatorial (System I) region is listed. To monitor the movement and development of any feature, amateurs often measure the time a feature crosses the central meridian of the planet. Features on Saturn are less obvious than those seen on Jupiter and a 20 to 25cm telescope is needed to glimpse any details.

The longitude can be worked out from the "longitude of central meridian" tables. All the times on the main tables (ie. daily figures) are calculated for 0hrs UT (8:00am WAST) of date. To get to your time you will need to add multiple hours/minutes from the small "Increase in Longitude" tables. For example the longitude of central meridian for Jupiter (system I) for Mar. 21 at 12:20am WAST would be calculated as follows:

The longitude. on Mar 20 is 356.4°. To this add an adjustment. for the 16 hours since 8 am which is 225.3° and finally for the 20 mins add 12.2°. This equals 593.9°; subtracting 360° gives a final answer of 233.9°.

Saturn's Rings. (p 84) The appearance of the planets diagrams in part 1, show how "open" (or face-on) the rings are for 1995. The plane of the rings is tilted with respect to the plane of the ecliptic by 28°. The planet's "year" is 29.5 (Earth) years. During this period the Earth can be up to 28° above or below the plane of the rings. Every 7 years, after each of these maximum ring "openings", the Earth passes through the plane of the rings and they are seen "edge-on". As previously described in detail in part 1, the rings are edge-on during 1995. The rings were last wide open in 1988.

Satellites of Saturn (pages 85 & 86). The paths of these moons around Saturn are normally illustrated diagrammatically (eg. see ASTRONOMY 1994, page 86). Unfortunately, with the rings "edge-on", the orbits of the satellites, like the rings, are edge on and are mostly reduced to straight lines compared to the normal ellipses, therefore no diagram appears this year. The positions of the moons can still be approximately worked out. For Titan, Iapetus and Hyperion the times are already given for the greatest western/eastern elongations and inferior/superior conjunctions hence the position can be approximated by rough interpolation (remember in an "edge-on" situation the moon will appear to spend more time near its elongations compared to conjunctions). For the remaining satellites, the only data that are given are the times of greatest eastern elongation. However it is easy to estimate the other information. The western elongation will occur approx. half way between two consecutive "easterns". Further halving of these intervals will approximate the times of the two conjunctions. Once these times have been estimated the process is the same as for Titan, Iapetus and Hyperion. For people who have access to large telescopes it is worthwhile remembering, that while the ring system is reduced to a faint line, this presents a unique opportunity. Try looking for some of the faint inner moons, which would normally be invisible against the glare of the rings.

URANUS / NEPTUNE / PLUTO

Finder Chart for Uranus/Neptune (see p. 88). To help in locating this star field in Sagittarius, its position has been marked on the large sky view for June 30 on page 30.

Satellites of Uranus (see p. 90).Titania (III) and Oberon (IV) are the easiest to observe visually. However, at least a 20cm telescope under "dark skies" is needed to glimpse these distant bodies. The inner satellites, I and II, are harder to observe and they would be a real test for a 40cm telescope. The orbits of the satellites are nearly face-on as seen from Earth (see diagram). The orbits' apparent minor axis (running east/west) is 75% that of the apparent major axis (north/south). For example, Oberon, at opposition, has a maximum elongation of 44" (see p. 57). Its minimum elongation would be 75% of this or 33". The greatest northern elongation's position angle is 10° (ie. 10° towards the east). To locate the approximate position angle (degrees east of north) for a satellite, at your time of observation:

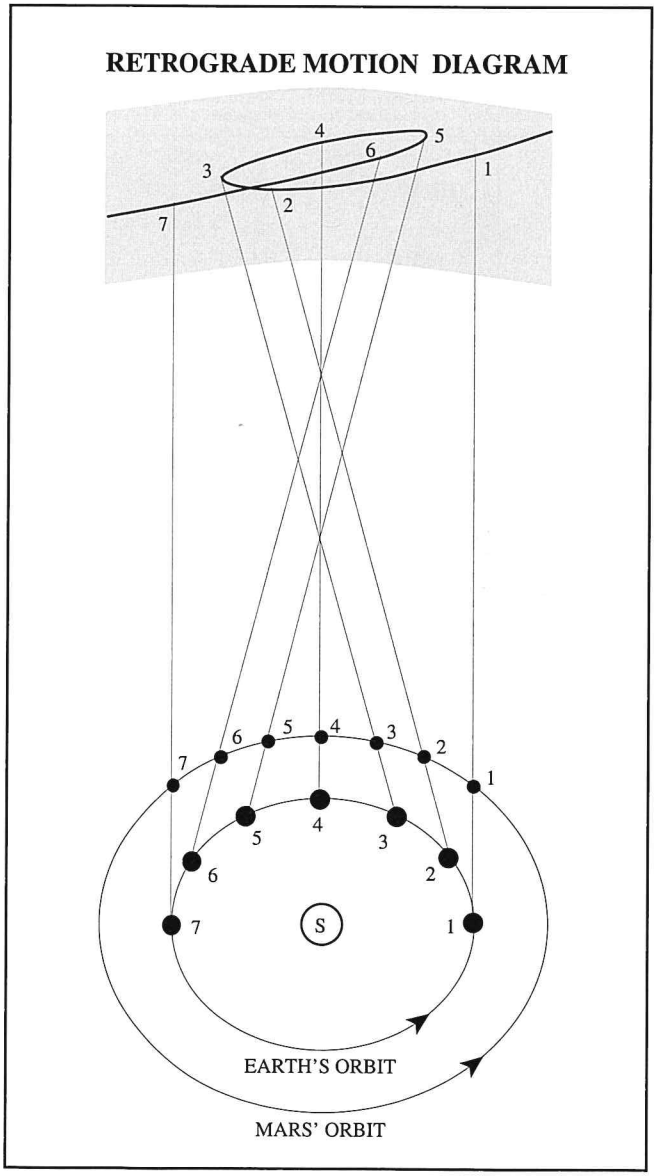
1) Work out how long since the satellite's most recent greatest northern elongation.
2) Express this as a fraction of the sidereal orbital period. Satellites II, III, and IV have periods of 4.14, 8.71 and 13.46 days respectively.
3) Multiply the result by 360° and add 10°.

Satellites of Neptune (see p. 90). With typical amateur telescopes, Triton (I) is the only observable moon. To find Triton, the same approach as described above for the satellites of Uranus is used. Except in this case, the apparent major axis is in the east/west direction. The greatest eastern elongation is actually 13° towards the south, from east, at position angle 103°. Like Uranus, the orbits of the Neptunian satellites are currently, relatively open or "face-on" (see diagram). In 1995, Triton's apparent orbit as seen from Earth is a pronounced ellipse with the minor axis being 75% of the major axis. Therefore Triton, at opposition, varies from 17" (see p. 57) down to 13". To find the approximate position angle of Triton, the same approach is used as above for Uranus. The sidereal orbital period for Triton is 5.88 days and in step 3 add 103° (not 10°). If the answer is greater than 360°, subtract 360°.

PLUTO (see pp. 88 and 89). The pointer chart (p. 88) is designed to help people find the general area for Pluto. The shaded block shows the position of the main chart (p. 89). The main finder chart shows stars down to magnitude 14.5. This is necessary to pick out the faint star-like image of Pluto (magnitude 13.7) from the other numerous faint stars in the field. The commonly available star atlases do not include stars down to anywhere near this magnitude limit (or faintness).

To create the main finder chart, the authors "constructed" this field from data in the "Hubble (space telescope) Guide Star Catalogue". This is the most complete catalogue of stars available. It covers some 19 million stars and deep sky objects!

MINOR PLANETS (see pp. 96 and 97). As well as the 9 planets, their moons and the comets, the Solar System contains numerous smaller bodies known as the "minor planets" or "asteroids". There are now some 5000 such bodies catalogued! Their sizes vary from around a thousand kilometres down to a few hundred metres. Most of these orbit in the asteroid belt between the orbits of Mars and Jupiter. The majority of these objects are extremely faint and difficult to observe. Most need to be found by photographing them, at least twice, over a number of days and detecting them as they move against the distant star field. The same can be achieved by observing the field and making drawings over a number of days to detect which star has moved. Be sure you have the right field of view! . Only about 60 of these bodies can be considered to be bright (by amateur standards) and most of them only around their time of opposition. The ephemerides are for 20 of the minor planets (mostly returning to opposition) that are expected to reach magnitude 10 or brighter this year.



PART 3 - THE APPENDICES

GENERAL NOTES

Appendix A -"The Brightest Stars" Table (p. 98) The column descriptions are:

Designation The name of the star in the system created by Bayer. He numbered the stars in the constellations using Greek letters (see p. 112). They were ordered by their brightness; Alpha being the most brilliant.

Name Other common names for the stars.

Constellation The star's constellation.

RA and Dec. The position of the star, epoch 2000.0.

Magnitude App. The apparent magnitude as seen in the sky.

Magnitude Abs. The absolute magnitude. This is a good indication of how the stars true luminosities compare. It is the brightness of the star if placed at a distance of 10 parsecs (approx. 32.6 light years) from Earth.

Spectral Type The spectral classification of the star (see below)

Parallax see glossary.

ly is light year and **pc** is parsec.

The spectral type of a star gives a broad indication of its temperature and colour. The primary classes are **O**, **B**, **A**, **F**, **G**, **K** and **M** (remembered by the mnemonic **O**h **B**e **A** **F**ine **G**irl(Guy) **K**iss **M**e) These are then broken down into ten subclasses (1 to 10) and then even further subdivided into I, II, III, IV etc. A discussion of these subclasses is beyond this publication.

- The **O** class stars are the hottest blue stars.
- **B** and **A** are white (eg. Sirius, Rigel)
- **G** and early **K** (subclass <5) are yellow (eg. Capella, the Sun and Arcturus)
- Late **K**(subclass > 5) and **M** stars are the cooler red stars (eg. Aldebaran, Betelgeuse).

It is interesting trying to see the colour in stars, but it is worthwhile knowing the limitations of the human eye. The photosensitive screen of the eye is the retina. It consists of two types of light receptors, the rods and cones. The cones perceive colour and rods see only in shades of grey. The cones only work when there is sufficient light. Starlight to the unaided eye, activates the rods and cones to different degrees. Faint stars are only seen as grey (ie. no colour).

The colours of stars can be simply photographed. Mount your normal 35mm camera on a tripod and take a time exposure (some minutes) using a fast film. The resulting star trails often show the colours very well. An equatorially tracked time exposure (eg. piggybacked on a telescope) with the camera slightly out of focus results in nicely coloured discs of the brightest stars. If the camera is in focus the colour of the brightest stars can be lost as their images burn out on the negative. All such astronomical photography should be conducted in country areas, away from city lights.

Appendix I - Hours of RA/ Constellations on the Meridian (p. 104) The ideal time to observe any astronomical object is when it crosses the meridian or culminates, providing of course the sun (ie. twilight) or the Moon does not interfere. This is the time when the object is at its highest point in the sky and it is observable through a minimum thickness of atmosphere ie. it has least atmospheric turbulence effecting the image. This is certainly important for northern objects which don't get very high in the sky, even at culmination. The "X" axis of this diagram is the local mean time. If you know the RA, you can determine quickly when this object culminates on the date of interest. For example, minor planet 6 Hebe (p. 96) in early November, has an RA of around 2 hours. From the diagram the diagonal 2 hour line, at this time of the year, crosses the meridian at approximately midnight (0 or 24 hours). Therefore this object will be up most of the night and it would be expected to be near opposition (opposition is Oct. 27). Another example, supposing it is November 1 and you wish to go out and observe the Andromeda galaxy. Looking along the line which marks the beginning of November, the diagonal RA line for the constellation Andromeda (0 hr) is found at 21:30 hours (9:30pm). It is therefore best to observe this object early in the evening. When an object is on the meridian its right ascension (RA) also corresponds to the sidereal time.

SOLAR SYSTEM DATA — THE PLANETS

NAME	MEAN DISTANCE FROM SUN (x 10^3 kms)	(Earth = 1)	MAG at OPP	EQUATOR-IAL DIA. (kms).	OBLATE-NESS [1]	No of MOONS	MASS ($x10^{24}$ kg)	(Earth = 1)
Sun	-		-26.8	1392530	0	-	1989085	332946
Moon	-		-12.14 [11]	3476	0	-	0.073483	0.0123
Mercury	57856	0.387	0.16 [12]	4878	0	0	0.33022	0.055
Venus	108132	0.723	-4.07 [12]	12104	0	0	4.869	0.816
Earth	149492	1.000	-3.5 [13]	12756	0.00335364	1	5.9742	1.000
Mars	227780	1.524	-2.01	6794	0.006476	2	0.64191	0.107
Jupiter	777776	5.203	-2.70	142984	0.0648074	16	1898.8	317.900
Saturn	1425983	9.540	0.67	120536	0.097962	18	568.5	95.200
Uranus	2867760	19.180	5.52	51118	0.022927	15	86.625	14.500
Neptune	4492800	30.700	7.84	49528	0.017081	8	102.78	17.400
Pluto	5745000	39.670	15.12	2302	0	1	0.015	0.003

NAME	VOLUME (Earth = 1)	SIDEREAL PERIOD [2]	SYNODIC PERIOD (days) [3]	AXIAL ROTATION (days) [4]	ALBEDO [5]	ECCEN-TRICITY [6]	INCLIN-ATION [7]	OBLIQ-UITY [8]
Sun	1300000	-	-	25.38 [9]	-	-	-	7° 15' [10]
Moon	0.02	27.32 d	29.4	27.32166	0.12	0.0549	5° 08' 40"	6° 41'
Mercury	0.06	87.97 d	115.8	58.6462	0.11	0.20562	7° 00' 00"	0° 00'
Venus	0.86	224.7 d	583.9	-243.01	0.65	0.00681	3° 23' 38"	92° 00'
Earth	1	365.256 d	-	0.9972697	0.37	0.01681	0° 00' 00"	23° 26'
Mars	0.15	687 d	779.8	1.0259567	0.15	0.09333	1° 51' 01"	25° 10'
Jupiter	1323	11.86 y	398.8	0.41354 [14]	0.52	0.04837	1° 18' 28"	3° 07'
Saturn	752	29.46 y	378.0	0.44401 [14]	0.47	0.05582	2° 29' 29"	26° 45'
Uranus	64	84.01 y	369.7	0.71833	0.50	0.0471	0° 46' 22"	98° 00'
Neptune	54	164.8 y	367.5	0.67125	0.41	0.00855	1° 46' 38"	29° 00'
Pluto	0.007	249.9 y	366.7	-6.3872	0.30	0.2486	17° 09' 00"	118° 00'

Notes:

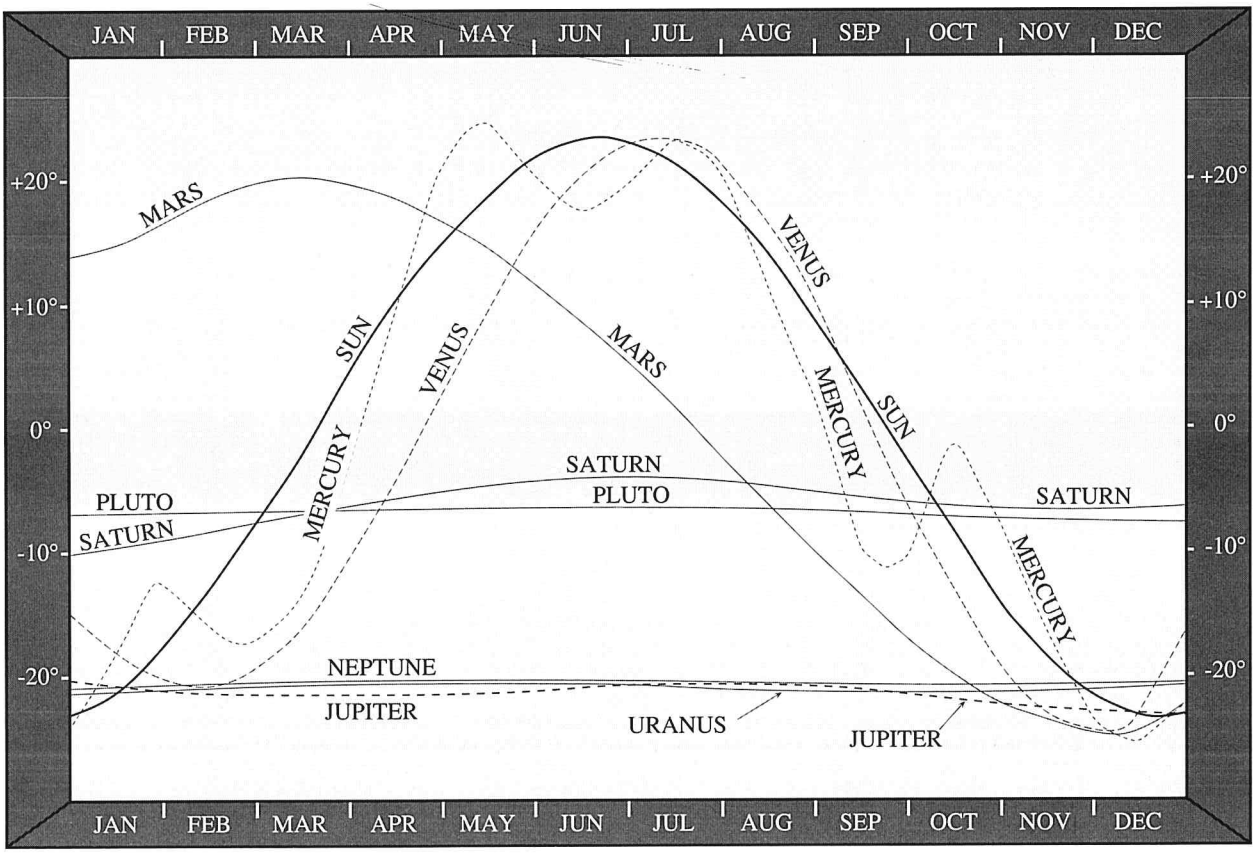
1 The ratio of the difference of the equatorial and polar radii to the equatorial radius.
2 The planet's year.
3 The period of the planet's orbit with respect to the Earth.
4 The planet's day. A negative sign indicates the rotation is retrograde with respect to the North pole.
5 The ratio of the sunlight reflected to that received.
6 The measure of how long or thin the ellipse of the planet's orbit is.
7 The angle of the planet's orbit from the plane of the ecliptic.
8 The degree of inclination of the planet's equator to its orbit
9 The equatorial region (the polar areas of the Sun rotate in a period of 29 to 30 days).
10 To the ecliptic.
11 From the Earth.
12 At mean greatest elongation.
13 As seen from the Sun.
14 Based on System III rotation. Similar to systems I or II except a radio source within the planet is used as the reference point.

SOLAR SYSTEM DATA — SATELLITES

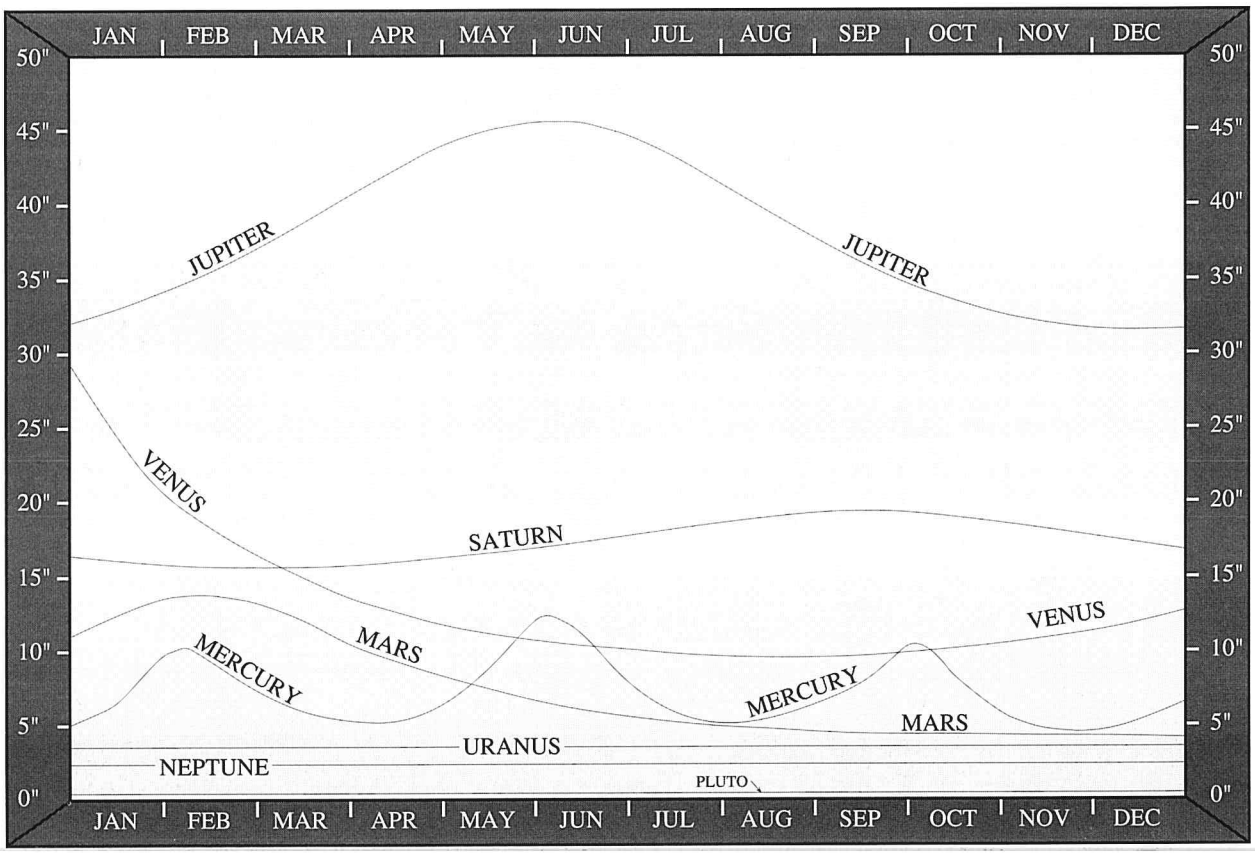
PLANET / SATELLITE		ORBITAL [1] PERIOD (days) (R=retrograde)	MAX. ELONG AT MEAN OPPOSITION	SEMIMAJOR AXIS ($x10^3$ km)	ORBITAL ECCENTRICITY	INCLINATION TO PLANET'S EQUATOR (°)	MASS (1/PLANET)	RADIUS (kms)	SIDEREAL PERIOD OF ROTATION (days) [4]	MAGNITUDE AT OPPOSITION
Earth										
Moon		27.321661		384.4	0.054900489	18.28-28.58	0.01230002	1738	S	-12.74
Mars										
Phobos	I	0.31891023	25"	9.378	0.015	1.0	$1.5x10^{-8}$	13.5x10.8x9.4	S	11.30
Deimos	II	1.2624407	1'02"	23.459	0.0005	0.9-2.7	$3x10^{-9}$	7.5x6.1x5.5	S	12.40
Jupiter										
Io	I	1.769137786	2'18"	422	0.004	0.04	$4.68x10^{-5}$	1815	S	5.02
Europa	II	3.551181041	3'40"	671	0.009	0.47	$2.52x10^{-5}$	1569	S	5.29
Ganymede	III	7.15455296	5'51"	1070	0.002	0.21	$7.80x10^{-5}$	2631	S	4.61
Callisto	IV	16.6890184	10'18"	1883	0.007	0.51	$5.66x10^{-5}$	2400	S	5.65
Amalthea	V	0.49817905	59"	181	0.003	0.4	$38x10^{-10}$	135x83x75	S	14.10
Himalia	VI	250.5662	1°02'46"	11480	0.15798	27.63	$50x10^{-10}$	93	0.4	14.84
Elara	VII	259.6528	1°04'10"	11737	0.20719	24.77	$4x10^{-10}$	38	0.5	16.77
Pasiphae	VIII	735. R	2°08'26"	23500	0.378	145	$1x10^{-10}$	25		17.03
Sinope	IX	758. R	2°09'31"	23700	0.275	153	$0.4x10^{-10}$	18		18.30
Lysithea	X	259.22	1°04'04"	11720	0.107	29.02	$0.4x10^{-10}$	18		18.40
Carme	XI	692. R	2°03'31"	22600	0.20678	164	$0.5x10^{-10}$	20		18.00
Ananke	XII	631. R	1°55'52"	21200	0.1687	147	$0.2x10^{-10}$	15		18.90
Leda	XIII	238.72	1°00'39"	11094	0.14762	26.07	$0.03x10^{-10}$	8		20.20
Thebe	XIV	0.6745	1'13"	222	0.015	0.8	$4x10^{-10}$	55x45	S	15.70
Adrastea	XV	0.29826	42"	129			$0.1x10^{-10}$	12.5x10x7.5		19.10
Metis	XVI	0.29478	42"	128			$0.5x10^{-10}$	20		17.50
Saturn										
Mimas	I	0.942421813	30"	185.52	0.0202	1.53	$8.0x10^{-8}$	196	S	12.90
Enceladus	II	1.370217855	38"	238.02	0.00452	0	$1.3x10^{-7}$	250	S	11.70
Tethys	III	1.88780216	48"	294.66	0	1.86	$1.3x10^{-6}$	530	S	10.20
Dione	IV	2.736914742	1'01"	377.4	0.00223	0.02	$1.85x10^{-6}$	560	S	10.40
Rhea	V	4.517500436	1'25"	527.04	0.001	0.35	$4.4x10^{-6}$	765	S	9.70
Titan	VI	15.94542068	3'17"	1221.83	0.029192	0.33	$2.38x10^{-4}$	2575	S	8.28
Hyperion	VII	21.2766088	3'59"	1481.1	0.104	0.43	$3x10^{-8}$	205x130x110		14.19
Iapetus	VIII	79.3301825	9'35"	3561.3	0.02828	14.72	$3.3x10^{-6}$	730	S	11.10
Phoebe	IX	550.48 R	34'51"	12952	0.16326	177 [2]	$7x10^{-10}$	110	0.4	16.45
Janus	X	0.6945	24"	151.472	0.007	0.14		110x100x80	S	14.00
Epimetheus	XI	0.6942	24"	151.422	0.009	0.34		70x60x50	S	15.00
Helene	XII	2.7369	1'01"	377.4	0.005	0		18x16x15		18.00
Telesto	XIII	1.8878	48"	294.66				17x14x13		18.50
Calypso	XIV	1.8878	48"	294.66				17x11x11		18.70
Atlas	XV	0.6019	22"	137.67	0	0.3		20x10		18.00
Prometheus	XVI	0.613	23"	139.353	0.003	0		70x50x40		16.00
Pandora	XVII	0.6285	23"	141.7	0.004	0		55x45x35		16.00
Pan	XVIII	0.575	21"	133.583				10		
Uranus										
Ariel	I	2.52037935	14"	191.02	0.0034	0.3	$1.56x10^{-5}$	579	S	14.16
Umbriel	II	4.1441772	20"	266.3	0.005	0.36	$1.35x10^{-5}$	586	S	14.81
Titania	III	8.7058717	33"	435.91	0.0022	0.14	$4.06x10^{-5}$	790	S	13.73
Oberon	IV	13.4632389	44"	583.52	0.0008	0.1	$3.47x10^{-5}$	762	S	13.94
Miranda	V	1.41347925	10"	129.39	0.0027	4.2	$0.08x10^{-5}$	240	S	16.30
Cordelia	VI	0.335033	4"	49.77	<0.001	0.1		13		24.10
Ophelia	VII	0.376409	4"	53.79	0.01	0.1		15		23.80
Bianca	VIII	0.434577	4"	59.17	<0.001	0.2		21		23.00
Cressida	IX	0.46357	5"	61.78	<0.001	0		31		22.20
Desdemona	X	0.473651	5"	62.68	<0.001	0.2		27		22.50
Juliet	XI	0.493066	5"	64.35	<0.001	0.1		42		21.50
Portia	XII	0.513196	5"	66.09	<0.001	0.1		54		21.00
Rosalind	XIII	0.558459	5"	69.94	<0.001	0.3		27		22.50
Belinda	XIV	0.623525	6"	75.26	<0.001	0		33		22.10
Puck	XV	0.761832	7"	86.01	<0.001	0.31		77		20.20
Neptune										
Triton	I	5.8768541 R	17"	354.76	0.000016	157.345	$2.09x10^{-4}$	1353	S	13.47
Nereid	II	360.13619	4'21"	5513.4	0.7512	27.6 [3]	$2x10^{-7}$	170		18.70
Naiad	III	0.294396	2"	48.23	<0.001	4.74		29		24.70
Thalassa	IV	0.311485	2"	50.07	<0.001	0.21		40		23.80
Despina	V	0.334655	2"	52.53	<0.001	0.07		74		22.60
Galatea	VI	0.428745	3"	61.95	<0.001	0.05		79		22.30
Larissa	VII	0.554654	3"	73.55	0.0014	0.2		104x89		22.00
Proteus	VIII	1.122315	6"	117.65	<0.001	0.55		218x208x201		20.30
Pluto										
Charon	I	6.38725	<1"	19.6	<0.001	99 [3]	0.22	593	S	16.80

Notes: **1** - Sidereal periods, except tropical periods are given for Saturn. **2** - Relative to the ecliptic plane. **3** - Referred to the equator of 1950.0
4 - S = Synchronous, rotation period same as orbital period. ie. keeps the same section of its surface facing its planet.

DECLINATIONS of the SUN and PLANETS

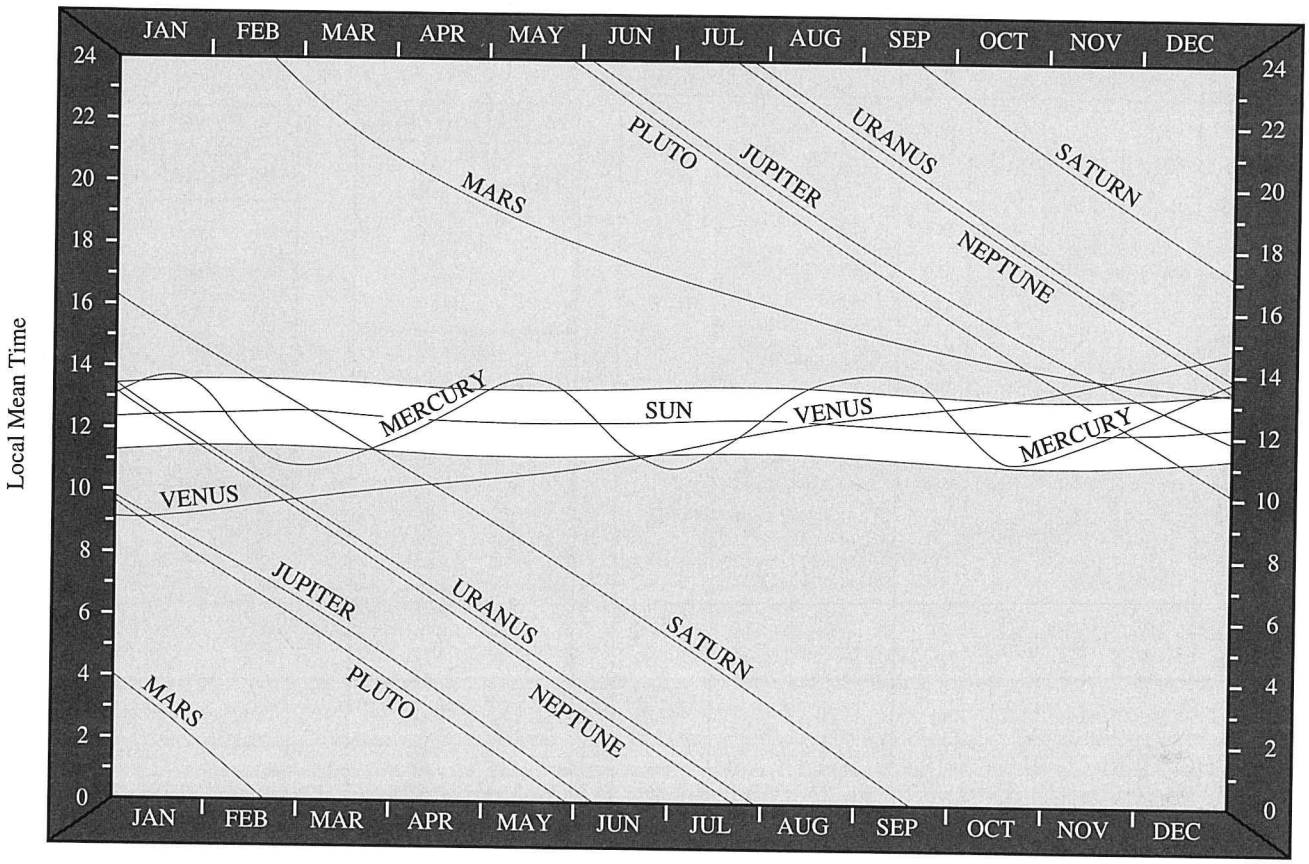


PLANETARY ANGULAR SIZE



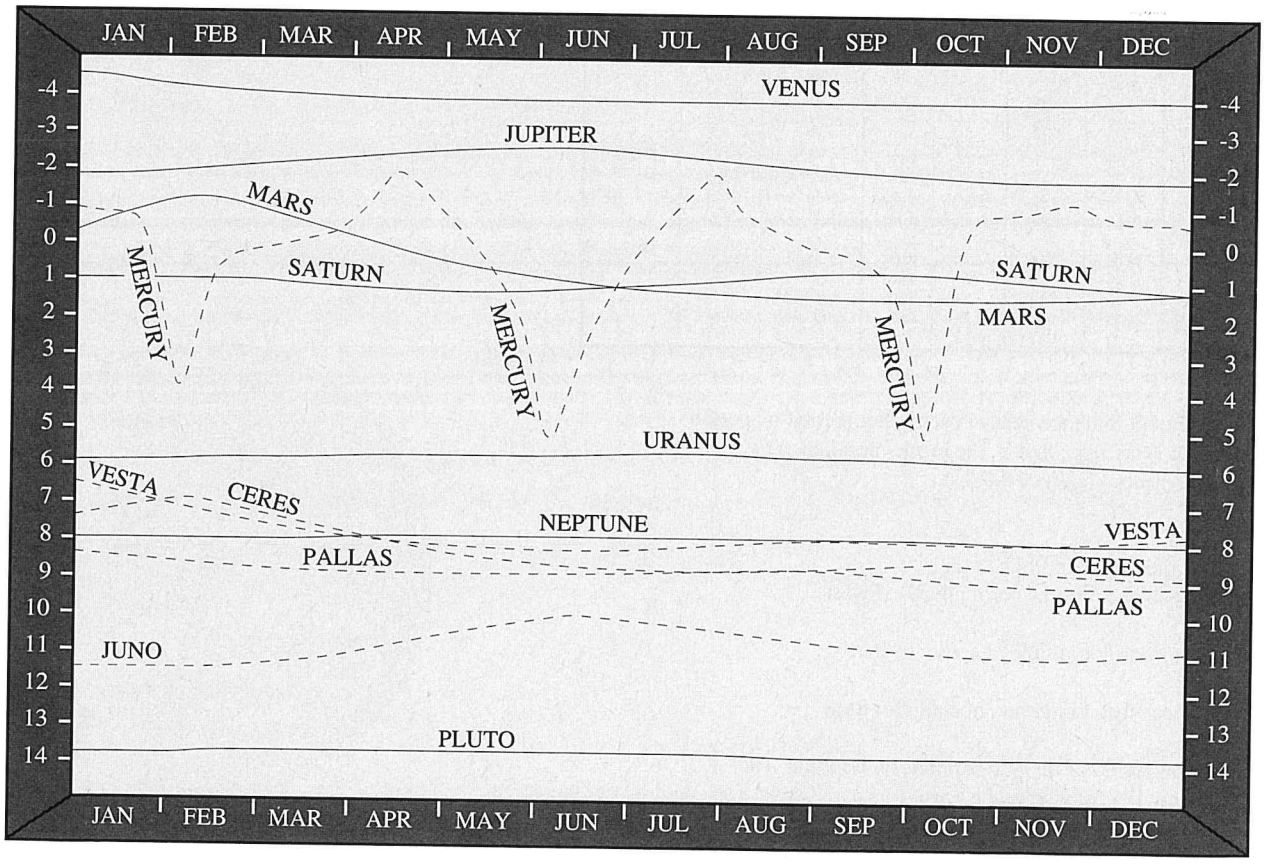
See explanation (part 2) page 53

MERIDIAN PASSAGE of the SUN and PLANETS



See explanation (part 2) page 53

MAGNITUDES of the PLANETS and MAJOR ASTEROIDS



SUN — RISE, SET (for Perth, W.A.S.T.) and ORIENTATION

DATE		SUN SET	TWILIGHT ENDS	TWILIGHT BEGINS	SUN RISE	P°	B_o°	L_o°
		h m	h m	h m	h m	0hr UT		
Jan	7	19 27	21 05	3 40	5 18	- 0.65	- 3.67	270.00
	14	19 26	21 03	3 47	5 24	- 3.99	- 4.42	177.82	-
	21	19 24	20 59	3 56	5 31	7.24	- 5.10	085.65	-
	28	19 21	20 54	4 04	5 37	10.32	- 5.70	353.49	
Feb	4	19 17	20 47	4 13	5 44	- 13.21	- 6.21	261.32
	11	19 11	20 39	4 22	5 50	- 15.86	- 6.63	169.16	-
	18	19 04	20 31	4 30	5 56	18.25	- 6.94	076.98	-
	25	18 57	20 22	4 37	6 02	20.35	- 7.15	344.79	
Mar	4	18 49	20 12	4 44	6 08	- 22.16	- 7.24	252.59
	11	18 40	20 03	4 50	6 13	- 23.66	- 7.23	160.36	-
	18	18 31	19 53	4 56	6 18	24.83	- 7.11	068.10	-
	25	18 22	19 44	5 01	6 23	25.66	- 6.89	335.81	
Apr	1	18 13	19 34	5 06	6 27	- 26.16	- 6.56	243.48
	8	18 05	19 26	5 11	6 32	- 26.30	- 6.15	151.12	-
	15	17 56	19 18	5 15	6 37	26.08	- 5.64	058.72	-
	22	17 49	19 10	5 20	6 42	25.51	- 5.06	326.27	-
	29	17 41	19 04	5 24	6 46	24.57	- 4.40	233.79	
May	6	17 35	18 58	5 28	6 51	- 23.28	- 3.69	141.27
	13	17 29	18 54	5 32	6 56	- 21.64	- 2.93	048.72	-
	20	17 25	18 50	5 36	7 01	19.68	- 2.14	316.13	-
	27	17 22	18 48	5 39	7 05	17.41	- 1.31	223.52	
Jun	3	17 20	18 46	5 43	7 09	- 14.87	- 0.47	130.89
	10	17 19	18 46	5 46	7 13	- 12.10	+ 0.38	038.25	-
	17	17 19	18 47	5 48	7 15	9.15	+ 1.21	305.59	-
	24	17 21	18 48	5 50	7 17	6.07	+ 2.04	212.93	
Jul	1	17 23	18 50	5 50	7 18	- 2.92	+ 2.83	120.28
	8	17 26	18 53	5 50	7 17	+ 0.26	+ 3.58	027.63	+
	15	17 30	18 56	5 49	7 15	3.40	+ 4.29	294.99	+
	22	17 34	18 59	5 47	7 12	6.47	+ 4.94	202.36	+
	29	17 38	19 03	5 44	7 08	9.41	+ 5.53	109.76	
Aug	5	17 43	19 06	5 39	7 03	+ 12.19	+ 6.04	017.19
	12	17 47	19 10	5 34	6 57	+ 14.79	+ 6.47	284.63	+
	19	17 52	19 14	5 27	6 50	17.17	+ 6.81	192.10	+
	26	17 56	19 18	5 20	6 42	19.31	+ 7.05	099.60	
Sep	2	18 00	19 21	5 12	6 33	+ 21.20	+ 7.20	007.12
	9	18 04	19 26	5 03	6 24	+ 22.82	+ 7.25	274.67	+
	16	18 09	19 30	4 54	6 15	24.15	+ 7.20	182.24	+
	23	18 13	19 35	4 45	6 06	25.17	+ 7.04	089.84	+
	30	18 17	19 40	4 35	5 57	25.88	+ 6.78	357.46	
Oct	7	18 22	19 45	4 25	5 48	+ 26.25	+ 6.43	265.09
	14	18 27	19 51	4 15	5 39	+ 26.26	+ 5.97	172.74	+
	21	18 32	19 58	4 05	5 31	25.91	+ 5.43	080.41	+
	28	18 38	20 05	3 56	5 24	25.18	+ 4.81	348.09	
Nov	4	18 44	20 13	3 48	5 17	+ 24.07	+ 4.11	255.79
	11	18 50	20 21	3 40	5 12	+ 22.58	+ 3.35	163.49	+
	18	18 56	20 30	3 34	5 08	20.70	+ 2.54	071.21	+
	25	19 02	20 38	3 29	5 05	18.47	+ 1.69	338.95	
Dec	2	19 08	20 46	3 26	5 03	+ 15.91	+ 0.80	246.69
	9	19 14	20 53	3 24	5 03	+ 13.06	- 0.09	154.44	+
	16	19 19	20 59	3 25	5 05	9.98	- 0.99	062.21	+
	23	19 23	21 03	3 28	5 08	6.72	- 1.87	330.00	+
	30	19 25	21 05	3 32	5 12	3.35	- 2.72	237.80	

VARIATION OF L_o

DAILY	
1	13.18
2	26.37
3	39.55
4	52.73
5	65.91
6	79.10

HOURLY	
1	0.55
2	1.10
3	1.65
4	2.20
5	2.75
6	3.30
7	3.84
8	4.39
9	4.94
10	5.49
11	6.04
12	6.59
13	7.14
14	7.69
15	8.24
16	8.79
17	9.34
18	9.89
19	10.43
20	10.98
21	11.53
22	12.08
23	12.63
24	13.18

SYNODIC ROTATION NUMBERS (UT)

		d.dd
1892	Jan	27.51
1893	Feb	23.85
1894	Mar	23.17
1895	Apr	19.45
1896	May	16.69
1897	Jun	12.89
1898	Jul	10.09
1899	Aug	6.30
1900	Sep	2.54
1901	Sep	29.81
1902	Oct	27.10
1903	Nov	23.40
1904	Dec	20.72

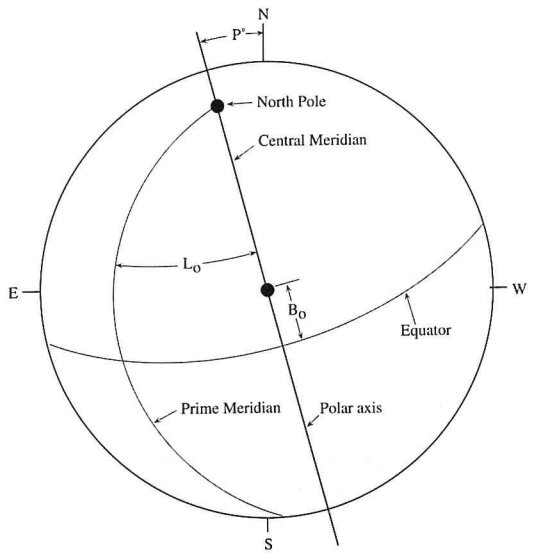
At the date of commencement of each synodic rotation period the value of Lo is zero; that is, the prime meridian passes through the central point of the disk.

P° Position angle of Polar Axis.
+ when pole east of north point, - if west

Bo Heliocentric Latitude of centre of Sun

Lo Heliocentric Longitude of centre of Sun

The rotation period of the Sun depends on Latitude. The sidereal period of rotation at the equator is 25.38 days. The mean synodic period is 27.28 days.



SUN

GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "
1	18 44 13	- 23 03 02	20 56 43	- 17 16 19	22 46 08	- 07 49 08	00 39 58	+ 04 18 10	02 31 18	+ 14 53 22	04 34 00	+ 21 58 07
2	18 48 38	- 22 58 08	21 00 48	- 16 59 16	22 49 53	- 07 26 20	00 43 37	+ 04 41 20	02 35 07	+ 15 11 33	04 38 05	+ 22 06 19
3	18 53 03	- 22 52 47	21 04 52	- 16 41 56	22 53 38	- 07 03 26	00 47 16	+ 05 04 25	02 38 57	+ 15 29 29	04 42 11	+ 22 14 07
4	18 57 27	- 22 46 58	21 08 55	- 16 24 18	22 57 22	- 06 40 27	00 50 55	+ 05 27 25	02 42 47	+ 15 47 10	04 46 18	+ 22 21 33
5	19 01 51	- 22 40 43	21 12 58	- 16 06 23	23 01 06	- 06 17 21	00 54 34	+ 05 50 19	02 46 38	+ 16 04 34	04 50 25	+ 22 28 34
6	19 06 14	- 22 34 00	21 16 59	- 15 48 12	23 04 49	- 05 54 11	00 58 13	+ 06 13 06	02 50 30	+ 16 21 43	04 54 32	+ 22 35 12
7	19 10 37	- 22 26 51	21 21 00	- 15 29 44	23 08 32	- 05 30 55	01 01 53	+ 06 35 47	02 54 21	+ 16 38 36	04 58 39	+ 22 41 27
8	19 15 00	- 22 19 15	21 25 00	- 15 11 01	23 12 14	- 05 07 36	01 05 32	+ 06 58 22	02 58 14	+ 16 55 11	05 02 47	+ 22 47 17
9	19 19 22	- 22 11 13	21 28 59	- 14 52 02	23 15 56	- 04 44 12	01 09 12	+ 07 20 49	03 02 07	+ 17 11 30	05 06 55	+ 22 52 44
10	19 23 43	- 22 02 44	21 32 57	- 14 32 49	23 19 37	- 04 20 45	01 12 52	+ 07 43 09	03 06 01	+ 17 27 32	05 11 03	+ 22 57 46
11	19 28 04	- 21 53 50	21 36 54	- 14 13 20	23 23 18	- 03 57 14	01 16 33	+ 08 05 20	03 09 55	+ 17 43 16	05 15 11	+ 23 02 25
12	19 32 24	- 21 44 31	21 40 51	- 13 53 38	23 26 59	- 03 33 41	01 20 13	+ 08 27 24	03 13 50	+ 17 58 42	05 19 20	+ 23 06 38
13	19 36 44	- 21 34 46	21 44 47	- 13 33 42	23 30 40	- 03 10 05	01 23 54	+ 08 49 19	03 17 45	+ 18 13 50	05 23 28	+ 23 10 28
14	19 41 03	- 21 24 36	21 48 42	- 13 13 33	23 34 20	- 02 46 27	01 27 35	+ 09 11 05	03 21 41	+ 18 28 39	05 27 37	+ 23 13 53
15	19 45 22	- 21 14 01	21 52 36	- 12 53 11	23 38 00	- 02 22 48	01 31 17	+ 09 32 42	03 25 37	+ 18 43 10	05 31 46	+ 23 16 53
16	19 49 39	- 21 03 02	21 56 30	- 12 32 36	23 41 39	- 01 59 07	01 34 58	+ 09 54 09	03 29 34	+ 18 57 22	05 35 56	+ 23 19 29
17	19 53 56	- 20 51 39	22 00 23	- 12 11 49	23 45 19	- 01 35 25	01 38 41	+ 10 15 27	03 33 31	+ 19 11 15	05 40 05	+ 23 21 40
18	19 58 13	- 20 39 52	22 04 15	- 11 50 51	23 48 58	- 01 11 42	01 42 23	+ 10 36 35	03 37 30	+ 19 24 48	05 44 14	+ 23 23 26
19	20 02 28	- 20 27 41	22 08 07	- 11 29 41	23 52 37	- 00 47 59	01 46 06	+ 10 57 32	03 41 28	+ 19 38 02	05 48 24	+ 23 24 47
20	20 06 43	- 20 15 07	22 11 58	- 11 08 20	23 56 16	- 00 24 16	01 49 50	+ 11 18 18	03 45 28	+ 19 50 55	05 52 34	+ 23 25 44
21	20 10 58	- 20 02 11	22 15 48	- 10 46 49	23 59 55	- 00 00 34	01 53 33	+ 11 38 53	03 49 27	+ 20 03 28	05 56 43	+ 23 26 16
22	20 15 11	- 19 48 51	22 19 38	- 10 25 07	00 03 33	+ 00 23 08	01 57 18	+ 11 59 17	03 53 28	+ 20 15 41	06 00 53	+ 23 26 23
23	20 19 24	- 19 35 10	22 23 27	- 10 03 16	00 07 12	+ 00 46 49	02 01 02	+ 12 19 29	03 57 29	+ 20 27 33	06 05 02	+ 23 26 05
24	20 23 36	- 19 21 07	22 27 15	- 09 41 15	00 10 50	+ 01 10 29	02 04 48	+ 12 39 29	04 01 30	+ 20 39 04	06 09 12	+ 23 25 23
25	20 27 47	- 19 06 42	22 31 03	- 09 19 06	00 14 29	+ 01 34 06	02 08 33	+ 12 59 17	04 05 32	+ 20 50 14	06 13 21	+ 23 24 15
26	20 31 57	- 18 51 56	22 34 50	- 08 56 48	00 18 07	+ 01 57 42	02 12 19	+ 13 18 51	04 09 35	+ 21 01 02	06 17 31	+ 23 22 43
27	20 36 07	- 18 36 49	22 38 37	- 08 34 22	00 21 46	+ 02 21 15	02 16 06	+ 13 38 13	04 13 38	+ 21 11 28	06 21 40	+ 23 20 46
28	20 40 16	- 18 21 22	22 42 23	- 08 11 49	00 25 24	+ 02 44 45	02 19 53	+ 13 57 21	04 17 41	+ 21 21 33	06 25 49	+ 23 18 25
29	20 44 24	- 18 05 35			00 29 03	+ 03 08 12	02 23 41	+ 14 16 16	04 21 45	+ 21 31 15	06 29 58	+ 23 15 39
30	20 48 31	- 17 49 29			00 32 41	+ 03 31 36	02 27 29	+ 14 34 56	04 25 50	+ 21 40 35	06 34 07	+ 23 12 29
31	20 52 38	- 17 33 03			00 36 20	+ 03 54 55			04 29 54	+ 21 49 32		

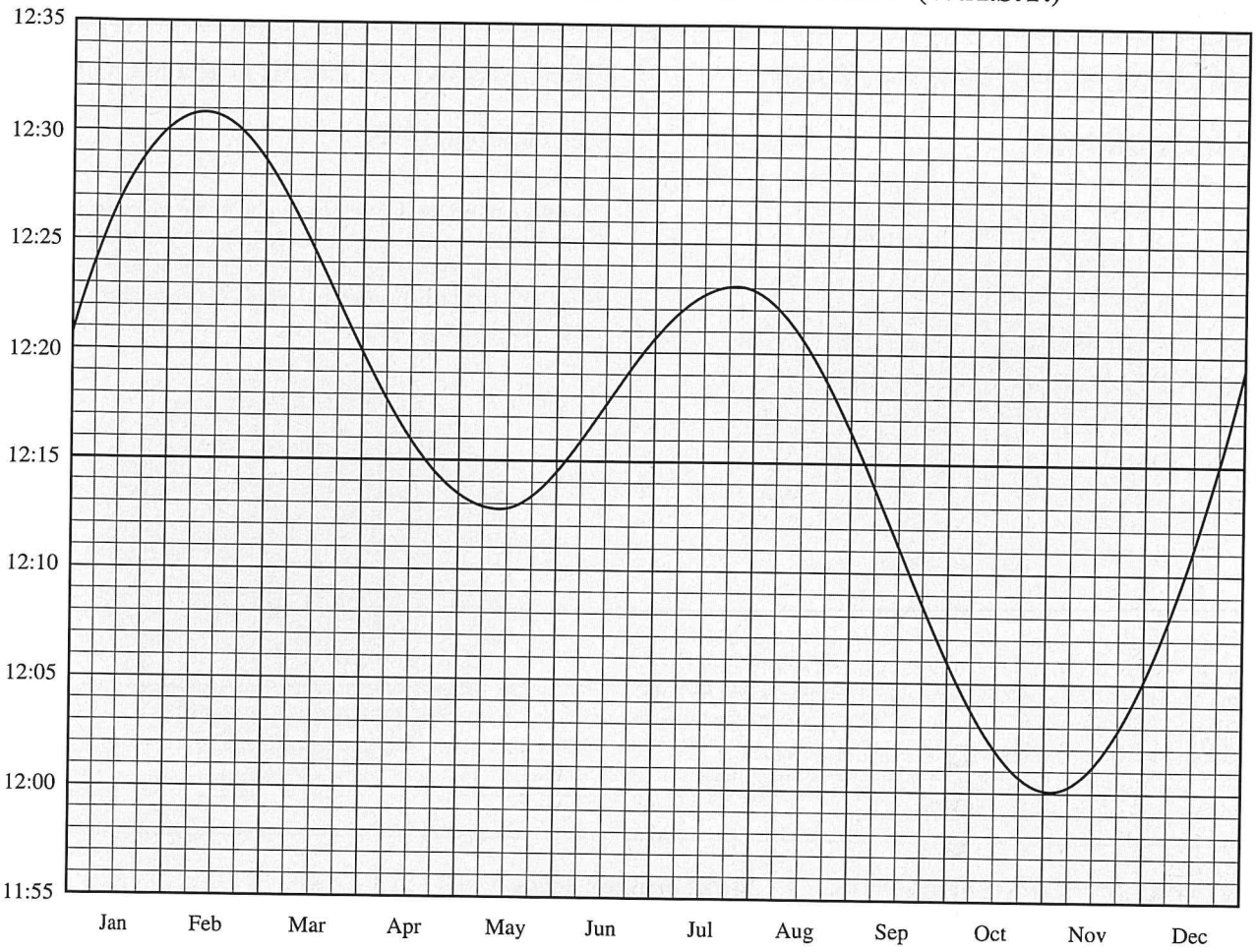
	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
1	06 38 15	+ 23 08 54	08 43 10	+ 18 10 20	10 39 16	+ 08 30 25	12 27 13	- 02 56 28	14 23 07	- 14 13 28	16 26 30	- 21 42 05
2	06 42 24	+ 23 04 55	08 47 03	+ 17 55 17	10 42 54	+ 08 08 41	12 30 50	- 03 19 45	14 27 02	- 14 32 43	16 30 48	- 21 51 28
3	06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

SUN TRANSIT TIMES FOR PERTH (W.A.S.T.)

Jan 1	12 20 01	Feb 1	12 30 10	Mar 1	12 29 03	Apr 1	12 20 37	May 1	12 13 44	Jun 1	12 14 20
Jan 2	12 20 29	Feb 2	12 30 18	Mar 2	12 28 51	Apr 2	12 20 19	May 2	12 13 37	Jun 2	12 14 29
Jan 3	12 20 57	Feb 3	12 30 25	Mar 3	12 28 39	Apr 3	12 20 01	May 3	12 13 31	Jun 3	12 14 39
Jan 4	12 21 25	Feb 4	12 30 31	Mar 4	12 28 26	Apr 4	12 19 44	May 4	12 13 25	Jun 4	12 14 49
Jan 5	12 21 52	Feb 5	12 30 36	Mar 5	12 28 13	Apr 5	12 19 26	May 5	12 13 19	Jun 5	12 14 59
Jan 6	12 22 19	Feb 6	12 30 41	Mar 6	12 27 59	Apr 6	12 19 09	May 6	12 13 14	Jun 6	12 15 10
Jan 7	12 22 45	Feb 7	12 30 45	Mar 7	12 27 45	Apr 7	12 18 52	May 7	12 13 10	Jun 7	12 15 21
Jan 8	12 23 11	Feb 8	12 30 48	Mar 8	12 27 31	Apr 8	12 18 35	May 8	12 13 06	Jun 8	12 15 32
Jan 9	12 23 36	Feb 9	12 30 50	Mar 9	12 27 16	Apr 9	12 18 19	May 9	12 13 03	Jun 9	12 15 44
Jan 10	12 24 01	Feb 10	12 30 51	Mar 10	12 27 01	Apr 10	12 18 02	May 10	12 13 00	Jun 10	12 15 55
Jan 11	12 24 25	Feb 11	12 30 52	Mar 11	12 26 45	Apr 11	12 17 46	May 11	12 12 58	Jun 11	12 16 07
Jan 12	12 24 48	Feb 12	12 30 52	Mar 12	12 26 29	Apr 12	12 17 31	May 12	12 12 56	Jun 12	12 16 19
Jan 13	12 25 11	Feb 13	12 30 51	Mar 13	12 26 13	Apr 13	12 17 15	May 13	12 12 55	Jun 13	12 16 32
Jan 14	12 25 33	Feb 14	12 30 49	Mar 14	12 25 57	Apr 14	12 17 00	May 14	12 12 55	Jun 14	12 16 44
Jan 15	12 25 55	Feb 15	12 30 46	Mar 15	12 25 40	Apr 15	12 16 45	May 15	12 12 55	Jun 15	12 16 57
Jan 16	12 26 16	Feb 16	12 30 43	Mar 16	12 25 23	Apr 16	12 16 30	May 16	12 12 56	Jun 16	12 17 09
Jan 17	12 26 36	Feb 17	12 30 39	Mar 17	12 25 06	Apr 17	12 16 16	May 17	12 12 57	Jun 17	12 17 22
Jan 18	12 26 56	Feb 18	12 30 35	Mar 18	12 24 48	Apr 18	12 16 02	May 18	12 12 59	Jun 18	12 17 35
Jan 19	12 27 14	Feb 19	12 30 29	Mar 19	12 24 31	Apr 19	12 15 49	May 19	12 13 01	Jun 19	12 17 48
Jan 20	12 27 32	Feb 20	12 30 23	Mar 20	12 24 13	Apr 20	12 15 36	May 20	12 13 04	Jun 20	12 18 01
Jan 21	12 27 50	Feb 21	12 30 17	Mar 21	12 23 55	Apr 21	12 15 23	May 21	12 13 07	Jun 21	12 18 14
Jan 22	12 28 06	Feb 22	12 30 09	Mar 22	12 23 37	Apr 22	12 15 11	May 22	12 13 12	Jun 22	12 18 27
Jan 23	12 28 22	Feb 23	12 30 02	Mar 23	12 23 19	Apr 23	12 14 59	May 23	12 13 16	Jun 23	12 18 40
Jan 24	12 28 37	Feb 24	12 29 53	Mar 24	12 23 01	Apr 24	12 14 48	May 24	12 13 21	Jun 24	12 18 53
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Jan 29	12 29 41			Mar 29	12 21 31	Apr 29	12 14 00	May 29	12 13 55	Jun 29	12 19 56
Jan 30	12 29 51			Mar 30	12 21 13	Apr 30	12 13 52	May 30	12 14 03	Jun 30	12 20 09
Jan 31	12 30 01			Mar 31	12 20 55			May 31	12 14 11		

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

TRANSIT TIME OF THE SUN AT PERTH (W.A.S.T.)



SOLAR AND LUNAR ECLIPSES

During 1995 there are four eclipses, two of the Sun and two of the Moon. One solar eclipse is annular and the other total. One lunar eclipse is partial and the other penumbral. From Australia, the partial phases of the total solar eclipse are visible from the northern regions of the continent (see map on page 65). Both lunar eclipses are visible from Australia and New Zealand.

15th April - PARTIAL ECLIPSE of the MOON

The Moon's ingress into the Earth's umbral shadow is very shallow during this event (at mid eclipse only 12% of the Moon's diameter is covered by the umbra). Consequently it will lack the remarkable brightness and colour changes anticipated with a total or large partial lunar eclipse. While the penumbral phases will be barely detectable, the intrusion of the umbral shadow on the lunar limb will show as a distinct "bite".

Moon enters penumbra	April 15th	18hrs 08.0m	(W.A.S.T.)
Moon enters umbra		19hrs 40.7m	
Middle of eclipse		20hrs 18.0m	
Moon leaves umbra		20hrs 55.5m	
Moon leaves penumbra		22hrs 28.1m	

30th April - ANNULAR ECLIPSE of the SUN

The Annular phase is visible across Peru and Brazil. The Partial phases are visible over South America (except the extreme southern tip), southern Mexico, Central America, Cuba, and West Indies.

8th October - PENUMBRAL ECLIPSE of the MOON

The Moon will be tainted only slightly by the Earth's penumbral shadow at this eclipse. Generally, penumbral eclipses are not worthy of observation, this one is no exception especially when you consider it occurs late at night. At mid eclipse 85% of the Moon's diameter is covered by the penumbra.

Moon enters penumbra	October 8th	21hrs 58.0m	(W.A.S.T.)
Middle of eclipse	October 9th	00hrs 04.2m	
Moon leaves penumbra		02hrs 10.2m	

24th October - TOTAL ECLIPSE of the SUN

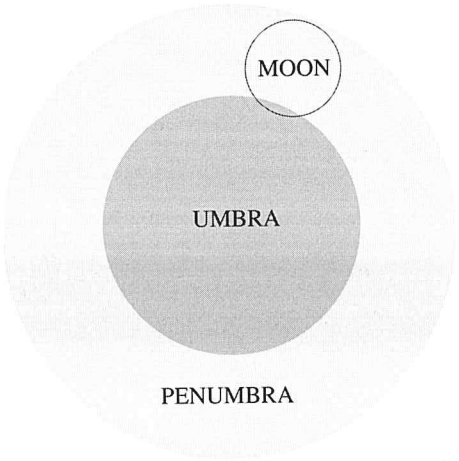
The eclipse begins in central Iran and moves south eastward toward the equator, crossing Afghanistan, Pakistan, India, Thailand, Cambodia, Vietnam, South China Sea, and Borneo. The last notable landfall is on the island of Pulau Sangihe in the Celebes Sea, the path then moves eastward between the Philippines and New Guinea, ending in the Pacific Ocean. The path of totality is 13,600km long and covers less than 0.1% of the Earth's surface area. The weather prospects for the eclipse are good to begin with and end with cloudier skies. Reasonable prospects can be expected from the Calcutta area (eclipse length about 1 minute 20 seconds) to Delhi and Agra (length less than 1 minute) in India. The maximum length of totality is 2 minutes 10 seconds, and occurs over the South China Sea. A partial eclipse will be seen over most of Asia, the Indonesian archipelago and the northern regions of Australia (see diagrams on page 64 and map on page 65.).

	WAST	Longitude	Latitude
Eclipse begins	09h 51.9m	+ 64° 14.0'	+ 27° 34.8'
Central eclipse begins	10h 52.6m	+ 51° 05.9'	+ 34° 50.2'
Central eclipse at apparent noon	12h 22.5m	+ 110° 26.8'	+ 09° 49.9'
Central eclipse ends	14h 12.4m	+ 171° 47.8'	+ 05° 39.1'
Eclipse ends	15h 13.1m	+ 158° 08.4'	- 01° 40.0'

SOLAR & LUNAR ECLIPSES

PARTIAL ECLIPSE of the MOON

15th April 1995

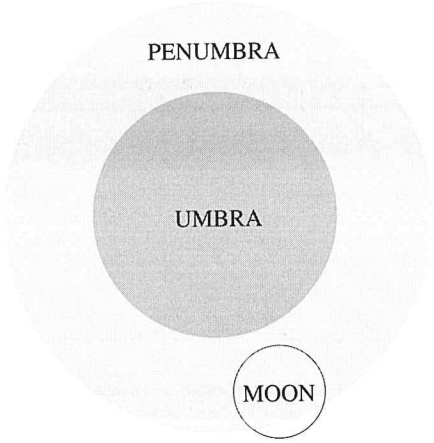


The diagram above shows the position of the Moon in relation to the Earth's shadow during mid eclipse (8:18pm WAST). As the Moon moves through the penumbral shadow it will be only slightly dimmed. Contact with the darker umbra is only shallow (about 12% of the Moon's diameter) and lasts for about 75 minutes. Aside from a slight indentation in the lunar limb, observers can expect an uneventful event.

PENUMBRAL ECLIPSE of the MOON

9th October 1995

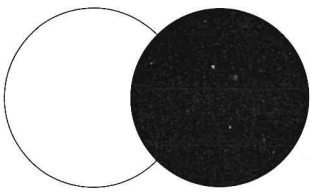
The diagram below shows the position of the Moon in relation to the Earth's shadow during mid eclipse (12:04am WAST). Like the April eclipse the Moon will only be slightly dimmed (with 85% of the disk immersed within the penumbra), a casual observer will probably be unaware of the event.



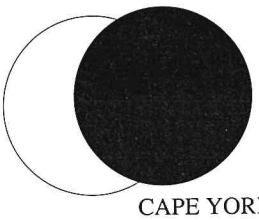
TOTAL ECLIPSE of the SUN 24th October 1995

The diagrams show the partial phase of the Total Solar eclipse as seen from various Australian locations at greatest (mid) eclipse. The Moon's umbral shadow (path of totality) begins in the Middle East, moves across India, Southeast Asia, and the South China Sea where it makes brief contact with the northern tip of Borneo. The path then sweeps between the Philippines and New Guinea, and ends at sunset in the Pacific Ocean south of the Marshall Islands. The partial eclipse is visible over the broader area covered by the Moon's penumbral shadow as detailed in the map on page 65. New Zealand, Sydney, Melbourne, Hobart, Adelaide and Perth are all too far south to see the eclipse.

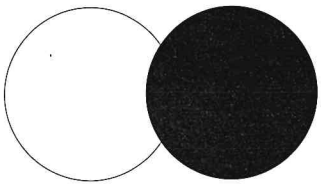




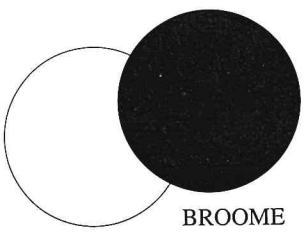
TOWNSVILLE
QLD 4:10pm



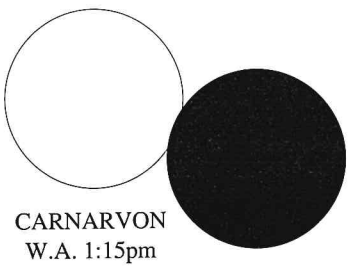
CAPE YORK
QLD 3:00pm



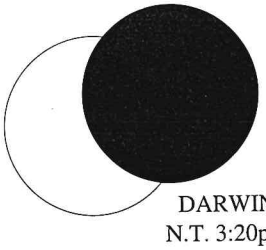
ALICE SPRINGS
N.T. 3:40pm



BROOME
W.A. 1:40pm

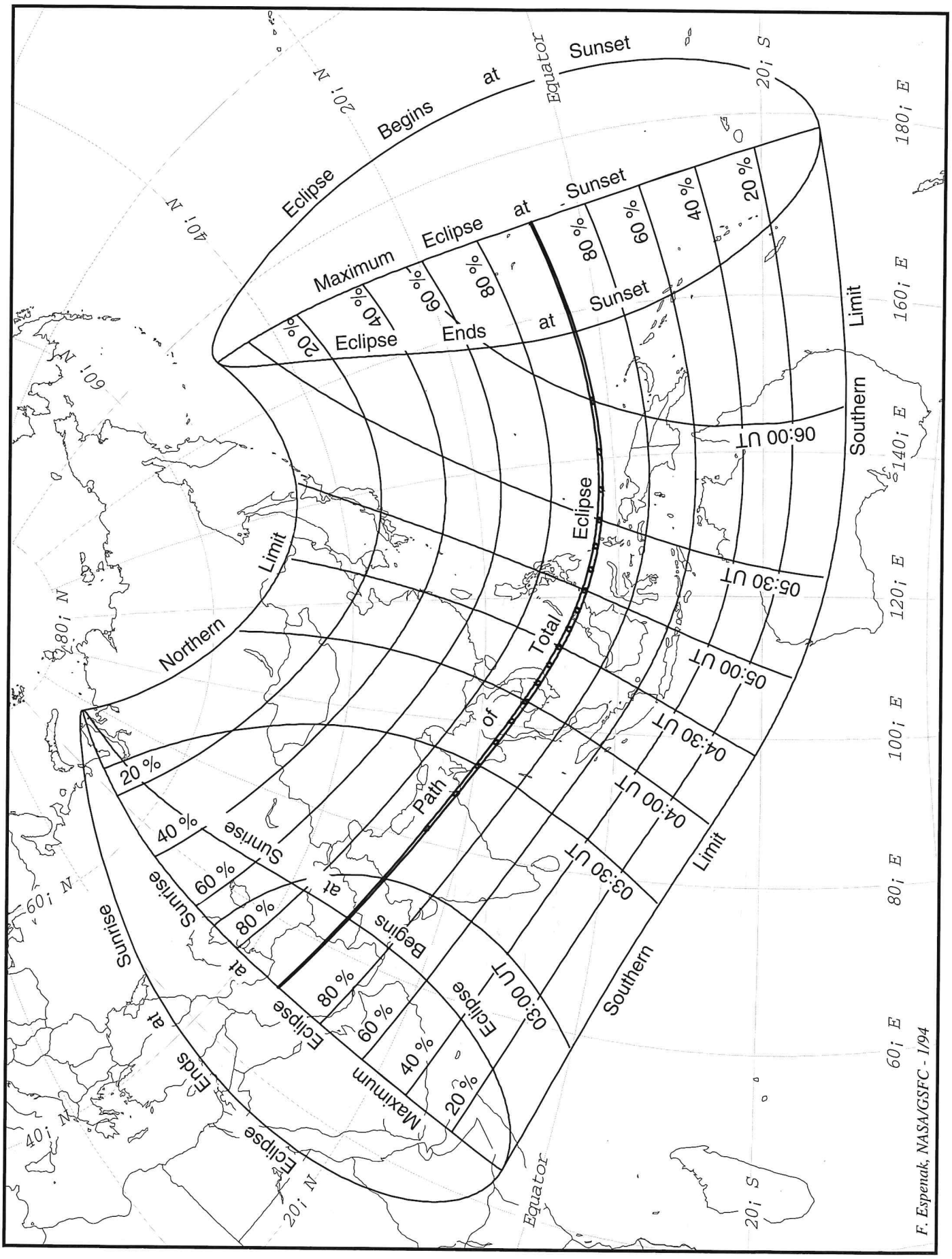


CARNARVON
W.A. 1:15pm



DARWIN
N.T. 3:20pm

Total Solar Eclipse of October 24 1995



MOON

GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "
1	18 16 12	- 19 27 14	21 44 09	- 08 30 04	22 16 27	- 05 51 12	01 16 56	+ 09 31 59	03 28 56	+ 17 11 01	06 35 38	+ 18 32 47
2	19 18 17	- 17 33 04	22 36 11	- 04 06 05	23 07 03	- 01 26 57	02 05 20	+ 12 54 22	04 18 37	+ 18 40 36	07 25 07	+ 16 56 04
3	20 17 35	- 14 32 46	23 26 12	+ 00 22 20	23 56 22	+ 02 55 37	02 54 10	+ 15 40 12	05 08 38	+ 19 20 34	08 13 59	+ 14 34 28
4	21 13 35	- 10 45 23	00 14 50	+ 04 41 57	00 44 56	+ 07 04 13	03 43 30	+ 17 43 09	05 58 42	+ 19 09 24	09 02 19	+ 11 33 22
5	22 06 25	- 06 30 21	01 02 42	+ 08 42 11	01 33 13	+ 10 48 39	04 33 16	+ 18 58 37	06 48 31	+ 18 07 37	09 50 22	+ 07 59 09
6	22 56 37	- 02 04 37	01 50 24	+ 12 14 43	02 21 36	+ 14 00 34	05 23 20	+ 19 23 44	07 37 56	+ 16 17 38	10 38 38	+ 03 59 01
7	23 44 57	+ 02 18 15	02 38 23	+ 15 12 40	03 10 23	+ 16 33 17	06 13 29	+ 18 57 25	08 26 56	+ 13 43 14	11 27 46	- 00 18 34
8	00 32 10	+ 06 27 43	03 27 00	+ 17 30 13	03 59 42	+ 18 21 31	07 03 32	+ 17 40 15	09 15 44	+ 10 29 24	12 18 31	- 04 43 21
9	01 19 00	+ 10 15 27	04 16 25	+ 19 02 15	04 49 33	+ 19 21 15	07 53 26	+ 15 34 20	10 04 43	+ 06 42 15	13 11 38	- 09 02 18
10	02 06 05	+ 13 34 23	05 06 38	+ 19 44 32	05 39 52	+ 19 29 47	08 43 14	+ 12 43 15	10 54 24	+ 02 29 23	14 07 47	- 12 59 04
11	02 53 53	+ 16 18 01	05 57 30	+ 19 33 59	06 30 28	+ 18 45 49	09 33 10	+ 09 12 12	11 45 29	- 01 59 23	15 07 14	- 16 14 23
12	03 42 40	+ 18 20 15	06 48 43	+ 18 29 20	07 21 11	+ 17 09 44	10 23 35	+ 05 08 18	12 38 39	- 06 31 10	16 09 43	- 18 28 16
13	04 32 30	+ 19 35 25	07 40 00	+ 16 31 34	08 11 55	+ 14 43 46	11 15 00	+ 00 41 12	13 34 30	- 10 49 26	17 14 07	- 19 24 31
14	05 23 13	+ 19 58 57	08 31 08	+ 13 44 21	09 02 39	+ 11 32 21	12 07 56	- 03 56 18	14 33 22	- 14 34 22	18 18 44	- 18 55 49
15	06 14 30	+ 19 28 05	09 22 02	+ 10 14 06	09 53 33	+ 07 42 17	13 02 55	- 08 27 58	15 35 04	- 17 25 01	19 21 47	- 17 06 23
16	07 05 53	+ 18 02 32	10 12 48	+ 06 09 56	10 44 52	+ 03 23 09	14 00 17	- 12 34 45	16 38 41	- 19 03 28	20 21 59	- 14 10 25
17	07 56 59	+ 15 45 02	11 03 44	+ 01 43 18	11 37 01	- 01 12 39	15 00 01	- 15 56 29	17 42 45	- 19 19 36	21 18 49	- 10 27 09
18	08 47 34	+ 12 41 10	11 55 13	- 02 52 26	12 30 26	- 05 49 59	16 01 33	- 18 15 11	18 45 34	- 18 14 07	22 12 27	- 06 16 09
19	09 37 38	+ 08 58 58	12 47 46	- 07 22 25	13 25 30	- 10 11 35	17 03 51	- 19 18 43	19 45 48	- 15 57 31	23 03 28	- 01 54 24
20	10 27 25	+ 04 48 19	13 41 51	- 11 30 58	14 22 25	- 13 59 19	18 05 35	- 19 03 31	20 42 49	- 12 46 12	23 52 36	+ 02 24 30
21	11 17 19	+ 00 20 31	14 37 46	- 15 02 13	15 21 07	- 16 56 06	19 05 30	- 17 34 43	21 36 39	- 08 57 55	00 40 39	+ 06 29 50
22	12 07 55	- 04 12 05	15 35 32	- 17 41 19	16 21 05	- 18 48 13	20 02 51	- 15 03 54	22 27 47	- 04 48 57	01 28 17	+ 10 12 57
23	12 59 54	- 08 36 00	16 34 48	- 19 15 57	17 21 27	- 19 27 33	20 57 25	- 11 45 44	23 16 55	- 00 33 03	02 16 04	+ 13 26 27
24	13 53 51	- 12 36 34	17 34 49	- 19 38 16	18 21 12	- 18 52 48	21 49 25	- 07 55 17	00 04 50	+ 03 38 25	03 04 24	+ 16 03 42
25	14 50 11	- 15 58 07	18 34 34	- 18 46 33	19 19 25	- 17 09 20	22 39 23	- 03 46 31	00 52 13	+ 07 35 44	03 53 25	+ 17 58 53
26	15 48 59	- 18 24 53	19 33 05	- 16 45 43	20 15 33	- 14 27 29	23 27 58	+ 00 28 01	01 39 40	+ 11 10 20	04 43 06	+ 19 07 10
27	16 49 44	- 19 43 05	20 29 42	- 13 46 22	21 09 25	- 11 00 27	00 15 48	+ 04 37 11	02 27 36	+ 14 14 22	05 33 12	+ 19 25 18
28	17 51 25	- 19 44 00	21 24 07	- 10 02 53	22 01 12	- 07 02 30	01 03 27	+ 08 30 51	03 16 15	+ 16 40 42	06 23 21	+ 18 52 09
29	18 52 43	- 18 26 32			22 51 21	- 02 47 40	01 51 22	+ 11 59 44	04 05 37	+ 18 23 13	07 13 11	+ 17 28 56
30	19 52 24	- 15 58 15			23 40 21	+ 01 30 52	02 39 49	+ 14 55 31	04 55 32	+ 19 17 21	08 02 27	+ 15 19 11
31	20 49 37	- 12 33 28			00 28 43	+ 05 41 01			05 45 40	+ 19 20 35		

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

MOON RISE AND SET (for Perth)

(W.A.S.T.)

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
	h mm	h mm	h mm	h mm	h mm	h mm	h mm	h mm	h mm	h mm	h mm	h mm
1	4 53	19 07	6 54	19 57	5 39	18 29	7 21	18 49	7 56	18 45	9 07	19 52
2	6 00	19 58	7 56	20 34	6 40	19 05	8 16	19 27	8 48	19 29	9 49	20 44
3	7 06	20 44	8 55	21 09	7 38	19 40	9 10	20 06	9 37	20 16	10 28	21 38
4	8 11	21 25	9 53	21 43	8 36	20 16	10 03	20 48	10 24	21 05	11 05	22 33
5	9 13	22 03	10 49	22 18	9 32	20 52	10 54	21 33	11 08	21 57	11 41	23 29
6	10 13	22 38	11 44	22 55	10 27	21 30	11 43	22 21	11 49	22 50	12 16	DNS
7	11 10	23 11	12 38	23 33	11 20	22 10	12 29	23 12	12 28	23 45	12 52	0 27
8	12 06	23 45	13 30	DNS	12 12	22 53	13 12	DNS	13 05	DNS	13 29	1 27
9	13 00	DNS	14 21	0 15	13 02	23 40	13 53	0 05	13 42	0 41	14 09	2 29
10	13 54	0 20	15 11	0 59	13 50	DNS	14 32	1 00	14 18	1 40	14 54	3 34
11	14 47	0 57	15 58	1 47	14 35	0 29	15 09	1 57	14 55	2 40	15 44	4 41
12	15 39	1 36	16 43	2 39	15 18	1 21	15 46	2 55	15 35	3 43	16 40	5 48
13	16 30	2 19	17 25	3 33	15 59	2 16	16 24	3 56	16 19	4 48	17 42	6 54
14	17 19	3 05	18 05	4 30	16 38	3 13	17 03	4 59	17 07	5 56	18 48	7 56
15	18 05	3 55	18 43	5 28	17 16	4 12	17 45	6 04	18 01	7 04	19 55	8 52
16	18 48	4 48	19 20	6 27	17 53	5 13	18 31	7 11	19 00	8 12	21 02	9 41
17	19 29	5 43	19 57	7 28	18 31	6 15	19 21	8 19	20 03	9 15	22 06	10 25
18	20 08	6 40	20 35	8 29	19 11	7 19	20 17	9 26	21 08	10 12	23 07	11 05
19	20 44	7 38	21 14	9 32	19 54	8 24	21 16	10 29	22 13	11 03	DNR	11 42
20	21 20	8 37	21 56	10 36	20 40	9 30	22 18	11 28	23 17	11 48	0 06	12 17
21	21 56	9 36	22 43	11 40	21 30	10 35	23 21	12 21	DNR	12 29	1 03	12 52
22	22 33	10 37	23 34	12 43	22 25	11 39	DNR	13 08	0 17	13 06	1 59	13 27
23	23 13	11 39	DNR	13 45	23 24	12 39	0 23	13 50	1 16	13 41	2 53	14 04
24	23 56	12 42	0 29	14 44	DNR	13 34	1 24	14 28	2 13	14 16	3 47	14 43
25	DNR	13 47	1 29	15 37	0 25	14 24	2 23	15 04	3 09	14 50	4 39	15 25
26	0 44	14 51	2 31	16 26	1 27	15 09	3 21	15 39	4 04	15 26	5 30	16 10
27	1 38	15 53	3 35	17 11	2 29	15 50	4 18	16 14	4 58	16 03	6 19	16 57
28	2 36	16 52	4 38	17 51	3 30	16 27	5 14	16 49	5 51	16 43	7 05	17 48
29	3 39	17 45			4 29	17 03	6 09	17 25	6 43	17 26	7 48	18 40
30	4 44	18 34			5 27	17 38	7 03	18 04	7 34	18 12	8 29	19 34
31	5 50	19 17			6 25	18 13			8 22	19 01		

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
1	9 07	20 28	9 31	22 11	10 15	DNS	10 55	0 07	12 59	1 22	13 53	1 18
2	9 43	21 24	10 08	23 11	11 06	0 12	11 57	1 02	14 00	2 02	14 50	1 54
3	10 18	22 20	10 47	DNS	12 01	1 13	13 00	1 53	14 59	2 40	15 46	2 30
4	10 53	23 18	11 29	0 13	13 01	2 12	14 03	2 40	15 58	3 16	16 42	3 08
5	11 28	DNS	12 17	1 16	14 04	3 07	15 05	3 22	16 55	3 53	17 36	3 47
6	12 06	0 17	13 10	2 19	15 09	3 57	16 07	4 02	17 52	4 29	18 28	4 28
7	12 47	1 19	14 09	3 21	16 14	4 43	17 07	4 40	18 48	5 08	19 18	5 12
8	13 33	2 23	15 12	4 21	17 18	5 26	18 07	5 17	19 42	5 48	20 06	5 59
9	14 24	3 28	16 18	5 16	18 20	6 05	19 05	5 54	20 34	6 31	20 50	6 48
10	15 22	4 33	17 25	6 05	19 21	6 43	20 02	6 32	21 23	7 17	21 31	7 39
11	16 25	5 37	18 31	6 51	20 20	7 21	20 57	7 11	22 09	8 05	22 09	8 31
12	17 32	6 36	19 35	7 32	21 18	7 58	21 50	7 53	22 52	8 54	22 46	9 24
13	18 40	7 29	20 37	8 11	22 14	8 36	22 41	8 37	23 32	9 46	23 20	10 18
14	19 47	8 17	21 37	8 49	23 08	9 16	23 29	9 23	DNR	10 38	23 55	11 12
15	20 51	9 00	22 35	9 25	DNR	9 59	DNR	10 12	0 10	11 32	DNR	12 07
16	21 53	9 39	23 31	10 02	0 00	10 43	0 14	11 02	0 46	12 26	0 29	13 05
17	22 53	10 16	DNR	10 41	0 49	11 30	0 56	11 54	1 21	13 22	1 06	14 05
18	23 50	10 52	0 25	11 21	1 36	12 20	1 35	12 48	1 56	14 20	1 45	15 07
19	DNR	11 28	1 18	12 04	2 20	13 12	2 13	13 43	2 33	15 21	2 28	16 12
20	0 46	12 04	2 09	12 49	3 01	14 05	2 49	14 40	3 12	16 24	3 17	17 18
21	1 41	12 43	2 57	13 37	3 40	15 00	3 25	15 38	3 54	17 29	4 12	18 23
22	2 34	13 24	3 42	14 28	4 18	15 57	4 02	16 38	4 42	18 36	5 13	19 25
23	3 25	14 07	4 25	15 21	4 54	16 55	4 40	17 41	5 34	19 42	6 19	20 22
24	4 15	14 54	5 06	16 15	5 30	17 54	5 21	18 45	6 33	20 45	7 27	21 13
25	5 02	15 43	5 44	17 11	6 08	18 55	6 06	19 51	7 36	21 43	8 35	21 59
26	5 47	16 35	6 21	18 08	6 46	19 57	6 55	20 56	8 41	22 35	9 41	22 40
27	6 29	17 28	6 57	19 06	7 28	21 01	7 49	21 59	9 47	23 21	10 44	23 19
28	7 08	18 23	7 33	20 05	8 13	22 05	8 48	22 57	10 51	DNS	11 45	23 56
29	7 45	19 19	8 09	21 05	9 03	23 07	9 50	23 51	11 54	0 03	12 44	DNS
30	8 21	20 15	8 48	22 07	9 57	DNS	10 53	DNS	12 54	0 42	13 41	0 32
31	8 56	21 13	9 30	23 09			11 57	0 39			14 37	1 09

MOON PHASES (W.A.S.T.)

Lunation	New Moon	First Quarter	Full Moon	Last Quarter
	d h m	d h m	d h m	d h m
891	Jan 01 18:56	Jan 08 23:46	Jan 17 04:26	Jan 24 12:58
892	Jan 31 06:48	Feb 07 20:54	Feb 15 20:15	Feb 22 21:04
893	Mar 01 19:48	Mar 09 18:14	Mar 17 09:26	Mar 24 04:10
894	Mar 31 10:09	Apr 08 13:35	Apr 15 20:08	Apr 22 11:18
895	Apr 30 01:36	May 08 05:44	May 15 04:48	May 21 19:36
896	May 29 17:27	Jun 06 18:26	Jun 13 12:03	Jun 20 06:01
897	Jun 28 08:50	Jul 06 04:02	Jul 12 18:49	Jul 19 19:10
898	Jul 27 23:13	Aug 04 11:16	Aug 11 02:15	Aug 18 11:04
899	Aug 26 12:31	Sep 02 17:03	Sep 09 11:37	Sep 17 05:09
900	Sep 25 00:55	Oct 01 22:36	Oct 08 23:52	Oct 17 00:26
901	Oct 24 12:36	Oct 31 05:17	Nov 07 15:20	Nov 15 19:40
902	Nov 22 23:43	Nov 29 14:28	Dec 07 09:27	Dec 15 13:31
903	Dec 22 10:22	Dec 29 03:06		

MOON (W.A.S.T.)

APOGEE		PERIGEE	
	d hh		d hh
Jan	12 06	Jan	28 07
Feb	9 02	Feb	23 10
Mar	8 23	Mar	20 21
Apr	5 18	Apr	17 16
May	3 09	May	15 23
May	30 16	Jun	13 09
Jun	26 19	Jul	11 18
Jul	24 04	Aug	8 22
Aug	20 20	Sep	5 09
Sep	17 14	Sep	30 12
Oct	15 10	Oct	27 05
Nov	12 05	Nov	24 07
Dec	9 18	Dec	22 18

LUNAR OCCULTATIONS

INTRODUCTION

An occultation is when a body passes in front of a more distant astronomical object. As viewed from Earth, no solar system body occults more stars, more often, than our own Moon. The reasons for this are -

1. Its large apparent angular size. Although the Moon is small in comparison to the planets; it appears large, 0.5° wide, because of its proximity. The Moon travels along a 0.5° wide path across the sky, as the Sun does.
2. The rapid motion of the Moon across the sky. It completes one revolution about every 28 days.
3. With it moving approximately in the plane of the ecliptic, as do all Solar System bodies, the Moon frequently (monthly) moves across the heavily star populated Milky Way. It also occasionally occults the Sun and the planets. An eclipse of the Sun is indeed the most spectacular lunar occultation!

From month to month the Moon does not occult the same stars. In fact over a number of years it drifts in declination between plus and minus 28 degrees. The brighter stars, which the Moon occults, are listed in the Zodiacal Catalogue (ZC). There are about 3500 stars in the ZC.

The Moon moves from west to east, therefore it sets and rises later from day to day. From just after New Moon to just before Full Moon, stars being occulted, will disappear behind part of the dark limb and reappear from the bright limb. The limb is another way of saying the edge of the Moon. After Full Moon, a star will disappear on the bright limb and reappear on the dark limb. There is no dark limb at the time of Full Moon.

Without a doubt "dark" limb events, in particular disappearances, are the easiest to observe. Following a star until it "winks out" is much easier than scanning the lunar limb waiting for it to suddenly reappear. The brighter the star the more spectacular the event. The following table presents the easier to observe occultations for 1995 as predicted for Perth. For any particular star, both events (ie. the disappearance and reappearance) are not necessarily included. An event may not be present because:-

1. The moon is in daylight
2. The moon is too close to or below the horizon.
3. For faint stars, events on a bright limb (in particular reappearances) are difficult to observe and have been omitted.

THE TIMING OF OCCULTATIONS.

Besides being a spectacular event, occultations is an area in which the amateur can make a scientific contribution. The exact timing of when a star goes into or out of occultation helps astronomers in refining their knowledge of the Moon's position and the shape of the limb.

TIMING EQUIPMENT. For a single event, such as a normal occultation, a stop-watch and the telephone time signal, as a reference, is all that is required. For multiple events, the amateur may tape record simultaneously a shortwave radio time signal (eg. VNG) with his own voice calling out the events (eg. star gone ... now !). The tape would be later played back (often at a slower speed) and the precise times determined. An accuracy of within 0.2 seconds is not unusual for the experienced observer.

TELESCOPE REQUIREMENTS. This varies greatly with the brightness of the star being observed,the brightness of the moon (how close to Full Moon) and whether the event is on a bright or dark limb. Disappearances of first magnitude stars on the dark limb can be observed with the naked eye!

For further information on timing methods for occultations it would be worthwhile contacting your local astronomical society (see page 108).

LUNAR OCCULTATION TABLES

The faintest stars, which have occultation predictions on the following pages, are approximately 9th magnitude. The selection of stars included is based on an IOTA observability equation which takes into account such factors as the altitude of the Moon, whether it is a dark or bright limb event, whether it is in daylight or twilight etc. For example only bright limb events of the brightest stars are listed.

EXPLANATION

W.A.S.T. Is the date and time of the occultation. Hr & min are in W.A.S.T. .

CATALOG is the primary identification of the star, needed on an observation report. 1 to 4 digit numbers are from the ZC catalogue. Five-digit numbers preceded by letter X are from the USNO subset of the Smithsonian Star catalogue (XZ) for the zodiacal regions of the sky. Other letters designate special catalogues, such as P for Pleiades Catalog. Numbers starting with "M" or "NG" are from the Messier or NGC catalogs of deep sky objects.

PD This is the event which consists of two letters. The first letter is the type of Event ie. "D" = Disappearance , "R" = Reappearance, "G" = Graze and "M" = Miss with a graze nearby. The second letter represents: "D" = Dark limb, "B" = a bright limb event and "U"= event during lunar eclipse.

Mag is the magnitude of the star.

Elg is the elongation or separation of the Moon from the Sun as measured in degrees.

Alt. Is the altitude of the Moon during the occultation.

P.A. Position Angle is the position the event occurs on the limb of the Moon (measured as degrees east of north).

A Coefficient of Longitude (see below)

B Coefficient of Latitude (see below)

**** NB. For some stars, close to "grazing", A and B values become useless, and no values are recorded.

CALCULATING EVENT TIME FOR OTHER LOCATIONS

Unless the event is close to a "graze" (ie. PA is close to 0° or 180°) this calculation will give a good approximation for any location within about 500km from Perth. The formula is:

Predicted Time at your location

= Time from Table + (A x n) + (B x p)

where "n" and "p" is the change in longitude and latitude respectively (in decimal degrees).

"n" is positive(+) if West, negative(-) if East

"p" is positive(+) if North, negative(-) if South.

The values for A and B are taken from the tables.

WORKED EXAMPLE

An observer wishes to calculate a more accurate time for the disappearance of ZC 0894 on Jan. 14 for their location in Wagin (117° 20' E, 33° 19' S), see p. 103.

-The change in longitude from Perth (decimal degrees)

= 115°.85 - 117°.33 = -1°.48 — "n"

-The change in latitude from Perth (decimal degrees)

= 31°.95 - 33°.32= -1°.37 — "p"

From the table, the time of the event is 22:14 WAST and the values of A and B are -2.5 and -4.0 respectively.

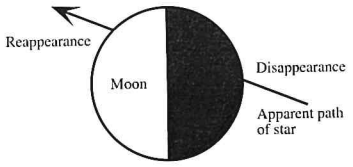
Therefore the equation becomes :-

22:14 + (-2.5 × -1.48) + (-4.0 × -1.37)

= 22:14 + (3.7) + (5.5)

= 22:14 + 9.2 = 22:23 (approx..).

The event will be visible from Wagin approx. 9 mins later than Perth ie. at 22:23 (10:06PM) WAST on Jan. 14.



LUNAR OCCULTATION TABLE

PERTH (31° 57' S, 115° 51'E)

W.A.S.T	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Jan 04 20:21	3166	DD	4.8	41	12	352	+ 1.1	+ 6.0
Jan 07 20:23	X00107	DD	8.4	77	33	112	- 2.0	+ 0.2
Jan 07 20:49	X00124	DD	8.2	77	28	90	- 1.4	+ 1.1
Jan 07 20:51	X00126	DD	8.4	77	27	81	- 1.3	+ 1.4
Jan 08 21:09	0124	DD	8.0	89	29	74	- 1.5	+ 1.5
Jan 09 19:48	X02380	DD	8.8	99	43	76	- 2.5	+ 1.0
Jan 09 21:01	X02403	DD	8.2	100	35	28	- 1.6	+ 3.0
Jan 12 20:02	0614	DD	5.7	132	37	130	- 3.5	- 2.6
Jan 13 21:23	X06429	DD	8.0	143	37	38	- 2.3	+ 2.1
Jan 14 01:35	0765	DD	5.3	145	15	126	- 0.7	- 0.2
Jan 14 21:20	0892	DD	6.6	154	35	149	- 2.9	- 3.7
Jan 14 22:14	0894	DD	4.6	154	38	156	- 2.5	- 4.0
Jan 14 22:42	X07874	DD	8.2	155	38	96	- 2.7	- 0.2
Jan 16 00:18	1043	DD	7.6	166	37	122	- 2.1	- 0.7
Jan 18 21:11	1381	RD	6.3	159	12	341	- 1.0	- 3.5
Jan 19 02:06	X14242	RD	8.1	158	47	264	- 2.9	+ 0.4
Jan 21 03:13	X16690	RD	8.1	133	56	295	- 2.1	- 1.0
Jan 21 03:16	1611	RD	5.7	133	56	318	- 1.6	- 1.8
Jan 23 02:13	X18818	RD	7.5	108	44	12	+ 1.8	- 7.2
Jan 23 03:13	X18823	RD	8.3	108	55	301	- 1.6	- 1.7
Jan 24 02:34	X19640	RD	8.1	95	41	281	- 1.2	- 1.3
Jan 24 03:21	1966	RD	8.1	95	50	285	- 1.5	- 1.3
Jan 26 02:56	2232	RD	7.2	69	26	251	- 0.8	- 0.5
Jan 29 05:09	X25887	RD	7.8	28	17	264	- 0.3	- 0.8
Feb 08 20:38	X05038	DD	8.2	101	34	133	- 2.3	- 1.3
Feb 10 20:06	0837	DD	6.1	122	37	92	- 2.7	- 0.2
Feb 12 22:52	X10921	DD	7.9	145	39	145	- 1.6	- 1.8
Feb 12 22:55	X10926	DD	8.1	145	39	139	- 1.8	- 1.4
Feb 13 23:52	X12435	DD	7.8	157	41	43	- 5.2	+ 5.0
Feb 15 01:46	X13874	DD	7.7	169	38	63	- 3.1	+ 2.6
Feb 15 02:48	1364	DD	6.5	170	29	108	- 1.3	+ 0.3
Feb 17 01:59	X16239	RD	8.0	165	53	277	- 2.5	+ 0.0
Feb 17 02:24	1577	RD	7.1	165	51	357	- 0.1	- 3.9
Feb 17 23:02	X17435	RD	8.0	153	37	287	- 1.3	- 1.4
Feb 18 23:17	1798	RD	6.3	140	33	18	****	****
Feb 19 03:16	1807	RD	5.9	139	64	342	- 1.0	- 3.1
Feb 19 04:46	1817	RD	6.9	138	55	17	****	****
Feb 20 01:15	1932	RD	8.1	127	48	353	+ 0.0	- 4.1
Feb 20 03:51	X19447	RD	8.3	126	68	326	- 1.5	- 2.4
Feb 20 23:04	2053	RD	4.6	115	13	264	- 0.3	- 0.9
Feb 22 02:10	2197	RD	7.6	100	41	328	- 0.4	- 2.8
Feb 23 01:07	2346	RD	8.2	87	18	221	- 1.1	+ 1.1
Feb 24 02:14	X23468	RD	8.0	73	20	216	- 1.3	+ 1.5
Feb 24 03:38	X23520	RD	8.7	73	37	275	- 0.9	- 1.1
Feb 24 04:31	X23555	RD	8.5	73	48	302	- 1.1	- 2.1
Feb 24 05:45	2522	RD	8.0	72	63	258	- 2.1	- 0.1
Feb 25 03:09	X25252	RD	7.9	60	19	285	- 0.2	- 1.4
Feb 25 04:02	X25300	RD	8.7	60	30	298	- 0.4	- 1.9
Feb 25 04:03	K07308	RD	8.6	60	30	271	- 0.7	- 1.0
Feb 25 04:34	2680	DB	5.8	59	36	113	- 0.7	- 1.8
Feb 25 04:55	X25349	RD	8.9	59	41	295	- 0.9	- 1.9
Feb 25 05:24	2686	DB	5.2	59	46	37	- 2.0	+ 1.9
Feb 25 05:40	2680	RD	5.8	59	50	246	- 1.7	+ 0.1
Feb 26 05:21	X27053	RD	8.8	46	33	301	- 0.7	- 2.3
Feb 27 05:12	X28396	RD	8.0	33	19	301	- 0.2	- 2.3
Feb 27 05:27	X28413	RD	8.0	33	22	229	- 0.8	+ 0.4
Feb 27 05:31	X28412	RD	7.9	33	23	299	- 0.4	- 2.2
Mar 06 19:53	X03647	DD	8.4	58	17	48	- 1.4	+ 2.4
Mar 07 20:06	X04587	DD	8.1	69	21	78	- 1.6	+ 1.4
Mar 09 20:42	0783	DD	7.7	91	28	126	- 1.6	- 0.5
Mar 09 21:07	X06737	DD	8.0	91	25	105	- 1.6	+ 0.5
Mar 09 21:24	X06732	DD	7.8	91	23	153	- 0.4	- 2.1
Mar 09 21:41	X06757	DD	7.7	91	20	101	- 1.3	+ 0.7
Mar 09 22:07	0790	DD	6.8	91	16	92	- 1.2	+ 1.0
Mar 10 18:54	0915	DD	4.7	101	38	52	- 2.9	+ 1.5
Mar 10 20:04	0915	RB	4.7	101	36	322	- 2.0	- 1.7
Mar 10 23:06	0930	DD	8.1	103	14	102	- 0.9	+ 0.7
Mar 11 19:27	X10101	DD	8.0	113	39	92	- 2.7	- 0.3
Mar 13 00:19	1190	DD	7.1	126	21	129	- 0.7	- 0.3
Mar 14 20:05	X14412	DD	7.9	148	37	120	- 1.7	- 1.7
Mar 14 23:03	X14494	DD	8.2	149	47	125	- 1.9	- 1.0
Mar 15 03:09	1429	DD	6.8	150	12	104	- 0.5	+ 0.6
Mar 16 03:05	1546	DD	7.2	163	25	137	- 0.6	- 0.7
Mar 17 23:26	1754	RD	6.9	172	56	261	- 2.6	- 0.1
Mar 18 04:54	X18324	RD	7.3	170	28	342	- 0.6	- 2.3
Mar 19 23:36	2014	RD	7.8	146	45	329	- 0.6	- 2.7
Mar 20 02:10	X20029	RD	8.3	145	70	334	- 1.2	- 3.1
Mar 20 02:20	2024	RD	7.4	144	71	251	- 2.9	+ 1.0
Mar 20 05:56	X20113	RD	8.1	143	42	265	- 1.3	+ 1.2
Mar 21 05:06	2170	RD	6.8	130	64	314	- 1.9	- 1.6
Mar 22 01:55	X22055	RD	7.7	117	53	219	- 3.2	+ 3.0
Mar 22 02:36	2313	RD	7.0	117	61	266	- 2.0	- 0.5
Mar 22 03:41	2316	RD	6.4	117	72	265	- 2.3	- 0.1
Mar 22 04:52	X22142	RD	7.5	116	76	307	- 2.2	- 1.7
Mar 23 01:23	X23078	RD	7.8	104	35	209	- 2.6	+ 3.5
Mar 23 01:46	X23088	RD	8.1	104	40	242	- 1.5	+ 0.1
Mar 23 04:50	X23247	RD	8.1	103	74	334	- 1.8	- 5.2
Mar 24 00:49	2613	RD	7.8	91	16	194	- 2.8	+ 6.5
Mar 24 02:59	2628	RD	8.0	90	42	328	- 0.4	- 4.1
Mar 24 03:00	X24750	RD	8.6	90	43	287	- 1.1	- 1.6
Mar 24 04:45	K07278	RD	8.2	90	64	267	- 2.1	- 0.5
Mar 24 05:19	K07288	RD	8.1	89	70	324	- 2.1	- 4.5
Mar 24 05:27	K07285	RD	8.2	89	71	267	- 2.3	- 0.2
Mar 24 05:28	X24920	RD	8.0	89	71	214	- 2.3	+ 3.3
Mar 24 05:53	2640	RD	6.1	89	75	290	- 2.4	- 1.2
Mar 25 01:57	2789	RD	7.3	78	18	270	- 0.3	- 1.0
Mar 25 04:42	X26588	RD	8.8	76	51	304	- 1.5	- 2.7
Mar 25 05:35	2808	RD	7.4	76	62	204	- 2.0	+ 3.8
Mar 27 04:20	NG7009	RD	8.4	51	22	203	- 0.9	+ 2.1
Mar 28 04:28	3212	RD	7.5	38	11	314	- 0.1	- 3.8
Apr 05 18:49	X06303	DD	8.6	60	27	80	- 2.0	+ 1.3
Apr 05 19:24	X06321	DD	8.0	60	22	68	- 1.9	+ 1.8
Apr 07 18:32	X09384	DD	7.7	81	38	140	- 2.0	- 1.7
Apr 07 19:21	X09433	DD	7.8	82	35	85	- 2.5	+ 0.8
Apr 08 22:20	1141	DD	5.6	94	18	94	- 1.2	+ 0.9
Apr 09 22:31	X12639	DD	8.0	105	26	150	- 0.5	- 1.4
Apr 10 19:12	X13874	DD	7.7	116	44	53	- 3.8	+ 2.0
Apr 10 20:18	1364	DD	6.5	116	46	106	- 2.4	- 0.5
Apr 12 18:54	X16239	DD	8.0	140	36	162	- 0.8	- 3.2
Apr 12 19:27	1577	DD	7.1	140	42	91	- 2.0	- 0.9
Apr 14 19:08	1807	DD	5.9	166	25	152	- 0.3	- 2.5
Apr 14 20:34	1817	DD	6.9	167	42	141	- 0.9	- 2.3
Apr 15 19:47	1945	RU	5.4	180	25	257	- 0.8	- 0.7
Apr 18 04:31	2259	RD	6.7	148	58	227	- 1.6	+ 3.2
Apr 18 23:31	X22561	RD	7.2	136	38	316	- 0.4	- 2.5
Apr 19 02:38	X22659	RD	7.9	135	74	277	- 2.2	- 0.6
Apr 19 03:26	2423	RD	8.1	134	77	225	- 2.5	+ 2.8
Apr 19 05:13	X22755	RD	8.1	134	62	291	- 2.1	- 0.3
Apr 19 05:50	X22789	RD	7.4	134	55	294	- 1.9	- 0.3
Apr 20 02:32	2573	RD	7.3	121	63	239	- 2.2	+ 0.9
Apr 20 04:41	2578	RD	6.4	120	76	302	- 2.5	- 1.6
Apr 20 05:22	M23	RD	6.9	120	71	248	- 2.0	+ 1.4
Apr 21 04:26	X26138	RD	7.8	107	71	310	- 2.5	- 3.0
Apr 22 06:32	X27790	RD	8.4	93	73	266	- 2.4	+ 0.3
Apr 23 06:00	3054	RD	6.4	80	64	303	- 3.2	- 3.1
Apr 24 03:29	X29975	RD	8.2	68	25	201	- 0.8	+ 2.2
Apr 24 06:23	X30051	RD	8.3	67	58	215	- 1.5	+ 2.0
Apr 25 05:07	X30814	RD	8.5	56	33	239	- 1.1	+ 0.2
Apr 25 05:23	X30826	RD	8.7	55	36	196	- 0.7	+ 2.7
Apr 26 04:44	3444	RD	6.5	44	16	247	- 0.5	- 0.3
May 05 17:50	X10518	DD	7.9	62	37	52	- 3.6	+ 2.8
May 05 18:16	X10553	DD	8.5	62	34	108	- 2.0	+ 0.0
May 05 18:50	X10573	DD	8.6	62	30	43	- 3.9	+ 4.6
May 06 17:42	1197	RB	6.0	73	42	208	****	****
May 06 19:13	X12034	DD	8.7	73	35	125	- 1.6	- 0.5
May 08 20:49	1429	DD	6.8	97	41	119	- 1.7	- 0.4
May 09 21:56	1546	DD	7.2	109	41	142	- 1.1	- 1.3
May 10 19:01	X17008	DD	7.6	121	52	158	- 1.0	- 2.9
May 10 22:08	1649	DD	6.3	122	50	159	- 0.9	- 2.5
May 11 18:38	1754	DD	6.9	134	44	154	- 0.8	- 2.8
May 11 22:06	X18242	DD	8.2	135	60	153	- 1.3	- 2.3
May 12 00:30	X18324	DD	7.3	136	38	60	- 1.9	+ 3.1
May 12 02:05	1779	DD	6.7	137	19	101	- 0.6	+ 0.7
May 13 18:28	2014	DD	7.8	161	25	96	- 0.6	- 1.1
May 14 00:17	X20113	DD	8.1	163	65	142	- 1.7	- 2.0
May 14 03:03	2053	DD	4.6	164	34	73	- 0.9	+ 1.7
May 15 21:16	X22142	RD	7.5	170	39	249	- 1.3	- 0.2
May 16 01:45	2346	RD	8.2	168	74	234	- 2.3	+ 2.3
May 16 04:11	2361	DB	4.2	166	47	65	- 1.2	+ 1.8
May 16 05:12	2361	RD	4.2	166	34	293	- 1.1	+ 0.2
May 16 22:35	2494	RD	7.5	155	42	292	- 0.9	- 1.6
May 16 22:46	2497	RD	6.6	154	45	200	- 3.9	+ 7.2
May 17 04:44	X23610	RD	8.2	152	53	265	- 1.5	+ 1.0
May 17 23:17	X25252	RD	7.9	140	38	246	- 1.2	- 0.1
May 18 02:48	X25415	RD	8.1	139	76	287	- 2.4	- 1.0
May 18 02:50	2686	RD	5.2	139	76	257	- 2.2	+ 0.5
May 18 03:51	2690	RD	7.0	138	73	250	- 2.1	+ 1.1
May 19 01:12	X27115	RD	7.8	125	48	320	- 1.3	- 4.3
May 19 03:24	2856	RD	6.6	125	72	231	- 2.0	+ 1.6
May 19 03:27	X27210	RD	7.6	125	72	244	- 2.1	+ 0.9
May 19 23:37	X28396	RD	8.0	113	16	255	- 0.4	- 0.5
May 19 23:54	X28412	RD	7.9	113	20	253	- 0.5	- 0.5
May 20 05:21	X28634	RD	8.4	110	71	242	- 2.0	+ 1.3
May 20 06:23	X28659	RD	8.0	110	64	256	- 2.0	+ 1.0
May 21 01:47	3133	RD	5.8	99	30	223	- 1.0	+ 0.8
May 22 01:54	3272	RD	5.8	86	19	275	- 0.6	- 1.3
May 22 06:28	3287	RD	5.8	84	63	225	- 1.8	+ 1.8
May 23 05:58	X31362	RD	8.7	72	52	266	- 2.4	- 0.4
May 25 04:10	0105	DB	4.6	49	11	71	- 0.5	- 0.5
May 25 04:25	0103	RD	6.1	49	14	170	+ 1.4	+ 7.9
May 25 05:19	0105	RD	4.6	49	25	239	- 0.9	+ 0.1
May 25 05:57	X01066	RD	8.5	49	31	300	- 2.6	- 3.3
May 25 06:08	X01082	RD	8.5	49	33	220	- 0.9	+ 1.0
May 27 05:53	X03271	RD	8.6	27	10	260	- 0.6	- 0.8
May 27 05:58	X03272	RD	8.7	26	11	270	- 0.8	- 1.1
Jun 01 18:38	X10089	DD	7.7	33	13	91	- 1.0	+ 1.1
Jun 02 19:06	1176	DD	7.4	44	18	106	- 0.9	+ 0.5
Jun 03 19:46	X13003	DD	7.7	56	20	82	- 1.4	+ 1.5
Jun 03 19:47	X13006	DD	8.4	56	20	83	- 1.4	+ 1.4
Jun 03 19:48	X12993	DD	8.3	56	20	147	- 0.3	- 1.1
Jun 04 19:21	X14242	DD	8.1	67	34	83	- 2.1	+ 1.3
Jun 04 19:58	1394	DD	8.4	67	28	88	- 1.6	+ 1.1
Jun 05 19:08	X15335	DD	8.6	78	45	108	- 2.1	- 0.1
Jun 06 19:57	X16583	DD	8.2	90	49	143	- 1.3	- 1.6
Jun 06 22:36	X16690	DD	8.1	92	22	95	- 0.9	+ 0.9
Jun 06 22:50	1611	DD	5.7	92	19	69	- 1.0	+ 2.3
Jun 08 22:46	X18818	DD	7.5	117	44	70	- 1.9	+ 2.1
Jun 09 21:52	X19640	DD	8.1	130	65	172	- 0.8	- 4.6
Jun 09 22:45	1966	DD	8.1	130	56	175	- 0.8	- 5.4
Jun 09 23:07	X19701	DD	7.7	130	53	91	- 1.9	+ 0.7
Jun 11 02:17	X20660	DD	8.0	145	28	141	- 1.0	- 1.1
Jun 11 02:29	X20674	DD	7.4	145	25	66	- 0.5	+ 1.9
Jun 12 01:00	2259	DD	6.7	159	57	151	- 2.0	- 2.9
Jun 12 21:44	X22659	DD	7.9	171	60	92	- 1.8	- 0.7
Jun 13 21:30	2573	RD	7.3	173	45	243	- 1.5	+ 0.2
Jun 14 00:01	M23	RD	6.9	172	73	268	- 2.2	- 0.2
Jun 14 02:36	2596	RD	7.3	171	63	225	- 1.4	+ 2.6
Jun 15 03:21	2789	RD	7.3	157	65	278	- 2.2	+ 0.2
Jun 16 06:07	X28127	RD	8.2	141	43	191	+ 0.2	+ 3.9
Jun 16 23:28	X29175	RD	8.0	131	29	258	- 0.9	- 0.6
Jun 18 04:01	3229	RD	5.6	116	63	279	- 2.8	- 0.7
Jun 18 05:21	X30345	RD	8.2	115	62	274	- 2.7	+ 0.1
Jun 18 07:03	3241	RD	7.9	114	48	308	- 3.5	- 1.9
Jun 19 02:04	3354	RD	7.9	104	35	242	- 1.2	+ 0.1
Jun 19 02:41	X31076	RD	8.3	103	42	289	- 2.1	- 2.2
Jun 20 01:50	3494	RD	4.6	91	20	260	- 0.8	- 0.7
Jun 20 03:48	X31886	RD	7.8	91	42	248	- 1.6	+ 0.1
Jun 22 04:27	0201	RD	7.5	67	27	294	- 2.2	- 2.6
Jun 22 06:36	0209	RD	7.2	66	45	209	- 1.2	+ 2.0
Jun 23 05:34	0325	RD	7.4	55	28	314	- 3.9	- 5.5

LUNAR OCCULTATION TABLE

PERTH (31° 57' S, 115° 51'E)

W.A.S.T	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Jun 24 06:04	X03988	RD	8.0	44	24	278	- 1.7	- 1.4
Jun 25 06:47	0575	RD	7.8	33	22	289	- 1.9	- 1.9
Jun 30 18:03	X12621	DD	8.7	26	16	104	- 0.9	+ 0.6
Jun 30 18:25	X12633	DD	9.1	26	13	115	- 0.5	+ 0.2
Jun 30 18:30	X12642	DD	9.1	26	12	109	- 0.6	+ 0.4
Jun 30 18:32	1257	DD	7.5	26	11	71	- 1.1	+ 2.0
Jun 30 18:38	X12652	DD	9.1	26	10	74	- 1.0	+ 1.9
Jul 01 18:02	1364	DD	6.5	37	27	117	- 1.1	+ 0.0
Jul 02 19:17	X15061	DD	8.4	49	24	64	- 1.8	+ 2.8
Jul 03 20:10	X16239	DD	8.0	61	25	135	- 0.7	- 0.7
Jul 03 21:01	1577	DD	7.1	62	15	60	- 1.0	+ 2.9
Jul 04 19:14	X17435	DD	8.0	73	46	109	- 1.8	+ 0.0
Jul 04 19:22	X17446	DD	8.7	73	45	97	- 1.9	+ 0.5
Jul 04 19:38	1685	DD	4.5	73	42	174	- 0.3	- 3.8
Jul 04 20:19	1685	RB	4.5	73	35	238	- 2.1	+ 3.5
Jul 05 18:04	X18427	DD	8.0	85	63	145	- 1.5	- 2.2
Jul 05 18:12	X18431	DD	8.0	85	62	45	- 6.0	+ 6.6
Jul 06 17:46	X19264	DD	8.8	97	64	160	- 0.9	- 3.3
Jul 06 18:50	X19293	DD	8.4	98	67	112	- 2.2	- 0.9
Jul 06 19:12	X19300	DD	8.5	98	66	89	- 2.6	+ 0.3
Jul 06 21:19	X19340	DD	8.5	99	47	93	- 1.7	+ 0.7
Jul 07 00:07	1932	DD	8.1	100	14	84	- 0.3	+ 1.3
Jul 07 21:32	2053	DD	4.6	112	57	127	- 1.8	- 1.0
Jul 07 21:41	X20192	DD	8.2	112	56	139	- 1.7	- 1.6
Jul 07 22:45	2053	RB	4.6	112	43	264	- 1.4	+ 1.2
Jul 08 00:56	2065	DD	6.6	113	16	41	+ 0.1	+ 3.6
Jul 08 18:05	X21051	DD	7.8	124	54	55	- 2.7	+ 1.2
Jul 08 18:11	2170	DD	6.8	124	56	171	+ 0.1	- 4.9
Jul 09 00:30	2197	DD	7.6	127	35	104	- 1.0	+ 0.5
Jul 09 17:47	X22163	DD	8.3	138	40	109	- 0.9	- 1.5
Jul 10 01:15	2361	DD	4.2	141	39	91	- 1.1	+ 0.9
Jul 10 02:19	2361	RB	4.2	141	25	267	- 0.5	+ 1.1
Jul 10 18:55	2494	DD	7.5	152	42	75	- 1.3	- 0.4
Jul 10 19:47	2497	DD	6.6	153	53	155	- 0.5	- 4.4
Jul 11 01:01	X23610	DD	8.2	155	55	94	- 1.7	+ 0.6
Jul 11 03:57	2531	DD	7.3	156	19	109	- 0.5	+ 0.4
Jul 11 19:23	X25252	DD	7.9	166	34	93	- 0.8	- 1.0
Jul 11 22:18	2680	DD	5.8	167	69	145	- 2.0	- 4.5
Jul 11 22:45	2686	DD	5.2	168	73	74	- 2.2	+ 0.4
Jul 11 23:44	2690	DD	7.0	168	76	78	- 2.2	+ 0.6
Jul 13 02:28	2876	MD	5.4	173	60	161	****	****
Jul 13 03:36	2880	RD	5.1	173	47	173	+ 2.5	+ 9.1
Jul 14 00:33	X28665	RD	8.3	162	67	241	- 2.0	+ 0.9
Jul 15 00:17	3159	RD	8.0	148	53	271	- 2.0	- 0.8
Jul 15 01:26	X29866	RD	8.1	148	63	239	- 1.9	+ 0.9
Jul 15 05:06	X29975	RD	8.2	147	47	210	- 0.7	+ 2.7
Jul 16 00:37	3305	RD	7.8	135	44	225	- 1.3	+ 1.0
Jul 16 06:50	X30870	RD	8.7	133	34	234	- 0.9	+ 1.9
Jul 17 06:35	3462	RD	7.5	120	42	240	- 1.5	+ 1.7
Jul 18 01:53	0030	RD	7.0	109	34	171	+ 1.1	+ 6.8
Jul 19 03:37	X01518	RD	7.7	97	40	216	- 1.1	+ 1.4
Jul 19 03:48	X01513	RD	8.0	97	41	265	- 2.2	- 0.5
Jul 19 07:05	X01622	RD	7.2	96	44	305	- 3.6	- 1.6
Jul 20 03:39	X02684	RD	7.8	85	31	311	- 3.7	- 4.9
Jul 21 03:48	0403	RD	5.8	74	23	257	- 1.2	- 0.6
Jul 21 05:05	X03709	RD	8.3	74	34	191	- 0.1	+ 3.2
Jul 21 06:08	0413	RD	6.8	74	40	224	- 1.7	+ 1.3
Jul 22 03:37	0517	MD	6.4	63	11	342	****	****
Jul 22 05:28	X04631	RD	8.6	63	29	268	- 1.9	- 0.8
Jul 22 06:12	X04660	RD	8.6	62	34	272	- 2.4	- 0.8
Jul 23 04:35	0654	RD	6.0	52	12	238	- 0.5	+ 0.0
Jul 23 05:45	0668	DB	3.6	51	23	115	- 2.1	- 2.1
Jul 23 05:49	X05737	RD	7.9	52	24	226	- 0.9	+ 0.7
Jul 23 06:53	0668	RD	3.6	51	32	217	- 1.3	+ 1.4
Jul 24 05:34	0790	MD	6.8	41	13	350	****	****
Jul 24 06:17	X06774	RD	8.4	41	21	282	- 1.7	- 1.5
Jul 24 07:04	0793	RD	6.2	40	27	314	- 2.8	- 3.1
Jul 30 18:27	X15858	DD	9.0	32	21	79	- 1.1	+ 1.7
Jul 30 18:35	X15855	DD	8.6	32	19	137	- 0.5	- 0.7
Jul 30 18:43	X15864	DD	8.7	32	18	64	- 1.2	+ 2.7
Aug 01 20:59	1768	DD	7.0	57	14	100	- 0.4	+ 0.7
Aug 01 20:59	1769	DD	6.7	57	14	99	- 0.4	+ 0.8
Aug 02 18:53	1881	DD	8.5	68	51	66	- 2.4	+ 2.4
Aug 02 19:42	X19106	DD	8.8	69	42	123	- 1.4	- 0.4
Aug 03 19:21	X19892	DD	8.5	81	57	105	- 2.0	+ 0.0
Aug 03 20:08	X19912	DD	8.7	82	49	116	- 1.6	- 0.2
Aug 03 20:52	X19923	DD	8.5	82	40	121	- 1.3	- 0.3
Aug 03 21:53	2014	DD	7.8	82	28	116	- 0.9	+ 0.1
Aug 06 17:56	X22758	DD	8.6	121	57	99	- 1.7	- 1.1
Aug 06 18:05	X22755	DD	8.1	121	59	135	- 1.3	- 2.6
Aug 06 18:38	X22789	DD	7.4	121	65	119	- 1.7	- 1.8
Aug 06 22:34	2448	DD	6.4	122	57	101	- 1.8	+ 0.3
Aug 07 18:19	M23	DD	6.9	135	49	134	- 1.0	- 2.8
Aug 07 20:34	X24366	DD	8.1	135	74	18	- 2.4	+ 7.0
Aug 07 21:34	2596	MD	7.3	136	77	175	****	****
Aug 08 01:52	2628	DD	8.0	138	29	99	- 0.8	+ 0.7
Aug 08 22:34	2789	DD	7.3	150	75	58	- 2.0	+ 1.5
Aug 09 22:42	2936	GD	6.8	164	72	162	****	****
Aug 10 01:58	X28127	DD	8.2	165	50	100	- 1.8	+ 0.5
Aug 12 01:02	X30367	RD	7.9	167	65	234	- 1.8	+ 1.4
Aug 12 23:13	3370	RD	6.2	154	43	264	- 1.7	- 0.6
Aug 12 23:59	X31166	RD	7.9	154	50	217	- 1.3	+ 1.5
Aug 13 23:36	X31988	RD	7.2	142	35	271	- 1.6	- 1.1
Aug 14 00:15	3515	RD	6.2	141	41	183	- 0.1	+ 3.9
Aug 14 01:46	X32054	RD	8.2	141	53	228	- 1.7	+ 1.3
Aug 14 04:00	X32108	RD	8.0	140	51	264	- 2.4	+ 0.7
Aug 14 04:03	3525	RD	7.7	140	51	272	- 2.5	+ 0.4
Aug 14 04:14	X32120	RD	7.9	140	49	251	- 2.0	+ 1.2
Aug 15 04:17	0103	RD	6.1	128	49	259	- 2.4	+ 0.7
Aug 21 05:44	X07749	RD	7.1	59	27	219	- 1.2	+ 1.3
Aug 21 06:16	0888	RD	6.0	59	31	305	- 2.6	- 2.2
Aug 21 06:30	X07767	RD	7.8	59	33	276	- 2.4	- 0.9
Aug 22 05:47	X09626	RD	8.5	49	22	240	- 1.2	+ 0.0
Aug 28 18:38	X17943	DD	9.0	27	17	68	- 0.7	+ 2.1
Aug 28 18:57	X17954	DD	9.0	27	13	58	- 0.5	+ 2.8
Aug 30 19:58	X19735	DD	8.5	52	25	106	- 0.8	+ 0.5
Aug 31 18:19	2092	DD	7.2	65	57	107	- 1.9	- 0.1
Aug 31 18:49	X20515	DD	8.9	65	52	71	- 1.8	+ 1.8
Aug 31 19:32	2096	DD	8.3	65	43	32	- 1.2	+ 6.8
Sep 01 19:54	2239	DD	8.8	78	51	94	- 1.7	+ 0.7
Sep 01 21:40	2246	DD	7.4	79	30	104	- 0.9	+ 0.5
Sep 02 18:56	2390	DD	6.7	91	73	67	- 2.3	+ 1.5
Sep 02 22:16	X22561	DD	7.2	92	35	140	- 1.6	- 1.3
Sep 04 22:20	2722	DD	7.1	119	57	35	- 1.0	+ 3.1
Sep 05 01:21	2737	DD	6.8	120	20	19	+ 0.6	+ 3.4
Sep 05 20:08	2880	DD	5.1	132	70	135	- 2.8	- 3.9
Sep 07 03:08	3054	DD	6.4	148	19	54	- 0.2	+ 1.8
Sep 07 18:21	3159	DD	8.0	158	25	33	- 0.8	+ 1.3
Sep 07 19:12	X29866	DD	8.1	158	35	57	- 1.1	+ 0.3
Sep 07 22:58	X29975	DD	8.2	160	67	60	- 2.0	+ 1.3
Sep 08 23:15	3320	DD	5.3	173	61	95	- 2.7	- 0.4
Sep 10 20:24	0030	RD	7.0	162	12	288	- 0.7	- 1.9
Sep 10 23:06	0041	RD	8.0	161	42	290	- 2.6	- 2.1
Sep 13 05:04	0319	RD	7.6	135	36	270	- 2.2	+ 0.8
Sep 17 04:24	0830	RD	8.1	90	33	254	- 2.2	- 0.1
Sep 19 05:15	X10701	RD	8.1	68	29	289	- 2.1	- 1.5
Sep 20 04:34	X12105	RD	8.4	57	17	297	- 1.3	- 1.9
Sep 21 04:35	1326	RD	8.2	46	10	326	- 1.0	- 2.9
Sep 27 19:52	2070	DD	6.7	35	13	158	- 0.8	- 2.1
Sep 29 20:42	X22352	DD	7.2	62	28	72	- 0.5	+ 1.6
Sep 29 21:32	X22370	DD	8.1	62	18	122	- 0.6	+ 0.0
Sep 30 19:19	2508	DD	6.3	75	57	54	- 1.4	+ 2.3
Sep 30 20:57	X23552	DD	8.3	75	37	47	- 0.5	+ 2.5
Sep 30 21:28	X23569	DD	8.5	76	31	42	- 0.2	+ 2.7
Oct 01 19:11	K07304	DD	8.7	88	69	120	- 2.6	- 1.2
Oct 01 19:54	X25286	DD	8.5	88	61	89	- 2.0	+ 0.7
Oct 01 20:58	2674	DD	6.0	89	49	44	- 0.8	+ 2.6
Oct 02 22:43	X27115	DD	7.8	103	38	113	- 1.5	+ 0.1
Oct 02 23:38	X27160	DD	8.2	103	27	50	- 0.2	+ 2.0
Oct 03 20:25	2973	DD	8.3	115	70	19	- 1.1	+ 3.8
Oct 03 20:56	X28396	DD	8.0	115	67	88	- 2.3	+ 0.5
Oct 03 21:22	X28412	DD	7.9	116	63	97	- 2.4	+ 0.2
Oct 04 23:29	3133	DD	5.8	129	47	120	- 2.5	- 0.6
Oct 05 01:41	X29728	DD	7.7	130	20	40	- 0.2	+ 2.2
Oct 05 18:56	3259	DD	7.4	141	45	124	- 2.3	- 3.5
Oct 05 20:26	X30506	DD	8.2	141	59	46	- 1.7	+ 1.4
Oct 05 22:46	3272	DD	5.8	142	59	357	+ 0.4	+ 5.5
Oct 06 02:30	3287	DD	5.8	144	18	66	- 0.4	+ 1.6
Oct 08 01:11	0006	DD	6.9	168	45	72	- 1.9	+ 1.3
Oct 11 03:40	X03541	RD	7.0	155	35	278	- 2.2	+ 0.5
Oct 13 03:08	0639	RD	6.0	132	39	267	- 2.7	+ 0.1
Oct 15 02:20	X08084	RD	7.6	111	28	285	- 2.1	- 1.4
Oct 27 19:24	X23072	DD	8.3	44	30	122	- 1.1	- 0.1
Oct 27 19:43	X23089	DD	8.4	44	26	131	- 1.1	- 0.5
Oct 27 19:51	X23106	DD	8.6	44	25	91	- 0.5	+ 0.9
Oct 27 20:13	X23129	DD	8.4	44	20	69	- 0.2	+ 1.5
Oct 28 19:01	X24646	DD	9.1	57	47	18	+ 0.0	+ 4.9
Oct 28 19:37	X24682	DD	8.7	58	39	16	+ 0.3	+ 4.7
Oct 28 19:56	X24739	DD	8.7	58	36	87	- 0.9	+ 1.0
Oct 29 19:02	X26484	DD	8.4	71	58	81	- 1.7	+ 1.0
Oct 29 20:56	X26565	DD	8.5	72	34	20	+ 0.2	+ 3.5
Oct 30 19:24	2937	DD	7.6	85	62	48	- 1.5	+ 2.2
Oct 30 22:25	X28117	DD	8.4	86	27	78	- 0.6	+ 1.3
Oct 31 23:12	3098	DD	8.0	99	26	20	+ 0.0	+ 3.0
Nov 01 22:22	3229	DD	5.6	112	44	46	- 1.0	+ 2.2
Nov 01 23:29	X30345	DD	8.2	112	31	43	- 0.6	+ 2.2
Nov 02 20:29	3354	DD	7.9	124	61	42	- 1.7	+ 1.9
Nov 03 22:20	X31886	DD	7.8	137	52	357	+ 0.2	+ 5.2
Nov 04 00:16	3507	DD	6.4	137	35	80	- 1.5	+ 1.3
Nov 04 01:57	X31988	DD	7.2	138	16	146	- 1.2	- 3.8
Nov 09 01:53	0593	RD	5.8	164	39	252	- 2.5	+ 0.9
Nov 10 04:03	0736	RD	6.2	152	30	299	- 1.8	- 0.2
Nov 10 23:33	X07312	RD	7.8	142	22	317	- 2.5	- 3.4
Nov 11 00:38	X07370	RD	8.2	142	31	223	- 1.6	+ 1.1
Nov 11 02:16	X07454	RD	8.2	142	38	266	- 2.7	+ 0.0
Nov 12 03:22	X09384	RD	7.7	130	39	302	- 2.6	- 1.2
Nov 13 01:41	1116	RD	7.4	120	29	253	- 1.9	- 0.4
Nov 18 02:51	X17197	RD	8.0	63	11	263	- 0.4	- 0.9
Nov 18 03:00	X17216	RD	7.6	63	13	339	- 0.3	- 3.0
Nov 18 03:22	1661	RD	7.6	63	17	261	- 0.7	- 0.9
Nov 18 03:38	X17248	RD	8.3	63	20	346	- 0.4	- 3.4
Nov 19 04:01	X18300	RD	8.3	50	18	286	- 0.5	- 1.5
Nov 25 20:20	2737	DD	6.8	40	16	52	+ 0.1	+ 1.8
Nov 26 19:40	X27628	DD	8.4	53	35	75	- 0.8	+ 1.4
Nov 26 19:49	X27608	DD	8.6	53	33	358	+ 1.5	+ 6.3
Nov 27 21:31	3054	DD	6.4	68	22	50	- 0.2	+ 1.9
Nov 28 20:28	X30051	DD	8.3	80	43	66	- 1.2	+ 1.6
Nov 28 21:27	X30074	DD	8.3	81	31	12	+ 0.0	+ 3.5
Nov 29 20:04	3320	RB	5.3	93	53	207	- 1.0	+ 2.8
Nov 29 21:20	3326	DD	6.4	93	40	42	- 1.0	+ 2.3
Nov 29 22:03	X30908	DD	7.7	94	32	57	- 0.9	+ 1.9
Dec 01 00:04	3477	DD	6.6	107	14	2	- 0.1	+ 4.6
Dec 01 20:09	0041	DD	8.0	118	53	48	- 1.9	+ 1.7
Dec 03 20:15	0290	DD	6.1	141	42	48	- 1.7	+ 1.1
Dec 03 22:50	X02827	DD	7.5	142	42	33	- 1.8	+ 2.6
Dec 08 22:44	X08598	RD	7.7	162	26	270	- 1.8	- 0.9
Dec 08 23:17	0947	RD	5.2	162	31	223	- 1.6	+ 1.2
Dec 09 01:41	X08737	RD	7.5	162	38	309	- 2.4	- 1.4
Dec 10 02:03	X10518	RD	7.9	151	40	322	- 2.2	- 2.1
Dec 13 00:03	X14398	RD	7.7	119	15	268	- 0.9	- 1.1
Dec 13 00:43	X14440	RD	8.0	118	22	342	- 1.2	- 3.8
Dec 14 03:49	1518	RD	6.3	106	47	276	- 2.5	- 0.9
Dec 15 04:27	X16826	RD	8.3	95	50	293	- 2.1	- 1.4
Dec 16 05:03	1735	RD	6.4	83	52	284	- 2.1	- 1.2
Dec 17 03:12	X18809	RD	8.5	71	25	327	- 0.4	- 2.5
Dec 17 04:26	X18839	RD	8.5	70	41	232	- 2.8	+ 1.4
Dec 29 20:56	0131	DD	8.2	99	39	77	- 2.0	+ 1.3
Dec 29 23:11	X01368	DD	8.2	100	16	51	- 0.8	+ 2.1
Dec 29 23:34	0142	DD	7.8	100	11	86	- 0.6	+ 1.2
Dec 31 22:24	X03546	DD	7.7	122	35	93	- 2.2	+ 0.7

MERCURY

GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "
1	19 30 07	- 24 00 50	21 18 17	- 12 27 41	21 02 01	- 17 04 15	23 54 55	- 2 54 23	03 38 13	+ 21 31 28	05 01 41	+ 21 19 52
2	19 37 06	- 23 45 13	21 13 53	- 12 35 58	21 06 15	- 16 56 27	00 01 30	- 2 08 00	03 45 12	+ 22 00 59	04 59 42	+ 20 59 35
3	19 44 03	- 23 28 02	21 09 10	- 12 47 29	21 10 39	- 16 47 14	00 08 09	- 1 20 37	03 51 59	+ 22 28 00	04 57 37	+ 20 39 18
4	19 50 58	- 23 09 20	21 04 18	- 13 01 44	21 15 11	- 16 36 36	00 14 53	- 0 32 15	03 58 33	+ 22 52 31	04 55 26	+ 20 19 14
5	19 57 50	- 22 49 07	20 59 24	- 13 18 11	21 19 51	- 16 24 35	00 21 40	+ 0 17 03	04 04 54	+ 23 14 34	04 53 12	+ 19 59 33
6	20 04 37	- 22 27 24	20 54 37	- 13 36 15	21 24 38	- 16 11 12	00 28 33	+ 1 07 15	04 11 00	+ 23 34 11	04 50 58	+ 19 40 28
7	20 11 20	- 22 04 13	20 50 03	- 13 55 24	21 29 32	- 15 56 26	00 35 30	+ 1 58 18	04 16 51	+ 23 51 25	04 48 46	+ 19 22 12
8	20 17 58	- 21 39 37	20 45 49	- 14 15 06	21 34 32	- 15 40 18	00 42 32	+ 2 50 08	04 22 27	+ 24 06 20	04 46 38	+ 19 04 56
9	20 24 30	- 21 13 39	20 42 00	- 14 34 55	21 39 38	- 15 22 50	00 49 39	+ 3 42 43	04 27 45	+ 24 19 00	04 44 37	+ 18 48 51
10	20 30 55	- 20 46 23	20 38 39	- 14 54 25	21 44 49	- 15 04 01	00 56 52	+ 4 35 56	04 32 47	+ 24 29 27	04 42 44	+ 18 34 07
11	20 37 11	- 20 17 55	20 35 49	- 15 13 19	21 50 06	- 14 43 54	01 04 09	+ 5 29 44	04 37 32	+ 24 37 47	04 41 01	+ 18 20 54
12	20 43 18	- 19 48 20	20 33 32	- 15 31 20	21 55 27	- 14 22 27	01 11 32	+ 6 24 00	04 41 58	+ 24 44 03	04 39 30	+ 18 09 18
13	20 49 14	- 19 17 46	20 31 47	- 15 48 18	22 00 52	- 13 59 42	01 19 00	+ 7 18 37	04 46 05	+ 24 48 19	04 38 12	+ 17 59 26
14	20 54 57	- 18 46 22	20 30 36	- 16 04 02	22 06 21	- 13 35 40	01 26 33	+ 8 13 29	04 49 54	+ 24 50 40	04 37 09	+ 17 51 22
15	21 00 26	- 18 14 18	20 29 56	- 16 18 26	22 11 55	- 13 10 21	01 34 11	+ 9 08 27	04 53 23	+ 24 51 09	04 36 22	+ 17 45 10
16	21 05 38	- 17 41 47	20 29 48	- 16 31 26	22 17 32	- 12 43 46	01 41 54	+ 10 03 21	04 56 33	+ 24 49 51	04 35 51	+ 17 40 52
17	21 10 32	- 17 09 03	20 30 08	- 16 42 59	22 23 12	- 12 15 55	01 49 41	+ 10 58 01	04 59 22	+ 24 46 49	04 35 38	+ 17 38 26
18	21 15 04	- 16 36 22	20 30 57	- 16 53 02	22 28 56	- 11 46 48	01 57 31	+ 11 52 16	05 01 50	+ 24 42 07	04 35 42	+ 17 37 54
19	21 19 12	- 16 04 03	20 32 10	- 17 01 35	22 34 44	- 11 16 28	02 05 25	+ 12 45 55	05 03 58	+ 24 35 48	04 36 04	+ 17 39 12
20	21 22 54	- 15 32 26	20 33 48	- 17 08 37	22 40 34	- 10 44 53	02 13 21	+ 13 38 45	05 05 44	+ 24 27 56	04 36 45	+ 17 42 17
21	21 26 05	- 15 01 54	20 35 48	- 17 14 07	22 46 28	- 10 12 06	02 21 19	+ 14 30 34	05 07 10	+ 24 18 35	04 37 45	+ 17 47 06
22	21 28 44	- 14 32 51	20 38 09	- 17 18 06	22 52 25	- 9 38 06	02 29 17	+ 15 21 09	05 08 15	+ 24 07 49	04 39 04	+ 17 53 34
23	21 30 47	- 14 05 43	20 40 48	- 17 20 34	22 58 25	- 9 02 54	02 37 15	+ 16 10 18	05 08 59	+ 23 55 41	04 40 41	+ 18 01 34
24	21 32 12	- 13 40 55	20 43 45	- 17 21 33	23 04 29	- 8 26 31	02 45 11	+ 16 57 48	05 09 22	+ 23 42 16	04 42 37	+ 18 11 02
25	21 32 56	- 13 18 53	20 46 57	- 17 21 01	23 10 35	- 7 48 57	02 53 04	+ 17 43 29	05 09 25	+ 23 27 38	04 44 52	+ 18 21 51
26	21 32 56	- 13 00 01	20 50 24	- 17 19 01	23 16 45	- 7 10 14	03 00 53	+ 18 27 10	05 09 09	+ 23 11 53	04 47 26	+ 18 33 54
27	21 32 13	- 12 44 41	20 54 05	- 17 15 33	23 22 58	- 6 30 22	03 08 36	+ 19 08 43	05 08 33	+ 22 55 06	04 50 18	+ 18 47 03
28	21 30 46	- 12 33 10	20 57 57	- 17 10 37	23 29 14	- 5 49 22	03 16 13	+ 19 48 00	05 07 41	+ 22 37 23	04 53 28	+ 19 01 11
29	21 28 36	- 12 25 41			23 35 34	- 5 07 15	03 23 42	+ 20 24 56	05 06 32	+ 22 18 52	04 56 58	+ 19 16 11
30	21 25 45	- 12 22 19			23 41 57	- 4 24 02	03 31 03	+ 20 59 27	05 05 07	+ 21 59 40	05 00 45	+ 19 31 54
31	21 22 17	- 12 23 03			23 48 25	- 3 39 45			05 03 30	+ 21 39 57		

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
1	05 04 51	+ 19 48 11	09 02 53	+ 18 41 29	12 11 59	- 2 43 21	12 53 30	- 9 13 58	13 33 51	- 7 48 57	16 44 19	- 23 34 01
2	05 09 15	+ 20 04 55	09 11 02	+ 18 06 28	12 16 17	- 3 21 06	12 50 00	- 8 38 14	13 39 49	- 8 28 08	16 51 03	- 23 50 59
3	05 13 58	+ 20 21 55	09 19 02	+ 17 30 05	12 20 29	- 3 58 04	12 46 18	- 7 59 10	13 45 50	- 9 07 28	16 57 48	- 24 06 43
4	05 18 58	+ 20 39 02	09 26 53	+ 16 52 29	12 24 35	- 4 34 14	12 42 29	- 7 17 27	13 51 53	- 9 46 50	17 04 34	- 24 21 12
5	05 24 17	+ 20 56 07	09 34 34	+ 16 13 48	12 28 33	- 5 09 30	12 38 41	- 6 33 57	13 57 58	- 10 26 06	17 11 22	- 24 34 25
6	05 29 54	+ 21 13 00	09 42 05	+ 15 34 09	12 32 24	- 5 43 51	12 34 57	- 5 49 37	14 04 05	- 11 05 10	17 18 11	- 24 46 20
7	05 35 48	+ 21 29 30	09 49 27	+ 14 53 40	12 36 07	- 6 17 11	12 31 26	- 5 05 30	14 10 14	- 11 43 57	17 25 01	- 24 56 57
8	05 42 01	+ 21 45 26	09 56 39	+ 14 12 27	12 39 42	- 6 49 26	12 28 14	- 4 22 41	14 16 24	- 12 22 21	17 31 52	- 25 06 14
9	05 48 31	+ 22 00 36	10 03 42	+ 13 30 37	12 43 08	- 7 20 32	12 25 25	- 3 42 14	14 22 36	- 13 00 18	17 38 45	- 25 14 09
10	05 55 18	+ 22 14 50	10 10 37	+ 12 48 14	12 46 25	- 7 50 24	12 23 06	- 3 05 04	14 28 49	- 13 37 44	17 45 37	- 25 20 42
11	06 02 23	+ 22 27 55	10 17 22	+ 12 05 26	12 49 32	- 8 18 56	12 21 19	- 2 32 02	14 35 03	- 14 14 36	17 52 31	- 25 25 50
12	06 09 44	+ 22 39 40	10 24 00	+ 11 22 16	12 52 29	- 8 46 03	12 20 08	- 2 03 47	14 41 18	- 14 50 50	17 59 25	- 25 29 34
13	06 17 20	+ 22 49 53	10 30 29	+ 10 38 50	12 55 14	- 9 11 37	12 19 34	- 1 40 46	14 47 35	- 15 26 24	18 06 19	- 25 31 52
14	06 25 12	+ 22 58 21	10 36 50	+ 9 55 12	12 57 48	- 9 35 32	12 19 39	- 1 23 18	14 53 52	- 16 01 15	18 13 13	- 25 32 42
15	06 33 18	+ 23 04 53	10 43 03	+ 9 11 25	13 00 08	- 9 57 38	12 20 21	- 1 11 29	15 00 11	- 16 35 21	18 20 06	- 25 32 04
16	06 41 37	+ 23 09 19	10 49 09	+ 8 27 34	13 02 14	- 10 17 49	12 21 41	- 1 05 18	15 06 31	- 17 08 39	18 26 59	- 25 29 58
17	06 50 07	+ 23 11 29	10 55 07	+ 7 43 41	13 04 05	- 10 35 53	12 23 35	- 1 04 36	15 12 52	- 17 41 08	18 33 51	- 25 26 22
18	06 58 48	+ 23 11 14	11 00 59	+ 6 59 51	13 05 40	- 10 51 40	12 26 02	- 1 09 07	15 19 15	- 18 12 46	18 40 41	- 25 21 15
19	07 07 37	+ 23 08 27	11 06 44	+ 6 16 07	13 06 57	- 11 04 59	12 28 59	- 1 18 31	15 25 38	- 18 43 31	18 47 29	- 25 14 39
20	07 16 34	+ 23 03 03	11 12 22	+ 5 32 31	13 07 56	- 11 15 38	12 32 23	- 1 32 26	15 32 03	- 19 13 20	18 54 15	- 25 06 32
21	07 25 35	+ 22 54 58	11 17 53	+ 4 49 07	13 08 34	- 11 23 23	12 36 12	- 1 50 28	15 38 30	- 19 42 14	19 00 57	- 24 56 54
22	07 34 40	+ 22 44 10	11 23 19	+ 4 05 57	13 08 51	- 11 28 00	12 40 23	- 2 12 11	15 44 58	- 20 10 09	19 07 35	- 24 45 47
23	07 43 47	+ 22 30 40	11 28 38	+ 3 23 03	13 08 46	- 11 29 15	12 44 52	- 2 37 09	15 51 28	- 20 37 05	19 14 09	- 24 33 12
24	07 52 53	+ 22 14 30	11 33 51	+ 2 40 29	13 08 17	- 11 26 53	12 49 38	- 3 04 58	15 57 59	- 21 03 00	19 20 38	- 24 19 09
25	08 01 58	+ 21 55 45	11 38 58	+ 1 58 17	13 07 23	- 11 20 40	12 54 38	- 3 35 15	16 04 31	- 21 27 53	19 27 00	- 24 03 42
26	08 10 59	+ 21 34 28	11 43 58	+ 1 16 29	13 06 04	- 11 10 23	12 59 51	- 4 07 38	16 11 05	- 21 51 42	19 33 14	- 23 46 51
27	08 19 56	+ 21 10 49	11 48 53	+ 0 35 08	13 04 21	- 10 55 51	13 05 13	- 4 41 46	16 17 41	- 22 14 25	19 39 20	- 23 28 42
28	08 28 47	+ 20 44 53	11 53 43	- 0 05 42	13 02 12	- 10 36 56	13 10 44	- 5 17 20	16 24 18	- 22 36 03	19 45 15	- 23 09 19
29	08 37 30	+ 20 16 50	11 58 26	- 0 46 02	12 59 39	- 10 13 35	13 16 23	- 5 54 05	16 30 57	- 22 56 32	19 50 58	- 22 48 46
30	08 46 06	+ 19 46 49	12 03 03	- 1 25 46	12 56 44	- 9 45 52	13 22 08	- 6 31 45	16 37 37	- 23 15 52	19 56 28	- 22 27 11
31	08 54 34	+ 19 14 59	12 07 34	- 2 04 54			13 27 57	- 7 10 06			20 01 42	- 22 04 40

MERCURY

RISE AND SET TIMES FOR PERTH (W.A.S.T.)

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

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

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

VENUS

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

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

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

VENUS

GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "	R.A. hh mm ss	Dec. ° ' "
1	15 29 54	- 15 14 58	17 42 02	- 20 32 15	19 58 43	- 19 34 24	22 27 02	- 10 34 17	00 42 04	+ 2 43 20	03 04 56	+ 15 58 01
2	15 33 36	- 15 27 25	17 46 46	- 20 37 19	20 03 38	- 19 24 16	22 31 38	- 10 10 27	00 46 32	+ 3 11 11	03 09 46	+ 16 19 23
3	15 37 21	- 15 39 55	17 51 30	- 20 41 54	20 08 33	- 19 13 35	22 36 14	- 9 46 21	00 51 00	+ 3 38 59	03 14 37	+ 16 40 21
4	15 41 09	- 15 52 27	17 56 16	- 20 46 01	20 13 28	- 19 02 22	22 40 48	- 9 21 57	00 55 29	+ 4 06 45	03 19 30	+ 17 00 54
5	15 44 59	- 16 04 58	18 01 03	- 20 49 38	20 18 23	- 18 50 36	22 45 23	- 8 57 17	00 59 58	+ 4 34 27	03 24 23	+ 17 21 02
6	15 48 52	- 16 17 28	18 05 51	- 20 52 45	20 23 17	- 18 38 18	22 49 56	- 8 32 22	01 04 27	+ 5 02 05	03 29 18	+ 17 40 44
7	15 52 47	- 16 29 56	18 10 40	- 20 55 22	20 28 10	- 18 25 29	22 54 29	- 8 07 12	01 08 57	+ 5 29 37	03 34 13	+ 18 00 00
8	15 56 45	- 16 42 19	18 15 29	- 20 57 28	20 33 04	- 18 12 08	22 59 02	- 7 41 47	01 13 27	+ 5 57 04	03 39 10	+ 18 18 48
9	16 00 45	- 16 54 38	18 20 20	- 20 59 02	20 37 56	- 17 58 16	23 03 34	- 7 16 09	01 17 58	+ 6 24 25	03 44 08	+ 18 37 09
10	16 04 47	- 17 06 50	18 25 11	- 21 00 05	20 42 48	- 17 43 53	23 08 05	- 6 50 18	01 22 29	+ 6 51 39	03 49 07	+ 18 55 01
11	16 08 52	- 17 18 54	18 30 03	- 21 00 36	20 47 39	- 17 29 00	23 12 36	- 6 24 15	01 27 00	+ 7 18 45	03 54 07	+ 19 12 23
12	16 12 59	- 17 30 50	18 34 56	- 21 00 34	20 52 30	- 17 13 37	23 17 07	- 5 58 00	01 31 32	+ 7 45 43	03 59 08	+ 19 29 16
13	16 17 08	- 17 42 36	18 39 49	- 20 59 59	20 57 20	- 16 57 45	23 21 37	- 5 31 34	01 36 05	+ 8 12 32	04 04 10	+ 19 45 38
14	16 21 19	- 17 54 11	18 44 43	- 20 58 52	21 02 10	- 16 41 24	23 26 07	- 5 04 57	01 40 38	+ 8 39 11	04 09 13	+ 20 01 29
15	16 25 33	- 18 05 34	18 49 38	- 20 57 11	21 06 59	- 16 24 34	23 30 36	- 4 38 11	01 45 12	+ 9 05 39	04 14 18	+ 20 16 48
16	16 29 48	- 18 16 43	18 54 32	- 20 54 57	21 11 47	- 16 07 16	23 35 05	- 4 11 15	01 49 46	+ 9 31 57	04 19 23	+ 20 31 35
17	16 34 06	- 18 27 39	18 59 28	- 20 52 09	21 16 34	- 15 49 31	23 39 34	- 3 44 12	01 54 22	+ 9 58 03	04 24 30	+ 20 45 49
18	16 38 25	- 18 38 19	19 04 23	- 20 48 47	21 21 21	- 15 31 19	23 44 03	- 3 17 00	01 58 58	+ 10 23 56	04 29 37	+ 20 59 30
19	16 42 47	- 18 48 43	19 09 19	- 20 44 51	21 26 07	- 15 12 40	23 48 31	- 2 49 41	02 03 35	+ 10 49 37	04 34 46	+ 21 12 36
20	16 47 10	- 18 58 49	19 14 15	- 20 40 21	21 30 53	- 14 53 35	23 52 59	- 2 22 16	02 08 12	+ 11 15 03	04 39 55	+ 21 25 07
21	16 51 35	- 19 08 38	19 19 12	- 20 35 18	21 35 37	- 14 34 04	23 57 27	- 1 54 44	02 12 51	+ 11 40 15	04 45 05	+ 21 37 04
22	16 56 03	- 19 18 07	19 24 08	- 20 29 40	21 40 21	- 14 14 09	00 01 55	- 1 27 08	02 17 30	+ 12 05 12	04 50 17	+ 21 48 24
23	17 00 31	- 19 27 16	19 29 05	- 20 23 27	21 45 05	- 13 53 49	00 06 22	- 0 59 27	02 22 10	+ 12 29 52	04 55 29	+ 21 59 08
24	17 05 02	- 19 36 04	19 34 01	- 20 16 41	21 49 47	- 13 33 05	00 10 50	- 0 31 42	02 26 51	+ 12 54 16	05 00 42	+ 22 09 16
25	17 09 34	- 19 44 30	19 38 58	- 20 09 21	21 54 29	- 13 11 59	00 15 17	- 0 03 54	02 31 34	+ 13 18 23	05 05 56	+ 22 18 46
26	17 14 08	- 19 52 34	19 43 54	- 20 01 27	21 59 10	- 12 50 30	00 19 45	+ 0 23 55	02 36 17	+ 13 42 11	05 11 10	+ 22 27 39
27	17 18 44	- 20 00 14	19 48 51	- 19 53 00	22 03 50	- 12 28 39	00 24 12	+ 0 51 47	02 41 01	+ 14 05 41	05 16 26	+ 22 35 53
28	17 23 21	- 20 07 29	19 53 47	- 19 43 58	22 08 30	- 12 06 26	00 28 40	+ 1 19 40	02 45 46	+ 14 28 51	05 21 42	+ 22 43 29
29	17 27 59	- 20 14 20			22 13 09	- 11 43 53	00 33 08	+ 1 47 34	02 50 32	+ 14 51 41	05 26 58	+ 22 50 27
30	17 32 39	- 20 20 45			22 17 47	- 11 21 00	00 37 36	+ 2 15 27	02 55 19	+ 15 14 09	05 32 15	+ 22 56 45
31	17 37 20	- 20 26 44			22 22 25	- 10 57 48			03 00 07	+ 15 36 17		

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
1	05 37 33	+ 23 02 23	08 21 26	+ 20 22 35	10 52 43	+ 8 40 51	13 09 38	- 6 18 59	15 38 49	- 19 40 12	18 19 05	- 24 43 38
2	05 42 51	+ 23 07 22	08 26 35	+ 20 07 05	10 57 21	+ 8 12 30	13 14 13	- 6 48 50	15 43 56	- 19 59 36	18 24 33	- 24 42 40
3	05 48 10	+ 23 11 40	08 31 42	+ 19 51 01	11 01 59	+ 7 43 55	13 18 49	- 7 18 32	15 49 04	- 20 18 28	18 30 01	- 24 40 57
4	05 53 29	+ 23 15 18	08 36 48	+ 19 34 22	11 06 36	+ 7 15 07	13 23 26	- 7 48 05	15 54 13	- 20 36 46	18 35 28	- 24 38 28
5	05 58 48	+ 23 18 16	08 41 53	+ 19 17 10	11 11 12	+ 6 46 07	13 28 03	- 8 17 28	15 59 23	- 20 54 30	18 40 56	- 24 35 15
6	06 04 08	+ 23 20 33	08 46 57	+ 18 59 25	11 15 48	+ 6 16 56	13 32 41	- 8 46 41	16 04 35	- 21 11 40	18 46 22	- 24 31 17
7	06 09 28	+ 23 22 09	08 52 00	+ 18 41 08	11 20 23	+ 5 47 34	13 37 20	- 9 15 41	16 09 48	- 21 28 13	18 51 49	- 24 26 34
8	06 14 48	+ 23 23 04	08 57 02	+ 18 22 18	11 24 57	+ 5 18 02	13 42 00	- 9 44 30	16 15 01	- 21 44 11	18 57 15	- 24 21 07
9	06 20 08	+ 23 23 18	09 02 03	+ 18 02 58	11 29 32	+ 4 48 21	13 46 40	- 10 13 05	16 20 16	- 21 59 31	19 02 40	- 24 14 55
10	06 25 28	+ 23 22 50	09 07 03	+ 17 43 08	11 34 06	+ 4 18 32	13 51 21	- 10 41 26	16 25 32	- 22 14 14	19 08 04	- 24 07 59
11	06 30 49	+ 23 21 42	09 12 02	+ 17 22 47	11 38 39	+ 3 48 34	13 56 03	- 11 09 33	16 30 49	- 22 28 19	19 13 28	- 24 00 19
12	06 36 09	+ 23 19 52	09 16 59	+ 17 01 57	11 43 12	+ 3 18 30	14 00 45	- 11 37 24	16 36 08	- 22 41 45	19 18 51	- 23 51 56
13	06 41 29	+ 23 17 20	09 21 56	+ 16 40 39	11 47 45	+ 2 48 19	14 05 29	- 12 04 59	16 41 27	- 22 54 31	19 24 14	- 23 42 50
14	06 46 49	+ 23 14 08	09 26 51	+ 16 18 53	11 52 18	+ 2 18 03	14 10 14	- 12 32 17	16 46 47	- 23 06 38	19 29 35	- 23 33 01
15	06 52 09	+ 23 10 14	09 31 46	+ 15 56 39	11 56 50	+ 1 47 42	14 14 59	- 12 59 18	16 52 08	- 23 18 04	19 34 56	- 23 22 30
16	06 57 28	+ 23 05 40	09 36 39	+ 15 33 59	12 01 23	+ 1 17 17	14 19 46	- 13 26 00	16 57 30	- 23 28 49	19 40 15	- 23 11 18
17	07 02 47	+ 23 00 24	09 41 32	+ 15 10 54	12 05 55	+ 0 46 48	14 24 34	- 13 52 22	17 02 52	- 23 38 53	19 45 34	- 22 59 24
18	07 08 06	+ 22 54 28	09 46 23	+ 14 47 23	12 10 27	+ 0 16 17	14 29 23	- 14 18 24	17 08 16	- 23 48 14	19 50 51	- 22 46 49
19	07 13 25	+ 22 47 51	09 51 13	+ 14 23 27	12 14 59	- 0 14 16	14 34 13	- 14 44 05	17 13 40	- 23 56 54	19 56 08	- 22 33 33
20	07 18 43	+ 22 40 33	09 56 03	+ 13 59 08	12 19 31	- 0 44 50	14 39 04	- 15 09 25	17 19 05	- 24 04 50	20 01 23	- 22 19 38
21	07 24 00	+ 22 32 36	10 00 51	+ 13 34 26	12 24 03	- 1 15 25	14 43 56	- 15 34 22	17 24 30	- 24 12 03	20 06 37	- 22 05 04
22	07 29 17	+ 22 23 59	10 05 38	+ 13 09 22	12 28 36	- 1 46 00	14 48 49	- 15 58 56	17 29 56	- 24 18 33	20 11 50	- 21 49 52
23	07 34 33	+ 22 14 42	10 10 25	+ 12 43 56	12 33 08	- 2 16 34	14 53 44	- 16 23 05	17 35 23	- 24 24 19	20 17 01	- 21 34 01
24	07 39 49	+ 22 04 46	10 15 10	+ 12 18 09	12 37 41	- 2 47 06	14 58 39	- 16 46 50	17 40 50	- 24 29 20	20 22 12	- 21 17 33
25	07 45 04	+ 21 54 11	10 19 55	+ 11 52 02	12 42 14	- 3 17 36	15 03 36	- 17 10 08	17 46 17	- 24 33 37	20 27 21	- 21 00 29
26	07 50 18	+ 21 42 58	10 24 38	+ 11 25 35	12 46 47	- 3 48 02	15 08 34	- 17 33 01	17 51 45	- 24 37 10	20 32 28	- 20 42 49
27	07 55 32	+ 21 31 07	10 29 21	+ 10 58 50	12 51 20	- 4 18 24	15 13 34	- 17 55 25	17 57 13	- 24 39 58	20 37 34	- 20 24 33
28	08 00 44	+ 21 18 38	10 34 03	+ 10 31 48	12 55 54	- 4 48 42	15 18 34	- 18 17 22	18 02 41	- 24 42 00	20 42 39	- 20 05 43
29	08 05 56	+ 21 05 32	10 38 44	+ 10 04 27	13 00 28	- 5 18 54	15 23 36	- 18 38 50	18 08 09	- 24 43 18	20 47 43	- 19 46 19
30	08 11 07	+ 20 51 49	10 43 25	+ 9 36 51	13 05 03	- 5 49 00	15 28 39	- 18 59 48	18 13 37	- 24 43 51	20 52 45	- 19 26 22
31	08 16 17	+ 20 37 30	10 48 04	+ 9 08 59			15 33 44	- 19 20 16			20 57 45	- 19 05 53

MARS AT OPPOSITION

On February 12th 1995 Mars comes to opposition, providing the best opportunity to observe the red planet since January 1993. The period between successive oppositions (the synodic period) is 779.8 days, but because of the highly elliptical nature of the planet's orbit the Earth and Mars distance at each opposition varies greatly. This apparition is a poor one (with Mars 0.68 A.U. from Earth), but shouldn't be ignored by observers as eight years must lapse until the next favourable opposition (see figure 2).

When the Earth passes Mars every 26 months we get a close view of the planet; but when Mars is at perihelion (the point in its orbit closest to the Sun) we get a particularly good view. The perihelic oppositions happen only every 15 or 17 years, with the next due in the year 2003. Oppositions happening in the early months of the year are always unfavourable because Mars is at aphelion and at close to twice the distance from the Earth than at perihelion. Also the planet's northern declination, at this time, means a low altitude for southern observers.

Perihelic oppositions happen around August, and fortunately for southern hemisphere observers, Mars is at its greatest southerly declination then. When near conjunction (on the opposite side of the Sun from the Earth) Mars has a disc diameter of only 3.5 seconds of arc, smaller than Uranus, and scarcely worth telescope time. At a poor opposition the diameter is around 14", increasing to 25" at a perihelic opposition (see figure 1). During the 1995 opposition, the disc steadily grows from 11" at the beginning of the year to 14" at opposition, it then decreases to 4" by year's end. It's generally recommended that observations begin and end about six weeks either side of opposition; the period where most can be gained from the enlarged disc. Since the Martian day is about 40 minutes longer than Earth's day, surface features cross the central meridian 40 minutes later each night. As the 40 minute delay equals about 9° of longitude per day, observations made at the same time each night will see all surface features cross the central meridian in under six weeks.

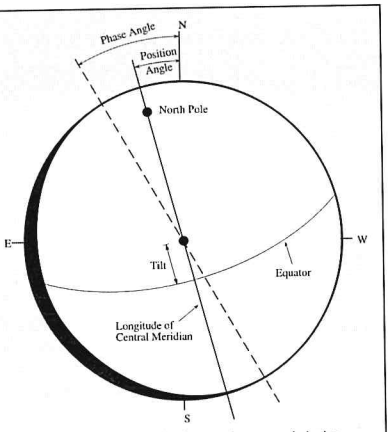
Phase: The fraction of the disc of Mars illuminated by the Sun. 1.0 would be the entire disc. At opposition the "phase" is at maximum.

Phase Angle: The number of degrees (east of north) the "Phase" is rotated.

Cent. Mer.: Longitude of central meridian is the longitude that is centred on the disc.

P.A.: The number of degrees (east of north) that Mars' north pole is rotated from north.

Tilt: (or Sub-Earth latitude) is the number of degrees that Mars' north pole is tilted towards (positive value) or away (negative value) as seen from the Earth. It is also equal to the latitude of the centre of the disc.

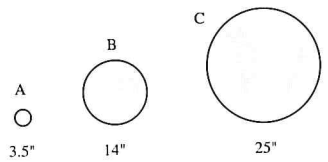


NOTE. Example diagram only, does not refer to any particular date

FIGURE 1

COMPARATIVE SIZES OF MARS AT:

A - Conjunction
B - Poor opposition
C - Perihelic opposition



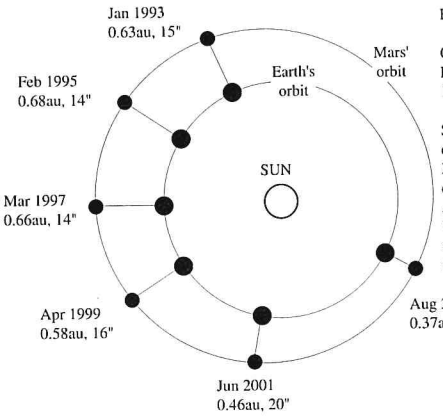


FIGURE 2

OPPOSITIONS FROM 1993 to 2003

Shown under each date is the Earth/Mars distance in Astronomical Units, and the angular diameter in seconds of arc.

Central Meridian — Increase in Longitude

hr	deg°	hr	deg°	hr	deg°	min	deg°
01	014.6	09	131.6	17	248.6	10	002.4
02	029.2	10	146.2	18	263.2	20	004.9
03	043.9	11	160.8	19	277.8	30	007.3
04	058.5	12	175.5	20	292.4	40	009.7
05	073.1	13	190.1	21	307.0	50	012.2
06	087.7	14	204.7	22	321.7		
07	102.3	15	219.3	23	336.3		
08	117.0	16	233.9	24	350.9		

EPHEMERIS FOR PHYSICAL OBSERVATIONS (0hr UT)

	DECEMBER '94					JANUARY '95					FEBRUARY '95					MARCH '95					APRIL '95					MAY '95					
	Cent Mer°	Tilt°	P.A.°	Phase	Phase Angle	Cent Mer°	Tilt°	P.A.°	Phase	Phase Angle	Cent Mer°	Tilt°	P.A.°	Phase	Phase Angle	Cent Mer°	Tilt°	P.A.°	Phase	Phase Angle	Cent Mer°	Tilt°	P.A.°	Phase	Phase Angle	Cent Mer°	Tilt°	P.A.°	Phase	Phase Angle	
1	070.1	21.8	7.9	0.901	36.7	141.8	21.8	11.7	0.940	28.4	225.3	19.8	8.5	0.993	9.5	341.0	17.4	1.8	0.986	13.8	061.8	17.6	359.5	0.931	30.4	141.6	20.4	3.6	0.900	36.8	1
2	060.7	21.8	8.1	0.902	36.6	132.7	21.8	11.7	0.941	28.0	216.6	19.7	8.3	0.994	8.8	332.1	17.4	1.7	0.984	14.5	052.6	17.6	359.6	0.930	30.7	132.1	20.6	3.8	0.900	36.9	2
3	051.2	21.8	8.3	0.902	36.4	123.6	21.7	11.7	0.943	27.6	207.9	19.6	8.0	0.995	8.0	323.3	17.3	1.5	0.983	15.2	043.4	17.7	359.6	0.928	31.1	122.7	20.7	4.0	0.899	37.0	3
4	041.8	21.9	8.5	0.903	36.3	114.5	21.7	11.8	0.945	27.1	199.2	19.5	7.8	0.996	7.2	314.5	17.3	1.3	0.981	15.9	034.2	17.8	359.7	0.927	31.4	113.2	20.8	4.3	0.899	37.1	4
5	032.4	21.9	8.7	0.904	36.1	105.4	21.7	11.7	0.947	26.7	190.4	19.4	7.6	0.997	6.5	305.6	17.2	1.1	0.979	16.5	025.0	17.8	359.8	0.925	31.7	103.7	20.9	4.5	0.898	37.2	5
6	023.0	21.9	8.9	0.905	35.9	096.4	21.6	11.7	0.949	26.2	181.7	19.3	7.3	0.997	5.7	296.8	17.2	1.0	0.978	17.2	015.7	17.9	359.8	0.924	32.0	094.2	21.0	4.7	0.898	37.3	6
7	013.6	21.9	9.1	0.906	35.7	087.3	21.6	11.7	0.951	25.7	173.0	19.2	7.1	0.998	5.0	287.9	17.2	0.8	0.976	17.9	006.5	18.0	359.9	0.923	32.3	084.7	21.1	4.9	0.897	37.4	7
8	004.2	22.0	9.2	0.907	35.6	078.3	21.5	11.7	0.952	25.2	164.3	19.1	6.8	0.999	4.4	279.0	17.1	0.6	0.974	18.5	357.2	18.1	0.0	0.921	32.6	075.2	21.3	5.2	0.897	37.5	8
9	354.8	22.0	9.4	0.908	35.4	069.3	21.5	11.6	0.954	24.7	155.6	19.0	6.6	0.999	3.7	270.1	17.1	0.5	0.972	19.2	347.9	18.2	0.1	0.920	32.8	065.7	21.4	5.4	0.897	37.5	9
10	345.5	22.0	9.6	0.909	35.2	060.3	21.4	11.6	0.956	24.1	146.9	18.9	6.4	0.999	3.2	261.2	17.1	0.4	0.970	19.8	338.6	18.3	0.2	0.919	33.1	056.2	21.5	5.6	0.896	37.6	10
11	336.1	22.0	9.7	0.910	35.0	051.3	21.4	11.5	0.958	23.6	138.2	18.9	6.1	0.999	2.9	252.3	17.1	0.3	0.969	20.4	329.3	18.3	0.3	0.918	33.4	046.7	21.6	5.9	0.896	37.6	11
12	326.7	22.0	9.9	0.911	34.7	042.3	21.3	11.5	0.960	23.0	129.5	18.8	5.8	0.999	2.7	243.3	17.0	0.1	0.967	21.0	320.0	18.4	0.5	0.916	33.6	037.1	21.7	6.1	0.896	37.7	12
13	317.4	22.0	10.0	0.912	34.5	033.3	21.2	11.4	0.962	22.5	120.8	18.7	5.6	0.999	2.8	234.4	17.0	0.0	0.965	21.6	310.7	18.5	0.6	0.915	33.8	027.6	21.9	6.4	0.895	37.7	13
14	308.1	22.1	10.2	0.913	34.3	024.4	21.2	11.3	0.964	21.9	112.1	18.6	5.3	0.999	3.1	225.4	17.0	359.9	0.963	22.2	301.4	18.6	0.7	0.914	34.1	018.1	22.0	6.6	0.895	37.8	14
15	298.7	22.1	10.3	0.914	34.0	015.4	21.1	11.2	0.966	21.3	103.4	18.5	5.1	0.999	3.6	216.4	17.0	359.8	0.961	22.7	292.1	18.7	0.8	0.913	34.3	008.5	22.1	6.9	0.895	37.8	15
16	289.4	22.1	10.5	0.915	33.8	006.5	21.1	11.1	0.968	20.7	094.7	18.4	4.8	0.999	4.2	207.4	17.0	359.8	0.959	23.3	282.7	18.8	1.0	0.912	34.5	359.0	22.2	7.1	0.895	37.9	16
17	280.1	22.1	10.6	0.917	33.5	357.6	21.0	11.0	0.970	20.1	086.0	18.3	4.6	0.998	4.9	198.4	17.0	359.7	0.957	23.8	273.4	18.9	1.1	0.911	34.7	349.4	22.3	7.4	0.895	37.9	17
18	270.8	22.1	10.7	0.918	33.3	348.7	20.9	10.9	0.971	19.4	077.3	18.2	4.3	0.998	5.6	189.4	17.0	359.6	0.956	24.3	264.0	19.0	1.3	0.910	34.9	339.8	22.4	7.7	0.894	37.9	18
19	261.5	22.1	10.8	0.919	33.0	339.8	20.9	10.8	0.973	18.8	068.6	18.1	4.1	0.997	6.3	180.4	17.1	359.6	0.954	24.8	254.6	19.1	1.4	0.909	35.1	330.3	22.6	7.9	0.894	38.0	19
20	252.3	22.1	10.9	0.921	32.7	330.9	20.8	10.7	0.975	18.1	059.8	18.0	3.8	0.996	7.0	171.3	17.1	359.5	0.952	25.3	245.3	19.2	1.6	0.908	35.3	320.7	22.7	8.2	0.894	38.0	20
21	243.0	22.0	11.0	0.922	32.4	322.0	20.7	10.5	0.977	17.5	051.1	18.0	3.6	0.995	7.8	162.3	17.1	359.5	0.950	25.8	235.9	19.3	1.7	0.907	35.5	311.1	22.8	8.5	0.894	38.0	21
22	233.7	22.0	11.1	0.924	32.1	313.2	20.6	10.4	0.979	16.8	042.4	17.9	3.4	0.994	8.6	153.2	17.1	359.4	0.948	26.3	226.5	19.4	1.9	0.906	35.6	301.5	22.9	8.7	0.894	38.0	22
23	224.5	22.0	11.2	0.925	31.8	304.4	20.6	10.2	0.980	16.1	033.6	17.8	3.1	0.993	9.3	144.1	17.1	359.4	0.946	26.8	217.1	19.5	2.1	0.906	35.8	292.0	23.0	9.0	0.894	38.0	23
24	215.3	22.0	11.3	0.926	31.5	295.5	20.5	10.1	0.982	15.4	024.9	17.7	2.9	0.992	10.1	135.0	17.2	359.4	0.945	27.2	207.7	19.7	2.3	0.905	35.9	282.4	23.1	9.3	0.894	38.0	24
25	206.0	22.0	11.4	0.928	31.1	286.7	20.4	9.9	0.984	14.7	016.1	17.7	2.7	0.991	10.8	125.9	17.2	359.4	0.943	27.6	198.3	19.8	2.4	0.904	36.1	272.8	23.2	9.6	0.894	38.0	25
26	196.8	22.0	11.5	0.930	30.8	277.9	20.3	9.7	0.985	14.0	007.3	17.6	2.5	0.990	11.6	116.8	17.3	359.4	0.941	28.1	188.8	19.9	2.6	0.903	36.2	263.2	23.3	9.8	0.894	38.0	26
27	187.6	21.9	11.5	0.931	30.4	269.1	20.2	9.5	0.987	13.3	358.5	17.5	2.3	0.989	12.3	107.7	17.3	359.4	0.939	28.5	179.4	20.0	2.8	0.903	36.4	253.6	23.4	10.1	0.894	38.0	27
28	178.5	21.9	11.6	0.933	30.0	260.4	20.1	9.3	0.988	12.5	349.8	17.5	2.0	0.987	13.0	098.5	17.3	359.4	0.938	28.9	170.0	20.1	3.0	0.902	36.5	244.0	23.6	10.4	0.894	38.0	28
29	169.3	21.9	11.6	0.934	29.7	251.6	20.1	9.1	0.989	11.8						089.4	17.4	359.4	0.936	29.3	160.5	20.2	3.2	0.901	36.6	234.3	23.7	10.7	0.894	38.0	29
30	160.1	21.9	11.7	0.936	29.3	242.8	20.0	8.9	0.991	11.0						080.2	17.5	359.4	0.935	29.6	151.1	20.3	3.4	0.901	36.7	224.7	23.8	11.0	0.894	38.0	30
31	151.0	21.8	11.7	0.938	28.9	234.1	19.9	8.7	0.992	10.3						071.0	17.5	359.5	0.933	30.0						215.1	23.9	11.3	0.894	38.0	31

MARS

RISE, SET (for Perth, W.A.S.T.)

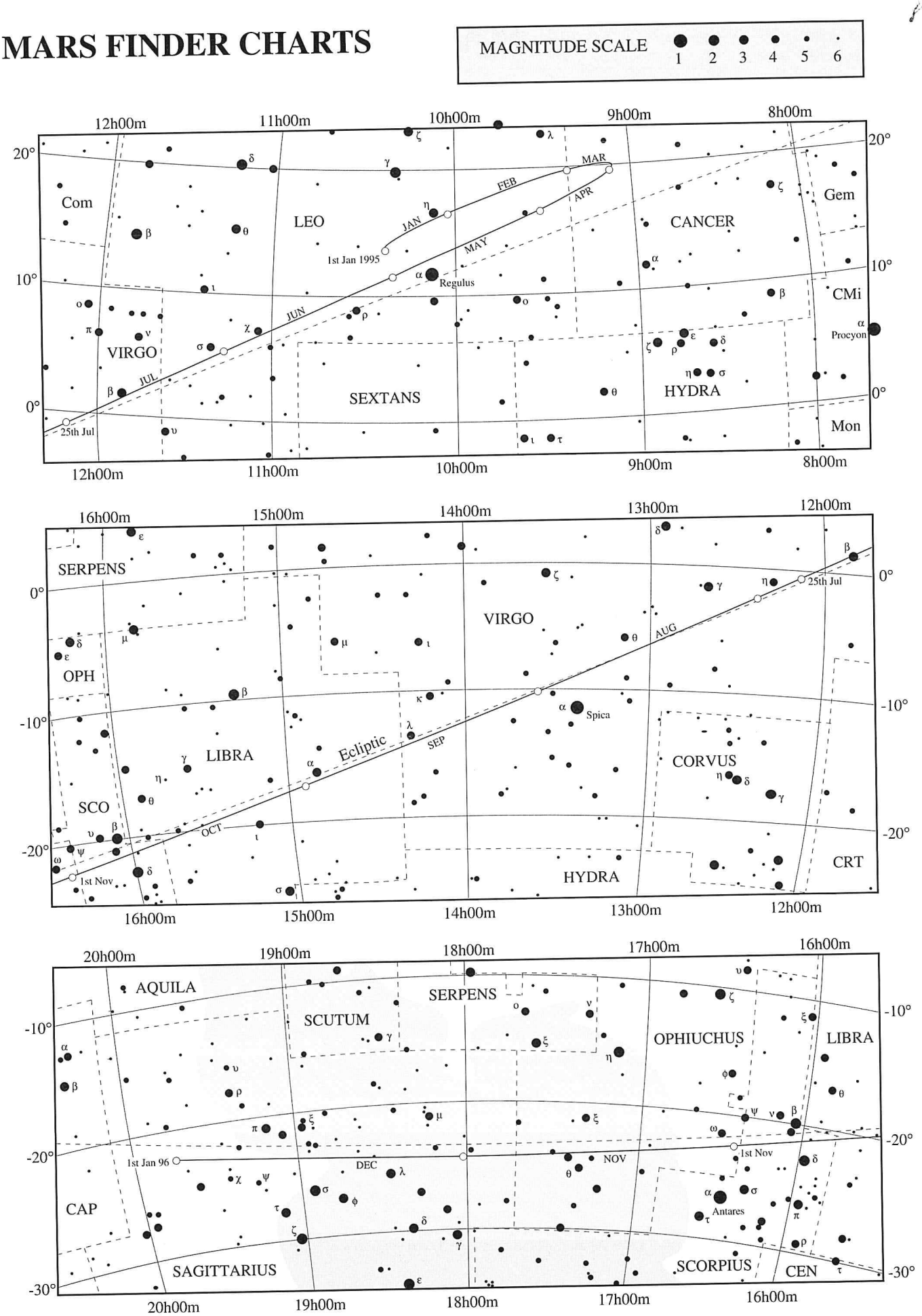
AND

GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

	RA h m s	DEC ° ′ ″	RISE h mm	SET h mm
Jan 7	10 23 48	+ 13 58 56	22 06	9 03
14	10 21 30	+ 14 28 40	21 38	8 31
21	10 16 37	+ 15 11 04	21 07	7 57
28	10 09 18	+ 16 03 41	20 35	7 20
Feb 4	09 59 55	+ 17 02 05	20 00	6 41
11	09 49 13	+ 18 00 19	19 25	6 00
18	09 38 11	+ 18 52 30	18 49	5 19
25	09 27 48	+ 19 34 04	18 13	4 39
Mar 4	09 18 59	+ 20 02 14	17 38	4 01
11	09 12 25	+ 20 16 17	17 05	3 27
18	09 08 22	+ 20 17 07	16 33	2 55
25	09 06 53	+ 20 06 18	16 04	2 26
Apr 1	09 07 50	+ 19 45 14	15 36	2 01
8	09 10 59	+ 19 15 11	15 11	1 38
15	09 16 03	+ 18 37 13	14 46	1 17
22	09 22 45	+ 17 52 10	14 24	0 58
29	09 30 50	+ 17 00 31	14 02	0 41
May 6	09 40 04	+ 16 02 38	13 41	0 25
13	09 50 17	+ 14 58 55	13 21	0 10
20	10 01 18	+ 13 49 45	13 01	23 55
27	10 12 59	+ 12 35 23	12 42	23 43
Jun 3	10 25 15	+ 11 16 03	12 23	23 31
10	10 38 01	+ 9 52 08	12 05	23 20
17	10 51 11	+ 8 24 00	11 47	23 09
24	11 04 44	+ 6 52 00	11 29	22 59

	RA h m s	DEC ° ′ ″	RISE h mm	SET h mm
Jul 1	11 18 38	+ 5 16 27	11 11	22 49
8	11 32 51	+ 3 37 48	10 53	22 40
15	11 47 23	+ 1 56 32	10 36	22 31
22	12 02 13	+ 0 13 05	10 19	22 23
29	12 17 22	- 1 32 04	10 02	22 15
Aug 5	12 32 51	- 3 18 25	9 46	22 07
12	12 48 40	- 5 05 20	9 30	22 00
19	13 04 51	- 6 52 14	9 14	21 53
26	13 21 26	- 8 38 28	8 58	21 47
Sep 2	13 38 26	- 10 23 22	8 43	21 41
9	13 55 53	- 12 06 07	8 28	21 35
16	14 13 47	- 13 45 56	8 14	21 30
23	14 32 13	- 15 21 59	8 01	21 25
30	14 51 10	- 16 53 21	7 48	21 21
Oct 7	15 10 39	- 18 19 03	7 36	21 16
14	15 30 42	- 19 38 07	7 25	21 13
21	15 51 18	- 20 49 31	7 14	21 09
28	16 12 27	- 21 52 15	7 04	21 06
Nov 4	16 34 08	- 22 45 19	6 56	21 03
11	16 56 16	- 23 27 46	6 48	20 59
18	17 18 51	- 23 58 45	6 42	20 56
25	17 41 47	- 24 17 32	6 36	20 52
Dec 2	18 04 59	- 24 23 33	6 31	20 48
9	18 28 22	- 24 16 23	6 27	20 44
16	18 51 50	- 23 55 53	6 24	20 38
23	19 15 18	- 23 22 02	6 22	20 32
30	19 38 41	- 22 35 07	6 20	20 26

MARS FINDER CHARTS



JUPITER

RISE, SET (for Perth, W.A.S.T.)

AND

GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

	RA h m s	DEC ° ′ ″	RISE h mm	SET h mm
Jan 7	16 16 58	- 20 33 28	2 33	16 25
14	16 22 34	- 20 46 48	2 10	16 04
21	16 27 53	- 20 58 45	1 47	15 42
28	16 32 55	- 21 09 20	1 24	15 20
Feb 4	16 37 35	- 21 18 35	1 01	14 57
11	16 41 51	- 21 26 30	0 37	14 35
18	16 45 41	- 21 33 11	0 13	14 11
25	16 49 02	- 21 38 38	23 45	13 47
Mar 4	16 51 52	- 21 42 57	23 20	13 23
11	16 54 07	- 21 46 10	22 55	12 58
18	16 55 46	- 21 48 20	22 29	12 32
25	16 56 48	- 21 49 30	22 02	12 05
Apr 1	16 57 11	- 21 49 42	21 35	11 38
8	16 56 54	- 21 48 58	21 07	11 10
15	16 55 58	- 21 47 17	20 39	10 42
22	16 54 24	- 21 44 42	20 10	10 13
29	16 52 16	- 21 41 13	19 40	9 43
May 6	16 49 35	- 21 36 52	19 10	9 12
13	16 46 29	- 21 31 44	18 40	8 42
20	16 43 01	- 21 25 54	18 09	8 10
27	16 39 20	- 21 19 30	17 38	7 39
Jun 3	16 35 33	- 21 12 45	17 07	7 07
10	16 31 48	- 21 05 54	16 36	6 36
17	16 28 11	- 20 59 12	16 06	6 04
24	16 24 51	- 20 52 57	15 35	5 33

	RA h m s	DEC ° ′ ″	RISE h mm	SET h mm
Jul 1	16 21 54	- 20 47 26	15 05	5 02
8	16 19 25	- 20 42 57	14 35	4 32
15	16 17 27	- 20 39 41	14 06	4 02
22	16 16 05	- 20 37 49	13 37	3 33
29	16 15 20	- 20 37 28	13 09	3 05
Aug 5	16 15 12	- 20 38 41	12 41	2 37
12	16 15 42	- 20 41 28	12 14	2 11
19	16 16 50	- 20 45 45	11 47	1 44
26	16 18 33	- 20 51 25	11 21	1 19
Sep 2	16 20 52	- 20 58 20	10 56	0 54
9	16 23 44	- 21 06 20	10 31	0 30
16	16 27 06	- 21 15 15	10 06	0 06
23	16 30 57	- 21 24 51	9 42	23 39
30	16 35 16	- 21 34 57	9 18	23 17
Oct 7	16 39 59	- 21 45 21	8 55	22 54
14	16 45 05	- 21 55 50	8 32	22 32
21	16 50 31	- 22 06 13	8 09	22 11
28	16 56 16	- 22 16 18	7 47	21 50
Nov 4	17 02 17	- 22 25 56	7 25	21 29
11	17 08 32	- 22 34 56	7 03	21 08
18	17 15 00	- 22 43 11	6 42	20 47
25	17 21 37	- 22 50 32	6 20	20 26
Dec 2	17 28 22	- 22 56 55	5 59	20 06
9	17 35 13	- 23 02 14	5 38	19 46
16	17 42 08	- 23 06 25	5 17	19 25
23	17 49 05	- 23 09 26	4 57	19 05
30	17 56 01	- 23 11 17	4 36	18 44

JUPITER — LONGITUDE OF CENTRAL MERIDIAN

SYSTEM I (0hr UT)

DATE	JAN °	FEB °	MAR °	APR °	MAY °	JUN °	JUL °	AUG °	SEP °	OCT °	NOV °	DEC °	DATE
1	285.0	136.2	236.0	091.9	152.1	011.3	071.2	286.0	137.3	188.4	035.9	085.5	1
2	082.7	294.0	033.9	249.9	310.1	169.3	229.2	083.8	295.0	346.0	193.5	243.1	2
3	240.5	091.8	191.8	047.9	108.2	327.4	027.1	241.6	092.7	143.7	351.2	040.8	3
4	038.2	249.7	349.7	205.9	266.2	125.4	185.1	039.5	250.5	301.4	148.8	198.5	4
5	196.0	047.5	147.6	003.8	064.3	283.4	343.0	197.3	048.2	099.1	306.5	356.1	5
6	353.8	205.3	305.5	161.8	222.3	081.4	140.9	355.1	205.9	256.7	104.1	153.8	6
7	151.5	003.1	103.4	319.8	020.3	239.5	298.9	152.9	003.6	054.4	261.8	311.4	7
8	309.3	161.0	261.3	117.8	178.4	037.5	096.8	310.7	161.4	212.1	059.4	109.1	8
9	107.0	318.8	059.3	275.8	336.4	195.5	254.7	108.5	319.1	009.7	217.1	266.8	9
10	264.8	116.6	217.2	073.8	134.4	353.5	052.6	266.3	116.8	167.4	014.7	064.4	10
11	062.6	274.5	015.1	231.8	292.5	151.5	210.6	064.1	274.5	325.1	172.4	222.1	11
12	220.3	072.3	173.0	029.8	090.5	309.5	008.5	221.9	072.2	122.7	330.1	019.8	12
13	018.1	230.2	330.9	187.8	248.6	107.5	166.4	019.7	229.9	280.4	127.7	177.4	13
14	175.9	028.0	128.8	345.8	046.6	265.6	324.3	177.5	027.6	078.1	285.4	335.1	14
15	333.7	185.9	286.8	143.8	204.7	063.6	122.2	335.3	185.3	235.7	083.0	132.8	15
16	131.4	343.7	084.7	301.8	002.7	221.6	280.1	133.1	343.0	033.4	240.7	290.4	16
17	289.2	141.6	242.6	099.8	160.7	019.6	078.0	290.9	140.7	191.1	038.3	088.1	17
18	087.0	299.4	040.6	257.8	318.8	177.5	235.9	088.7	298.4	348.7	196.0	245.8	18
19	244.8	097.3	198.5	055.8	116.8	335.5	033.8	246.4	096.1	146.4	353.6	043.5	19
20	042.6	255.2	356.4	213.8	274.9	133.5	191.6	044.2	253.8	304.0	151.3	201.1	20
21	200.4	053.0	154.4	011.9	072.9	291.5	349.5	202.0	051.5	101.7	308.9	358.8	21
22	358.2	210.9	312.3	169.9	230.9	089.5	147.4	359.8	209.2	259.3	106.6	156.5	22
23	155.9	008.8	110.3	327.9	029.0	247.5	305.3	157.5	006.9	057.0	264.2	314.2	23
24	313.7	166.6	268.2	125.9	187.0	045.5	103.1	315.3	164.6	214.7	061.9	111.8	24
25	111.5	324.5	066.2	283.9	345.1	203.4	261.0	113.0	322.3	012.3	219.5	269.5	25
26	269.3	122.4	224.1	082.0	143.1	001.4	058.9	270.8	120.0	170.0	017.2	067.2	26
27	067.1	280.3	022.1	240.0	301.1	159.4	216.7	068.5	277.7	327.6	174.9	224.9	27
28	224.9	078.2	180.1	038.0	099.2	317.3	014.6	226.3	075.3	125.3	332.5	022.6	28
29	022.8		338.0	196.0	257.2	115.3	172.4	024.0	233.0	282.9	130.2	180.3	29
30	180.6		136.0	354.1	055.2	273.3	330.3	181.8	030.7	080.6	287.8	337.9	30
31	338.4		294.0		213.3		128.1	339.5		238.2		135.6	31

SYSTEM II (0hr UT)

DATE	JAN °	FEB °	MAR °	APR °	MAY °	JUN °	JUL °	AUG °	SEP °	OCT °	NOV °	DEC °	DATE
1	157.7	132.3	018.5	357.8	189.1	171.8	002.8	341.0	315.8	138.0	109.0	289.7	1
2	307.8	282.5	168.8	148.2	339.5	322.2	153.1	131.2	105.9	288.1	259.0	079.8	2
3	097.9	072.7	319.0	298.5	129.9	112.6	303.4	281.4	256.0	078.1	049.1	229.8	3
4	248.0	222.9	109.3	088.9	280.3	263.0	093.7	071.6	046.1	228.2	199.1	019.8	4
5	038.1	013.1	259.6	239.2	070.7	053.4	244.0	221.8	196.2	018.2	349.1	169.9	5
6	188.3	163.3	049.8	029.6	221.1	203.7	034.3	012.0	346.3	168.2	139.1	319.9	6
7	338.4	313.5	200.1	179.9	011.5	354.1	184.6	162.2	136.4	318.3	289.2	109.9	7
8	128.5	103.7	350.4	330.3	161.9	144.5	334.9	312.4	286.5	108.3	079.2	259.9	8
9	278.7	253.9	140.7	120.7	312.4	294.9	125.2	102.5	076.6	258.4	229.2	050.0	9
10	068.8	044.1	290.9	271.0	102.8	085.3	275.5	252.7	226.7	048.4	019.2	200.0	10
11	218.9	194.3	081.2	061.4	253.2	235.7	065.8	042.9	016.7	198.4	169.2	350.1	11
12	009.1	344.5	231.5	211.7	043.6	026.1	216.1	193.1	166.8	348.5	319.3	140.1	12
13	159.2	134.7	021.8	002.1	194.0	176.4	006.4	343.2	316.9	138.5	109.3	290.1	13
14	309.4	284.9	172.1	152.5	344.4	326.8	156.7	133.4	107.0	288.5	259.3	080.2	14
15	099.5	075.2	322.4	302.9	134.8	117.2	306.9	283.6	257.1	078.6	049.3	230.2	15
16	249.6	225.4	112.7	093.2	285.2	267.6	097.2	073.7	047.1	228.6	199.4	020.2	16
17	039.8	015.6	263.0	243.6	075.6	057.9	247.5	223.9	197.2	018.6	349.4	170.3	17
18	189.9	165.8	053.3	034.0	226.1	208.3	037.7	014.0	347.3	168.7	139.4	320.3	18
19	340.1	316.1	203.6	184.4	016.5	358.7	188.0	164.2	137.3	318.7	289.4	110.4	19
20	130.3	106.3	353.9	334.8	166.9	149.0	338.2	314.3	287.4	108.7	079.4	260.4	20
21	280.4	256.5	144.2	125.2	317.3	299.4	128.5	104.4	077.5	258.8	229.5	050.5	21
22	070.6	046.8	294.5	275.5	107.7	089.7	278.7	254.6	227.5	048.8	019.5	200.5	22
23	220.7	197.0	084.9	065.9	258.1	240.1	069.0	044.7	017.6	198.8	169.5	350.6	23
24	010.9	347.3	235.2	216.3	048.5	030.4	219.2	194.8	167.7	348.8	319.5	140.6	24
25	161.1	137.5	025.5	006.7	198.9	180.8	009.5	345.0	317.7	138.9	109.6	290.7	25
26	311.2	287.7	175.8	157.1	349.3	331.1	159.7	135.1	107.8	288.9	259.6	080.7	26
27	101.4	078.0	326.2	307.5	139.7	121.5	309.9	285.2	257.8	078.9	049.6	230.8	27
28	251.6	228.3	116.5	097.9	290.2	271.8	100.1	075.3	047.9	228.9	199.6	020.8	28
29	041.8		266.8	248.3	080.6	062.1	250.4	225.5	197.9	019.0	349.7	170.9	29
30	191.9		057.2	038.7	231.0	212.4	040.6	015.6	348.0	169.0	139.7	320.9	30
31	342.1		207.5		021.4		190.8	165.7		319.0		111.0	31

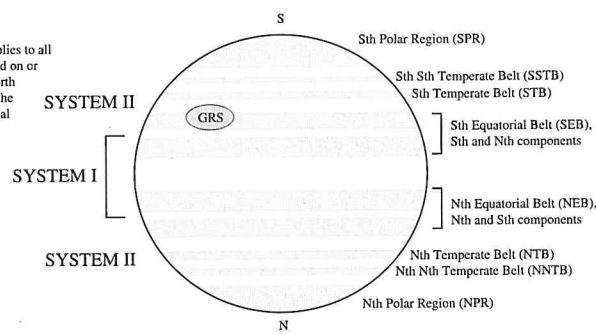
SYSTEM I
Rotation: 9h 50m 30.003s

hr	deg°	hr	deg°	min	deg°
01	036.6	13	115.5	05	03.0
02	073.2	14	152.1	10	06.1
03	109.7	15	188.7	15	09.1
04	146.3	16	225.3	20	12.2
05	182.9	17	261.8	25	15.2
06	219.5	18	298.4	30	18.3
07	256.1	19	335.0	35	21.3
08	292.6	20	011.6	40	24.4
09	329.2	21	048.2	45	27.4
10	005.8	22	084.7	50	30.5
11	042.4	23	121.3	55	33.5
12	079.0	24	157.9	60	36.6

Increase in longitude

SYSTEM I applies to all features situated on or between the north component of the South Equatorial Belt and the south component of the North Equatorial Belt.

SYSTEM II applies to the remainder of the surface.



SYSTEM II
Rotation: 9h 55m 40.062s

hr	deg°	hr	deg°	min	deg°
01	036.3	13	111.4	05	03.0
02	072.5	14	147.7	10	06.0
03	108.8	15	183.9	15	09.1
04	145.0	16	220.2	20	12.1
05	181.3	17	256.5	25	15.1
06	217.6	18	292.7	30	18.1
07	253.8	19	329.0	35	21.2
08	290.1	20	005.2	40	24.2
09	326.4	21	041.5	45	27.2
10	002.6	22	077.8	50	30.2
11	038.9	23	114.0	55	33.2
12	075.1	24	150.3	60	36.3

Increase in longitude

For further explanation see p. 53

JUPITER SATELLITE EVENTS

EXPLANATION

Jupiter and its moons can be likened to a miniature solar system. Although there are currently 16 known Jovian satellites, most of them are too faint for amateur equipment. The four Galilean satellites, named after their discover, Galileo (who suggested calling them the "Medicean Stars"), are bright enough to be visible to small telescopes (or moderate sized binoculars). The dance of these moons, as they pass back and forth across Jupiter, is illustrated in the monthly "Jupiter's Moons" in Part 1. All the moons orbit in roughly the same plane, which is very close to the Earth's orbit. Hence we see the Jovian system as "edge-on". This is the key point to understanding the satellite phenomena. From our perspective on Earth, we see four types of events. They are:-

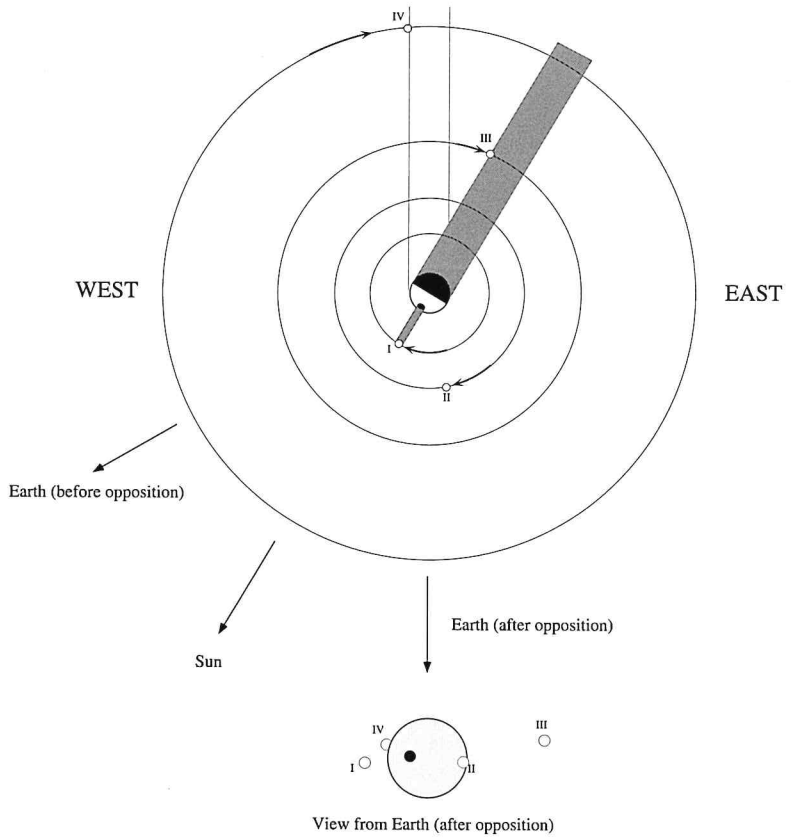
1 The satellite appears to pass in front of Jupiter. This is called a **Satellite Transit**.

2 The shadow of a satellite can move across the "surface" of the planet. This is called a **Satellite Shadow Transit.** The start of a satellite or shadow transit is called its ingress, the finish - egress.

Before opposition, the shadow transit of a satellite will commence before that of the satellite itself. After opposition, the satellite will transit before the shadow. Jupiter's opposition date in 1995 is June 1st.

3 A satellite can go into **occultation** ie. pass behind the disc of Jupiter.

4 A satellite can be **eclipsed** as it passes into Jupiter's shadow. The closer Jupiter is to opposition, the more likely the eclipse events, or at least one event ie. disappearance or reappearance, will be obscured (hidden) by the planet's disc. This is especially relevant for the close-in satellites. In fact, Io is so close to Jupiter it is impossible to see both the disappearance and reappearance for the same eclipse. The positions for the disappearance (d) and reappearance (r) for each moon, relative to Jupiter, for each month, is presented diagrammatically in the "Phases of the Eclipses" (under the "Jupiter's Moons") in Part 1. The event positions, as measured in Jupiter radii (East-West, North-South) from the planet's centre, is presented in tabular form on page 82.



The diagram at left illustrates all of the Jupiter satellite events. It is only an example and does not represent any particular date.

Viewed from the Earth (after opposition) :-

Satellite I's (Io) shadow is currently in transit. The satellite itself would have recently egressed from a transit.

Satellite II (Europa) has just commenced a satellite transit (ingress).

Satellite III (Ganymede) is about to be eclipsed (disappear)

Satellite IV (Callisto) is about to move out of sight as it is occulted by Jupiter's disc.

NOTE: There are no events for Callisto (IV) during 1995.

JUPITER SATELLITE EVENT TABLES (following 2 pages)

Legend

Column 1, - Date & time (in WAST). Date only appears for the first event for each day.
Column 2 - I = Io, II = Europa, III = Ganymede, IV = Callisto
Column 3 - Oc = Occultation, Sh = Shadow Transit, Tr = Satellite Transit, Ec = Eclipse
Column 4 - I = Ingress, E = Egress, D = Disappearance, R = Reappearance

JUPITER SATELLITE EVENTS (Times are WAST)

JANUARY

1	03:56	II	Tr E
3	03:51	I	Ec D
4	03:09	I	Sh E
	03:54	I	Tr E
8	02:38	II	Sh I
	04:14	II	Tr I
	05:04	II	Sh E
10	05:44	I	Ec D
11	02:24	III	Oc D
	02:52	I	Sh I
	03:43	I	Tr I
	04:33	III	Oc R
	05:02	I	Sh E
12	03:15	I	Oc R
15	05:12	II	Sh I
17	03:44	II	Oc R
18	02:57	III	Ec D
	04:46	I	Sh I
	05:02	III	Ec R
	05:42	I	Tr I
19	02:06	I	Ec D
	05:13	I	Oc R
20	02:22	I	Tr E
24	01:57	II	Ec D
26	01:32	II	Tr E
	03:59	I	Ec D
27	02:10	I	Tr I
	03:18	I	Sh E
	04:20	I	Tr E
28	01:40	I	Oc R
29	03:08	III	Tr E
31	04:32	II	Ec D

FEBRUARY

2	01:45	II	Tr I
	02:02	II	Sh E
	04:13	II	Tr E
	05:52	I	Ec D
3	03:02	I	Sh I
	04:08	I	Tr I
	05:11	I	Sh E
4	03:37	I	Oc R
5	02:48	III	Sh E
	05:18	III	Tr I
9	02:10	II	Sh I
	04:25	II	Tr I
	04:36	II	Sh E
10	04:55	I	Sh I
	06:04	I	Tr I
11	01:17	II	Oc R
	02:13	I	Ec D
	05:34	I	Oc R
12	01:33	I	Sh E
	02:44	I	Tr E
	04:42	III	Sh I
16	01:43	III	Oc R
	04:43	II	Sh I
18	03:58	II	Oc R
	04:06	I	Ec D
19	01:17	I	Sh I
	02:30	I	Tr I
	03:27	I	Sh E
	04:39	I	Tr E
20	01:58	I	Oc R
23	00:50	III	Ec R
	03:43	III	Oc D
	05:48	III	Oc R
25	01:35	II	Ec D
	04:04	II	Ec R
	04:06	II	Oc D
	05:59	I	Ec D
26	03:11	I	Sh I
	04:25	I	Tr I
	05:20	I	Sh E
27	00:28	I	Ec D
	01:26	II	Tr E
	03:52	I	Oc R
	23:49	I	Sh E
28	01:03	I	Tr E

MARCH

2	02:40	III	Ec D
	04:48	III	Ec R
4	04:10	II	Ec D
5	05:04	I	Sh I
	06:19	I	Tr I
	23:43	III	Tr E
6	01:32	II	Sh E
	01:32	II	Tr I
	02:21	I	Ec D
	04:00	II	Tr E
	05:46	I	Oc R
	23:32	I	Sh I
7	00:47	I	Tr I
	01:42	I	Sh E
	02:57	I	Tr E
8	00:14	I	Oc R
9	06:37	III	Ec D
13	01:38	II	Sh I
	01:39	III	Tr I
	03:40	III	Tr E
	04:04	II	Tr I
	04:05	II	Sh E
	04:13	I	Ec D
	06:32	II	Tr E
14	01:26	I	Sh I
	02:40	I	Tr I
	03:36	I	Sh E
	04:50	I	Tr E
15	01:07	II	Oc R
	02:06	I	Oc R
	23:18	I	Tr E
20	00:29	III	Sh I
	02:36	III	Sh E
	04:11	II	Sh I
	05:31	III	Tr I
	06:06	I	Ec D
	06:34	II	Tr I
	06:38	II	Sh E
21	03:19	I	Sh I
	04:32	I	Tr I
	05:29	I	Sh E
	06:42	I	Tr E
	22:39	II	Ec D
22	00:34	I	Ec D
	03:40	II	Oc R
	03:57	I	Oc R
	23:00	I	Tr I
	23:58	I	Sh E
23	01:10	I	Tr E
	22:16	II	Tr E
	22:25	I	Oc R
27	04:28	III	Sh I
	06:35	III	Sh E
	06:43	II	Sh I
28	05:13	I	Sh I
	06:23	I	Tr I
29	01:15	II	Ec D
	02:27	I	Ec D
	05:47	I	Oc R
	06:10	II	Oc R
	23:41	I	Sh I
30	00:51	I	Tr I
	01:51	I	Sh E
	03:01	I	Tr E
	22:15	II	Tr I
	22:27	II	Sh E
	23:12	III	Oc D
31	00:15	I	Oc R
	00:43	II	Tr E
	01:14	III	Oc R

APRIL

5	03:51	II	Ec D
	04:20	I	Ec D
6	01:35	I	Sh I
	02:40	I	Tr I
	03:45	I	Sh E
	04:50	I	Tr E
	22:26	III	Ec D
	22:32	II	Sh I
	22:49	I	Ec D
7	00:36	III	Ec R
	00:40	II	Tr I
	01:00	II	Sh E
	02:04	I	Oc R
	02:53	III	Oc D
	03:08	II	Tr E
	04:55	III	Oc R
	22:13	I	Sh E
	23:18	I	Tr E
8	21:50	II	Oc R
12	06:13	I	Ec D
	06:27	II	Ec D
13	03:28	I	Sh I
	04:29	I	Tr I
	05:39	I	Sh E
	06:39	I	Tr E
14	00:42	I	Ec D
	01:05	II	Sh I
	02:23	III	Ec D
	03:02	II	Tr I
	03:33	II	Sh E
	03:51	I	Oc R
	04:34	III	Ec R
	05:30	II	Tr E
	06:30	III	Oc D
	21:57	I	Sh I
	22:56	I	Tr I
15	00:07	I	Sh E
	01:06	I	Tr E
	22:18	I	Oc R
16	00:15	II	Oc R
17	22:14	III	Tr E
20	05:22	I	Sh I
	06:16	I	Tr I
21	02:35	I	Ec D
	03:38	II	Sh I
	05:23	II	Tr I
	05:38	I	Oc R
	06:06	II	Sh E
	06:21	III	Ec D
	23:50	I	Sh I
22	00:43	I	Tr I
	02:01	I	Sh E
	02:53	I	Tr E
	21:03	I	Ec D
	22:20	II	Ec D
23	00:05	I	Oc R
	02:37	II	Oc R
	20:30	I	Sh E
	21:20	I	Tr E
24	20:17	III	Sh I
	21:00	II	Tr E
	22:28	III	Sh E
	23:45	III	Tr I
25	01:43	III	Tr E
28	04:28	I	Ec D
	06:10	II	Sh I
29	01:44	I	Sh I
	02:29	I	Tr I
	03:55	I	Sh E
	04:40	I	Tr E
	22:56	I	Ec D
30	00:56	II	Ec D
	01:50	I	Oc R
	04:57	II	Oc R
	20:12	I	Sh I
	20:56	I	Tr I
	22:23	I	Sh E
	23:06	I	Tr E

MAY

1	20:17	I	Oc R
	20:50	II	Tr I
	21:56	II	Sh E
	23:18	II	Tr E
2	00:15	III	Sh I
	02:27	III	Sh E
	03:11	III	Tr I
	05:10	III	Tr E
5	06:21	I	Ec D
6	03:38	I	Sh I
	04:15	I	Tr I
	05:49	I	Sh E
	06:25	I	Tr E
7	00:50	I	Ec D
	03:32	II	Ec D
	03:35	I	Oc R
	07:16	II	Oc R
	22:06	I	Sh I
	22:41	I	Tr I
8	00:17	I	Sh E
	00:52	I	Tr E
	19:18	I	Ec D
	22:00	II	Sh I
	22:01	I	Oc R
	23:06	II	Tr I
9	00:30	II	Sh E
	01:34	II	Tr E
	04:13	III	Sh I
	06:26	III	Sh E
	06:34	III	Tr I
	19:18	I	Tr E
10	20:25	II	Oc R
12	22:15	III	Oc R
13	05:32	I	Sh I
	06:00	I	Tr I
14	02:43	I	Ec D
	05:20	I	Oc R
	06:08	II	Ec D
15	00:00	I	Sh I
	00:26	I	Tr I
	02:12	I	Sh E
	02:36	I	Tr E
	21:11	I	Ec D
	23:46	I	Oc R
16	00:33	II	Sh I
	01:21	II	Tr I
	03:04	II	Sh E
	03:50	II	Tr E
	18:29	I	Sh I
	18:52	I	Tr I
	20:40	I	Sh E
	21:03	I	Tr E
17	19:27	II	Ec D
	22:42	II	Oc R
19	22:11	III	Ec D
20	01:33	III	Oc R
	07:26	I	Sh I
21	04:37	I	Ec D
	07:03	I	Oc R
22	01:54	I	Sh I
	02:10	I	Tr I
	04:06	I	Sh E
	04:21	I	Tr E
	23:05	I	Ec D
23	01:29	I	Oc R
	03:07	II	Sh I
	03:36	II	Tr I
	05:38	II	Sh E
	06:04	II	Tr E
	20:23	I	Sh I
	20:36	I	Tr I
	22:34	I	Sh E
	22:47	I	Tr E
24	19:55	I	Oc R
	22:03	II	Ec D
25	00:58	II	Oc R
26	18:55	II	Sh E
	19:11	II	Tr E
27	02:09	III	Ec D
	04:51	III	Oc R
28	06:30	I	Ec D
29	03:49	I	Sh I
	03:54	I	Tr I
	06:00	I	Sh E
	06:05	I	Tr E
30	00:59	I	Ec D
	03:13	I	Oc R
	05:41	II	Sh I
	05:49	II	Tr I
	18:23	III	Sh E
	18:29	III	Tr E
	22:17	I	Sh I
	22:20	I	Tr I
31	00:29	I	Sh E
	00:31	I	Tr E
	19:27	I	Ec D
	21:39	I	Oc R

JUNE

1	00:39	II	Ec D
	03:13	II	Oc R
	18:57	I	Tr E
	18:57	I	Sh E
2	18:56	II	Tr I
	18:58	II	Sh I
	21:25	II	Tr E
	21:29	II	Sh E
3	06:05	III	Oc D
5	05:38	I	Tr I
	05:43	I	Sh I
6	02:47	I	Oc D
	05:04	I	Ec R
	19:43	III	Tr I
	20:07	III	Sh I
	21:45	III	Tr E
	22:22	III	Sh E
7	00:04	I	Tr I
	00:12	I	Sh I
	02:15	I	Tr E
	02:23	I	Sh E
	21:13	I	Oc D
	23:32	I	Ec R

JUPITER SATELLITE EVENTS (Times are WAST)

8	02:58	II	Oc D
	05:49	II	Ec R
	18:30	I	Tr I
	18:40	I	Sh I
	20:41	I	Tr E
	20:52	I	Sh E
9	18:01	I	Ec R
	21:10	II	Tr I
	21:32	II	Sh I
	23:38	II	Tr E
10	00:04	II	Sh E
11	19:07	II	Ec R
13	04:31	I	Oc D
	22:59	III	Tr I
14	00:05	III	Sh I
	01:03	III	Tr E
	01:49	I	Tr I
	02:06	I	Sh I
	02:21	III	Sh E
	03:59	I	Tr E
	04:18	I	Sh E
	22:57	I	Oc D
15	01:26	I	Ec R
	05:14	II	Oc D
	20:15	I	Tr I
	20:35	I	Sh I
	22:25	I	Tr E
	22:46	I	Sh E
16	17:23	I	Oc D
	19:55	I	Ec R
	23:24	II	Tr I
17	00:06	II	Sh I
	01:53	II	Tr E
	02:38	II	Sh E
	16:52	I	Tr E
	17:15	I	Sh E
18	18:22	II	Oc D
	21:43	II	Ec R
21	02:18	III	Tr I
	03:33	I	Tr I
	04:01	I	Sh I
	04:04	III	Sh I
	04:24	III	Tr E
	05:44	I	Tr E
22	00:41	I	Oc D
	03:21	I	Ec R
	22:00	I	Tr I
	22:29	I	Sh I
23	00:10	I	Tr E
	00:41	I	Sh E
	19:07	I	Oc D
	21:49	I	Ec R
24	01:40	II	Tr I
	02:41	II	Sh I
	04:09	II	Tr E
	05:13	II	Sh E
	16:58	I	Sh I
	18:37	I	Tr E
	19:09	I	Sh E
	20:21	III	Ec R
25	20:39	II	Oc D
26	00:20	II	Ec R
27	17:18	II	Tr E
	18:31	II	Sh E
29	02:26	I	Oc D
	23:46	I	Tr I
30	00:24	I	Sh I
	01:56	I	Tr E
	02:35	I	Sh E
	20:53	I	Oc D
	23:44	I	Ec R

JULY

1	03:57	II	Tr I
	18:12	I	Tr I
	18:53	I	Sh I
	19:18	III	Oc D
	20:23	I	Tr E
	21:04	I	Sh E
	21:29	III	Oc R
	22:01	III	Ec D
2	00:20	III	Ec R
	18:12	I	Ec R
	22:58	II	Oc D
3	02:57	II	Ec R
4	17:06	II	Tr I
	18:34	II	Sh I
	19:36	II	Tr E
	21:06	II	Sh E
6	04:12	I	Oc D
7	01:32	I	Tr I
	02:19	I	Sh I
	03:43	I	Tr E
	04:30	I	Sh E
	22:39	I	Oc D
8	01:38	I	Ec R
	19:59	I	Tr I
	20:48	I	Sh I
	22:09	I	Tr E
	22:43	III	Oc D
	22:59	I	Sh E
9	00:56	III	Oc R
	01:59	III	Ec D
	04:20	III	Ec R
	17:06	I	Oc D
	20:07	I	Ec R
10	01:18	II	Oc D
	17:27	I	Sh E
11	19:26	II	Tr I
	21:09	II	Sh I
	21:56	II	Tr E
	23:42	II	Sh E
12	18:21	III	Sh E
13	18:52	II	Ec R
14	03:20	I	Tr I
15	00:26	I	Oc D
	03:33	I	Ec R
	21:47	I	Tr I
	22:42	I	Sh I
	23:57	I	Tr E
16	00:53	I	Sh E
	02:13	III	Oc D
	18:53	I	Oc D
	22:02	I	Ec R
17	03:40	II	Oc D
	17:11	I	Sh I
	18:24	I	Tr E
	19:22	I	Sh E
18	21:48	II	Tr I
	23:44	II	Sh I
19	00:18	II	Tr E
	02:18	II	Sh E
	18:15	III	Tr E
	20:00	III	Sh I
	22:20	III	Sh E
20	21:28	II	Ec R
22	02:15	I	Oc D
	23:36	I	Tr I
23	00:37	I	Sh I
	01:46	I	Tr E
	02:48	I	Sh E
	20:42	I	Oc D
	23:57	I	Ec R
24	18:03	I	Tr I
	19:06	I	Sh I
	20:13	I	Tr E
	21:17	I	Sh E
25	18:25	I	Ec R
26	00:12	II	Tr I
	02:20	II	Sh I
	02:43	II	Tr E
	19:36	III	Tr I
	21:52	III	Tr E
	23:59	III	Sh I
27	02:19	III	Sh E
	19:17	II	Oc D
28	00:04	II	Ec R
29	18:12	II	Sh E
30	01:26	I	Tr I
	02:32	I	Sh I
	22:32	I	Oc D
31	01:52	I	Ec R
	19:53	I	Tr I
	21:01	I	Sh I
	22:04	I	Tr E
	23:12	I	Sh E

AUGUST

1	20:21	I	Ec R
2	02:39	II	Tr I
	17:40	I	Sh E
	23:15	III	Tr I
3	01:33	III	Tr E
	21:45	II	Oc D
4	02:40	II	Ec R
5	18:14	II	Sh I
	18:24	II	Tr E
	20:48	II	Sh E
6	17:57	III	Ec D
	20:20	III	Ec R
7	00:23	I	Oc D
	21:45	I	Tr I
	22:56	I	Sh I
	23:55	I	Tr E
8	01:07	I	Sh E
	18:51	I	Oc D
	22:16	I	Ec R
9	17:25	I	Sh I
	18:23	I	Tr E
	19:35	I	Sh E
11	00:14	II	Oc D
12	18:23	II	Tr I
	20:51	II	Sh I
	20:54	II	Tr E
	23:25	II	Sh E
13	19:17	III	Oc R
	21:56	III	Ec D
14	00:20	III	Ec R
	18:35	II	Ec R
	23:37	I	Tr I
15	00:51	I	Sh I
	01:47	I	Tr E
	20:43	I	Oc D
16	00:11	I	Ec R
	18:05	I	Tr I
	19:20	I	Sh I
	20:16	I	Tr E
	21:30	I	Sh E
17	18:40	I	Ec R
19	20:55	II	Tr I
	23:27	II	Sh I
	23:27	II	Tr E
20	20:45	III	Oc D
	23:09	III	Oc R
21	21:11	II	Ec R
22	01:30	I	Tr I
	22:37	I	Oc D
23	19:59	I	Tr I
	21:15	I	Sh I
	22:09	I	Tr E
	23:25	I	Sh E
24	18:21	III	Sh E
	20:35	I	Ec R
25	17:54	I	Sh E
26	23:30	II	Tr I
28	00:40	III	Oc D
	18:37	II	Oc D
	23:46	II	Ec R
30	00:31	I	Oc D
	17:58	II	Sh E
	21:54	I	Tr I
	23:10	I	Sh I
31	00:04	I	Tr E
	19:00	I	Oc D
	19:56	III	Sh I
	22:21	III	Sh E
	22:30	I	Ec R

SEPTEMBER

1	17:39	I	Sh I
	18:33	I	Tr E
	19:49	I	Sh E
4	21:13	II	Oc D
6	17:59	II	Tr E
	18:00	II	Sh I
	20:35	II	Sh E
	23:49	I	Tr I
7	18:44	III	Tr I
	20:56	I	Oc D
	21:10	III	Tr E
	23:55	III	Sh I
8	00:26	I	Ec R
	18:18	I	Tr I
	19:33	I	Sh I
	20:29	I	Tr E
	21:44	I	Sh E
9	18:55	I	Ec R
11	23:51	II	Oc D
13	18:05	II	Tr I
	20:37	II	Sh I
	20:40	II	Tr E
	23:13	II	Sh E
14	22:49	III	Tr I
	22:53	I	Oc D
15	18:16	II	Ec R
	20:15	I	Tr I
	21:28	I	Sh I
	22:25	I	Tr E
	23:39	I	Sh E
16	20:50	I	Ec R
17	18:08	I	Sh E
18	17:53	III	Ec D
	20:22	III	Ec R
20	20:47	II	Tr I
	23:14	II	Sh I
	23:22	II	Tr E
22	20:51	II	Ec R
	22:12	I	Tr I
	23:23	I	Sh I
23	19:20	I	Oc D
	22:45	I	Ec R
24	17:52	I	Sh I
	18:52	I	Tr E
	20:03	I	Sh E
25	19:34	III	Oc R
	21:52	III	Ec D
29	18:33	II	Oc D
30	21:19	I	Oc D

OCTOBER

1	18:39	I	Tr I
	19:47	I	Sh I
	20:50	I	Tr E
	21:58	I	Sh E
2	19:10	I	Ec R
	21:16	III	Oc D
6	18:21	III	Sh E
	21:15	II	Oc D
8	18:14	II	Tr E
	20:25	II	Sh E
	20:38	I	Tr I
	21:41	I	Sh I
	22:49	I	Tr E
9	21:05	I	Ec R
10	18:21	I	Sh E
13	18:15	III	Tr E
	19:51	III	Sh I
	22:22	III	Sh E
15	18:24	II	Tr I
	20:25	II	Sh I
	21:01	II	Tr E
16	19:48	I	Oc D
17	18:05	I	Sh I
	19:19	I	Tr E
	20:16	I	Sh E
20	20:02	III	Tr I
22	21:12	II	Tr I
23	21:48	I	Oc D
24	19:07	I	Tr I
	19:59	I	Sh I
	20:29	II	Ec R
	21:19	I	Tr E
25	19:24	I	Ec R
31	18:53	II	Oc D
	20:23	III	Ec R
	21:07	I	Tr I

NOVEMBER

1	18:19	I	Oc D
	21:19	I	Ec R
2	18:34	I	Sh E
7	19:01	III	Oc D
8	20:21	I	Oc D
9	18:56	II	Tr E
	19:50	I	Tr E
	20:16	II	Sh E
	20:28	I	Sh E
16	19:07	II	Tr I
	19:38	I	Tr I
	20:11	I	Sh I
	20:14	II	Sh I
17	19:38	I	Ec R
24	18:55	I	Oc D
25	18:46	I	Sh E
	19:44	III	Sh I
	20:05	II	Ec R

DECEMBER

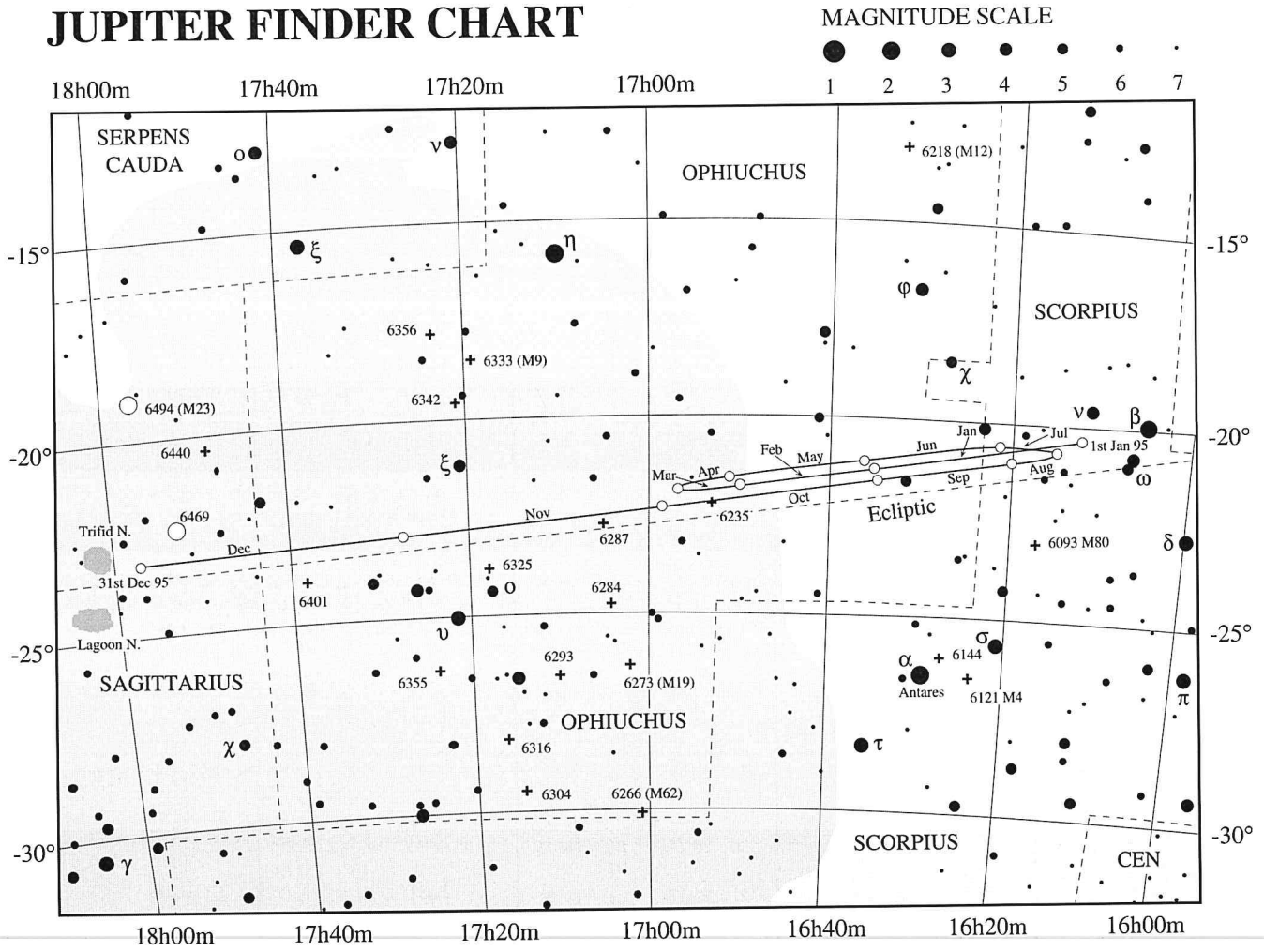
2	19:27	II	Oc D
18	18:57	I	Tr E
	18:57	I	Sh E
23	05:16	I	Oc R
28	05:03	III	Oc R
30	04:53	I	Ec D

JOVIAN SATELLITE ECLIPSE CO-ORDINATES

MONTH	I Ec D	I Ec R	2 Ec D	2 Ec R	3 EC D	3 Ec R
Jan	1.7W, 0.3S	—	2.1W, 0.5S	—	2.6W, 0.7S	1.5W, 0.7S
Feb	2.0W, 0.3S	—	2.5W, 0.5S	—	3.2W, 0.7S	2.1W, 0.7S
Mar	2.0W, 0.3S	—	2.6W, 0.5S	0.9W, 0.5S	3.3W, 0.7S	2.2W, 0.8S
Apr	1.8W, 0.3S	—	2.2W, 0.5S	—	2.8W, 0.8S	1.6W, 0.8S
May	1.3W, 0.3S	—	1.4W, 0.5S	—	1.7W, 0.8S	—
Jun	—	1.2E, 0.3S	—	1.3E, 0.5S	—	1.5E, 0.8S
Jul	—	1.7E, 0.3S	—	2.2E, 0.4S	1.4E, 0.7S	2.7E, 0.7S
Aug	—	2.0E, 0.3S	—	2.6E, 0.4S	2.1E, 0.7S	3.4E, 0.7S
Sep	—	2.0E, 0.3S	—	2.6E, 0.4S	2.1E, 0.7S	3.5E, 0.7S
Oct	—	1.8E, 0.2S	—	2.2E, 0.4S	1.5E, 0.7S	2.8E, 0.7S
Nov	—	1.4E, 0.2S	—	1.7E, 0.3S	—	2.0E, 0.6S
Dec	—	1.0E, 0.2S	—	1.0E, 0.3S	—	0.9E, 0.6S

The co-ordinates above are offsets from the centre of Jupiter. They are given for the middle of the month and are in units of "Jupiter Radii". These figures are graphically represented at the bottom of the "Jupiter's Moons" diagrams. (see part 1).

JUPITER FINDER CHART



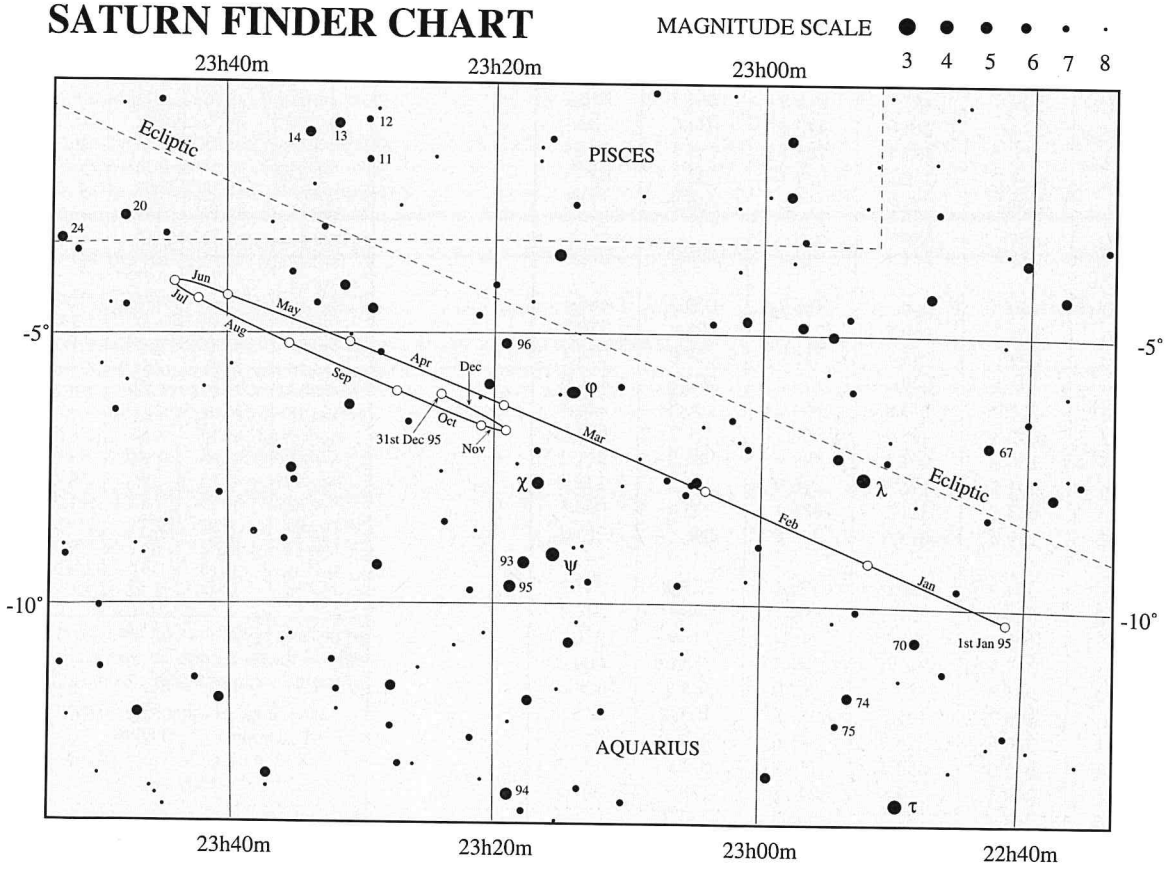
SATURN

RISE, SET (for Perth, W.A.S.T.) AND GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

		RA h m s	DEC ° ' "	RISE h mm	SET h mm
Jan	7	22 43 32	- 10 00 32	9 27	22 21
	14	22 46 00	- 09 45 08	9 03	21 56
	21	22 48 38	- 09 28 42	8 39	21 30
	28	22 51 26	- 09 11 20	8 15	21 05
Feb	4	22 54 21	- 08 53 11	7 51	20 39
	11	22 57 23	- 08 34 26	7 27	20 14
	18	23 00 30	- 08 15 13	7 03	19 49
	25	23 03 40	- 07 55 42	6 40	19 23
Mar	4	23 06 51	- 07 36 01	6 16	18 58
	11	23 10 04	- 07 16 20	5 53	18 33
	18	23 13 15	- 06 56 49	5 29	18 08
	25	23 16 23	- 06 37 36	5 06	17 43
Apr	1	23 19 28	- 06 18 51	4 42	17 17
	8	23 22 28	- 06 00 43	4 18	16 52
	15	23 25 21	- 05 43 21	3 54	16 27
	22	23 28 06	- 05 26 53	3 30	16 01
	29	23 30 42	- 05 11 28	3 06	15 36
May	6	23 33 08	- 04 57 15	2 42	15 10
	13	23 35 23	- 04 44 21	2 17	14 44
	20	23 37 24	- 04 32 54	1 52	14 18
	27	23 39 12	- 04 23 01	1 27	13 52
Jun	3	23 40 46	- 04 14 49	1 01	13 26
	10	23 42 03	- 04 08 23	0 35	12 59
	17	23 43 04	- 04 03 47	0 09	12 32
	24	23 43 47	- 04 01 06	23 38	12 06

		RA h m s	DEC ° ' "	RISE h mm	SET h mm
Jul	1	23 44 13	- 04 00 21	23 11	11 38
	8	23 44 20	- 04 01 33	22 44	11 11
	15	23 44 10	- 04 04 41	22 16	10 44
	22	23 43 41	- 04 09 40	21 47	10 16
	29	23 42 56	- 04 16 27	21 19	9 48
Aug	5	23 41 54	- 04 24 51	20 50	9 20
	12	23 40 37	- 04 34 42	20 21	8 51
	19	23 39 07	- 04 45 47	19 51	8 23
	26	23 37 26	- 04 57 51	19 22	7 54
Sep	2	23 35 36	- 05 10 35	18 52	7 25
	9	23 33 40	- 05 23 41	18 22	6 56
	16	23 31 42	- 05 36 50	17 52	6 27
	23	23 29 43	- 05 49 40	17 22	5 58
	30	23 27 48	- 06 01 52	16 52	5 29
Oct	7	23 25 59	- 06 13 07	16 22	5 01
	14	23 24 20	- 06 23 07	15 52	4 32
	21	23 22 52	- 06 31 39	15 23	4 03
	28	23 21 38	- 06 38 30	14 54	3 35
Nov	4	23 20 40	- 06 43 28	14 25	3 06
	11	23 20 00	- 06 46 29	13 57	2 38
	18	23 19 38	- 06 47 26	13 29	2 11
	25	23 19 35	- 06 46 19	13 02	1 43
Dec	2	23 19 51	- 06 43 07	12 34	1 15
	9	23 20 27	- 06 37 52	12 08	0 48
	16	23 21 22	- 06 30 40	11 41	0 21
	23	23 22 34	- 06 21 34	11 15	23 51
	30	23 24 04	- 06 10 41	10 50	23 24

SATURN FINDER CHART



SATURN

LONGITUDE OF CENTRAL MERIDIAN (System I) 0 hrs UT

Date	JAN °	FEB °	MAR °	APR °	MAY °	JUN °
1	273.1	162.0	038.8	289.1	056.7	310.0
2	037.3	286.1	163.0	053.4	181.0	074.4
3	161.4	050.3	287.1	177.6	305.2	198.7
4	285.6	174.5	051.3	301.8	069.5	323.0
5	049.7	298.6	175.5	066.1	193.8	087.4
6	173.9	062.8	299.7	190.3	318.1	211.7
7	298.0	186.9	063.9	314.5	082.4	336.0
8	062.2	311.1	188.1	078.8	206.7	100.4
9	186.3	075.3	312.3	203.0	331.0	224.7
10	310.5	199.4	076.5	327.2	095.2	349.1
11	074.7	323.6	200.7	091.5	219.5	113.4
12	198.8	087.8	324.9	215.7	343.8	237.7
13	323.0	211.9	089.1	340.0	108.1	002.1
14	087.1	336.1	213.3	104.2	232.4	126.4
15	211.3	100.3	337.5	228.5	356.7	250.8
16	335.4	224.5	101.7	352.7	121.0	015.1
17	099.6	348.6	225.9	117.0	245.3	139.5
18	223.8	112.8	350.1	241.2	009.6	263.8
19	347.9	237.0	114.3	005.5	133.9	028.2
20	112.1	001.1	238.5	129.7	258.2	152.5
21	236.2	125.3	002.7	254.0	022.5	276.9
22	000.4	249.5	126.9	018.3	146.9	041.2
23	124.5	013.7	251.2	142.5	271.2	165.6
24	248.7	137.9	015.4	266.8	035.5	290.0
25	012.9	262.0	139.6	031.1	159.8	054.3
26	137.0	026.2	263.8	155.3	284.1	178.7
27	261.2	150.4	028.0	279.6	048.4	303.1
28	025.3	274.6	152.2	043.9	172.8	067.4
29	149.5		276.5	168.1	297.1	191.8
30	273.6		040.7	292.4	061.4	316.1
31	037.8		164.9		185.7	

Date	JUL °	AUG °	SEP °	OCT °	NOV °	DEC °
1	080.5	336.4	232.5	003.5	256.9	024.1
2	204.9	100.8	356.9	127.8	021.2	148.3
3	329.3	225.2	121.3	252.1	145.5	272.5
4	093.6	349.6	245.7	016.5	269.7	036.7
5	218.0	114.0	010.0	140.8	034.0	160.9
6	342.4	238.4	134.4	265.1	158.3	285.1
7	106.8	002.7	258.8	029.5	282.5	049.3
8	231.1	127.1	023.2	153.8	046.8	173.5
9	355.5	251.5	147.6	278.1	171.0	297.7
10	119.9	015.9	271.9	042.4	295.3	061.9
11	244.3	140.3	036.3	166.7	059.5	186.1
12	008.6	264.7	160.7	291.1	183.8	310.2
13	133.0	029.1	285.1	055.4	308.0	074.4
14	257.4	153.5	049.4	179.7	072.3	198.6
15	021.8	277.9	173.8	304.0	196.5	322.8
16	146.2	042.3	298.2	068.3	320.7	087.0
17	270.6	166.7	062.5	192.6	085.0	211.2
18	034.9	291.1	186.9	316.9	209.2	335.4
19	159.3	055.5	311.2	081.2	333.4	099.5
20	283.7	179.9	075.6	205.5	097.7	223.7
21	048.1	304.3	200.0	329.8	221.9	347.9
22	172.5	068.6	324.3	094.1	346.1	112.1
23	296.9	193.0	088.7	218.4	110.4	236.2
24	061.3	317.4	213.0	342.7	234.6	000.4
25	185.6	081.8	337.4	107.0	358.8	124.6
26	310.0	206.2	101.7	231.3	123.0	248.8
27	074.4	330.6	226.1	355.6	247.2	012.9
28	198.8	095.0	350.4	119.8	011.4	137.1
29	323.2	219.4	114.8	244.1	135.7	261.3
30	087.6	343.8	239.1	008.4	259.9	025.4
31	212.0	108.1		132.7		149.6

Central Meridian Increase in Longitude

hr	deg	hr	deg	min	deg
1	035.2	13	097.3	5	02.9
2	070.4	14	132.5	10	05.9
3	105.5	15	167.7	15	08.8
4	140.7	16	202.9	20	11.7
5	175.9	17	238.1	25	14.7
6	211.1	18	273.2	30	17.6
7	246.3	19	308.4	35	20.5
8	281.4	20	343.6	40	23.5
9	316.6	21	018.8	45	26.4
10	351.8	22	054.0	50	29.3
11	027.0	23	089.1	55	32.2
12	062.2	24	124.3	60	35.2

See part 2 Introduction (page 53) for explanation

SATURN'S RINGS

Date	Major "	Minor "	U °	B °
Jan 03	36.99	4.43	210.891	+06.875
Jan 11	36.62	4.16	211.527	+06.529
Jan 19	36.29	3.89	212.222	+06.154
Jan 27	36.01	3.61	212.968	+05.753
Feb 04	35.78	3.32	213.757	+05.332
Feb 12	35.60	3.04	214.580	+04.894
Feb 20	35.48	2.75	215.427	+04.446
Feb 28	35.41	2.46	216.289	+03.991
Mar 08	35.40	2.18	217.159	+03.535
Mar 16	35.44	1.90	218.028	+03.081
Mar 24	35.54	1.63	218.886	+02.635
Apr 01	35.68	1.37	219.728	+02.201
Apr 09	35.88	1.12	220.543	+01.784
Apr 17	36.13	0.88	221.324	+01.388
Apr 25	36.43	0.65	222.065	+01.017
May 03	36.78	0.43	222.756	+00.675
May 11	37.17	0.24	223.390	+00.366
May 19	37.60	0.06	223.960	+00.094
May 27	38.07	0.09	224.460	-00.138
Jun 04	38.57	0.22	224.883	-00.327
Jun 12	39.10	0.32	225.223	-00.470
Jun 20	39.64	0.39	225.475	-00.566
Jun 28	40.20	0.43	225.636	-00.612
Jul 06	40.76	0.43	225.703	-00.608
Jul 14	41.30	0.40	225.676	-00.554
Jul 22	41.83	0.33	225.555	-00.452
Jul 30	42.32	0.22	225.343	-00.303
Aug 07	42.76	0.08	225.048	-00.113
Aug 15	43.14	0.09	224.677	+00.114
Aug 23	43.45	0.28	224.241	+00.371
Aug 31	43.67	0.50	223.754	+00.650
Sep 08	43.80	0.72	223.233	+00.942
Sep 16	43.84	0.95	222.694	+01.238
Sep 24	43.77	1.17	222.155	+01.528
Oct 02	43.61	1.37	221.635	+01.802
Oct 10	43.36	1.55	221.152	+02.051
Oct 18	43.02	1.70	220.723	+02.266
Oct 26	42.61	1.81	220.361	+02.440
Nov 03	42.14	1.89	220.079	+02.568
Nov 11	41.63	1.92	219.886	+02.645
Nov 19	41.09	1.91	219.789	+02.669
Nov 27	40.53	1.87	219.791	+02.639
Dec 05	39.97	1.78	219.893	+02.555
Dec 13	39.42	1.66	220.095	+02.419
Dec 21	38.88	1.51	220.392	+02.232
Dec 29	38.37	1.34	220.782	+01.998

Major and Minor axes (in arc secs) are for the outer edge of the outer ring. To work out the dimensions of the other rings, multiply by the following factors.

Inner edge of outer ring 0.8932 Outer edge of inner ring 0.8596 Inner edge of inner ring 0.6726 Inner edge of dusky ring 0.5477

"U" and "B" equal the Geocentric longitude and the tilt of the rings respectively.

SATELLITES OF SATURN

Saturn is in opposition on September the 14th. On this date, however, the Earth is very near the orbital plane of the inner satellites, so that the apparent orbits approximate straight lines. For this reason, the diagram of the apparent orbits is not given.

TITAN (WAST) Mean Synodic Period 15d 23.3h

Greatest Eastern Elongation	Inferior Conjunction	Greatest Western Elongation	Superior Conjunction
		Dec 31 07.4	Jan 3 03.4
Jan 7 00.5	Jan 11 04.6	Jan 15 07.4	Jan 19 03.4
Jan 23 00.7	Jan 27 04.9	Jan 31 07.7	Feb 4 03.7
Feb 8 01.1	Feb 12 05.4	Feb 16 08.2	Feb 20 04.1
Feb 24 01.6	Feb 28 06.0	Mar 4 08.7	Mar 8 04.5
Mar 12 02.2	Mar 16 06.7	Mar 20 09.2	Mar 24 04.9
Mar 28 02.7	Apr 1 07.3	Apr 5 09.6	Apr 9 05.3
Apr 13 03.2	Apr 17 07.8	Apr 21 09.9	Apr 25 05.5
Apr 29 03.4	May 3 08.0	May 7 10.0	May 11 05.5
May 15 03.5	May 19 08.0	May 23 09.9	May 27 05.2
May 31 03.2	Jun 4 07.7	Jun 8 09.4	Jun 12 04.7
Jun 16 02.6	Jun 20 07.0	Jun 24 08.6	Jun 28 03.8
Jul 2 01.6	Jul 6 06.0	Jul 10 07.4	Jul 14 02.5
Jul 18 00.3	Jul 22 04.5	Jul 26 05.8	Jul 30 00.8
Aug 2 22.5	Aug 7 02.6	Aug 11 03.8	Aug 14 22.8
Aug 18 20.4	Aug 23 00.3	Aug 27 01.6	Aug 30 20.6
Sep 3 18.0	Sep 7 21.9	Sep 11 23.2	Sep 15 18.2
Sep 19 15.5	Sep 23 19.4	Sep 27 20.8	Oct 1 15.8
Oct 5 13.1	Oct 9 17.0	Oct 13 18.5	Oct 17 13.6
Oct 21 10.8	Oct 25 14.8	Oct 29 16.4	Nov 2 11.7
Nov 6 08.9	Nov 10 12.9	Nov 14 14.8	Nov 18 10.1
Nov 22 07.4	Nov 26 11.5	Nov 30 13.5	Dec 4 08.9
Dec 8 06.4	Dec 12 10.6	Dec 16 12.6	Dec 20 08.1
Dec 24 05.7	Dec 28 10.1	Jan 1 12.1	

IAPETUS (WAST) Mean Synodic Period 79d 22.1h

Greatest Eastern Elongation	Inferior Conjunction	Greatest Western Elongation	Superior Conjunction
		Jan 10 17.6	Jan 30 17.3
Feb 19 01.5	Mar 11 18.5	Apr 2 02.8	Apr 21 23.6
May 11 07.2	May 31 22.1	Jun 21 20.1	Jul 11 04.8
Jul 30 01.8	Aug 19 04.0	Sep 8 13.9	Sep 27 15.7
Oct 16 07.7	Nov 5 08.6	Nov 26 01.8	Dec 15 14.3
Jan 3 17.7			

HYPERION (WAST) Mean Synodic Period 21d 7.6h

Greatest Eastern Elongation	Inferior Conjunction	Greatest Western Elongation	Superior Conjunction
Dec 30 16.5	Jan 3 06.8	Jan 9 02.1	Jan 15 06.5
Jan 20 03.5	Jan 24 18.5	Jan 30 15.1	Feb 5 18.9
Feb 10 15.1	Feb 15 06.6	Feb 21 04.6	Feb 27 07.8
Mar 4 02.9	Mar 8 19.1	Mar 14 18.2	Mar 20 20.4
Mar 25 14.6	Mar 30 07.3	Apr 5 07.6	Apr 11 08.7
Apr 16 01.8	Apr 20 19.3	Apr 26 20.3	May 2 20.0
May 7 12.4	May 12 06.3	May 18 08.0	May 24 06.5
May 28 22.0	Jun 2 16.4	Jun 8 18.3	Jun 14 15.6
Jun 19 06.5	Jun 24 01.2	Jun 30 03.0	Jul 5 23.2
Jul 10 13.6	Jul 15 08.3	Jul 21 10.1	Jul 27 05.5
Jul 31 19.5	Aug 5 14.1	Aug 11 15.5	Aug 17 10.4
Aug 22 00.1	Aug 26 18.6	Sep 1 19.5	Sep 7 14.1
Sep 12 03.7	Sep 16 22.1	Sep 22 22.7	Sep 28 17.2
Oct 3 06.9	Oct 8 01.2	Oct 14 01.7	Oct 19 20.2
Oct 24 09.9	Oct 29 04.3	Nov 4 05.1	Nov 9 23.5
Nov 14 13.3	Nov 19 07.9	Nov 25 09.2	Dec 1 03.6
Dec 5 17.2	Dec 10 12.4	Dec 16 14.3	Dec 22 08.5
Dec 26 21.8	Dec 31 17.8	Jan 6 20.5	

TIMES OF GREATEST EASTERN ELONGATION (W.A.S.T.)

RHEA Mean Synodic Period 4d 12.5h

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h
1 10.1	2 01.9	1 05.3	1 21.3	3 13.1	4 04.6	1 07.2	1 22.0	2 12.4	4 02.7	4 17.3	1 19.8
5 22.6	6 14.5	5 17.9	6 09.8	8 01.6	8 17.0	5 19.7	6 10.3	7 00.7	8 15.1	9 05.6	6 08.2
10 11.1	11 03.0	10 06.5	10 22.4	12 14.1	13 05.5	10 08.1	10 22.7	11 13.0	13 03.4	13 18.1	10 20.7
14 23.7	15 15.6	14 19.0	15 10.9	17 02.6	17 17.9	14 20.5	15 11.0	16 01.4	17 15.8	18 06.5	15 09.2
19 12.2	20 04.2	19 07.6	19 23.5	21 15.1	22 06.4	19 08.9	19 23.4	20 13.7	22 04.1	22 18.9	19 21.7
24 00.8	24 16.7	23 20.2	24 12.0	26 03.6	26 18.8	23 21.2	24 11.7	25 02.0	26 16.5	27 07.3	24 10.2
28 13.3		28 08.7	29 00.5	30 16.1		28 09.6	29 00.0	29 14.4	31 04.9		28 22.7

DIONE Mean Synodic Period 2d 17.7h

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h
3 07.4	2 10.5	1 19.9	3 16.8	1 02.1	2 22.6	3 01.3	2 03.7	1 05.9	1 08.1	3 04.1	3 06.6
6 01.2	5 04.3	4 13.7	6 10.5	3 19.8	5 16.3	5 18.9	4 21.3	3 23.6	4 01.7	5 21.7	6 00.3
8 18.9	7 22.0	7 07.4	9 04.2	6 13.5	8 10.0	8 12.6	7 15.0	6 17.2	6 19.4	8 15.4	8 18.0
11 12.6	10 15.7	10 01.1	11 22.0	9 07.2	11 03.7	11 06.3	10 08.7	9 10.8	9 13.1	11 09.1	11 11.8
14 06.4	13 09.5	12 18.9	14 15.7	12 01.0	13 21.4	14 00.0	13 02.3	12 04.5	12 06.7	14 02.8	14 05.5
17 00.1	16 03.2	15 12.6	17 09.4	14 18.7	16 15.1	16 17.7	15 20.0	14 22.2	15 00.4	16 20.5	16 23.2
19 17.8	18 20.9	18 06.4	20 03.2	17 12.4	19 08.8	19 11.3	18 13.6	17 15.8	17 18.0	19 14.2	19 16.9
22 11.6	21 14.7	21 00.1	22 20.9	20 06.1	22 02.5	22 05.0	21 07.3	20 09.5	20 11.7	22 07.9	22 10.6
25 05.3	24 08.4	23 17.8	25 14.6	22 23.8	24 20.2	24 22.7	24 00.9	23 03.1	23 05.4	25 01.5	25 04.3
27 23.0	27 02.2	26 11.6	28 08.3	25 17.5	27 13.9	27 16.3	26 18.6	25 20.8	25 23.0	27 19.2	27 22.0
30 16.8		29 05.3		28 11.2	30 07.6	30 10.0	29 12.2	28 14.4	28 16.7	30 12.9	30 15.7
		31 23.0		31 04.9					31 10.4		

TETHYS Mean Synodic Period 1d 21.3h

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h
1 02.3	2 05.0	2 12.9	1 18.3	1 23.5	1 04.6	1 09.6	2 11.7	1 16.4	1 21.0	1 01.8	1 06.7
2 23.6	4 02.3	4 10.3	3 15.6	3 20.8	3 01.9	3 06.9	4 09.0	3 13.6	3 18.3	2 23.1	3 04.0
4 21.0	5 23.6	6 07.6	5 12.9	5 18.1	4 23.2	5 04.2	6 06.3	5 10.9	5 15.6	4 20.4	5 01.4
6 18.3	7 20.9	8 05.0	7 10.3	7 15.5	6 20.5	7 01.5	8 03.6	7 08.2	7 12.9	6 17.7	6 22.7
8 15.6	9 18.3	10 02.3	9 07.6	9 12.8	8 17.9	8 22.8	10 00.9	9 05.5	9 10.2	8 15.0	8 20.0
10 13.0	11 15.6	11 23.6	11 04.9	11 10.1	10 15.2	10 20.1	11 22.1	11 02.8	11 07.5	10 12.3	10 17.3
12 10.3	13 12.9	13 20.9	13 02.2	13 07.4	12 12.5	12 17.4	13 19.4	13 00.1	13 04.8	12 09.6	12 14.6
14 07.6	15 10.3	15 18.3	14 23.6	15 04.7	14 09.8	14 14.7	15 16.7	14 21.4	15 02.1	14 06.9	14 11.9
16 05.0	17 07.6	17 15.6	16 20.9	17 02.1	16 07.1	16 12.0	17 14.0	16 18.7	16 23.4	16 04.2	16 09.3
18 02.3	19 05.0	19 12.9	18 18.2	18 23.4	18 04.4	18 09.3	19 11.3	18 16.0	18 20.7	18 01.5	18 06.6
19 23.6	21 02.3	21 10.3	20 15.5	20 20.7	20 01.7	20 06.6	21 08.6	20 13.3	20 18.0	19 22.9	20 03.9
21 20.9	22 23.6	23 07.6	22 12.9	22 18.0	21 23.0	22 03.9	23 05.9	22 10.6	22 15.3	21 20.2	22 01.2
23 18.3	24 20.9	25 04.9	24 10.2	24 15.3	23 20.3	24 01.2	25 03.2	24 07.8	24 12.6	23 17.5	23 22.6
25 15.6	26 18.3	27 02.3	26 07.5	26 12.7	25 17.7	25 22.5	27 00.5	26 05.1	26 09.9	25 14.8	25 19.9
27 12.9	28 15.6	28 23.6	28 04.8	28 10.0	27 15.0	27 19.8	28 21.8	28 02.4	28 07.2	27 12.1	27 17.2
29 10.3		30 20.9	30 02.2	30 07.3	29 12.3	29 17.1	30 19.1	29 23.7	30 04.5	29 09.4	29 14.5
31 07.6						31 14.4					31 11.9

ENCELADUS Mean Synodic Period 1d 8.9h

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h	d hh.h
1 20.2	1 00.0	1 18.9	2 07.5	1 02.3	1 14.8	1 18.3	2 06.6	1 09.9	1 13.2	2 01.4	2 04.9
3 05.1	2 08.9	3 03.8	3 16.4	2 11.2	2 23.7	3 03.2	3 15.4	2 18.7	2 22.0	3 10.3	3 13.8
4 14.0	3 17.8	4 12.7	5 01.3	3 20.1	4 08.6	4 12.1	5 00.3	4 03.6	4 06.9	4 19.2	4 22.7
5 22.9	5 02.7	5 21.6	6 10.2	5 05.0	5 17.5	5 21.0	6 09.2	5 12.5	5 15.8	6 04.1	6 07.6
7 07.8	6 11.6	7 06.5	7 19.1	6 13.9	7 02.4	7 05.8	7 18.1	6 21.4	7 00.7	7 12.9	7 16.5
8 16.7	7 20.5	8 15.4	9 04.0	7 22.8	8 11.3	8 14.7	9 03.0	8 06.2	8 09.5	8 21.8	9 01.4
10 01.6	9 05.4	10 00.3	10 12.9	9 07.7	9 20.1	9 23.6	10 11.8	9 15.1	9 18.4	10 06.7	10 10.3
11 10.5	10 14.3	11 09.2	11 21.8	10 16.6	11 05.0	11 08.5	11 20.7	11 00.0	11 03.3	11 15.6	11 19.2
12 19.4	11 23.2	12 18.1	13 06.7	12 01.5	12 13.9	12 17.4	13 05.6	12 08.9	12 12.2	13 00.5	13 04.1
14 04.3	13 08.1	14 03.0	14 15.6	13 10.4	13 22.8	14 02.2	14 14.5	13 17.7	13 21.1	14 09.4	14 12.9
15 13.2	14 17.0	15 11.9	16 00.5	14 19.3	15 07.7	15 11.1	15 23.3	15 02.6	15 05.9	15 18.3	15 21.8
16 22.1	16 01.9	16 20.8	17 09.4	16 04.1	16 16.6	16 20.0	17 08.2	16 11.5	16 14.8	17 03.1	17 06.7
18 07.0	17 10.8	18 05.7	18 18.3	17 13.0	18 01.5	18 04.9	18 17.1	17 20.4	17 23.7	18 12.0	18 15.6
19 15.9	18 19.7	19 14.6	20 03.2	18 21.9	19 10.4	19 13.8	20 02.0	19 05.3	19 08.6	19 20.9	20 00.5
21 00.8	20 04.6	20 23.4	21 12.1	20 06.8	20 19.2	20 22.7	21 10.8	20 14.1	20 17.5	21 05.8	21 09.4
22 09.7	21 13.5	22 08.4	22 21.0	21 15.7	22 04.1	22 07.5	22 19.7	21 23.0	22 02.4	22 14.7	22 18.3
23 18.6	22 22.4	23 17.2	24 05.9	23 00.6	23 13.0	23 16.4	24 04.6	23 07.9	23 11.2	23 23.6	24 03.2
25 03.5	24 07.3	25 02.1	25 14.8	24 09.5	24 21.9	25 01.3	25 13.5	24 16.8	24 20.1	25 08.5	25 12.1
26 12.4	25 16.2	26 11.0	26 23.6	25 18.4	26 06.8	26 10.2	26 22.4	26 01.6	26 05.0	26 17.4	26 21.0
27 21.3	27 01.1	27 19.9	28 08.5	27 03.3	27 15.7	27 19.0	28 07.2	27 10.5	27 13.9	28 02.3	28 05.9
29 06.2	28 10.0	29 04.8	29 17.4	28 12.2	29 00.5	29 03.9	29 16.1	28 19.4	28 22.8	29 11.1	29 14.8
30 15.1		30 13.7		29 21.0	30 09.4	30 12.8	31 01.0	30 04.3	30 07.6	30 20.0	30 23.7
		31 22.6		31 05.9		31 21.7			31 16.5		

URANUS, NEPTUNE AND PLUTO

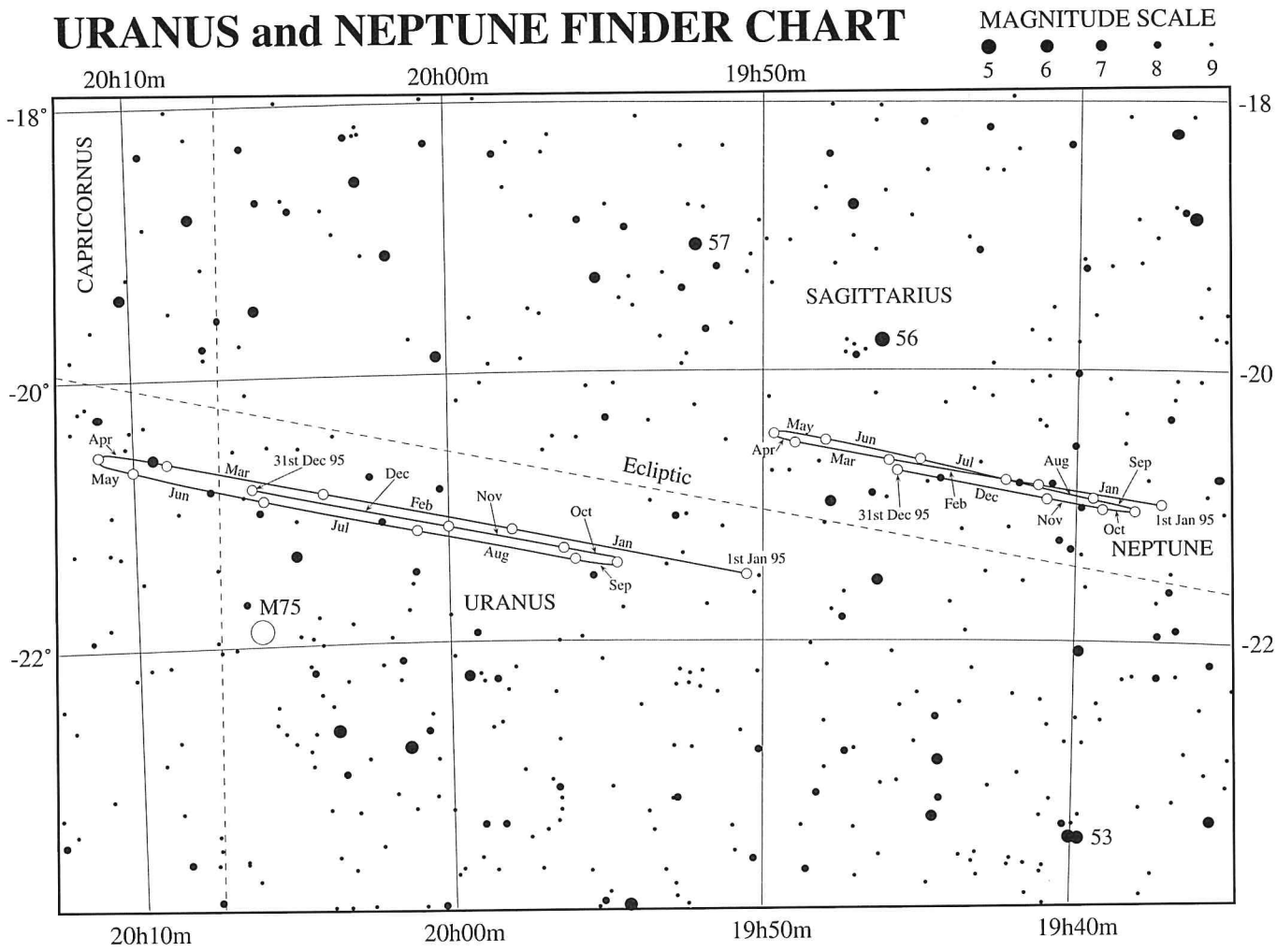
RISE AND SET TIMES

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

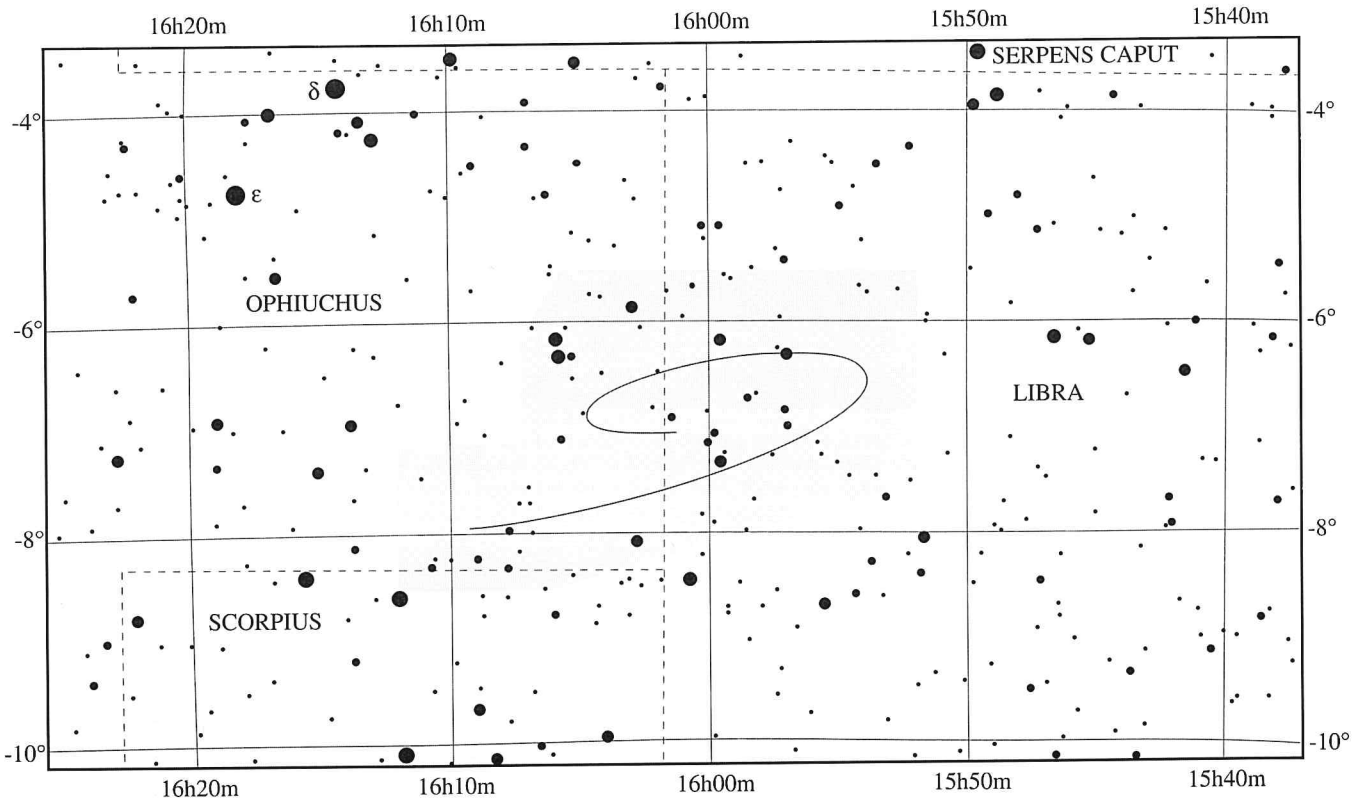
POSITION (0hr UT Epoch 2000.0)

URANUS RA h m s	URANUS DEC ° ' "	NEPTUNE RA h m s	NEPTUNE DEC ° ' "	PLUTO RA h m s	PLUTO DEC ° ' "
19 51 56	- 21 27 19	19 38 21	- 20 57 33	16 01 44	- 07 02 28
19 53 40	- 21 22 42	19 39 28	- 20 54 58	16 02 31	- 07 02 56
19 55 24	- 21 18 01	19 40 35	- 20 52 22	16 03 14	- 07 02 53
19 57 08	- 21 13 19	19 41 41	- 20 49 45	16 03 51	- 07 02 21
19 58 50	- 21 08 39	19 42 46	- 20 47 09	16 04 23	- 07 01 21
20 00 29	- 21 04 05	19 43 48	- 20 44 36	16 04 48	- 06 59 54
20 02 05	- 20 59 39	19 44 48	- 20 42 09	16 05 07	- 06 58 03
20 03 35	- 20 55 24	19 45 43	- 20 39 49	16 05 19	- 06 55 50
20 05 00	- 20 51 25	19 46 34	- 20 37 38	16 05 24	- 06 53 18
20 06 18	- 20 47 44	19 47 21	- 20 35 38	16 05 23	- 06 50 30
20 07 28	- 20 44 24	19 48 02	- 20 33 51	16 05 15	- 06 47 30
20 08 31	- 20 41 27	19 48 37	- 20 32 17	16 05 01	- 06 44 21
20 09 25	- 20 38 56	19 49 06	- 20 30 59	16 04 41	- 06 41 07
20 10 09	- 20 36 54	19 49 28	- 20 29 58	16 04 16	- 06 37 52
20 10 44	- 20 35 22	19 49 44	- 20 29 13	16 03 46	- 06 34 40
20 11 08	- 20 34 20	19 49 53	- 20 28 46	16 03 11	- 06 31 35
20 11 23	- 20 33 50	19 49 55	- 20 28 37	16 02 33	- 06 28 40
20 11 27	- 20 33 52	19 49 50	- 20 28 46	16 01 52	- 06 25 59
20 11 21	- 20 34 25	19 49 39	- 20 29 12	16 01 08	- 06 23 36
20 11 05	- 20 35 28	19 49 22	- 20 29 55	16 00 24	- 06 21 34
20 10 39	- 20 37 01	19 48 58	- 20 30 54	15 59 39	- 06 19 55
20 10 05	- 20 39 00	19 48 29	- 20 32 08	15 58 54	- 06 18 41
20 09 22	- 20 41 23	19 47 56	- 20 33 34	15 58 11	- 06 17 55
20 08 32	- 20 44 07	19 47 18	- 20 35 12	15 57 30	- 06 17 38
20 07 35	- 20 47 08	19 46 36	- 20 36 59	15 56 51	- 06 17 52
20 06 33	- 20 50 23	19 45 52	- 20 38 53	15 56 17	- 06 18 36
20 05 27	- 20 53 47	19 45 05	- 20 40 53	15 55 46	- 06 19 51
20 04 18	- 20 57 16	19 44 18	- 20 42 56	15 55 20	- 06 21 36
20 03 07	- 21 00 45	19 43 30	- 20 44 59	15 54 59	- 06 23 51
20 01 57	- 21 04 12	19 42 43	- 20 47 02	15 54 44	- 06 26 34
20 00 48	- 21 07 30	19 41 57	- 20 49 00	15 54 34	- 06 29 43
19 59 42	- 21 10 37	19 41 14	- 20 50 53	15 54 31	- 06 33 18
19 58 40	- 21 13 29	19 40 33	- 20 52 39	15 54 34	- 06 37 14
19 57 43	- 21 16 04	19 39 57	- 20 54 16	15 54 44	- 06 41 30
19 56 53	- 21 18 17	19 39 25	- 20 55 42	15 55 00	- 06 46 04
19 56 11	- 21 20 07	19 38 59	- 20 56 55	15 55 22	- 06 50 51
19 55 37	- 21 21 33	19 38 38	- 20 57 56	15 55 50	- 06 55 49
19 55 12	- 21 22 32	19 38 23	- 20 58 42	15 56 24	- 07 00 55
19 54 57	- 21 23 03	19 38 15	- 20 59 13	15 57 03	- 07 06 04
19 54 53	- 21 23 06	19 38 14	- 20 59 28	15 57 47	- 07 11 15
19 54 59	- 21 22 40	19 38 19	- 20 59 27	15 58 36	- 07 16 22
19 55 15	- 21 21 46	19 38 32	- 20 59 10	15 59 29	- 07 21 24
19 55 42	- 21 20 22	19 38 51	- 20 58 36	16 00 25	- 07 26 17
19 56 20	- 21 18 31	19 39 17	- 20 57 46	16 01 25	- 07 30 58
19 57 07	- 21 16 12	19 39 50	- 20 56 40	16 02 26	- 07 35 23
19 58 03	- 21 13 27	19 40 28	- 20 55 18	16 03 29	- 07 39 31
19 59 08	- 21 10 17	19 41 12	- 20 53 42	16 04 33	- 07 43 18
20 00 21	- 21 06 43	19 42 02	- 20 51 51	16 05 37	- 07 46 42
20 01 42	- 21 02 48	19 42 56	- 20 49 48	16 06 41	- 07 49 41
20 03 08	- 20 58 33	19 43 54	- 20 47 34	16 07 43	- 07 52 14
20 04 40	- 20 54 00	19 44 55	- 20 45 08	16 08 43	- 07 54 20
20 06 16	- 20 49 12	19 45 59	- 20 42 35	16 09 40	- 07 55 57

URANUS and NEPTUNE FINDER CHART

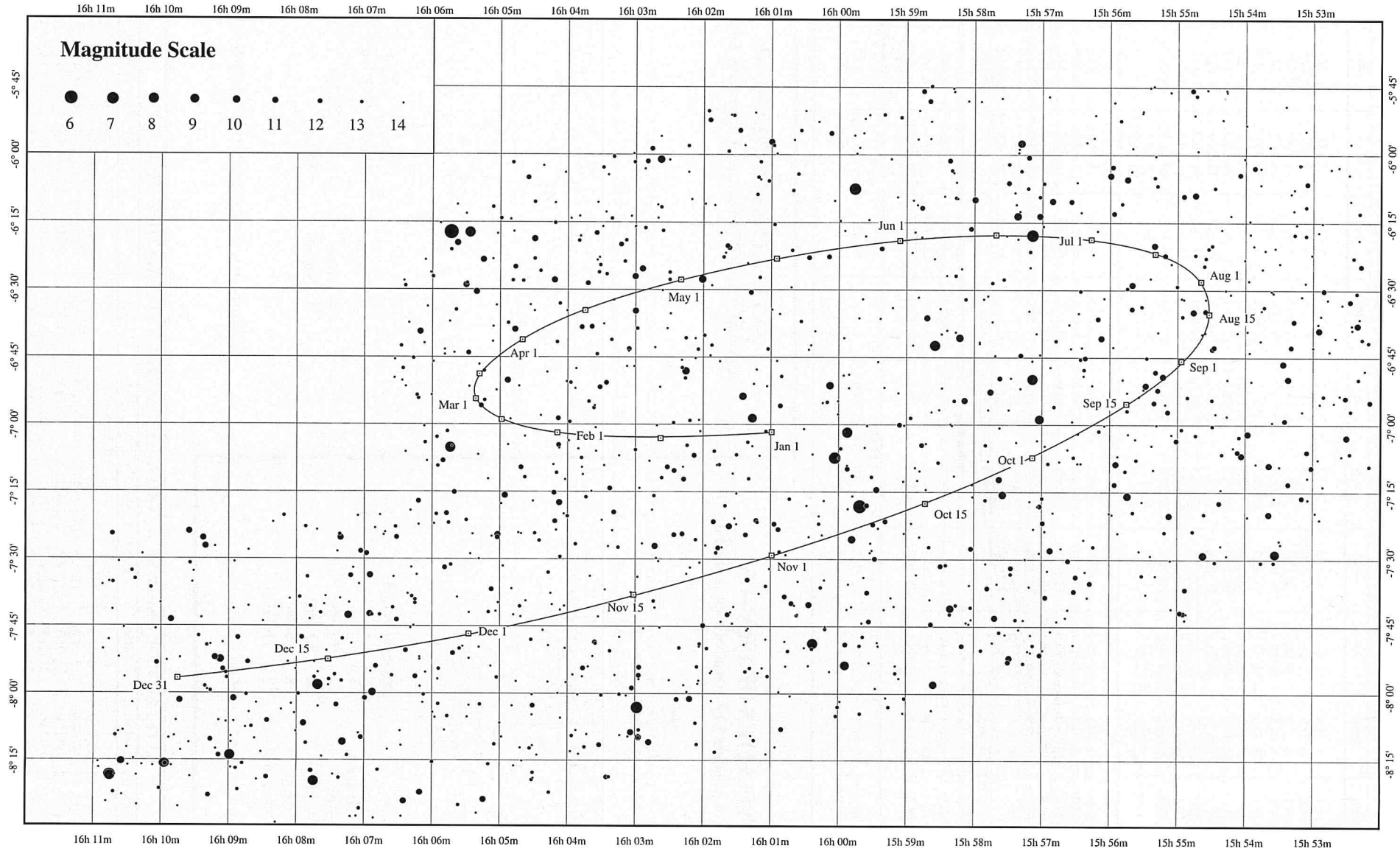


PLUTO POINTER CHART



See introduction to part 2 (page 53) for explanation

PLUTO FINDER CHART 1995 Epoch 2000.0



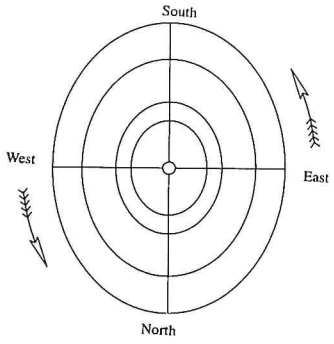
See introduction to part 2 (page 53) for explanation

SATELLITES OF URANUS — GREATEST NORTHERN ELONGATION (W.A.S.T.)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
					ARIEL						
2 12.4	1 18.1	1 11.4	3 05.7	3 11.5	2 17.3	2 23.1	2 05.1	1 11.0	1 17.0	3 11.4	1 04.8
5 00.9	4 06.6	3 23.9	5 18.1	5 23.9	5 05.8	5 11.6	4 17.6	3 23.5	4 05.5	5 23.8	3 17.3
7 13.4	6 19.1	6 12.4	8 06.7	8 12.4	7 18.3	8 00.1	7 06.1	6 12.0	6 18.0	8 12.4	6 05.8
10 01.8	9 07.6	9 00.8	10 19.1	11 00.9	10 06.7	10 12.6	9 18.6	9 00.5	9 06.5	11 00.8	8 18.3
12 14.3	11 20.1	11 13.3	13 07.6	13 13.4	12 19.2	13 01.1	12 07.1	11 13.0	11 19.0	13 13.3	11 06.8
15 02.8	14 08.6	14 01.8	15 20.1	16 01.8	15 07.7	15 13.6	14 19.6	14 01.5	14 07.5	16 01.8	13 19.2
17 15.3	16 21.0	16 14.3	18 08.6	18 14.3	17 20.2	18 02.1	17 08.1	16 14.0	16 20.0	18 14.3	16 07.7
20 03.7	19 09.5	19 02.7	20 21.1	21 02.8	20 08.7	20 14.6	19 20.6	19 02.5	19 08.4	21 02.8	18 20.2
22 16.2	21 22.0	21 15.2	23 09.5	23 15.3	22 21.2	23 03.1	22 09.0	21 15.0	21 20.9	23 15.3	21 08.7
25 04.7	24 10.5	24 03.7	25 22.0	26 03.8	25 09.7	25 15.5	24 21.5	24 03.5	24 09.4	26 03.8	23 21.2
27 17.2	26 23.0	26 16.2	28 10.5	28 16.3	27 22.1	28 04.1	27 10.0	26 16.0	26 21.9	28 16.3	26 09.6
30 05.7		29 04.7	30 23.0	31 04.8	30 10.7	30 16.6	29 22.5	29 04.5	29 10.4		28 22.1
		31 17.1							31 22.9		31 10.6
					UMBRIEL						
2 20.1	4 23.6	1 20.1	3 23.7	2 23.9	1 00.1	4 03.6	2 04.1	4 08.0	3 08.1	1 08.4	4 12.0
6 23.6	9 03.0	5 23.5	8 03.1	7 03.4	5 03.5	8 07.1	6 07.6	8 11.4	7 11.8	5 11.9	8 15.5
11 03.0	13 06.4	10 03.0	12 06.6	11 06.8	9 06.9	12 10.6	10 10.9	12 14.9	11 15.2	9 15.3	12 18.9
15 06.4	17 09.8	14 06.5	16 10.1	15 10.2	13 10.3	16 14.1	14 14.4	16 18.4	15 18.6	13 18.8	16 22.4
19 09.8	21 13.3	18 09.9	20 13.5	19 13.8	17 13.9	20 17.5	18 18.0	20 21.9	19 22.0	17 22.2	21 01.9
23 13.4	25 16.7	22 13.3	24 17.0	23 17.2	21 17.3	24 21.0	22 21.5	25 01.3	24 01.5	22 01.7	25 05.4
27 16.8		26 16.7	28 20.4	27 20.6	25 20.7	29 00.5	27 01.0	29 04.7	28 04.9	26 05.2	29 08.9
31 20.2		30 20.2			30 00.2		31 04.5			30 08.7	
					TITANIA						
4 04.0	7 23.5	6 02.1	1 04.6	6 00.1	1 02.9	5 23.0	1 02.0	4 22.0	1 00.8	4 20.7	9 16.4
12 20.9	16 16.4	14 19.0	9 21.5	14 17.1	9 20.0	14 16.0	9 19.0	13 14.9	9 17.8	13 13.6	18 09.2
21 13.7	25 09.1	23 11.8	18 14.4	23 10.0	18 12.9	23 09.0	18 12.0	22 07.9	18 10.7	22 06.5	27 02.1
30 06.6			27 07.2		27 05.9		27 05.0		27 03.7	30 23.5	
					OBERON						
1 04.5	10 13.0	9 10.7	5 08.6	2 07.0	11 16.3	8 14.6	4 13.2	13 23.0	10 21.6	6 19.5	3 17.3
14 15.3	24 00.0	22 21.6	18 19.7	15 18.1	25 03.4	22 02.0	18 00.4	27 10.4	24 08.6	20 06.5	17 04.4
28 02.2				29 05.1			31 11.8				30 15.3

SATELLITES OF URANUS

Apparent orbit of Satellites I-IV at date of opposition, July 21

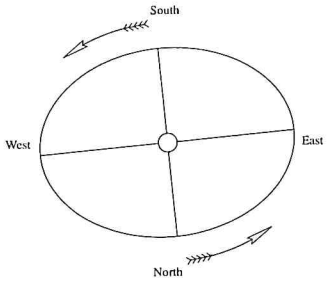


Name	Sidereal Period d	h
V Miranda	1.4	
I Ariel	2	12.489
II Umbriel	4	03.460
III Titania	8	16.941
IV Oberon	13	11.118

See introduction to part 2 (page 53) for explanation.

SATELLITES OF NEPTUNE

Apparent orbit of Triton at date of opposition, July 17



Name	Sidereal Period d	h
I Triton	5	21.044
II Nereid	360.2	

See introduction to part 2 (page 53) for explanation

SATELLITE OF NEPTUNE — GREATEST EASTERN ELONGATION (W.A.S.T.)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
					TRITON						
2 08.5	6 14.0	2 01.7	6 07.5	5 16.5	4 01.9	3 11.5	1 21.2	6 03.9	5 13.3	3 22.5	3 07.4
8 05.4	12 10.9	7 22.6	12 04.5	11 13.6	9 23.0	9 08.6	7 18.3	12 01.0	11 10.4	9 19.5	9 04.4
14 02.3	18 07.8	13 19.6	18 01.5	17 10.7	15 20.1	15 05.8	13 15.4	17 22.1	17 07.4	15 16.5	15 01.3
19 23.2	24 04.8	19 16.5	23 22.5	23 07.7	21 17.2	21 02.9	19 12.6	23 19.2	23 04.5	21 13.5	20 22.2
25 20.1		25 13.5	29 19.5	29 04.8	27 14.4	27 00.0	25 09.7	29 16.3	29 01.5	27 10.5	26 19.2
31 17.0		31 10.5					31 06.8				

COMETS FOR 1995

INTRODUCTION

WHAT IS A COMET? It is a member of the Solar System which is normally in a very eccentric orbit around the Sun. The orbits of the "periodic", or regularly reappearing, comets are quite elongated or "egg shaped" compared to those of the planets. They also differ from the planets by being far less massive and mainly composed of water, in the form of ice, and dust. A common analogy is a "dirty snowball" (admittedly a number of kilometres in diameter). The time a periodic comet takes to orbit the Sun varies greatly from comet to comet. The comet with the shortest period takes just over 3 years to orbit the Sun. There are also a number of comets that are not expected to return for hundreds of years. Each year sees the discovery of around 10 to 20 new comets that have not been recorded before. The majority of these have either open ended orbits (ie. they are believed to be making their only visit to the Solar System and are not expected to ever return) or have extremely long orbital periods, in the thousands of years.

As the comet draws closer to the Sun, the nucleus or snowball, heats up and the ice evaporates forming a cloud, called a "Coma", around the core. The coma can be tens of thousands of kilometres in diameter. The solar radiation or wind, on its outward journey from the Sun, sweeps the coma cloud away forming the "tail" of the comet. The lost material from the coma will continue to be replenished from the nucleus as long as the comet stays close to the Sun. Comets are normally named after their discoverers (up to the first three to report the find).

It is true that there is no such thing as a "typical comet". Like people, they are all slightly different. The orbits, the overall brightness, the size of the coma and the tail can vary dramatically from comet to comet. To watch one brighten, develop a tail and then fade away, over a period of a few weeks, can be a fascinating experience.

This section is devoted to the "periodic" comets, that are expected to return during 1995 (or late 1994 in the case of Borrelly). The table (opposite) lists these objects as well as their orbital elements (the data required to calculate their locations in the sky). This is followed by "ephemerides" (a list of expected positions in the sky and magnitude estimates for different dates) for some of the brighter comets. These tables of positions/ magnitudes are only approximates, for none of these comets (as of early September 94) had been found yet on this return. Hence the orbital elements and magnitude parameters, used to generate the ephemerides, have been based on their behaviour on previous returns. There are also non gravitational effects, associated with comets, which can render predicted ephemerides inaccurate.

Many of the comets expected in 1995 are extremely faint and would require professional size telescopes or long exposure astrophotographs to detect them. But who knows what new discoveries lie in the future!

NOTES ON SELECTED BRIGHT COMETS FOR 1995

P/ BORRELLY In early November 1994, the comet is near maximum brightness (mag. 7) and in the constellation of Gemini. In November it rises around midnight in the NE sky and is visible until dawn. The first half of the month is a good time to look for Borrelly, for there will be no interference from the Moon. The comet moves rapidly north, through Cancer and into Lynx in early December. In mid December it crosses into Ursa Major and by Christmas (at magn 8), Borrelly is lost over the northern horizon to observers in mid southern latitudes.

P/ HONDA-MAKOS-PAJDUSAKOVA. In November 1995 the comet is in Sagittarius. At the start of the month it is in the western evening sky, setting around 11pm. On November 22 the comet passes less than 1° from 2nd mag. Sigma Sgr. By the end of November it is setting around 10pm and has reached mag. 11. During December, the comet has a number of interesting conjunctions (see Diary of Events) as it moves into the western evening twilight sky. Around the time of perihelion (Dec. 25), the comet has reached its brightest (mag. 7) but unfortunately it is no longer visible in "dark" skies. The comet goes into conjunction with the sun and is not visible again until the end of January 1996, when it reappears in the eastern morning sky. At that time it is rising around 3am in the constellation of Ophiuchus, still at mag. 8. The comet passes within 2° of M10 on Feb. 1 and 2° from M5 (in Serpens) on Feb. 8. The comet fades rapidly to mag. 13 by the end of February.

P/ D'ARREST. By early June this comet rises at 10pm, in Delphinus, and is visible for the remainder of the night. On June 24, d'Arrest is less than 0.5° from Epsilon Peg. It moves slowly southeast, gradually rising earlier each day. On August 1, at maximum brightness of mag. 10.8 (perihelion was in late July), it will be located 2° above Saturn in Aquarius, rising at 9pm. By early September the comet has moved into Sculptor and is visible the whole night (rising at 6pm). d'Arrest remains in this inconspicuous constellation until the end of November. During this period the comet rapidly fades from view.

P/ JACKSON-NEUJMIN. In early June this comet is in Aquarius (about 10° from the comet d'Arrest), rising around 10pm. In the following months the comet continues to rise earlier. By August it will be rising at 6pm, being visible the whole night. On August 14 it passes within 0.5° of the globular cluster M2 in Aquarius. Jackson-Neujmin heads south and after a brief visit to Capricornus, the comet spends its brightest period (ie. the later half of September & first two weeks in October) back in Aquarius. Perihelion is in early October and it is still visible most of the night (setting at 5am). At the end of September it passes within 2° of the Helix nebula. Early December, the comet moves into Cetus, where it remains for the rest of the year. At the end of December the comet, now only mag. 15, is setting at 2am.

P/ CLARK. (not really one of your spectacular comets) In early April the comet, still only 14th magnitude, is embedded in the Sagittarius nebula/star clusters, rising around 10pm. The comet moves slowly to the southeast, rising earlier each night. In mid April, it makes a close approach to the globular "M22". At perihelion (May 31), Clark, still in Sagittarius, is rising at 8pm and visible the remainder of the night. In June it reaches maximum brightness (if you can call mag. 12 bright?). In mid June the comet moves into Microscopium (rising at 7pm) and remains there until the end of October. The comet remains visible the whole night until the end of September as it continues to fade.

P/ SCHWASSMANN-WACHMANN 3. (Like Clark, this also is not exactly bright) In early August, the comet (at only mag. 14) is a western evening object in the constellation of Virgo . It sets around 8.30pm during August and by the end of September it is setting at 9.30pm. In September, SW3 passes close to both Spica and Mars; in mid October Antares gets a visit (see Diary of events). Perihelion is in late September, when it reaches its maximum mag. of a dismal 12.2. In early October, SW3 moves into Scorpius where it remains for the rest of the year. By the end of October the comet is now setting at 11pm. In late Oct./ early Nov. this fading visitor becomes lost in the star clusters of Scorpius and Sagittarius.

P/ TUTTLE-GIACOBINI-KRESAK. At the start of June this faint comet (at this time mag. 14) is in the NW evening sky in Gemini (setting at 8pm). The comet remains in the NW evening sky, setting around 8pm, until the end of July. In early June, the comet moves into Cancer and then into Leo at the beginning of July. It passes within 1° of 3rd mag. Eta Leonis on July 12. At the start of August (now at maximum brightness of only mag. 12; perihelion was in late July) it passes into Virgo, setting at 8.30pm. In August, the comet makes a few interesting conjunctions with some of Leo's galaxies. In mid September the comet (now setting at 9.30pm) moves into Libra and stays there until early October as it fades out of sight.

EXPLANATION OF COMET ELEMENTS TABLE

Comet Name The prefix "P/" is the common practice used to indicate a comet is a periodic.

Perihelion Date. Date of closest approach to the Sun (UT).

q The perihelion distance, in AU (Astronomical units)

e The eccentricity of the comet's orbit. Values less than one indicate an elliptical orbit ie. a known periodic. NB. a value equal to one (or greater) would indicate an open orbit which means either it is a once only visit to the solar system or it has a very long period (hundreds of years) or the comet is newly discovered and astronomers have not clearly defined its orbit.

Period The comet's period in years. The time it takes to complete one orbit.

ω Argument of Perihelion. The angle from the ascending node to perihelion (measured in the plane of the comet's orbit in the direction of motion of the comet).

Ω Longitude of Ascending Node. The point of intersection between the plane of the comet's orbit and the plane of the earth's orbit (Ecliptic) as the comet moves north.

i Inclination. Angle between the plane of the comet's orbit and the plane of the Ecliptic. If the value is greater than 90°, the comets direction of orbit is retrograde ie. moving in the opposite direction to the planets.

H1 The absolute total magnitude of the comet, which is the theoretical brightness of the comet if it was one AU from the Sun and the Earth.

K1 A constant used in calculating the comet's total magnitude (see "explanation of comet ephemerides" for further details)

The mathematics used to calculate the ephemerides from these elements is complex (but not impossible, considering the power of home computers) but is beyond the scope of this publication.

EXPLANATION OF COMET EPHEMERIDES

DATE: is for 0 hr UT or 8am W.A.S.T. of date.

R.A, DEC Right Ascension and Declination are for equinox 2000.

Δ (delta) is the geocentric distance (The distance from the Earth) in AU.

R is the heliocentric distance (distance from the Sun) in AU .

MAG. This is the expected total magnitude of the comet. The value is only an estimate and for periodic comets it is invariably based on its brightness at its previous return(s).

The estimate of total magnitude is normally calculated using the formula:

$$MAG. = H1 + 5. \log (D) + K1. \log R.$$

See the table of elements for the values of H1 and K1. For many comets the K1 value is equal to 10. For newly discovered comets the value of "K1" is nearly always assumed to be equal to 10 until its light curve can be studied in detail. The brightness of a comet is often very uncertain; especially for those newly discovered. Comets have also been known to suddenly flare up or fade away and some have even shown a different behaviour in their light curve (changed values for "H1" and "K1") after perihelion compared to before. There are also constants of H2 and K2 used by astronomers which refer to the absolute magnitude and the K constant for the nucleus of the comet. These are not used in this publication.

COMETS FOR 1995 — ORBITAL ELEMENTS (EQUINOX 2000.0)

Comet Name	Perihelion Date yy mm d.dd	q A.U.	e	Period years	ω deg	Ω deg	i deg	H1	K1
P/ Borrelly	94 Nov. 01.49226	1.3651154	0.6228036	6.88	353.35863	075.42389	030.27061	4.5	25.0
P/ de Vico-Swift	95 Apr. 09.46602	2.1454496	0.4306808	7.32	001.92895	359.01752	006.09606	10.0	15.0
P/ Finlay	95 May 05.04180	1.0355636	0.7103059	6.76	323.54016	042.04801	003.67392	12.0	10.0
P/ Clark	95 May 31.24486	1.5525026	0.5020687	5.51	208.84473	059.72130	009.50346	10.5	15.0
P/ d'Arrest	95 Jul. 27.36197	1.3458686	0.6140404	6.51	178.05038	138.98743	019.52321	7.5	40.0
P/ Tuttle-Giacobini-Kresák	95 Jul. 28.64687	1.0652223	0.6564085	5.46	061.70144	141.49644	009.22475	10.0	40.0
P/ Reinmuth 1	95 Sep. 03.31665	1.8736009	0.5024910	7.31	013.28787	119.74122	008.12915	9.0	15.0
P/ Schwassmann-Wachmann 3	95 Sep. 22.75715	0.9327753	0.6948374	5.34	198.77446	069.94644	011.42302	12.0	15.0
P/ Jackson-Neujmin	95 Oct. 06.61876	1.3811252	0.6614285	8.24	200.34697	160.71768	013.47785	11.0	15.0
P/ Longmore	95 Oct. 09.32015	2.3989695	0.3430595	6.98	195.79735	015.65588	024.40989	11.0	10.0
P/ Perrine-Mrkos	95 Dec. 06.04814	1.2929296	0.6385838	6.77	166.54182	240.62933	017.83227	11.5	20.0
P/ Honda-Mrkos-Pajdusáková	95 Dec. 25.92969	0.5319294	0.8243020	5.27	326.06051	089.16686	004.25050	13.5	20.0
P/ Churyumov-Gerasimenko	96 Jan. 17.66177	1.3000348	0.6301925	6.59	011.38678	051.00616	007.11334	11.0	10.0

P/ Honda-Mrkos-Pajdusakova

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1995 Nov 4	18 09.8	- 25 50	1.437	1.122	15.3
1995 Nov 11	18 25.8	- 25 49	1.379	1.022	14.4
1995 Nov 18	18 43.6	- 25 39	1.307	0.921	13.4
1995 Nov 25	19 03.1	- 25 20	1.221	0.821	12.2
1995 Dec 2	19 24.0	- 24 47	1.119	0.726	11.0
1995 Dec 9	19 45.6	- 23 59	0.999	0.640	9.6
1995 Dec 16	20 06.2	- 22 55	0.864	0.572	8.3
1995 Dec 23	20 22.5	- 21 40	0.718	0.536	7.4
1995 Dec 30	20 29.8	- 20 25	0.573	0.539	6.9
1996 Jan 6	20 23.4	- 19 11	0.442	0.581	7.0
1996 Jan 13	19 59.4	- 17 44	0.335	0.653	7.4
1996 Jan 20	19 14.3	- 15 18	0.252	0.741	7.9
1996 Jan 27	18 03.9	- 10 33	0.196	0.837	8.4
1996 Feb 3	16 29.7	- 02 32	0.171	0.937	9.1
1996 Feb 10	14 51.0	+ 06 26	0.180	1.038	10.1
1996 Feb 17	13 31.0	+ 12 42	0.220	1.138	11.3
1996 Feb 24	12 34.7	+ 15 58	0.280	1.236	12.6
1996 Mar 2	11 56.8	+ 17 24	0.355	1.332	13.7
1996 Mar 9	11 31.4	+ 17 53	0.442	1.426	14.8
1996 Mar 16	11 14.4	+ 17 51	0.540	1.518	15.8

P/Schwassmann-Wachmann 3

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1995 Jul 22	11 11.0	+ 12 19	1.778	1.288	14.9
1995 Jul 29	11 28.2	+ 09 46	1.741	1.226	14.5
1995 Aug 5	11 46.5	+ 07 00	1.700	1.167	14.2
1995 Aug 12	12 05.9	+ 04 00	1.656	1.112	13.8
1995 Aug 19	12 26.5	+ 00 47	1.609	1.062	13.4
1995 Aug 26	12 48.6	- 02 40	1.560	1.018	13.1
1995 Sep 2	13 12.2	- 06 18	1.512	0.982	12.8
1995 Sep 9	13 37.7	- 10 05	1.464	0.955	12.5
1995 Sep 16	14 05.2	- 13 58	1.420	0.938	12.3
1995 Sep 23	14 35.0	- 17 50	1.380	0.933	12.2
1995 Sep 30	15 07.5	- 21 33	1.348	0.939	12.2
1995 Oct 7	15 42.6	- 24 57	1.325	0.956	12.3
1995 Oct 14	16 20.3	- 27 53	1.313	0.984	12.5
1995 Oct 21	17 00.0	- 30 09	1.314	1.021	12.7
1995 Oct 28	17 41.1	- 31 37	1.328	1.065	13.0
1995 Nov 4	18 22.2	- 32 16	1.356	1.116	13.4
1995 Nov 11	19 02.1	- 32 05	1.398	1.171	13.8
1995 Nov 18	19 39.7	- 31 13	1.453	1.230	14.2
1995 Nov 25	20 14.6	- 29 47	1.520	1.292	14.6

COMETS

P/Clark

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1995 Mar 11	17 03.7	- 19 03	1.369	1.737	14.8
1995 Mar 18	17 20.6	- 19 57	1.285	1.709	14.5
1995 Mar 25	17 37.7	- 20 50	1.206	1.683	14.3
1995 Apr 1	17 54.8	- 21 43	1.131	1.658	14.1
1995 Apr 8	18 11.9	- 22 35	1.060	1.636	13.8
1995 Apr 15	18 28.9	- 23 28	0.994	1.616	13.6
1995 Apr 22	18 45.6	- 24 23	0.933	1.599	13.4
1995 Apr 29	19 02.0	- 25 21	0.877	1.584	13.2
1995 May 6	19 17.9	- 26 23	0.826	1.572	13.0
1995 May 13	19 32.9	- 27 30	0.780	1.563	12.9
1995 May 20	19 47.0	- 28 43	0.739	1.556	12.7
1995 May 27	19 59.9	- 30 02	0.703	1.553	12.6
1995 Jun 3	20 11.2	- 31 28	0.673	1.553	12.5
1995 Jun 10	20 20.8	- 32 58	0.649	1.555	12.4
1995 Jun 17	20 28.3	- 34 32	0.631	1.561	12.4
1995 Jun 24	20 33.6	- 36 06	0.619	1.570	12.4
1995 Jul 1	20 36.7	- 37 35	0.614	1.581	12.4
1995 Jul 8	20 37.6	- 38 54	0.616	1.595	12.5
1995 Jul 15	20 36.9	- 39 58	0.626	1.612	12.6
1995 Jul 22	20 34.9	- 40 43	0.643	1.632	12.7
1995 Jul 29	20 32.4	- 41 06	0.668	1.653	12.9
1995 Aug 5	20 30.1	- 41 07	0.701	1.677	13.1
1995 Aug 12	20 28.5	- 40 47	0.742	1.703	13.3
1995 Aug 19	20 28.2	- 40 10	0.791	1.731	13.6
1995 Aug 26	20 29.2	- 39 18	0.847	1.760	13.8
1995 Sep 2	20 31.8	- 38 15	0.910	1.791	14.1
1995 Sep 9	20 35.8	- 37 04	0.980	1.823	14.4
1995 Sep 16	20 41.0	- 35 46	1.057	1.857	14.7
1995 Sep 23	20 47.4	- 34 25	1.139	1.891	14.9

P/d'Arrest

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1995 May 20	20 15.9	+ 07 38	0.907	1.554	14.9
1995 May 27	20 32.4	+ 08 32	0.836	1.517	14.4
1995 Jun 3	20 49.4	+ 09 14	0.769	1.483	13.8
1995 Jun 10	21 07.0	+ 09 40	0.707	1.452	13.2
1995 Jun 17	21 25.3	+ 09 45	0.650	1.424	12.7
1995 Jun 24	21 44.3	+ 09 21	0.597	1.400	12.2
1995 Jul 1	22 04.0	+ 08 23	0.549	1.380	11.8
1995 Jul 8	22 24.2	+ 06 44	0.507	1.365	11.4
1995 Jul 15	22 44.7	+ 04 18	0.472	1.354	11.1
1995 Jul 22	23 05.3	+ 01 02	0.443	1.347	10.9
1995 Jul 29	23 25.3	- 03 00	0.422	1.346	10.8
1995 Aug 5	23 44.1	- 07 41	0.410	1.350	10.8
1995 Aug 12	00 01.1	- 12 42	0.407	1.358	10.9
1995 Aug 19	00 15.8	- 17 43	0.413	1.371	11.1
1995 Aug 26	00 27.7	- 22 24	0.428	1.389	11.4
1995 Sep 2	00 36.6	- 26 30	0.452	1.411	11.8
1995 Sep 9	00 42.8	- 29 49	0.483	1.437	12.2
1995 Sep 16	00 46.5	- 32 18	0.521	1.466	12.7
1995 Sep 23	00 48.4	- 33 58	0.565	1.499	13.3
1995 Sep 30	00 48.9	- 34 52	0.615	1.534	13.9
1995 Oct 7	00 49.0	- 35 05	0.671	1.572	14.5

P/Tuttle-Giacobini-Kresak

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1995 Jun 17	08 33.7	+ 20 40	1.782	1.200	14.4
1995 Jun 24	08 58.5	+ 19 44	1.751	1.161	13.8
1995 Jul 1	09 24.2	+ 18 30	1.720	1.128	13.3
1995 Jul 8	09 50.8	+ 17 00	1.690	1.101	12.8
1995 Jul 15	10 18.1	+ 15 11	1.662	1.081	12.5
1995 Jul 22	10 45.9	+ 13 05	1.638	1.069	12.2
1995 Jul 29	11 14.1	+ 10 44	1.618	1.065	12.1
1995 Aug 5	11 42.7	+ 08 10	1.605	1.070	12.2
1995 Aug 12	12 11.4	+ 05 25	1.599	1.083	12.4
1995 Aug 19	12 40.2	+ 02 33	1.602	1.103	12.7
1995 Aug 26	13 08.8	- 00 20	1.614	1.131	13.2
1995 Sep 2	13 37.3	- 03 12	1.636	1.165	13.7
1995 Sep 9	14 05.4	- 05 56	1.668	1.205	14.3

P/Jackson-Neujmin

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1995 Jun 3	20 43.8	- 00 25	1.291	1.975	16.0
1995 Jun 10	20 51.1	+ 00 33	1.187	1.924	15.6
1995 Jun 17	20 57.9	+ 01 26	1.088	1.874	15.3
1995 Jun 24	21 04.0	+ 02 13	0.995	1.825	14.9
1995 Jul 1	21 09.6	+ 02 51	0.908	1.778	14.5
1995 Jul 8	21 14.4	+ 03 16	0.827	1.731	14.2
1995 Jul 15	21 18.7	+ 03 24	0.752	1.686	13.8
1995 Jul 22	21 22.3	+ 03 11	0.684	1.643	13.4
1995 Jul 29	21 25.4	+ 02 32	0.624	1.602	13.0
1995 Aug 5	21 28.3	+ 01 22	0.571	1.564	12.7
1995 Aug 12	21 31.1	- 00 22	0.526	1.528	12.4
1995 Aug 19	21 34.2	- 02 42	0.489	1.495	12.1
1995 Aug 26	21 38.2	- 05 34	0.461	1.466	11.8
1995 Sep 2	21 43.4	- 08 51	0.442	1.441	11.6
1995 Sep 9	21 50.5	- 12 21	0.431	1.420	11.5
1995 Sep 16	21 59.6	- 15 49	0.429	1.403	11.4
1995 Sep 23	22 10.9	- 18 59	0.435	1.391	11.3
1995 Sep 30	22 24.4	- 21 37	0.449	1.383	11.4
1995 Oct 7	22 39.6	- 23 36	0.469	1.381	11.5
1995 Oct 14	22 56.2	- 24 51	0.496	1.384	11.6
1995 Oct 21	23 13.6	- 25 23	0.528	1.392	11.8
1995 Oct 28	23 31.3	- 25 16	0.567	1.404	12.0
1995 Nov 4	23 49.0	- 24 34	0.610	1.422	12.2
1995 Nov 11	00 06.3	- 23 24	0.660	1.443	12.5
1995 Nov 18	00 23.1	- 21 52	0.714	1.469	12.8
1995 Nov 25	00 39.3	- 20 02	0.774	1.499	13.1
1995 Dec 2	00 54.9	- 18 01	0.839	1.532	13.4
1995 Dec 9	01 10.1	- 15 52	0.910	1.568	13.7
1995 Dec 16	01 24.8	- 13 39	0.987	1.606	14.1
1995 Dec 23	01 39.1	- 11 25	1.069	1.648	14.4
1995 Dec 30	01 53.1	- 09 12	1.157	1.691	14.7
1996 Jan 6	02 06.9	- 07 02	1.250	1.736	15.1
1996 Jan 13	02 20.5	- 04 56	1.348	1.783	15.4
1996 Jan 20	02 33.9	- 02 55	1.451	1.831	15.7
1996 Jan 27	02 47.2	- 01 00	1.558	1.880	16.1
1996 Feb 3	03 00.4	+ 00 48	1.669	1.930	16.4
1996 Feb 10	03 13.5	+ 02 30	1.784	1.980	16.7

P/Borrelly

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1994 Oct 15	06 55.6	+ 06 07	0.844	1.380	7.6
1994 Oct 22	07 13.8	+ 09 19	0.793	1.371	7.4
1994 Oct 29	07 32.1	+ 12 59	0.746	1.366	7.2
1994 Nov 5	07 50.4	+ 17 09	0.704	1.366	7.1
1994 Nov 12	08 08.6	+ 21 51	0.670	1.371	7.1
1994 Nov 19	08 26.6	+ 27 01	0.644	1.380	7.0
1994 Nov 26	08 44.1	+ 32 33	0.626	1.394	7.1
1994 Dec 3	09 00.8	+ 38 16	0.618	1.413	7.2
1994 Dec 10	09 16.3	+ 43 57	0.621	1.436	7.4
1994 Dec 17	09 29.9	+ 49 22	0.633	1.462	7.6
1994 Dec 24	09 41.0	+ 54 20	0.655	1.492	7.9
1994 Dec 31	09 48.7	+ 58 40	0.685	1.525	8.3
1995 Jan 7	09 52.5	+ 62 17	0.724	1.561	8.6
1995 Jan 14	09 51.9	+ 65 08	0.769	1.600	9.0
1995 Jan 21	09 47.1	+ 67 11	0.821	1.640	9.4
1995 Jan 28	09 39.1	+ 68 28	0.879	1.683	9.9
1995 Feb 4	09 29.5	+ 69 01	0.942	1.727	10.3
1995 Feb 11	09 20.4	+ 68 56	1.010	1.773	10.7
1995 Feb 18	09 13.3	+ 68 18	1.082	1.819	11.2
1995 Feb 25	09 08.8	+ 67 14	1.159	1.867	11.6
1995 Mar 4	09 07.3	+ 65 51	1.240	1.915	12.0
1995 Mar 11	09 08.4	+ 64 13	1.326	1.965	12.4
1995 Mar 18	09 11.8	+ 62 25	1.416	2.014	12.9
1995 Mar 25	09 16.9	+ 60 30	1.509	2.064	13.3
1995 Apr 1	09 23.3	+ 58 29	1.607	2.114	13.7
1995 Apr 8	09 30.8	+ 56 26	1.708	2.164	14.0
1995 Apr 15	09 39.0	+ 54 22	1.812	2.215	14.4
1995 Apr 22	09 47.7	+ 52 17	1.920	2.265	14.8
1995 Apr 29	09 56.8	+ 50 12	2.030	2.315	15.2
1995 May 6	10 06.1	+ 48 08	2.142	2.366	15.5
1995 May 13	10 15.6	+ 46 05	2.257	2.416	15.8

METEOR SHOWERS

In addition to the meteor showers listed in the accompanying tables, an average of about 5 to 10 sporadic meteors (originating from random points in the sky) are visible per hour under moonless dark sky conditions. More meteors are visible in the early morning sky than in the evening, and more during the latter half of the year.

Meteor showers occur when the Earth encounters large numbers of meteoroids moving together in the same orbit, in many cases these orbits can be identified with the orbits of comets. A group of meteoroids moving in such an orbit is known as a meteor stream and the visible manifestation in the Earth's atmosphere is known as a meteor shower. Due to perspective the meteors associated with showers appear to radiate from a focal point in the sky known as the radiant. The radiants are named after the constellation in which they appear and or after a bright star near the radiant.

If a very bright fireball is seen or photographed, the information should be reported immediately to your nearest astronomical society. If any sounds are heard accompanying the fireball, there is a possibility that some fragments may have reached the ground. If observers from several locations report accurate details on the fireball's path, astronomers may be able to track down the meteorite by triangulation and information provided by local witnesses in the suspected fall area.

DEFINITIONS: A meteoroid is a small solid particle moving through space in orbit about the Sun. A meteoroid striking the Earth's atmosphere and heated to incandescence is known as a meteor, or a fireball if negative magnitudes are reached. If the meteor is large enough to survive the trip through the atmosphere and falls to Earth it is known as a meteorite.

TABLE 2 - Virginid complex radiant centre motion.

Date	R.A.	Dec.	Date	R.A.	Dec.	Date	R.A.	Dec.	Date	R.A.	Dec.
Feb 03	159°	+ 15°	Mar 05	182°	+ 01°	Apr 04	200°	- 06°	May 04	211°	- 11°
13	167°	+ 09°	15	189°	- 02°	14	204°	- 08°	14	214°	- 12°
23	174°	+ 05°	25	195°	- 04°	24	208°	- 09°	24	217°	- 13°

TABLE 3 - Scorpid/Sagittarid complex radiant centre motion.

Date	R.A.	Dec.	Date	R.A.	Dec.	Date	R.A.	Dec.	Date	R.A.	Dec.
Apr 15	224°	- 18°	May 05	236°	- 25°	Jun 04	260°	- 30°	Jul 04	288°	- 27°
25	230°	- 22°	15	243°	- 27°	14	269°	- 30°	14	297°	- 24°
			25	251°	- 29°	24	279°	- 28°	24	306°	- 20°

TABLE 4 - Radiant drifts for the Alpha Capricornids, Delta Aquarids (S & N), Iota Aquarids (S & N), and the Perseids.

	Alpha Cap		Delta Aqr S		Delta Aqr N		Iota Aqr S		Iota Aqr N		Perseids	
Date	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
Jul 05	290°	-14°	321°	-21°								
15	296°	-13°	329°	-19°	316°	-10°	311°	-18°			012°	+51°
25	303°	-11°	337°	-17°	323°	-09°	322°	-17°			023°	+54°
Aug 05	312°	-09°	345°	-14°	332°	-06°	334°	-15°			037°	+57°
15	318°	-06°	352°	-12°	339°	-04°	345°	-13°	322°	-07°	050°	+59°
25	324°	-04°			347°	-02°	355°	-11°	332°	-05°	065°	+60°
Sep 05							343°	-03°				
15							353°	-02°				

TABLE 5 - Puppid/Velid complex radiant centre motion.

Date	R.A.	Dec.	Date	R.A.	Dec.	Date	R.A.	Dec.	Date	R.A.	Dec.
			Oct 10	107°	-44°	Nov 10	116°	-44°	Dec 10	132°	-44°
			20	110°	-44°	20	120°	-44°	20	137°	-44°
Sep 30	104°	-44°	30	113°	-44°	30	126°	-44°	30	141°	-44°

TABLE 6 - Radiant positions for the Taurids South and North.

TAURIDS S						TAURIDS N					
Date	R.A.	Dec.	Date	R.A.	Dec.	Date	R.A.	Dec.	Date	R.A.	Dec.
Sep 15	011°	+ 01°	Oct 30	047°	+ 13°	Sep 15	008°	+ 06°	Oct 30	047°	+ 20°
20	015°	+ 02°	Nov 10	056°	+ 15°	20	012°	+ 07°	Nov 10	058°	+ 22°
30	023°	+ 05°	20	064°	+ 16°	30	021°	+ 11°	20	067°	+ 24°
Oct 10	031°	+ 08°	25	069°	+ 17°	Oct 10	029°	+ 14°	25	072°	+ 24°
20	039°	+ 11°				20	038°	+ 17°			

NOTES ON TABLE 1. (opposite)

SHOWER: Name given to shower, associated with the constellation and or bright star that the radiant appears near. (n)* after shower name refer to notes below.

(1)* Major components of the Puppid/Velid complex.

(2)* Periodic shower producing listed rates only in certain years, at other times the activity may be much lower.

(3)* Major components of the Scorpid/Sagittarid complex.

MOON PHASE: Moon phase nearest date of maximum activity (this should not rule out all chance of observation as the Moon may be below the horizon when the radiant is at or near culmination.

ACTIVITY DURATION: Approximate dates when shower is active.

MAX ACTIVITY: Date when maximum activity can be expected.

RADIANT, R.A. & Dec: Position of shower radiant (R.A. is expressed in degrees). These co-ordinates refer to the radiant position on date of maximum activity.

DIA: Radiant diameter, when two figures are given the first is the spread in R.A. and the second the spread in Dec.

DRIFT, R.A. & Dec: Indicates the change in R.A. & Dec per day and compensates for the eastward drift of the radiant. These factors should be applied to dates either side of the radiant position given for maximum activity.

VEL km/s: Speed of encounter with the atmosphere.

ZHR: Zenith Hourly Rate, a theoretical rate assuming the radiant to be at the zenith with a sky limiting magnitude of 6.5 (perfect conditions).

METEOR SHOWERS - TABLE 1

SHOWER		MOON PHASE	ACTIVITY DURATION	MAX ACT	RADIANT		DIA	DRIFT		VEL	ZHR
					R.A.	Dec		R.A.	Dec	km/s	
Quadrantids		NM	Jan 01-Jan 05	Jan 03	230°	+49°	5°	+0.8°	-0.2°	41	110
Pi Puppids II	(1)*	FQ	Jan 06-Jan 14	Jan 10	113°	-43°	5°	+0.4°	-0.2°	35	
Delta Cancrids		FM	Jan 05-Jan 24	Jan 17	130°	+20°	10°-5°	+0.9°	-0.1°	28	5
Alpha Crucids		FM	Jan 06-Jan 28	Jan 19	192°	-63°	10°-5°	+1.1°	-0.2°	50	5
Lambda Velids II	(1)*	LQ	Jan 18-Jan 26	Jan 21	133°	-46°	5°	+0.7°	-0.2°	35	
Alpha Carinids		NM	Jan 24-Feb 09	Jan 31	095°	-54°	5°			25	
Virginids			Feb 01-May 30	Several	See table 2		15°-10°	See table 2		30	5
Theta Centaurids		NM	Jan 23-Mar 12	Feb 01	210°	-40°	6°	+1.1°	-0.2°	60	
Alpha Centaurids	(2)*	FQ	Jan 28-Feb 21	Feb 07	210°	-59°	4°	+1.2°	-0.3°	56	25
Omicron Centaurids		FM	Jan 31-Feb 19	Feb 11	177°	-56°	6°	+1.0°	-0.3°	51	
Delta Leonids		FM	Feb 05-Mar 19	Feb 15	159°	+19°	8°	+0.9°	-0.3°	23	3
Gamma Normids		FM	Feb 25-Mar 22	Mar 14	249°	-51°	5°	+1.1°	+0.1°	56	8
Beta Pavonids		FQ	Mar 11-Apr 16	Apr 07	308°	-63°	10°-15°	+1.2°	+0.1°	59	13
Scorpid/Sagittarids			Apr 15-Jul 25	Several	See table 2		15°-10°	See table 3		30	10
Lyrids	(2)*	LQ	Apr 16-Apr 25	Apr 22	271°	+34°	5°	+1.1°	+0.0°	49	90
Pi Puppids	(2)*	LQ	Apr 15-Apr 28	Apr 23	110°	-45°	5°	+0.6°	-0.2°	18	40
Alpha Bootids		NM	Apr 14-May 12	Apr 27	218°	+19°	8°	+0.9°	-0.1°	20	3
Eta Aquarids		FQ	Apr 19-May 28	May 03	336°	-02°	4°	+0.9°	+0.4°	66	50
Alpha Scorpids	(3)*	FQ	Mar 26-May 12	May 03	240°	-27°	5°	+0.9°	-0.1°	35	10
Ophiuchids N	(3)*	FQ	Apr 25-May 31	May 10	249°	-14°	5°	+0.9°	-0.1°	30	
Beta Corona Australids	(3)*	FM	Apr 23-May 30	May 15	284°	-40°	5°	+0.9°	-0.1°	45	
Kappa Scorpids	(3)*	LQ	May 04-May 27	May 19	267°	-39°	5°	+0.9°	+0.0°	45	
Ophiuchids S	(3)*	LQ	May 13-May 26	May 20	258°	-24°	5°	+0.9°	-0.1°	30	
Omega Scorpids	(3)*	FQ	May 23-Jun 15	Jun 04	243°	-22°	5°	+0.9°	-0.1°	23	
Chi Scorpids	(3)*	FQ	May 24-Jun 20	Jun 05	248°	-14°	6°	+0.9°	-0.1°	21	
Gamma Sagittarids	(3)*	FQ	May 22-Jun 13	Jun 06	272°	-28°	6°	+0.9°	+0.0°	29	
Theta Ophiuchids	(3)*	FM	Jun 04-Jul 15	Jun 13	267°	-20°	5°	+0.9°	+0.0°	27	
Lyrids (Jun)		LQ	Jun 11-Jun 21	Jun 16	278°	+35°	5°	+0.8°	+0.0°	31	5
Bootids (Jun)		NM	Jun 26-Jun 30	Jun 28	219°	+49°	8°			14	2
Lambda Sagittarids	(3)*	NM	Jun 05-Jul 25	Jul 01	276°	-25°	6°	+0.9°	+0.0°	23	
Pegasids		FM	Jul 07-Jul 11	Jul 10	340°	+15°	5°	+0.8°	+0.2°	70	8
Phoenicids (Jul)		LQ	Jun 24-Jul 18	Jul 15	021°	-43°	7°	+1.0°	+0.2°	47	
Piscis Austrinids		NM	Jul 09-Aug 17	Jul 29	341°	-30°	5°	+1.0°	+0.2°	35	8
Delta Aquarids S		NM	Jul 08-Aug 19	Jul 29	339°	-16°	5°	See table 4		41	20
Alpha Capricornids		NM	Jul 03-Aug 25	Jul 30	307°	-10°	8°	See table 4		23	8
Iota Aquarids S		FQ	Jul 15-Aug 25	Aug 04	333°	-15°	5°	See table 4		34	3
Delta Aquarids N		FM	Jul 15-Aug 25	Aug 12	337°	-05°	5°	See table 4		42	5
Perseids		FM	Jul 17-Aug 24	Aug 12	046°	+58°	5°	See table 4		59	95
Kappa Cygnids		LQ	Aug 03-Aug 31	Aug 19	286°	+59°	6°			25	5
Iota Aquarids N		LQ	Aug 11-Sep 20	Aug 20	327°	-06°	5°	See table 4		31	3
Pi Eridanids		FQ	Aug 20-Sep 05	Aug 29	052°	-15°	6°	+0.8°	+0.2°	59	
Alpha Aurigids		FQ	Aug 24-Sep 05	Sep 01	084°	+42°	5°	+1.1°	+0.0°	66	15
Delta Aurigids		FM	Sep 05-Oct 10	Sep 09	060°	+47°	5°	+1.0°	+0.1°	64	7
Piscids S		LQ	Aug 15-Oct 14	Sep 20	008°	+00°	8°	+0.9°	+0.2°	26	3
Kappa Aquarids		NM	Sep 08-Sep 30	Sep 21	339°	-02°	5°	+1.0°	+0.2°	16	3
Puppid/Velids			Sep 28-Dec 30	several	See table 5		10°	See table 5		41	
Capricornids (Oct)		FQ	Sep 20-Oct 14	Oct 03	303°	-10°	5°	+0.8°	+0.2°	15	3
Sigma Orionids		FM	Sep 10-Oct 26	Oct 05	086°	-03°	5°	+1.2°	+0.0°	65	3
Draconids	(2)*	FM	Oct 06-Oct 10	Oct 10	262°	+54°	5°			20	storm
Epsilon Geminids		LQ	Oct 14-Oct 27	Oct 20	104°	+27°	5°	+1.0°	+0.0°	71	5
Orionids		NM	Oct 02-Nov 07	Oct 22	095°	+16°	10°	+1.2°	+0.1°	66	25
Taurids S		FQ	Sep 15-Nov 25	Nov 03	050°	+14°	10°-5°	See table 6		27	10
Taurids N		LQ	Sep 13-Nov 25	Nov 13	060°	+23°	10°-5°	See table 6		29	8
Leonids	(2)*	LQ	Nov 14-Nov 21	Nov 18	152°	+22°	5°	+0.7°	-0.4°	71	storm
Alpha Monocerotids		NM	Nov 15-Nov 25	Nov 21	117°	-06°	5°	+1.1°	-0.1°	60	5
Chi Orionids		FQ	Nov 26-Dec 15	Dec 02	082°	+23°	8°	+1.2°	+0.0°	28	3
Phoenicids (Dec)	(2)*	FM	Nov 28-Dec 09	Dec 06	018°	-53°	5°	+0.8°	+0.1°	18	100
Sigma Puppids II	(1)*	FM	Nov 27-Dec 12	Dec 06	102°	-45°	5°	+0.3°	+0.1°	38	
Monocerotids (Dec)		FM	Nov 27-Dec 17	Dec 10	100°	+14°	5°	+1.2°	+0.0°	42	5
Sigma Hydrids		LQ	Dec 03-Dec 15	Dec 11	127°	+02°	5°	+0.7°	-0.2°	58	5
Geminids		LQ	Dec 07-Dec 17	Dec 14	112°	+33°	4°	+1.0°	-0.1°	35	110
Coma Berenicids		NM	Dec 12-Jan 23	Dec 19	175°	+25°	5°	+0.8°	-0.2°	65	5
Ursids	(2)*	NM	Dec 17-Dec 26	Dec 23	217°	+75°	5°			33	50
Tau Puppids	(1)*	NM	Dec 19-Dec 30	Dec 23	104°	-50°	5°	+0.2°	-0.1°	33	

MINOR PLANET POSITIONS (0hr UT, Epoch 2000.0)

	1 CERES			2 PALLAS			3 JUNO			4 VESTA			06 HEBE		
	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.
Jan 7	09 42.4	+26 10	7.3	03 15.9	-27 12	8.5	16 50.3	-12 19	11.5	05 59.1	+21 52	6.6	19 08.9	-16 49	10.4
14	09 39.0	+27 08	7.2	03 17.5	-25 51	8.5	16 59.2	-12 21	11.5	05 52.3	+22 12	6.8	19 23.3	-16 40	10.4
21	09 34.3	+28 07	7.0	03 20.5	-24 22	8.6	17 08.0	-12 20	11.5	05 46.8	+22 30	6.9	19 37.8	-16 26	10.4
28	09 28.5	+29 04	6.9	03 24.8	-22 46	8.6	17 16.5	-12 16	11.5	05 42.6	+22 49	7.1	19 52.4	-16 07	10.4
Feb 4	09 22.1	+29 55	6.9	03 30.4	-21 07	8.7	17 24.7	-12 08	11.5	05 40.0	+23 06	7.2	20 07.0	-15 43	10.5
11	09 15.5	+30 39	6.9	03 37.1	-19 24	8.7	17 32.5	-11 57	11.5	05 39.0	+23 23	7.3	20 21.6	-15 15	10.5
18	09 09.1	+31 11	7.1	03 44.8	-17 40	8.8	17 39.9	-11 42	11.4	05 39.6	+23 39	7.5	20 36.1	-14 43	10.5
25	09 03.4	+31 33	7.2	03 53.5	-15 56	8.8	17 46.8	-11 24	11.4	05 41.7	+23 55	7.6	20 50.7	-14 06	10.5
Mar 4	08 58.7	+31 44	7.3	04 03.0	-14 13	8.8	17 53.2	-11 03	11.3	05 45.2	+24 09	7.7	21 05.2	-13 26	10.5
11	08 55.3	+31 43	7.5	04 13.4	-12 31	8.9	17 59.0	-10 40	11.3	05 50.0	+24 23	7.8	21 19.6	-12 43	10.5
18	08 53.4	+31 33	7.6	04 24.4	-10 52	8.9	18 04.1	-10 14	11.2	05 55.9	+24 35	7.9	21 33.9	-11 57	10.5
25	08 52.9	+31 15	7.8	04 36.1	-09 17	8.9	18 08.5	-09 46	11.1	06 02.9	+24 46	8.0	21 48.2	-11 09	10.5
Apr 1	08 54.0	+30 49	7.9	04 48.4	-07 45	8.9	18 12.2	-09 16	11.1	06 10.8	+24 54	8.0	22 02.4	-10 19	10.4
8	08 56.4	+30 18	8.0	05 01.2	-06 18	8.9	18 14.9	-08 44	11.0	06 19.5	+25 00	8.1	22 16.5	-09 28	10.4
15	09 00.1	+29 41	8.1	05 14.5	-04 56	9.0	18 16.7	-08 12	10.9	06 28.9	+25 03	8.1	22 30.5	-08 35	10.4
22	09 04.9	+28 59	8.2	05 28.2	-03 39	9.0	18 17.6	-07 40	10.8	06 38.9	+25 02	8.2	22 44.5	-07 43	10.3
29	09 10.8	+28 13	8.3	05 42.3	-02 29	9.0	18 17.4	-07 08	10.7	06 49.5	+24 59	8.2	22 58.3	-06 51	10.3
May 6	09 17.5	+27 24	8.4	05 56.7	-01 24	9.0	18 16.2	-06 37	10.6	07 00.6	+24 52	8.3	23 12.0	-06 00	10.2
13	09 25.0	+26 31	8.5	06 11.4	-00 27	9.0	18 13.9	-06 08	10.5	07 12.1	+24 40	8.3	23 25.7	-05 10	10.2
20	09 33.1	+25 35	8.5	06 26.4	+00 24	9.0	18 10.6	-05 42	10.3	07 23.9	+24 25	8.3	23 39.2	-04 22	10.1
27	09 41.7	+24 36	8.6	06 41.5	+01 08	9.0	18 06.4	-05 20	10.2	07 36.0	+24 06	8.3	23 52.6	-03 38	10.1
Jun 3	09 50.8	+23 34	8.7	06 56.8	+01 45	9.0	18 01.5	-05 03	10.1	07 48.4	+23 43	8.3	00 05.8	-02 57	10.0
10	10 00.3	+22 29	8.7	07 12.1	+02 16	9.0	17 55.9	-04 51	10.0	08 00.9	+23 16	8.3	00 18.9	-02 20	9.9
17	10 10.2	+21 22	8.7	07 27.6	+02 39	9.0	17 49.9	-04 45	10.0	08 13.6	+22 44	8.3	00 31.8	-01 49	9.8
24	10 20.3	+20 13	8.8	07 43.0	+02 56	8.9	17 43.8	-04 45	10.0	08 26.4	+22 08	8.3	00 44.4	-01 23	9.7
Jul 1	10 30.6	+19 01	8.8	07 58.5	+03 07	8.9	17 37.8	-04 52	10.0	08 39.3	+21 29	8.3	00 56.8	-01 05	9.7
8	10 41.1	+17 47	8.8	08 13.9	+03 12	8.9	17 32.3	-05 05	10.1	08 52.2	+20 45	8.2	01 08.8	-00 54	9.6
15	10 51.7	+16 32	8.8	08 29.2	+03 11	8.9	17 27.3	-05 24	10.2	09 05.2	+19 58	8.2	01 20.4	-00 51	9.4
22	11 02.5	+15 15	8.8	08 44.5	+03 05	8.9	17 23.2	-05 48	10.3	09 18.2	+19 07	8.2	01 31.4	-00 59	9.3
29	11 13.4	+13 57	8.8	08 59.7	+02 54	8.8	17 20.0	-06 17	10.4	09 31.2	+18 13	8.1	01 41.9	-01 16	9.2
Aug 5	11 24.3	+12 37	8.8	09 14.7	+02 38	8.8	17 17.9	-06 48	10.4	09 44.2	+17 16	8.1	01 51.5	-01 45	9.1
12	11 35.4	+11 17	8.8	09 29.6	+02 19	8.8	17 16.9	-07 23	10.5	09 57.2	+16 16	8.0	02 00.3	-02 25	8.9
19	11 46.5	+09 56	8.8	09 44.4	+01 56	8.7	17 16.9	-07 59	10.6	10 10.1	+15 13	7.9	02 08.1	-03 17	8.8
26	11 57.7	+08 35	8.8	09 59.0	+01 30	8.7	17 18.0	-08 36	10.7	10 23.0	+14 08	7.9	02 14.7	-04 21	8.7
Sep 2	12 08.9	+07 13	8.7	10 13.5	+01 02	8.7	17 20.2	-09 13	10.8	10 35.9	+13 00	7.9	02 19.8	-05 36	8.5
9	12 20.2	+05 52	8.7	10 27.8	+00 31	8.8	17 23.3	-09 50	10.8	10 48.7	+11 51	8.0	02 23.5	-07 01	8.4
16	12 31.5	+04 31	8.6	10 42.0	+00 00	8.8	17 27.3	-10 27	10.9	11 01.5	+10 41	8.0	02 25.5	-08 34	8.2
23	12 42.8	+03 11	8.6	10 56.0	-00 33	8.9	17 32.3	-11 01	10.9	11 14.2	+09 29	8.0	02 25.8	-10 11	8.1
30	12 54.2	+01 52	8.5	11 09.8	-01 05	8.9	17 38.0	-11 34	11.0	11 26.9	+08 16	8.1	02 24.4	-11 48	8.0
Oct 7	13 05.7	+00 33	8.5	11 23.5	-01 38	9.0	17 44.4	-12 05	11.0	11 39.6	+07 03	8.1	02 21.5	-13 19	7.9
14	13 17.1	-00 43	8.5	11 37.0	-02 09	9.0	17 51.5	-12 33	11.0	11 52.2	+05 50	8.1	02 17.4	-14 39	7.8
21	13 28.6	-01 58	8.5	11 50.4	-02 39	9.1	17 59.3	-12 58	11.0	12 04.8	+04 37	8.1	02 12.3	-15 43	7.9
28	13 40.1	-03 11	8.6	12 03.6	-03 07	9.1	18 07.6	-13 21	11.1	12 17.3	+03 25	8.1	02 06.9	-16 27	7.9
Nov 4	13 51.6	-04 22	8.7	12 16.6	-03 33	9.1	18 16.4	-13 39	11.1	12 29.8	+02 14	8.1	02 01.7	-16 48	8.0
11	14 03.1	-05 31	8.7	12 29.4	-03 55	9.2	18 25.7	-13 54	11.1	12 42.3	+01 04	8.1	01 57.2	-16 46	8.1
18	14 14.6	-06 37	8.8	12 42.0	-04 13	9.2	18 35.4	-14 06	11.1	12 54.6	-00 04	8.1	01 53.7	-16 22	8.3
25	14 26.1	-07 39	8.8	12 54.3	-04 26	9.2	18 45.5	-14 13	11.0	13 06.9	-01 10	8.0	01 51.5	-15 38	8.4
Dec 2	14 37.4	-08 39	8.8	13 06.4	-04 34	9.2	18 55.9	-14 16	11.0	13 19.1	-02 13	8.0	01 50.8	-14 38	8.6
9	14 48.7	-09 36	8.9	13 18.2	-04 36	9.2	19 06.5	-14 16	11.0	13 31.2	-03 14	8.0	01 51.6	-13 24	8.8
16	14 59.9	-10 29	8.9	13 29.6	-04 32	9.2	19 17.5	-14 11	11.0	13 43.1	-04 11	7.9	01 53.9	-12 00	8.9
23	15 11.0	-11 18	8.9	13 40.7	-04 19	9.2	19 28.6	-14 01	10.9	13 54.9	-05 04	7.9	01 57.5	-10 28	9.1
30	15 21.9	-12 04	8.9	13 51.3	-03 59	9.2	19 39.9	-13 48	10.9	14 06.4	-05 53	7.8	02 02.4	-08 51	9.2

	07 IRIS			09 METIS			10 HYGIEA			13 EGERIA			16 PSYCHE		
	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.
Jan 7	20 03.4	-17 35	10.4	12 00.5	+07 47	10.4	17 41.2	-24 36	11.0	22 40.5	-20 25	12.4	22 18.7	-11 20	11.3
14	20 17.2	-16 47	10.3	12 03.9	+07 48	10.3	17 54.2	-24 36	11.0	22 50.2	-19 00	12.4	22 30.0	-10 19	11.3
21	20 31.0	-15 55	10.2	12 06.0	+07 58	10.2	18 07.0	-24 33	11.1	23 00.0	-17 34	12.3	22 41.4	-09 16	11.2
28	20 44.9	-14 58	10.1	12 06.6	+08 17	10.1	18 19.5	-24 25	11.1	23 10.0	-16 07	12.3	22 52.9	-08 09	11.2
Feb 4	20 58.8	-13 56	10.1	12 05.7	+08 45	9.9	18 31.9	-24 14	11.1	23 20.1	-14 39	12.3	23 04.6	-07 01	11.2
11	21 12.6	-12 50	10.1	12 03.3	+09 20	9.8	18 44.0	-23 59	11.1	23 30.3	-13 12	12.3	23 16.3	-05 50	11.2
18	21 26.5	-11 40	10.2	11 59.4	+10 01	9.6	18 55.7	-23 41	11.1	23 40.6	-11 44	12.2	23 28.1	-04 38	11.1
25	21 40.4	-10 27	10.2	11 54.3	+10 45	9.5	19 07.0	-23 21	11.1	23 51.0	-10 16	12.2	23 40.0	-03 25	11.1
Mar 4	21 54.2	-09 09	10.2	11 48.2	+11 30	9.3	19 18.0	-22 58	11.1	00 01.5	-08 48	12.1	23 52.0	-02 11	11.1
11	22 08.0	-07 48	10.3	11 41.5	+12 12	9.2	19 28.4	-22 33	11.1	00 11.9	-07 20	12.1	00 04.0	-00 56	11.0
18	22 21.8	-06 24	10.3	11 34.7	+12 48	9.3	19 38.4	-22 06	11.1	00 22.5	-05 53	12.0	00 16.0	+00 19	10.9
25	22 35.6	-04 57	10.3	11 28.2	+13 17	9.5	19 47.8	-21 39	11.1	00 33.0	-04 26	12.0	00 28.1	+01 33	10.8
Apr 1	22 49.3	-03 28	10.3	11 22.3	+13 35	9.7	19 56.6	-21 10	11.0	00 43.7	-03 00	12.0	00 40.2	+02 48	10.8
8	23 03.0	-01 56	10.3	11 17.5	+13 43	9.9	20 04.7	-20 42	11.0	00 54.3	-01 36	12.0	00 52.4	+04 01	10.9
15	23 16.8	-00 23	10.3	11 13.9	+13 41	10.0	20 12.2	-20 13	10.9	01 04.9	-00 12	12.0	01 04.5	+05 13	10.9
22	23 30.5	+01 12	10.2	11 11.7	+13 29	10.2	20 18.8	-19 46	10.9	01 15.6	+01 10	12.1	01 16.7	+06 24	11.0
29	23 44.3	+02 47	10.2	11 10.8	+13 08	10.4	20 24.6	-19 20	10.8	01 26.2	+02 31	12.1	01 28.9	+07 33	11.1
May 6	23 58.1	+04 23	10.2	11 11.2	+12 39	10.5	20 29.5	-18 56	10.7	01 36.9	+03 51	12.2	01 41.2	+08 40	11.1
13	00 11.9	+06 00	10.2	11 12.9	+12 03	10.7	20 33.4	-18 34	10.6	01 47.5	+05 09	12.2	01 53.4	+09 45	11.1
20	00 25.8	+07 36	10.1	11 15.7	+11 21	10.8	20 36.3	-18 16	10.5	01 58.2	+06 24	12.2	02 05.6	+10 47	11.2
27	00 39.7	+09 11	10.1	11 19.6	+10 34	10.9	20 38.1	-18 01	10.4	02 08.8	+07 38	12.2	02 17.8	+11 47	11.2
Jun 3	00 53.7	+10 46	10.0	11 24.3	+09 42	11.0	20 38.7	-17 49	10.3	02 19.3	+08 50	12.2	02 29.9	+12 43	11.2
10	01 07.8	+12 18	10.0	11 29.9	+08 46	11.1	20 38.1	-17 42	10.2	02 29.8	+10 00	12.2	02 42.0	+13 36	11.2
17	01 21.9	+13 49	9.9	11 36.1	+07 47	11.2	20 36.4	-17 39	10.1	02 40.3	+11 07	12.2	02 54.0	+14 25	11.2
24	01 36.1	+15 17	9.9	11 43.0	+06 45	11.3	20 33.5	-17 39	9.9	02 50.6	+12 12	12.2	03 05.9	+15 11	11.2
Jul 1	01 50.3	+16 42	9.8	11 50.4	+05 41	11.4	20 29.7	-17 43	9.8	03 00.8	+13 15	12.2	03 17.6	+15 53	11.2
8	02 04.6	+18 04	9.7	11 58.3	+04 34	11.5	20 24.9	-17 49	9.7	03 10.8	+14 16	12.1	03 29.2	+16 31	11.2
15	02 18.8	+19 21	9.7	12 06.6	+03 26	11.5	20 19.5	-17 58	9.5	03 20.6	+15 15	12.1	03 40.5	+17 05	11.2
22	02 32.9	+20 34	9.6	12 15.2	+02 16	11.6	20 13.8	-18 08	9.3	03 30.2	+16 11	12.1	03 51.6	+17 35	11.2
29	02 47.0	+21 42	9.5	12 24.2	+01 05	11.6	20 08.0	-18 18	9.4	03 39.5	+17 06	12.0	04 02.4	+18 01	11.2
Aug 5	03 00.9	+22 45	9.4	12 33.5	-00 07	11.7	20 02.4	-18 27	9.6	03 48.4	+17 59	12.0	04 12.8	+18 23	11.1
12	03 14.5	+23 42	9.3	12 43.1	-01 20	11.7	19 57.4	-18 36	9.8	03 57.0	+18 50	11.9	04 22.8	+18 41	11.1
19	03 27.7	+24 33	9.2	12 52.9	-02 32	11.7	19 53.2	-18 42	9.9	04 05.0	+19 40	11.8	04 32.3	+18 55	11.0
26	03 40.5	+25 18	9.1	13 03.0	-03 45	11.7	19 49.9	-18 47	10.1	04 12.4	+20 29	11.7	04 41.1	+19 06	11.0
Sep 2	03 52.6	+25 57	9.0	13 13.3	-04 58	11.7	19 47.7	-18 50	10.2	04 19.1	+21 18	11.6	04 49.3	+19 13	10.9
9	04 03.8	+26 29	8.9	13 23.7	-06 10	11.7	19 46.7	-18 50	10.4	04 24.9	+22 06	11.5	04 56.7	+19 17	10.8
16	04 14.2	+26 55	8.7	13 34.4	-07 22	11.7	19 46.9	-18 48	10.5	04 29.8	+22 54	11.4	05 03.2	+19 17	10.8
23	04 23.3	+27 14	8.6	13 45.3	-08 32	11.7	19 48.2	-18 44	10.6	04 33.7	+23 43	11.3	05 08.8	+19 16	10.7
30	04 31.0	+27 26	8.4	13 56.3	-09 42	11.7	19 50.6	-18 37	10.8	04 36.2	+24 33	11.2	05 13.2	+19 12	10.6
Oct 7	04 37.1	+27 32	8.3	14 07.5	-10 49	11.6	19 54.0	-18 28	10.9	04 37.4	+25 23	11.0	05 16.4	+19 06	10.5
14	04 41.3	+27 31	8.1	14 18.9	-11 56	11.6	19 58.3	-18 16	11.0	04 37.0	+26 15	10.9	05 18.3	+18 58	10.3
21	04 43.5	+27 22	7.9	14 30.4	-13 00	11.5	20 03.4	-18 01	11.1	04 35.0	+27 06	10.7	05 18.9	+18 49	10.2
28	04 43.6	+27 06	7.7	14 42.1	-14 01	11.5	20 09.3	-17 43	11.1	04 31.3	+27 57	10.5	05 18.0	+18 39	10.1
Nov 4	04 41.6	+26 42	7.5	14 53.9	-15 01	11.4	20 15.9	-17 22	11.2	04 25.9	+28 45	10.3	05 15.6	+18 29	10.0
11	04 37.7	+26 09	7.3	15 05.8	-15 58	11.3	20 23.0	-16 59	11.3	04 19.1	+29 30	10.2	05 12.0	+18 18	9.8
18	04 32.3	+25 29	7.1	15 17.8	-16 52	11.4	20 30.7	-16 32	11.3	04 11.1	+30 09	10.0	05 07.2	+18 07	9.7
25	04 25.8	+24 41	6.9	15 29.9	-17 42	11.5	20 38.7	-16 03	11.4	04 02.3	+30 41	9.9	05 01.4	+17 56	9.5
Dec 2	04 19.1	+23 49	6.8	15 42.0	-18 30	11.6	20 47.2	-15 30	11.4	03 53.3	+31 06	9.9	04 55.1	+17 46	9.4
9	04 12.8	+22 56	7.1	15 54.2	-19 14	11.6	20 56.0	-14 54	11.5	03 44.8	+31 23	10.1	04 48.6	+17 38	9.4
16	04 07.6	+22 05	7.4	16 06.4	-19 55	11.7	21 05.0	-14 16	11.5	03 37.2	+31 34	10.2	04 42.4	+17 31	9.6
23	04 03.8	+21 19	7.6	16 18.6	-20 33	11.7	21 14.2	-13 34	11.5	03 30.9	+31 41	10.4	04 36.7	+17 27	9.7
30	04 01.9	+20 40	7.8	16 30.7	-21 06	11.8	21 23.6	-12 50	11.5	03 26.4	+31 44	10.5	04 31.9	+17 26	9.9

See introduction to part 2 (page 53) for explanation

MINOR PLANET POSITIONS (0hr UT, Epoch 2000.0)

	18 MELPOMENE			19 FORTUNA			27 EURTERPE			29 AMPHITRITE			60 ECHO		
	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.	R.A. hr min	Dec. ° '	Mag.
Jan 7	18 09.8	- 16 53	11.4	08 19.5	+ 16 51	10.2	13 12.0	- 05 48	11.5	22 33.1	- 09 20	11.1	07 57.8	+ 13 33	10.1
14	18 23.9	- 16 51	11.4	08 12.4	+ 17 12	10.0	13 19.3	- 06 27	11.4	22 43.9	- 08 05	11.1	07 51.2	+ 13 52	10.0
21	18 38.0	- 16 44	11.4	08 05.0	+ 17 35	9.9	13 25.7	- 06 59	11.3	22 54.9	- 06 49	11.1	07 44.4	+ 14 16	10.0
28	18 52.2	- 16 32	11.4	07 57.7	+ 17 58	10.1	13 30.9	- 07 24	11.2	23 06.0	- 05 30	11.0	07 38.1	+ 14 44	10.2
Feb 4	19 06.3	- 16 15	11.4	07 51.1	+ 18 19	10.4	13 35.0	- 07 41	11.1	23 17.4	- 04 09	11.0	07 32.7	+ 15 13	10.4
11	19 20.4	- 15 53	11.4	07 45.5	+ 18 38	10.6	13 37.8	- 07 51	11.0	23 28.8	- 02 47	11.0	07 28.8	+ 15 42	10.6
18	19 34.5	- 15 27	11.4	07 41.3	+ 18 54	10.8	13 39.1	- 07 52	10.9	23 40.4	- 01 23	11.0	07 26.7	+ 16 09	10.7
25	19 48.5	- 14 56	11.4	07 38.6	+ 19 07	11.0	13 39.0	- 07 45	10.8	23 52.1	+ 00 02	10.9	07 26.3	+ 16 33	10.9
Mar 4	20 02.3	- 14 20	11.4	07 37.5	+ 19 16	11.2	13 37.3	- 07 29	10.6	00 03.9	+ 01 27	10.9	07 27.7	+ 16 54	11.1
11	20 16.1	- 13 41	11.3	07 37.9	+ 19 21	11.4	13 34.1	- 07 06	10.5	00 15.8	+ 02 53	10.9	07 30.9	+ 17 10	11.3
18	20 29.7	- 12 59	11.3	07 39.8	+ 19 23	11.5	13 29.6	- 06 35	10.3	00 27.7	+ 04 19	10.8	07 35.7	+ 17 21	11.5
25	20 43.1	- 12 13	11.2	07 43.0	+ 19 22	11.7	13 24.0	- 05 59	10.2	00 39.8	+ 05 44	10.7	07 41.9	+ 17 27	11.6
Apr 1	20 56.4	- 11 25	11.2	07 47.5	+ 19 17	11.8	13 17.6	- 05 20	10.0	00 52.0	+ 07 10	10.6	07 49.3	+ 17 28	11.8
8	21 09.4	- 10 34	11.1	07 52.9	+ 19 08	11.9	13 10.8	- 04 39	9.8	01 04.3	+ 08 34	10.5	07 57.8	+ 17 23	11.9
15	21 22.3	- 09 42	11.0	07 59.4	+ 18 55	12.1	13 04.1	- 04 00	10.0	01 16.7	+ 09 58	10.6	08 07.1	+ 17 12	12.0
22	21 34.9	- 08 49	11.0	08 06.6	+ 18 39	12.2	12 57.9	- 03 26	10.2	01 29.1	+ 11 20	10.7	08 17.3	+ 16 56	12.2
29	21 47.3	- 07 54	10.9	08 14.4	+ 18 19	12.3	12 52.5	- 02 57	10.5	01 41.7	+ 12 41	10.8	08 28.0	+ 16 34	12.3
May 6	21 59.4	- 07 00	10.8	08 22.9	+ 17 56	12.3	12 48.2	- 02 36	10.6	01 54.4	+ 14 00	10.8	08 39.2	+ 16 07	12.4
13	22 11.2	- 06 07	10.7	08 31.8	+ 17 28	12.4	12 45.1	- 02 24	10.8	02 07.1	+ 15 16	10.9	08 50.9	+ 15 34	12.5
20	22 22.7	- 05 15	10.6	08 41.2	+ 16 57	12.5	12 43.3	- 02 20	11.0	02 20.0	+ 16 31	10.9	09 02.8	+ 14 56	12.5
27	22 33.9	- 04 26	10.5	08 50.9	+ 16 23	12.5	12 42.9	- 02 24	11.2	02 32.9	+ 17 42	10.9	09 15.0	+ 14 14	12.6
Jun 3	22 44.7	- 03 39	10.4	09 00.8	+ 15 45	12.6	12 43.6	- 02 37	11.3	02 45.9	+ 18 51	10.9	09 27.4	+ 13 27	12.7
10	22 55.0	- 02 57	10.3	09 11.0	+ 15 04	12.6	12 45.6	- 02 57	11.5	02 58.9	+ 19 57	11.0	09 39.9	+ 12 35	12.8
17	23 04.9	- 02 21	10.1	09 21.3	+ 14 19	12.7	12 48.7	- 03 23	11.6	03 12.0	+ 21 00	11.0	09 52.4	+ 11 40	12.8
24	23 14.1	- 01 50	10.0	09 31.8	+ 13 32	12.7	12 52.7	- 03 54	11.8	03 25.2	+ 21 59	11.0	10 05.1	+ 10 41	12.9
Jul 1	23 22.7	- 01 28	9.8	09 42.4	+ 12 42	12.7	12 57.6	- 04 31	11.9	03 38.3	+ 22 54	11.0	10 17.8	+ 09 38	12.9
8	23 30.6	- 01 15	9.7	09 53.1	+ 11 49	12.7	13 03.2	- 05 12	12.0	03 51.4	+ 23 46	11.0	10 30.5	+ 08 33	13.0
15	23 37.5	- 01 12	9.5	10 03.8	+ 10 54	12.7	13 09.6	- 05 56	12.1	04 04.4	+ 24 35	11.0	10 43.2	+ 07 25	13.0
22	23 43.4	- 01 22	9.3	10 14.5	+ 09 56	12.7	13 16.6	- 06 43	12.2	04 17.4	+ 25 19	10.9	10 55.8	+ 06 15	13.1
29	23 48.2	- 01 46	9.1	10 25.3	+ 08 57	12.7	13 24.1	- 07 33	12.2	04 30.2	+ 26 00	10.9	11 08.5	+ 05 03	13.1
Aug 5	23 51.6	- 02 25	8.9	10 36.1	+ 07 56	12.7	13 32.2	- 08 25	12.3	04 42.8	+ 26 38	10.9	11 21.1	+ 03 50	13.1
12	23 53.7	- 03 20	8.7	10 46.9	+ 06 53	12.7	13 40.7	- 09 18	12.4	04 55.2	+ 27 12	10.8	11 33.7	+ 02 36	13.1
19	23 54.3	- 04 30	8.5	10 57.7	+ 05 48	12.6	13 49.6	- 10 12	12.4	05 07.2	+ 27 43	10.8	11 46.3	+ 01 20	13.1
26	23 53.4	- 05 55	8.3	11 08.4	+ 04 43	12.6	13 59.0	- 11 07	12.5	05 18.9	+ 28 11	10.7	11 58.9	+ 00 05	13.1
Sep 2	23 51.1	- 07 30	8.0	11 19.1	+ 03 37	12.5	14 08.6	- 12 01	12.5	05 30.1	+ 28 36	10.7	12 11.5	- 01 11	13.1
9	23 47.7	- 09 12	7.8	11 29.9	+ 02 30	12.4	14 18.6	- 12 56	12.5	05 40.8	+ 28 59	10.6	12 24.0	- 02 27	13.1
16	23 43.6	- 10 55	7.8	11 40.5	+ 01 23	12.3	14 28.9	- 13 50	12.5	05 50.8	+ 29 21	10.6	12 36.6	- 03 42	13.1
23	23 39.3	- 12 31	7.9	11 51.2	+ 00 15	12.3	14 39.5	- 14 43	12.5	06 00.1	+ 29 41	10.5	12 49.1	- 04 56	13.1
30	23 35.3	- 13 55	8.0	12 01.8	- 00 52	12.4	14 50.4	- 15 35	12.5	06 08.5	+ 30 01	10.4	13 01.7	- 06 09	13.1
Oct 7	23 32.0	- 15 02	8.2	12 12.3	- 02 00	12.5	15 01.5	- 16 25	12.5	06 15.8	+ 30 20	10.3	13 14.2	- 07 21	13.0
14	23 30.0	- 15 50	8.4	12 22.8	- 03 06	12.6	15 12.8	- 17 13	12.5	06 22.1	+ 30 40	10.2	13 26.7	- 08 31	12.9
21	23 29.5	- 16 17	8.6	12 33.2	- 04 12	12.7	15 24.3	- 17 59	12.5	06 27.0	+ 31 01	10.1	13 39.3	- 09 39	12.9
28	23 30.6	- 16 25	8.7	12 43.5	- 05 16	12.7	15 36.1	- 18 43	12.5	06 30.4	+ 31 24	9.9	13 51.8	- 10 44	13.0
Nov 4	23 33.4	- 16 15	8.9	12 53.8	- 06 20	12.8	15 48.0	- 19 24	12.4	06 32.3	+ 31 47	9.8	14 04.4	- 11 47	13.1
11	23 37.7	- 15 48	9.1	13 03.9	- 07 21	12.8	16 00.1	- 20 02	12.4	06 32.4	+ 32 12	9.7	14 16.9	- 12 47	13.2
18	23 43.4	- 15 07	9.2	13 13.9	- 08 21	12.9	16 12.3	- 20 36	12.3	06 30.7	+ 32 36	9.5	14 29.3	- 13 44	13.3
25	23 50.4	- 14 14	9.4	13 23.8	- 09 19	12.9	16 24.6	- 21 08	12.2	06 27.2	+ 32 59	9.4	14 41.8	- 14 38	13.3
Dec 2	23 58.6	- 13 10	9.5	13 33.5	- 10 14	12.9	16 37.0	- 21 36	12.1	06 22.1	+ 33 20	9.2	14 54.1	- 15 28	13.4
9	00 07.8	- 11 58	9.6	13 42.9	- 11 07	12.9	16 49.5	- 22 01	12.2	06 15.5	+ 33 35	9.0	15 06.4	- 16 15	13.4
16	00 17.8	- 10 39	9.8	13 52.2	- 11 57	12.9	17 02.0	- 22 21	12.3	06 07.8	+ 33 44	8.9	15 18.6	- 16 57	13.4
23	00 28.5	- 09 13	9.9	14 01.1	- 12 45	12.9	17 14.5	- 22 38	12.4	05 59.7	+ 33 46	8.9	15 30.6	- 17 36	13.5
30	00 39.8	- 07 43	10.0	14 09.6	- 13 28	12.8	17 27.0	- 22 51	12.5	05 51.6	+ 33 39	8.9	15 42.4	- 18 10	13.5

	63 AUSONIA			88 THISBE			387 AQUITANIA			654 ZELINDA			704 INTERAMNIA		
Jan 7	14 38.7	- 19 08	12.3	17 06.8	- 24 50	12.3	17 04.2	- 10 30	12.3	06 41.7	+ 19 46	9.8	18 08.6	- 26 34	12.0
14	14 50.5	- 20 17	12.3	17 20.9	- 25 01	12.4	17 19.3	- 10 53	12.3	06 33.0	+ 17 51	10.0	18 20.0	- 26 15	12.0
21	15 02.1	- 21 22	12.2	17 34.9	- 25 06	12.4	17 34.3	- 11 11	12.3	06 25.7	+ 16 02	10.2	18 31.3	- 25 53	12.1
28	15 13.5	- 22 24	12.1	17 48.9	- 25 07	12.4	17 49.3	- 11 23	12.2	06 20.2	+ 14 23	10.4	18 42.4	- 25 28	12.1
Feb 4	15 24.4	- 23 23	12.0	18 02.7	- 25 02	12.3	18 04.3	- 11 29	12.2	06 17.0	+ 12 56	10.6	18 53.4	- 25 00	12.1
11	15 35.0	- 24 20	11.9	18 16.3	- 24 54	12.3	18 19.1	- 11 31	12.2	06 16.0	+ 11 41	10.8	19 04.0	- 24 29	12.2
18	15 45.0	- 25 13	11.8	18 29.7	- 24 40	12.3	18 33.8	- 11 28	12.2	06 17.2	+ 10 38	11.0	19 14.4	- 23 55	12.2
25	15 54.4	- 26 04	11.7	18 42.8	- 24 23	12.3	18 48.3	- 11 20	12.1	06 20.5	+ 09 45	11.2	19 24.5	- 23 19	12.2
Mar 4	16 03.0	- 26 53	11.6	18 55.5	- 24 01	12.2	19 02.5	- 11 09	12.1	06 25.6	+ 09 01	11.4	19 34.3	- 22 40	12.2
11	16 10.7	- 27 38	11.5	19 07.9	- 23 36	12.2	19 16.5	- 10 54	12.1	06 32.3	+ 08 23	11.5	19 43.7	- 21 59	12.1
18	16 17.3	- 28 22	11.4	19 19.9	- 23 07	12.1	19 30.1	- 10 36	12.0	06 40.5	+ 07 49	11.6	19 52.6	- 21 17	12.1
25	16 22.7	- 29 03	11.2	19 31.3	- 22 36	12.1	19 43.4	- 10 15	12.0	06 49.9	+ 07 17	11.8	20 01.0	- 20 32	12.1
Apr 1	16 26.7	- 29 42	11.1	19 42.2	- 22 02	12.0	19 56.3	- 09 54	11.9	07 00.3	+ 06 46	11.9	20 09.0	- 19 46	12.0
8	16 29.1	- 30 18	10.9	19 52.5	- 21 26	11.9	20 08.7	- 09 31	11.9	07 11.7	+ 06 15	12.0	20 16.3	- 18 59	12.0
15	16 29.8	- 30 51	10.7	20 02.1	- 20 49	11.8	20 20.6	- 09 09	11.8	07 23.8	+ 05 42	12.1	20 23.1	- 18 10	11.9
22	16 28.7	- 31 19	10.6	20 11.0	- 20 11	11.7	20 31.9	- 08 48	11.7	07 36.6	+ 05 07	12.2	20 29.1	- 17 22	11.8
29	16 25.8	- 31 42	10.4	20 19.0	- 19 32	11.6	20 42.7	- 08 30	11.6	07 49.9	+ 04 29	12.3	20 34.5	- 16 32	11.8
May 6	16 21.2	- 31 58	10.2	20 26.2	- 18 54	11.5	20 52.7	- 08 15	11.5	08 03.7	+ 03 47	12.4	20 39.0	- 15 43	11.7
13	16 15.2	- 32 05	10.0	20 32.3	- 18 18	11.4	21 02.0	- 08 05	11.4	08 17.8	+ 03 02	12.4	20 42.6	- 14 55	11.6
20	16 08.1	- 32 03	9.9	20 37.3	- 17 43	11.3	21 10.5	- 08 01	11.3	08 32.2	+ 02 12	12.5	20 45.2	- 14 07	11.4
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Jun 3	15 53.2	- 31 29	9.9	20 43.7	- 16 41	11.0	21 24.6	- 08 17	11.1	09 01.7	+ 00 22	12.7	20 47.5	- 12 35	11.2
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17	15 41.2	- 30 29	10.1	20 44.7	- 15 54	10.7	21 34.3	- 09 17	10.8	09 31.7	- 01 43	12.8	20 45.2	- 11 11	10.9
24	15 37.3	- 29 56	10.3	20 43.1	- 15 37	10.5	21 37.2	- 10 07	10.7	09 46.8	- 02 51	12.8	20 42.3	- 10 34	10.7
Jul 1	15 35.3	- 29 24	10.5	20 40.1	- 15 25	10.4	21 38.6	- 11 10	10.5	10 02.0	- 04 02	12.9	20 38.4	- 09 59	10.5
8	15 35.0	- 28 54	10.6	20 35.8	- 15 17	10.2	21 38.7	- 12 28	10.4	10 17.3	- 05 15	12.9	20 33.5	- 09 29	10.4
15	15 36.6	- 28 30	10.8	20 30.6	- 15 13	10.0	21 37.4	- 13 59	10.2	10 32.5	- 06 31	13.0	20 27.8	- 09 03	10.2
22	15 39.9	- 28 10	10.9	20 24.7	- 15 13	9.8	21 34.7	- 15 41	10.0	10 47.8	- 07 48	13.0	20 21.6	- 08 40	10.0
29	15 44.8	- 27 55	11.0	20 18.4	- 15 15	9.7	21 30.9	- 17 30	9.8	11 03.0	- 09 07	13.0	20 15.1	- 08 22	10.0
Aug 5	15 51.2	- 27 45	11.2	20 12.4	- 15 19	9.9	21 26.4	- 19 22	9.7	11 18.3	- 10 27	13.1	20 08.8	- 08 08	10.1
12	15 58.8	- 27 38	11.3	20 06.9	- 15 23	10.1	21 21.5	- 21 12	9.7	11 33.6	- 11 47	13.1	20 02.8	- 07 58	10.2
19	16 07.6	- 27 35	11.4	20 02.3	- 15 27	10.3	21 16.6	- 22 54	9.9	11 48.9	- 13 07	13.1	19 57.6	- 07 51	10.4
26	16 17.4	- 27 34	11.5	19 58.9	- 15 30	10.4	21 12.2	- 24 24	10.1	12 04.2	- 14 27	13.2	19 53.2	- 07 47	10.5
Sep 2	16 28.2	- 27 34	11.6	19 57.0	- 15 32	10.6	21 08.8	- 25 41	10.3	12 19.6	- 15 46	13.2	19 50.0	- 07 44	10.7
9	16 39.8	- 27 34	11.7	19 56.5	- 15 31	10.8	21 06.5	- 26 42	10.5	12 34.9	- 17 04	13.2	19 48.0	- 07 43	10.8
16	16 52.2	- 27 34	11.8	19 57.5	- 15 29	10.9	21 05.7	- 27 29	10.7	12 50.3	- 18 20	13.2	19 47.3	- 07 42	10.9
23	17 05.1	- 27 32	11.8	19 59.9	- 15 23	11.1	21 06.3	- 28 00	10.9	13 05.8	- 19 35	13.2	19 47.8	- 07 40	11.0
30	17 18.7	- 27 29	11.9	20 03.7	- 15 14	11.2	21 08.4	- 28 19	11.1	13 21.3	- 20 46	13.2	19 49.5	- 07 37	11.1
Oct 7	17 32.7	- 27 22	12.0	20 08.7	- 15 02	11.3	21 11.9	- 28 25	11.3	13 36.8	- 21 55	13.2	19 52.4	- 07 33	11.2
14	17 47.1	- 27 12	12.0	20 14.8	- 14 46	11.4	21 16.7	- 28 21	11.5	13 52.4	- 23 01	13.2	19 56.4	- 07 26	11.3
21	18 01.9	- 26 58	12.1	20 21.9	- 14 27	11.5	21 22.6	- 28 08	11.6	14 08.0	- 24 03	13.2	20 01.3	- 07 16	11.4
28	18 16.9	- 26 39	12.1	20 29.9	- 14 03	11.6	21 29.5	- 27 45	11.7	14 23.7	- 25 01	13.2	20 07.1	- 07 04	11.5
Nov 4	18 32.2	- 26 16	12.1	20 38.6	- 13 35	11.7	21 37.4	- 27 15	11.9	14 39.4	- 25 55	13.2	20 13.8	- 06 48	11.5
11	18 47.6	- 25 48	12.2	20 48.0	- 13 02	11.8	21 45.9	- 26 39	12.0	14 55.1	- 26 45	13.2	20 21.1	- 06 28	11.6
18	19 03.1	- 25 14	12.2	20 57.9	- 12 26	11.9	21 55.1	- 25 56	12.1	15 10.7	- 27 30	13.2	20 29.1	- 06 04	11.6
25	19 18.6	- 24 36	12.2	21 08.3	- 11 45	12.0	22 04.8	- 25 08	12.2	15 26.4	- 28 10	13.2	20 37.7	- 05 36	11.7
Dec 2	19 34.1	- 23 52	12.2	21 19.1	- 11 00	12.0	22 14.9	- 24 15	12.3	15 42.0	- 28 45	13.3	20 46.7	- 05 03	11.7
9	19 49.6	- 23 03	12.2	21 30.1	- 10 10	12.1	22 25.4	- 23 18	12.4	15 57.5	- 29 15	13.4	20 56.2	- 04 27	11.7
16	20 05.0	- 22 09	12.3	21 41.5	- 09 17	12.1	22 36.2	- 22 17	12.4	16 12.8	- 29 40	13.5	21 06.1	- 03 46	11.7
23	20 20.3	- 21 10	12.3	21 53.1	- 08 20	12.2	22 47.1	- 21 13	12.5	16 28.0	- 30 00	13.5	21 16.2	- 03 01	11.7
30	20 35.5	- 20 07	12.3	22 04.8	- 07 20	12.2	22 58.3	- 20 06	12.6	16 43.0	- 30 14	13.6	21 26.7	- 02 12	11.7

APPENDIX A: THE BRIGHTEST STARS

See General Notes to Part 3 (page 55) for explanation.

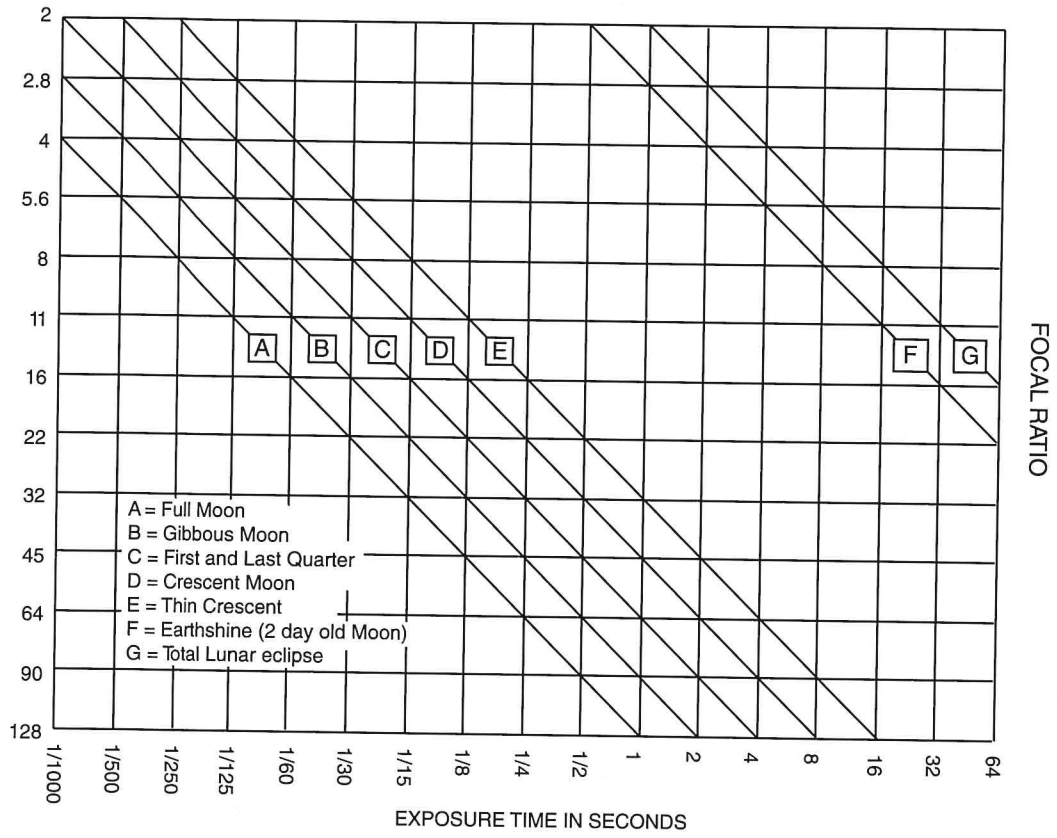
	Designation	Name	Constellation	R.A. (2000.0)	Dec	Magnitude App.	Magnitude Abs.	Spectral Type	Parallax	Distance ly	Distance pc
1		Sun				-26.70	4.8	G2 V			
2	α CMa	Sirius	Canis Major	06 45.2	-16 43	-1.46	1.4	A1 V	0.375	8.7	2.67
3	α Car	Canopus	Carina	06 23.9	-52 42	-0.72	-8.5	F0 Ia	0.018	180	55.21
4	α Cen	Rigil Kent	Centaurus	14 39.6	-60 50	-0.10	4.4	G2 V	0.751	4.3	1.32
5	α Boo	Arcturus	Bootes	14 15.7	+19 11	-0.04	-0.2	K2 IIIp	0.090	36	11.04
6	α Lyr	Vega	Lyra	18 36.9	+38 47	0.03	0.5	A0 V	0.123	26	7.98
7	α Aur	Capella	Auriga	05 16.7	+46 00	0.08	0.4	G8 III	0.073	45	13.80
8	β Ori	Rigel	Orion	05 14.5	-08 12	0.12	-7.1	B8 Ia	0.004	815	250.00
9	α CMi	Procyon	Canis Minor	07 39.3	+05 14	0.38	2.6	F5 IV	0.288	11	3.37
10	α Eri	Achernar	Eridanus	01 37.7	-57 14	0.46	-1.6	B5 IV	0.023	142	43.56
11	α Ori	Betelgeuse	Orion	05 55.2	+07 24	v0.50	-5.6	M2 Iab	0.005	650	199.39
12	β Cen	Hadar	Centaurus	14 03.8	-60 22	0.61	-5.1	B1 II	0.008	400	122.70
13	α Aql	Altair	Aquila	19 50.8	+08 52	0.77	2.2	A7 IV-V	0.198	16	4.91
14	α Tau	Aldebaran	Taurus	04 35.9	+16 31	0.85	-0.3	K5 III	0.048	68	20.86
15	α Cru	Acrux	Crux	12 26.6	-63 06	0.87	-3.9	B1 IV	0.012	270	82.82
16	α Sco	Antares	Scorpius	16 29.4	-26 26	0.96	-4.7	M1 Ib	0.008	400	122.70
17	α Vir	Spica	Virgo	13 25.2	-11 10	0.98	-3.5	B1 V	0.012	270	82.82
18	β Gem	Pollux	Gemini	07 45.3	+28 02	1.14	0.2	K0 III	0.093	35	10.74
19	α PsA	Fomalhaut	Piscis Austrinus	22 57.7	-29 37	1.16	2.0	A3 V	0.144	23	7.06
20	α Cyg	Deneb	Cygnus	20 41.4	+45 17	1.25	-7.5	A2 Ia	0.002	1600	490.80
21	β Cru	Becrux	Crux	12 47.7	-59 41	1.25	-5.0	B0 III	0.007	460	141.10
22	α Leo	Regulus	Leo	10 08.4	+11 58	1.35	-0.6	B7 V	0.039	85	26.07
23	ε CMa	Adhara	Canis Major	06 58.6	-28 58	1.50	-4.4	B2 II	0.005	650	199.39
24	α Gem	Castor	Gemini	07 34.6	+31 53	1.58	1.2	AI V	0.072	46	14.11
25	λ Sco	Shaula	Scorpius	17 33.6	-37 06	1.63	-3.0	B2 1V	0.010	300	92.02
26	γ Cru	Gacrux	Crux	12 31.2	-57 07	1.63	-0.5	M3 III	0.015	88	26.99
27	γ Ori	Bellatrix	Orion	05 25.1	+06 21	1.64	-3.6	B2 III	0.011	300	92.02
28	β Tau	Alnath	Taurus	05 26.3	+28 36	1.65	-1.6	B7 III	0.018	180	55.21
29	β Car	Miaplacidus	Carina	09 13.2	-69 43	1.68	-0.6	A0 III	0.031	85	26.07
30	ε Ori	Alnilam	Orion	05 36.2	-01 12	1.70	-6.2	BO Ia	0.003	1206	369.94

APPENDIX B: THE NEAREST STARS

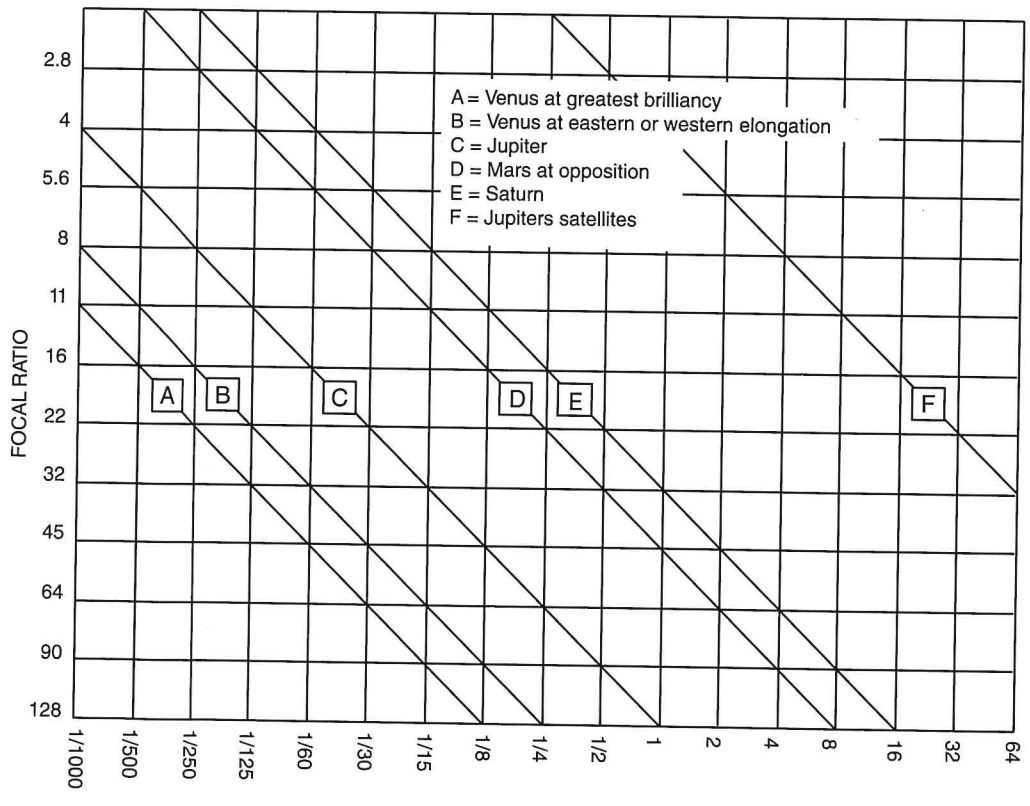
No	Star Name		Constellation	R.A. 2000 hh mm.m	Dec ° '	Magnitude Apparent	Magnitude Absolute	Spect Type	Parallax ' "	Proper Motion	Distance ly	Distance pc
1	Sun					-26.70	4.80	G2				
2	Proxima Centauri		Centaurus	14 30.0	-62 40	11.05	15.50	M5	0.772	3"85	4.2	1.37
3	Alpha Centauri	A	Centaurus	14 39.6	-60 50	0.00	4.40	G2	0.750	3"68	4.3	1.40
		B				1.39	5.70	K1				
4	Barnard's Star		Ophiuchus	17 57.9	+04 41	9.54	13.20	M4	0.547	10"31	6.0	1.96
5	Wolf 359		Leo	10 56.7	+07 00	13.53	16.60	M6	0.419	4"70	7.7	2.51
6	Lalande 21185		Ursa Major	11 03.4	+35 58	7.50	10.50	M2	0.398	4"78	8.2	2.67
7	UV Ceti (L726-8)	A	Cetus	01 38.8	-17 57	12.52	15.50	M6	0.382	3"36	8.4	2.74
		B				13.02	16.00	M6				
8	Sirius	A	Canis Major	06 45.1	-16 43	-1.46	1.40	A1	0.376	1"21	8.6	2.80
		B				8.30	11.20	A1				
9	Ross 154		Sagittarius	18 49.7	-23 49	10.45	13.10	M4	0.342	0"72	9.4	3.06
10	Ross 248		Andromeda	23 41.9	+44 10	12.29	14.80	M5	0.314	1"60	10.4	3.39
11	Epsilon Eridani		Eridanus	03 32.9	-09 28	3.73	6.10	K2	0.307	0"98	10.8	3.52
12	Ross 128		Virgo	11 47.6	+00 48	11.13	13.50	M4	0.302	1"38	10.9	3.55
13	61 Cygni	A	Cygnus	21 06.9	+38 45	5.22	7.60	K4	0.291	5"22	11.1	3.62
		B				6.03	8.40	K5				
14	Epsilon Indi		Indus	22 03.4	-56 47	4.68	7.00	K3	0.290	4"70	11.2	3.65
15	BD +43°44	A	Andromeda	00 18.1	+44 00	8.08	10.40	M1	0.291	2"90	11.2	3.65
	(Groombridge 34)	B				11.06	13.40	M4				
16	L 789-6		Aquarius	22 38.4	-15 18	12.18	14.50	M5	0.294	3"26	11.2	3.65
17	Procyon	A	Canis Minor	07 39.3	+05 14	0.37	2.60	M5	0.285	1"25	11.4	3.72
		B				10.70	13.00	F5				
18	BD +59°1915	A	Draco	18 42.9	+59 37	8.90	11.20	M3	0.290	2"27	11.6	3.78
		B				9.69	11.90	M4				
19	Lacaille 9352		Piscis Austrinus	23 05.9	-35 51	7.35	9.60	M1	0.286	6"90	11.7	3.81
20	G51-15			08 29.9	+26 46	14.81	17.00	M7	0.276	1"27	11.7	3.81
21	Tau Ceti		Cetus	01 44.1	-15 56	3.50	5.70	G8	0.287	1"92	11.8	3.85
22	Luyten (BD + 5°1668)		Canis Minor	07 27.4	+05 13	9.82	11.90	M4	0.266	3"77	12.3	4.01
23	YZ Ceti (L725-32)		Cetus	01 12.4	-16 59	12.04	14.10	M5	0.268	1"32	12.5	4.08
24	Lacaille 8760 (CD-39°14192)		Microscopium	21 17.3	-38 52	6.66	8.70	K6	0.260	3"46	12.5	4.08
25	Kapteyn's star		Pictor	05 11.2	-45 01	8.84	10.90	M0	0.260	8"84	12.7	4.14
26	Kruger 60	A	Cepheus	22 28.1	+57 42	9.85	11.90	M3	0.253	0"86	12.9	4.21
		B				11.30	13.30	M5				
27	Wolf 1061 (BD -12°4523)		Ophiuchus	16 30.3	-12 39	10.11	12.10	M4	0.245	1"18	13.2	4.30
28	Ross 614	A	Monoceros	06 29.3	-02 48	11.10	13.10	M5	0.242	1"00	13.3	4.34
		B				14.00	16.00	M5				
29	Wolf 28 (van Maanen's star)		Pisces	00 49.0	+05 23	12.37	14.20	DG	0.231	2"99	14.1	4.60
30	Wolf 424	A	Virgo	12 33.4	+09 01	13.16	15.00	M5	0.233	1"76	14.2	4.63
		B				13.40	15.20	M5				
31	CD-37°15492 (HD 225213)		Sculptor	00 05.1	-37 21	8.56	10.30	M2	0.223	6"11	14.5	4.73
32	TZ Aries (L1159-16)		Aries	02 00.2	+13 03	12.26	14.10	M5	0.223	2"09	14.6	4.76

APPENDIX C: PHOTOGRAPHIC EXPOSURE GUIDES

PHOTOGRAPHIC EXPOSURE GUIDE for the MOON



PHOTOGRAPHIC EXPOSURE GUIDE for the PLANETS



These charts provide recommended photographic exposures for the Moon (left) and selected planets (below) using 100 ISO film. The charts should only be treated as a guide as many factors will influence the exposure time.

Follow a horizontal line nearest to your systems focal ration to the oblique line that represents the moon aspect or planet required, then follow the intersecting vertical line down to find the correct exposure.

For the best result always take one photo at the recommended speed and follow up with one at half and one at twice the exposure. Bracketing exposures will help smooth out variables and should provide at least one image at the required density.

For ISO values other than 100 the following factors should be applied to the exposure time.

Film Speed	Mult. by
32 ISO	4
64 ISO	2
100 ISO	1
Film Speed	**Divide by**
200 ISO	2
400 ISO	4
800 ISO	8
1000 ISO	10
1600 ISO	16
3200 ISO	32

APPENDIX D: NON STELLAR OBJECTS

CAT	NUM	R.A.	DEC	SIZE	CON	TYPE	MAG	DESCRIPTION
NGC	55	00 14.9	-39° 11'	30'x6.3'	Scl	Spiral galaxy.	8.1	Brightest galaxy in Sculptor Group
NGC	104	00 24.1	-72° 05'	30.9'	Tuc	Globular cluster	3.8	47 Tucanae, one of the finest globulars
NGC	224	00 42.7	+41° 16'	185'x75'	And	Spiral galaxy	3.4	M31, The "Andromeda Galaxy"
NGC	253	00 47.6	-25° 17'	30'x6.9'	Scl	Spiral galaxy	7.6	Small bright nucleus, complex central lens
	SMC	00 52.7	-72° 30'	5°X4°	Tuc	Galaxy	2.3	Small Magellanic Cloud. Visible to unaided eye from dark sky (away from city)
NGC	288	00 52.8	-26° 35'	13.8'	Scl	Globular cluster	8.1	Low central condensation, brightest stars = 12.6 magnitude
NGC	330	00 56.2	-72° 29'	1.9'	Tuc	Open cluster	9.6	Small cluster in Small Magellanic Cloud
NGC	346	00 59.1	-72° 11'	14'x11'	Tuc	Emission nebula		Largest diffuse nebula in Small Magellanic Cloud
NGC	362	01 03.2	-70° 51'	12.9'	Tuc	Globular cluster	6.5	62 Tucanae, high central condensation
NGC	598	01 33.9	+30° 39'	67'x41.5'	Tri	Spiral galaxy	5.7	M33, "Triangulum" or "Pinwheel Galaxy", member of Local Group of Galaxies
NGC	752	01 57.8	+37° 41'	50'	And	Open cluster	5.7	Rich cluster, 60 stars, brightest member 9th magnitude.
NGC	1068	02 42.7	-00° 01'	8.2'x7.3'	Cet	Spiral galaxy	8.9	M77, Seyfert type with very bright nucleus
NGC	1261	03 12.3	-55° 13'	6.9'	Hor	Globular cluster	8.3	Brightest stars = 13.5 magnitude
	Pleiades	03 47.0	+24° 07'	2°	Tau	Open cluster	1.2	M45 or "Seven Sisters". Naked eye cluster, the brighter stars Mag. 2.
	Hyades	04 27.0	+16° 00'	6°	Tau	Open cluster	0.5	A naked eye, "V" shaped cluster. 28 stars, the brighter Mag. 3 and 4.
NGC	1647	04 46.0	+19° 04'	45'	Tau	Open cluster	6.4	Rich cluster, 200 stars, brightest member 8.6 magnitude
NGC	1837	05 04.9	-70° 43'		Men	Open cluster		Part of star cloud in LMC
NGC	1850	05 08.5	-68° 46'	3.4'	Dor	Open cluster	9.0	Rich in stars, nebulosity, part of LMC
NGC	1851	05 14.1	-40° 03'	11'	Col	Globular cluster	7.2	Rich, well resolved, bright centre
	LMC	05 23.6	-69° 45'	9°X10°	Dor	Galaxy	0.1	Large Magellanic Cloud. Visible to unaided eye from dark sky (away from city)
NGC	1904	05 24.5	-24° 33'	8.7'	Lep	Globular cluster	8.7	M79, rich and compressed, well resolved
IC	418	05 27.5	-12° 42'	12"	Lep	Planetary nebula	9.3	Disc structure with 10th magnitude central star
NGC	1912	05 28.7	+35° 50'	21'	Aur	Open cluster	6.4	M38, 100 stars magnitude 9.5 down in splendid field
NGC	1952	05 34.5	+22° 01'	6'x4'	Tau	Supernova remnant	8.4	M1, "Crab nebula", remnant from supernova of A.D. 1054
NGC	1976	05 35.4	-05° 27'	65'x60'	Ori	Gaseous nebula	4.0	M42, "Orion Nebula", emission and reflection nebula
NGC	1960	05 36.1	+34° 08'	12'	Aur	Open cluster	6.0	M36, 60 stars between 9th and 14th magnitude
NGC	2070	05 38.6	-69° 05'	30'x20'	Dor	Emission nebula	8.3	30 Doradus, "Tarantula Nebula", bright complex looped structure
NGC	2024	05 41.9	-01° 51'	30'	Ori	Emission nebula		Nebula bisected by 3' wide dark lane
NGC	2068	05 46.7	+00° 03'	8'x6'	Ori	Reflection nebula		M78, brightest and largest in group of four nebulae
NGC	2099	05 52.4	+32° 33'	20'	Aur	Open cluster	5.6	M37, 150 stars magnitude range 9 to12.5, central concentration
NGC	2169	06 08.4	+13° 57'	6'	Ori	Open cluster	5.9	Rich loose cluster, 30 stars magnitude 7 and fainter
NGC	2168	06 08.9	+24° 20'	28'	Gem	Open cluster	5.3	M35, 200 stars magnitude range 9 to16, no central concentration
IC	2165	06 21.7	-12° 59'	4"	CMa	Planetary nebula	10.6	Irregular disk with 15th magnitude central star
NGC	2244	06 32.4	-04° 52'	23'	Mon	Open cluster	4.8	Rich cluster of 100 stars, with nebulosity (Rosette Nebula)
NGC	2264	06 41.1	+09° 53'	20'	Mon	Open cluster	3.9	40 stars, large brightness range, involved in nebulosity (Cone Nebula)
NGC	2287	06 47.0	-20° 44'	38'	CMa	Open cluster	4.5	M41, 80 stars 7th magnitude and fainter with 6.9 mag red star near centre
NGC	2301	06 51.8	+00° 28'	12'	Mon	Open cluster	6.0	Rich cluster, 80 stars, large magnitude range, central concentration
NGC	2323	07 03.2	-08° 20'	16'	Mon	Open cluster	6.9	M50, rich cluster, 80 stars mags 8 to 12th, slight central concentration
NGC	2362	07 18.8	-24° 57'	8'	CMa	Open cluster	4.1	60 stars, large brightness range (4th mag down), strong central concentration
NGC	2392	07 29.2	+20° 55'	15"	Gem	Planetary nebula	9.2	"Eskimo" or "Clown Face Nebula", irregular disk with 10.5 mag central star.
NGC	2422	07 36.6	-14° 30'	29'	Pup	Open cluster	4.4	M47, Large coarse cluster with 30 bright and faint stars
NGC	2437	07 41.8	-14° 49'	27'	Pup	Open cluster	6.1	M46, rich open cluster, 100 stars, planetary nebula NGC2438 is same field
NGC	2447	07 44.6	-23° 52'	22'	Pup	Open cluster	6.2	M93, 80 stars magnitude 8 to 13 with strong central concentration
NGC	2451	07 45.4	-37° 58'	45'	Pup	Open cluster	2.8	Rich in stars with slight central concentration.
NGC	2477	07 52.3	-38° 33'	27'	Pup	Open cluster	5.8	160 stars around 10 -12th magnitude, strong central concentration
NGC	2467	07 52.6	-26° 23'	14'	Pup	Open cluster	7.1	50 stars, large brightness range, involved in nebulosity
NGC	2516	07 58.3	-60° 52'	29'	Car	Open cluster	3.8	80 stars 6th magnitude and fainter, strong central concentration
NGC	2547	08 10.7	-49° 16'	74'	Vel	Open cluster	4.7	Rich in stars with strong central concentration. Brightest stars mag. 6.
NGC	2548	08 13.8	-05° 48'	54'	Hya	Open cluster	5.8	M48, Large cluster of 80 stars 8 to 13th magnitude, strong central concentration
NGC	2632	08 40.1	+19° 59'	95'	Cnc	Open cluster	3.1	M44, "Praesepe" or "Beehive Cluster", very larger cluster, 50 stars 6th magnitude and fainter
IC	2391	08 40.2	-53° 04'	50'	Vel	Open cluster	2.5	Moderately rich in bright (approx. mag 3) and faint stars
IC	2395	08 41.1	-48° 12'	7'	Vel	Open cluster	4.6	40 stars 6th magnitude and fainter
NGC	2682	08 50.4	+11° 49'	29'	Cnc	Open cluster	6.9	M67, 200 stars 10 to 15th magnitude, large and rich
IC	2448	09 07.1	-69° 57'	8"	Car	Planetary nebula	10.4	Smooth disk of uniform brightness with 14th magnitude central star
NGC	2808	09 12.0	-64° 52'	13.8'	Car	Globular cluster	6.1	Large and rich, compressed centre, stars 13 to 15th magnitude
NGC	2867	09 21.4	-58° 19'	11"	Car	Planetary nebula	9.7	Ring structure, 15th magnitude central star
NGC	3114	10 02.7	-60° 07'	35'	Car	Open cluster	4.2	Rich cluster, stars 9 to 14th magnitude, slight central concentration

CAT	NUM	R.A.	DEC	SIZE	CON	TYPE	MAG	DESCRIPTION
NGC	3132	10 07.1	-40° 26'	30"	Vel	Planetary nebula	9.7	The "Eight Burst Nebula", ring and disk, 10th magnitude central star
NGC	3199	10 16.8	-57° 57'	20'x15'	Car	Emission nebula		Ring shaped, many stars involved in nebulosity
NGC	3242	10 24.8	-18° 38'	16"	Hya	Planetary nebula	7.8	The "Ghost of Jupiter", ring structure involved in larger and fainter disk
IC	2602	10 43.2	-64° 24'	50'	Car	Open cluster	1.9	Rich in stars, strong central concentration, brightest stars mag. 3.
NGC	3372	10 43.8	-59° 52'		Car	Emission nebula		The "Eta Carinae Nebula", very bright, prominent dark lanes
NGC	3532	11 06.4	-58° 40'	55'	Car	Open cluster	3.0	Rich and large, slight central concentration, 150 stars 7-12th magnitude
NGC	3766	11 36.1	-61° 37'	12'	Cen	Open cluster	5.3	Rich cluster, 100 stars magnitude range 7 to 12th
NGC	3918	11 50.3	-57° 11'	12"	Cen	Planetary nebula	8.1	Smooth disk of uniform brightness, 13th magnitude central star
NGC	4374	12 25.1	+12° 53'	5.1'x4.1'	Vir	Galaxy	9.1	M84, very bright centre, in same field as M86
NGC	4372	12 25.8	-72° 39'	18.6'	Mus	Globular cluster	7.3	Large, faint and rich, stars from 12th magnitude down
NGC	4486	12 30.8	+12° 24'	7.1'	Vir	Elliptical galaxy	8.6	M87, radio source, bright, smooth and featureless
NGC	4579	12 37.7	+11° 49'	5.5'x4.6'	Vir	Spiral galaxy	9.7	M58, bright diffuse nucleus, dark lanes
NGC	4590	12 39.5	-26° 45'	12'	Hya	Globular cluster	7.7	M68, rich and compressed, stars magnitude 12 and fainter
NGC	4594	12 40.0	-11° 37'	7.1'x4.4'	Vir	Spiral galaxy	8.7	M104 "Sombrero Galaxy", very bright central bulge, spiral arms, dark lane
NGC	4755	12 53.6	-60° 20'	10'	Cru	Open cluster	4.2	The "Jewel Box", rich in stars, large brightness range
NGC	4826	12 56.7	+21° 41'	9.2'x4.6'	Com	Spiral galaxy	8.5	M46 "Blackeye Galaxy", bright nucleus partly hidden by small dark lane
NGC	4833	12 59.6	-70° 53'	13.5'	Mus	Globular cluster	7.0	Dunlop 164, large and bright, stars 12th magnitude and fainter
NGC	4945	13 05.4	-49° 28'	23'x5.9'	Cen	Spiral galaxy	9.0	Large edge on spiral, good field, another small galaxy in same field
NGC	5024	13 12.9	+18° 10'	12.6'	Com	Globular cluster	7.5	M53, bright centre region, very compressed, slightly oval shape
NGC	5128	13 25.5	-43° 01'	31'x23'	Cen	Galaxy	6.7	Centaurus "A", Dunlop 482, bright sphere crossed by dark lane, radio source.
NGC	5139	13 26.8	-47° 29'	36'	Cen	Globular cluster	3.5	Omega Centauri, perhaps the finest example of a globular cluster
NGC	5236	13 37.0	-29° 52'	15.5'x13'	Hya	Spiral galaxy	7.6	M83, nearly face on, bright central nucleus, radio source
NGC	5272	13 42.2	+28° 23'	16.2'	CVn	Globular cluster	5.9	M3, large bright globular, brightens suddenly towards the middle
NGC	5281	13 46.6	-62° 54'	5'	Cen	Open cluster	5.9	40 stars, moderately rich in bright and faint stars, magnitudes 6 to 12
NGC	5617	14 29.8	-60° 43'	10'	Cen	Open cluster	6.3	80 stars, large brightness range, strong central concentration
NGC	5822	15 05.2	-54° 21'	39'	Lup	Open cluster	6.4	Rich cluster with 150 stars, moderate brightness range
NGC	5904	15 18.6	+02° 05'	17.4'	Ser	Globular cluster	5.7	M5, bright, large very compressed in middle, slightly oval in shape
NGC	5986	15 46.1	-37° 47'	9.8'	Lup	Globular cluster	7.5	Very bright, rich, gradually brightening towards middle
NGC	5999	15 52.2	-56° 28'	5'	Nor	Open cluster	9.2	40 stars, moderate brightness range, strong central concentration
NGC	6025	16 03.7	-60° 30'	12'	TrA	Open cluster	5.1	60 stars, large brightness range, slight central concentration
NGC	6067	16 13.2	-54° 13'	12'	Nor	Open cluster	5.6	100 stars, large brightness range, strong central concentration
NGC	6093	16 17.0	-22° 59'	8.9'	Sco	Globular cluster	7.3	M80, strong central concentration, bright, large, easily resolved
NGC	6087	16 18.9	-57° 54'	12.5'	Nor	Open cluster	5.4	40 stars, moderate brightness range, slight central concentration
NGC	6121	16 23.6	-26° 32'	26.3'	Sco	Globular cluster	5.8	M4, conspicuous globular near Antares
NGC	6124	16 25.6	-40° 40'	29'	Sco	Open cluster	5.8	100 stars, large brightness range, strong central concentration
NGC	6167	16 34.4	-49° 36'	7'	Nor	Open cluster	6.7	Moderately rich in bright and faint stars, probably not a true cluster
NGC	6193	16 41.3	-48° 46'	14'	Ara	Open cluster	5.2	Few stars, large brightness range, slight central concentration
NGC	6205	16 41.7	+36° 28'	16.6'	Her	Globular cluster	5.7	M13, the "Great Hercules Cluster", showpiece of northern skies
NGC	6231	16 54.0	-41° 48'	14'	Sco	Open cluster	2.6	A few stars with strong central concentration. Brightest stars mag.5.
NGC	6302	17 13.7	-37° 06'	50"	Sco	Planetary nebulae	9.6	The "Bug Nebula", anomalous form
NGC	6388	17 36.3	-44° 44'	8.7'	Sco	Globular cluster	6.7	Dunlop 457, very bright, large and rich
NGC	6405	17 40.1	-32° 13'	33'	Sco	Open cluster	4.2	M6, the "Butterfly Cluster", 80 stars, large brightness range
NGC	6397	17 40.7	-53° 40'	25.7'	Ara	Globular cluster	5.8	Loose, scattered structure, possibly the nearest of the globulars
NGC	6475	17 53.9	-34° 49'	80'	Sco	Open cluster	3.2	M7, 80 stars brighter than 10th magnitude, large brightness range
NGC	6494	17 56.8	-19° 01'	27'	Sgr	Open cluster	5.5	M23, 150 stars, moderate brightness range, lies in good star field
NGC	6514	18 02.3	-23° 02'	20'	Sgr	Gaseous nebula	5.0	M20 "Trifid Nebula", emission & reflection nebulosity cut by dark lanes
NGC	6523	18 03.8	-24° 23'	45'x30'	Sgr	Emission nebula	5.0	M8, the "Lagoon", densest section known as the "Hourglass", prominent dark lane
NGC	6572	18 12.1	+06° 51'	8"	Oph	Planetary nebula	8.1	Smooth disk with a brighter central region, 13th magnitude central star
NGC	6611	18 18.8	-13° 47'	21'	Ser	Open cluster	6.0	M16, 100 bright and faint stars, involved in the "Eagle Nebula"
NGC	6618	18 20.8	-16° 11'	20'x15'	Sgr	Emission nebula	7.0	M17 "Omega" or "Swan Nebula", very bright with conspicuous '2' shape
NGC	6626	18 24.5	-24° 52'	11.2'	Sgr	Globular cluster	6.8	M28, large, round, increasingly compressed in the middle
IC	4725	18 31.6	-19° 15'	32'	Sgr	Open cluster	4.6	M25, 30 stars loosely scattered
NGC	6656	18 36.4	-23° 54'	24'	Sgr	Globular cluster	5.1	M22. Fine Globular, only Omega Cen. and 47 Tuc are brighter.
NGC	6705	18 51.1	-06° 16'	13'	Sct	Open cluster	5.8	M11, The "Wild Duck Cluster", one of the richest, most compact open cluster.
NGC	6720	18 53.6	+33° 02'	1.1'	Lyr	Planetary nebula	8.8	M57, the "Ring Nebula", ring structure, 15th magnitude central star
NGC	6779	19 16.6	+30° 11'	7.1'	Lyr	Globular cluster	8.3	M56, irregularly round, very compressed in the middle
NGC	6853	19 59.6	+22° 43'	8'	Vul	Planetary nebula	7.3	M27 "Dumbbell Nebula", bright dumbbell shaped, 14th mag. central star
NGC	6885	20 12.0	+26° 29'	7'	Vul	Open cluster	8.1	30 stars, moderate brightness range, no central concentration
NGC	7009	21 04.2	-11° 22'	25"	Aqr	Planetary nebula	8.5	The "Saturn Nebula", ring structure in a larger and fainter halo
NGC	7078	21 30.0	+12° 10'	12.3'	Peg	Globular cluster	6.0	M15, bright, irregularly round, well resolved into faint stars
NGC	7293	22 29.6	-20° 48'	12'	Aqr	Planetary nebula	7.3	The "Helix Nebula", ring structure involved in larger and fainter disk, 14th mag central star

APPENDIX E: INTRODUCTION TO VARIABLE STARS

To the casual sky gazer it may come as a surprise to learn that the brightness of all stars is not as constant as they seem. It fact, astronomers (many of them amateurs) have discovered tens of thousands of stars whose brightness varies over periods ranging from minutes to years. The amplitude (how much they change in brightness ie. the range of magnitudes) and how long it takes for one cycle (ie. to be bright, fade and brighten again) varies greatly from star to star. Most of these objects are faint and require a telescope to observe them. However, there are a number of these stars that are quite bright. Brilliant enough for people to observe them go through their cycle of fading, and then brightening again, with only binoculars or even the naked eye. These few stars are ideal for the beginner. Some stars only vary by a fraction of a magnitude but it is not unusual for some stars to change by at least 4 to 6 magnitudes. This is typical of the Mira type variables (see below). To visualise 6 magnitudes try looking at the brightest star, Sirius (mag. -1), and compare it to the faintest stars you can see (around mag. 5 to 6). A few variables have been known to change by 10 magnitudes. If the Sun was like this it would fade, at times, to about the brightness of a full Moon!

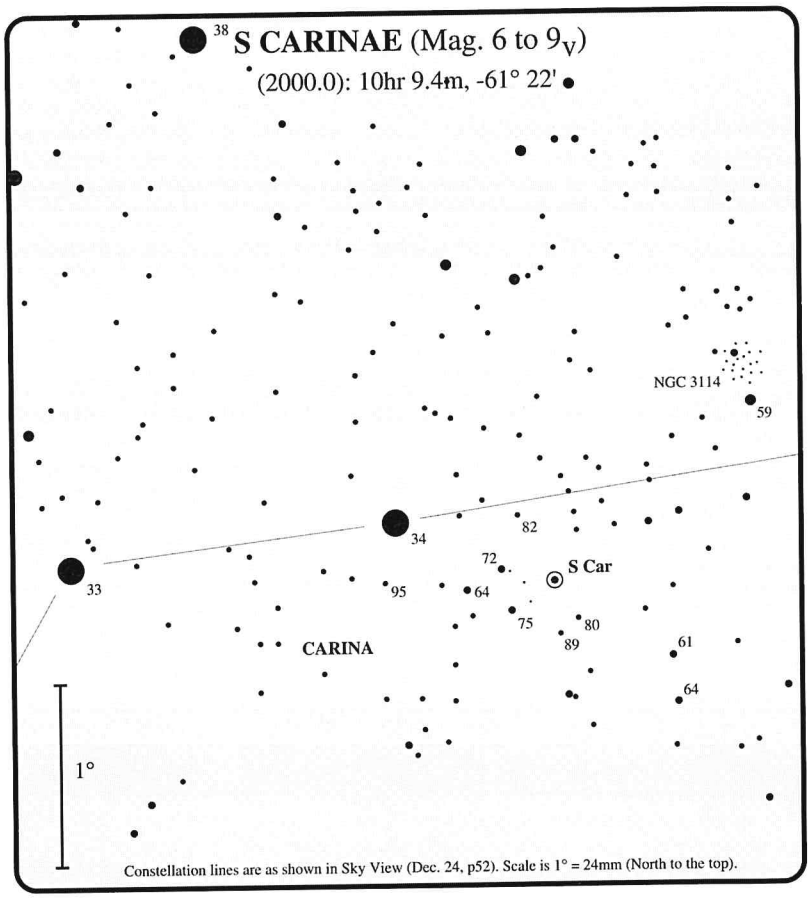
Variable stars are split into a number of classes. These are often named after the first star of the type to be discovered eg. RR Lyrae stars. Variables fit into two broad categories ie. those whose brightness changes are caused by a physical change in the star, or by an external factor. The most common type of "physical change" variability is when the star goes through pulsations. The most common pulsating variables are the *Cepheids* and the *Long Period Variables* (also known as Mira types). Both these classes have very regular periods. A graph of a pulsating variable's brightness vs. time looks a little like a sine wave. The period of Cepheid type stars can be a number of days; Mira variables - months. Cepheids have played an important role in man's understanding of the size of the universe. Early in the 20th century, it was discovered that the brighter a Cepheid variable the longer its period. If the absolute magnitude of these stars is calculated, the distance can then be derived for any of these stars no matter where they are in space.

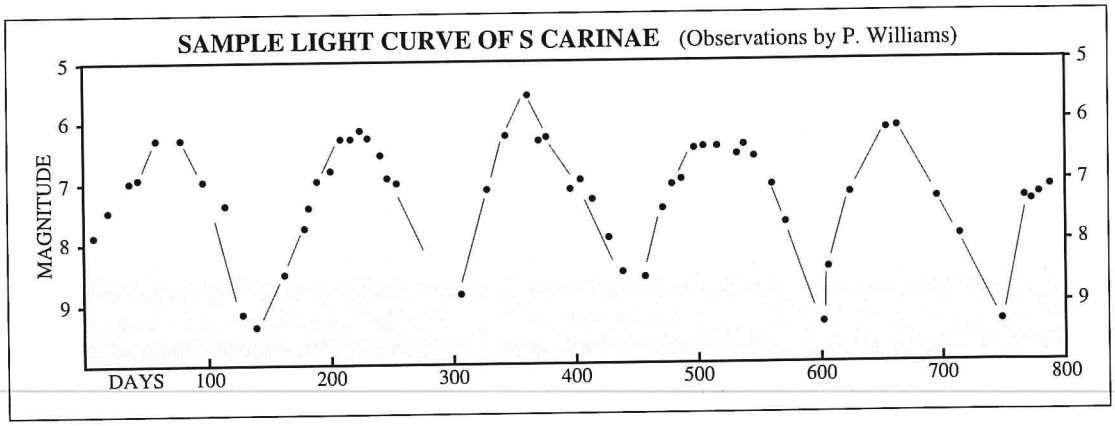
The most common "external factor" variable is the *eclipsing binary (EB)*. Many of the stars we see in the sky (if not the majority), are actually two stars in orbit around each other. Only the closest stars to Earth can be seen in telescopes as two objects. When the Earth happens to lie in the orbital plane of a binary pair, the stars will periodically eclipse each other. If one of these stars is much fainter than the other, the brightness of the star (as seen from Earth) can drop dramatically when the brighter component is covered by the other. For many of these stars this fade (which can be a number of magnitudes) occurs in only a few hours! They then return to maximum just as quickly. A typical period for EBs is a few days to a week or two.

There are also many other classes of Variables such as the spectacular eruptive *Novae* and *Supernovae* types.

S CARINAE (S Car)

This is a good star for the novice to try making estimates of brightness. S Car is a typical long period MIRA type variable. It is easy to find being located a little south west of the 3rd magn. star q Carinae. The star was found by the american astronomer Benjamin Gould from South America during the last century. This variable star has an extreme visual magnitude range of 5.5 down to 10.0 but it most often varies between 6th and 9th magnitude. Its current cycle (ie. bright to faint and back to bright) is approximately 150 days. At its brightest it is ideally suited for binoculars; at faintest a small telescope would be required. The star chart has reference stars with their magnitudes (the decimal point has been omitted ie. mag. 7.2 is shown as 72). When near maximum, S Car forms the western point of a small diamond figure with three field stars of magn. 7.2, 6.4 and 7.5 (as shown on the S Car. chart). When making estimates of brightness observers should try to pick a nearby star with the same magnitude. In most cases you will end up choosing 2 reference stars; one just fainter and one just brighter. Try then to interpolate as best as possible (you will get better with practice). It is recommended to make estimates when S Car (or any variable) is reasonably high in the sky. The star is well placed to observe in the early evening sky from February through to June. Weekly observations should be adequate to establish a good light curve. Once you have collected a number of observations a light curve similar to the one on this page can be created. The star is expected to return to maximum in 1995 during the months of February, June and December. To help find S Car, the star has been labelled on the wider field skyview diagram for December 24 (11:20pm) on page 52 (the black box in dashed lines corresponds to the S Car chart on this page).





APPENDIX F: RISE/SET TIME CORRECTIONS FOR OTHER LOCATIONS

This page is designed to help people, who live outside of Perth (Lat. 31° 57' S, Long. 115° 51' E), convert the rise/set times in this publication, to the corresponding times for their specific location. There are two corrections needed. they are:-

1. An adjustment for the difference in longitude. **For every degree of longitude east or west of Perth, subtract or add respectively 4 minutes to both the rise and set times.** Examples of corrections for various towns/cities are given in table 1.
2. An adjustment for the difference in latitude, which also requires the declination for the object of interest. Table 2 presents these corrections (south latitudes are negative). NB. **for rise times you add these values, for set - subtract**. For your specific latitude it is normally sufficient to interpolate these figures. If you wish a more accurate result, the following equation is used:-

$$\cos A = -\tan B * \tan C$$

where A = the semi-diurnal arc, B = declination of object and C = observer's latitude.

You need to calculate the value of A for Perth (C= -31.95) and subtract the value of A for your location/ object's declination. Express the answer in degrees (some computers give output in radians); then multiply by 4 to convert to minutes.

Example of rise/set time corrections.

Calculate the rise/set times for the Sun on Jan 21 for Kalgoorlie (30° 45'S, 121° 28'E).

	Rise	Set
From p. 60 the rise/set values are:-	5:31	19:24
Adjust for longitude (115.85 - 121.47) * 4	- :22	- :22
(or see table 1; value is negative due to Kalgoorlie being east of Perth.)		
Adjust for latitude/Declination of Sun from table 2	+:03	- :03
(Dec. = -20°02' see p. 61)		
Rise/Set times for Kalgoorlie are :-	5:12	18:59

TABLE 1

LONGITUDE ADJUSTS FOR SOME TOWNS/CITIES FROM PERTH

Location	Latitude (° 'S)	Longitude (° 'E)	Change in Longitude (decimal °)	correction (mins.)
W.A.				
Albany	35 01	117 53	-2.0	-8
Bickley Observatory	32 01	116 08	-0.3	-1
Bridgetown	33 58	116 08	-0.3	-1
Broome	17 58	122 14	-6.4	-26
Bunbury	33 20	115 38	0.2	1
Carnarvon	24 53	113 40	2.2	9
Denmark	34 58	117 21	-1.5	-6
Derby	17 19	123 38	-7.8	-31
Esperance	33 52	121 54	-6.1	-24
Eucla	31 41	128 53	-13.0	-52
Fitzroy Crossing	18 11	125 36	-9.8	-39
Geraldton	28 46	114 37	1.2	5
Giles Met. Stn	25 02	128 18	-12.5	-50
Kalgoorlie	30 45	121 28	-5.6	-22
Kellerberrin	31 38	117 43	-1.9	-7
Lake Grace	33 06	118 28	-2.6	-10
Marble Bar	21 10	119 45	-3.9	-16
Meekatharra	26 36	118 28	-2.6	-10
Mount Barker	34 38	117 40	-1.8	-7
Mount Magnet	28 04	117 51	-2.0	-8
Mount Newman	23 19	119 45	-3.9	-16
Mount Tom Price	22 41	117 47	-1.9	-8
Norseman	32 12	121 47	-5.9	-24
Northam	31 39	116 40	-0.8	-3
Onslow	21 38	115 07	0.7	3
Pemberton	34 27	116 02	-0.2	-1
Port Hedland	20 18	118 35	-2.7	-11
Rawlinna	31 01	125 20	-9.5	-38
Southern Cross	31 14	119 19	-3.5	-14
Wagin	33 19	117 20	-1.5	-6
Wiluna	26 35	120 14	-4.4	-18
Wyndham	15 28	128 06	-12.3	-49
Yampi Sound	16 08	123 36	-7.8	-31
OTHER AUSTRALIAN CITIES				
Adelaide	34 58	138 38	-22.8	-91
Brisbane	27 30	153 01	-37.2	-149
Darwin	12 21	130 55	-15.1	-60
Hobart	42 48	147 13	-31.4	-125
Melbourne	37 50	145 00	-29.2	-117
Sydney	33 54	151 15	-35.4	-142

TABLE 2 - RISE/SET CORRECTIONS FOR LATITUDE/DECLINATION FROM PERTH

Declination

South Latitude (negative)	30°	25°	20°	15°	10°	5°	0°	-5°	-10°	-15°	-20°	-25°	-30°
-12	-56	-45	-35	-25	-17	-8	0	8	17	25	35	45	56
-14	-51	-41	-32	-23	-15	-8	0	8	15	23	32	41	51
-16	-46	-37	-29	-21	-14	-7	0	7	14	21	29	37	46
-18	-41	-33	-25	-19	-12	-6	0	6	12	19	25	33	41
-20	-36	-29	-22	-16	-11	-5	0	5	11	16	22	29	36
-22	-30	-24	-19	-14	-9	-4	0	4	9	14	19	24	30
-24	-25	-20	-15	-11	-7	-4	0	4	7	11	15	20	25
-26	-19	-15	-12	-8	-6	-3	0	3	6	8	12	15	19
-28	-13	-10	-8	-6	-4	-2	0	2	4	6	8	10	13
-30	-7	-5	-4	-3	-2	-1	0	1	2	3	4	5	7
-32	0	0	0	0	0	0	0	0	0	0	0	0	0
-34	7	6	4	3	2	1	0	-1	-2	-3	-4	-6	-7
-36	15	12	9	6	4	2	0	-2	-4	-6	-9	-12	-15
-38	23	18	14	10	6	3	0	-3	-6	-10	-14	-18	-23
-40	31	25	19	13	9	4	0	-4	-9	-13	-19	-25	-31
-42	41	32	24	17	11	6	0	-6	-11	-17	-24	-32	-41
-44	51	39	30	22	14	7	0	-7	-14	-22	-30	-39	-51

APPENDIX G

JULIAN DATE — 1995

To calculate Julian Date, first convert local time to UT (subtract 8 hrs from W.A.S.T.) correcting the date if necessary. Next find the Julian date given in the table (below left) for the month you are interested in. Now add the day of the month. This will give you JD for 0hrs UT on the date in question. Then add the fraction of day from the second table (below right) that matches the time you are calculating for.

Example: you wish to know the Julian date at 21:00 WAST on July 17th. Subtract 8 hours to get UT

21 - 8 = 13:00 hrs

From the table The JD for July is 2449898.5 Add the day of month, 17 gives us 2449915.5

Now add the hours as a fraction of a day from the 2nd table. 13hr is 0.542. Thus JD at 21:00hr 17 Jul 95 WAST is 2449916.042

JULIAN DATE at 0hrs UT	
Month	Julian Date
Jan 0	244 9717.5
Feb 0	244 9748.5
Mar 0	244 9776.5
Apr 0	244 9807.5
May 0	244 9837.5
Jun 0	244 9868.5
Jul 0	244 9898.5
Aug 0	244 9929.5
Sep 0	244 9960.5
Oct 0	244 9990.5
Nov 0	245 0021.5
Dec 0	245 0051.5

Hours as Decimal Day			
01	0.042	13	0.542
02	0.083	14	0.583
03	0.125	15	0.625
04	0.167	16	0.667
05	0.208	17	0.708
06	0.250	18	0.750
07	0.292	19	0.792
08	0.333	20	0.833
09	0.375	21	0.875
10	0.417	22	0.917
11	0.458	23	0.958
12	0.500	24	1.000

APPENDIX H

SIDEREAL TIME — 1995

Greenwich mean sidereal time at 0hrs UT

Jan	0	06.6129	Jul	0	18.5063
Feb	0	08.6499	Aug	0	20.5433
Mar	0	10.4898	Sep	0	22.5803
Apr	0	12.5267	Oct	0	00.5516
May	0	14.4980	Nov	0	02.5886
Jun	0	16.5350	Dec	0	04.5599

You can use the following method to calculate Local Mean Sidereal Time. First convert your local time and date to U.T. Now calculate the Greenwich mean sidereal time (GMST) for that date.

GMST on day *d* of month at hour *t* U.T.

= GMST at 0h UT (from table above) + 0.06571 *d* + 1.00274 *t*

To convert this to Local mean sidereal time (LMST) we use

LMST = GMST + east longitude (or - west longitude)

where longitude is expressed in HOURS (not degrees!)

To convert longitude from degrees to hours, just divide by 15.

Example:

Find LMST at 21:00 hours Perth time on 17th July 1995.

21:00 local time = 13:00 UT. GMST for July 0 is 18.5063hrs.

GMST = 18.5063 + (0.06571 x 17) + (1.00274 x 13) = 32.6590

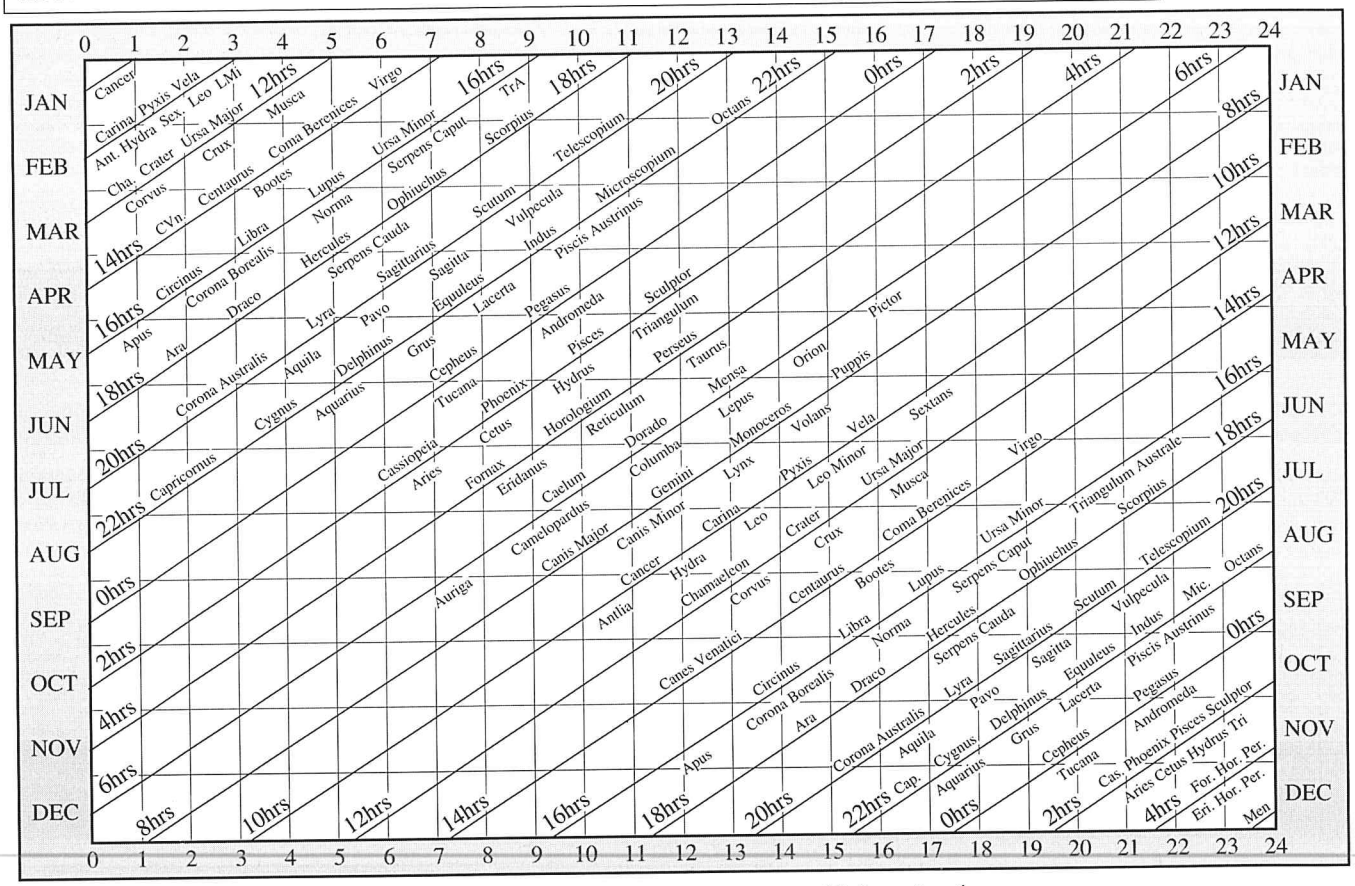
Perth's longitude is 115.85° which is 7.7233 hrs so

LMST = 32.6590 + 7.7233 = 40.3823

Subtract from or add to this multiples of 24 until it is in the range of 0 to 24

40.3820 - 24 = 16.3823 hrs or 16h 22m 56s

APPENDIX I — HOURS OF RIGHT ASCENSION / CONSTELLATIONS ON THE MERIDIAN



See introduction to part 2 (page 55) for explanation

APPENDIX J: OBSERVING MERCURY

This inner most world of our Solar System is not the easiest object to observe because of its constant closeness to the Sun (at its best elongations it does not stray by more than 30° from Sol). The best time to observe Mercury is at the time of maximum elongation (largest distance from the Sun). The time of the year of the "elongation" also effects its suitability. For example, the monthly text in this publication has already indicated that the "apparition" in September is the best time this year to observe Mercury in the evening sky. In fact, the period of Sept/Oct is a good time in the evening sky every year (if Mercury is correctly placed). Why?

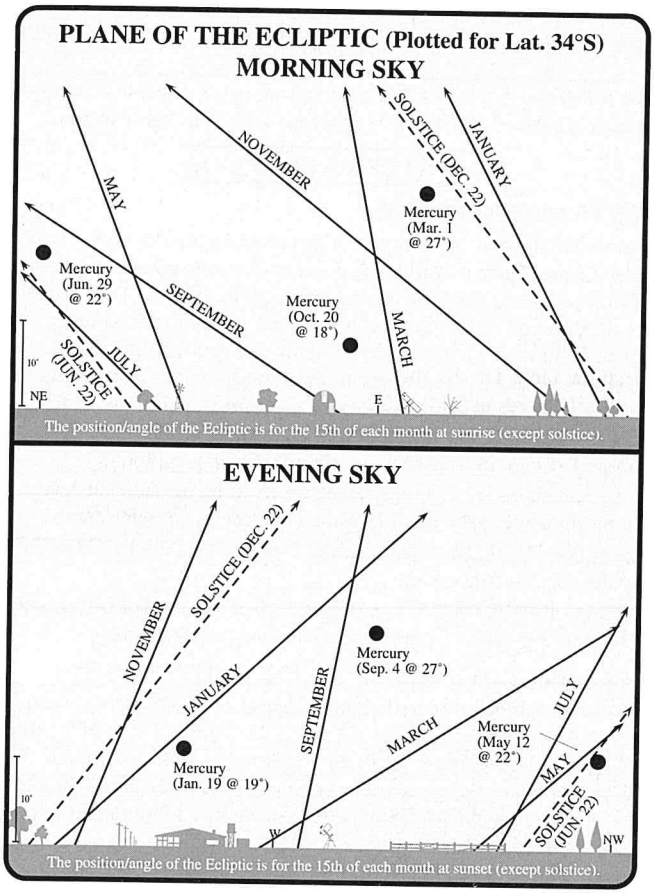
All the planets, except for Pluto, follow within a few degrees of the plane of the ecliptic (ie. the plane of the earth's orbit which shows as the apparent path the Sun takes each year through the heavens). The steeper (the more vertical) this "plane" is to the horizon, around the time of sunset/sunrise, the higher the altitude and better observability of a planet close to the Sun (assuming it is on the correct side of the Sun ie. on the east side after sunset, west - before sunrise). It can be seen from the accompanying diagram that:-

i) in the **evening sky** the ecliptic is steepest in September with the lowest angle in March (the actual dates are at the equinox). This is also why September is a good time of the year to look for the very young new moon.

ii) The reverse situation exists in the **morning sky** (western elongations); the "March 1st" elongation is well placed (regarding maximum altitude).

iii) **NB.** In the **northern hemisphere** points i) and ii) are the **exact opposite** (ie. March is best for evening observations). This can be a source of confusion when reading the USA/British biased astronomy magazines.

Mercury's observability, in any September evening elongation, is also assisted by the planet being near aphelion. That is, the planet is at its furthest point from the Sun (or widest angle as seen from earth). Note the September evening elongation is 27° compared to June and October's being 22° and 18° respectively. Because the planet does not lie exactly on the ecliptic, its relative ease of observing is also helped when the planet has a negative declination.



APPENDIX K: CONSTELLATIONS - Abbreviations and Culmination at 9pm.

Name	Genitive	Abr.	Cul.
Andromeda	Andromedae	And	Nov 23
Antlia	Antliae	Ant	Apr 10
Apus	Apodis	Aps	Jul 05
Aquarius	Aquarii	Aqr	Oct 09
Aquila	Aquilae	Aql	Aug 30
Ara	Arae	Ara	Jul 25
Aries	Arietis	Ari	Dec 14
Auriga	Aurigae	Aur	Feb 04
Bootes	Bootis	Boo	Jun 16
Caelum	Caeli	Cae	Jan 15
Camelopardus	Camelopardi	Cam	Feb 06
Cancer	Cancri	Cnc	Mar 16
Canes Venatici	Canum Venaticorum	CVn	May 22
Canis Major	Canis Majoris	CMa	Feb 16
Canis Minor	Canis Minoris	CMi	Feb 28
Capricornus	Capricorni	Cap	Sep 22
Carina	Carinae	Car	Mar 17
Cassiopeia	Cassiopeiae	Cas	Nov 23
Centaurus	Centauri	Cen	May 14
Cepheus	Cephei	Cep	Nov 13
Cetus	Ceti	Cet	Nov 29
Chamaeleon	Chamaeleontis	Cha	Apr 15
Circinus	Circini	Cir	Jun 14
Columba	Columbae	Col	Feb 01
Coma Berenices	Comae Berenices	Com	May 17
Corona Australis	Coronae Australis	CrA	Aug 14
Corona Borealis	Coronae Borealis	CrB	Jul 03
Corvus	Corvi	Crv	May 12
Crater	Crateris	Crt	Apr 26
Crux	Crucis	Cru	May 12
Cygnus	Cygni	Cyg	Sep 13
Delphinus	Delphini	Del	Sep 14
Dorado	Doradus	Dor	Jan 31
Draco	Draconis	Dra	Jul 08
Equuleus	Equulei	Equ	Sep 22
Eridanus	Eridani	Eri	Dec 25
Fornax	Fornacis	For	Dec 17
Gemini	Geminorum	Gem	Feb 19
Grus	Gruis	Gru	Oct 12
Hercules	Herculis	Her	Jul 28
Horologium	Horologii	Hor	Dec 25
Hydra	Hydrae	Hya	Apr 29
Hydrus	Hydri	Hyi	Dec 10
Indus	Indi	Ind	Sep 26
Lacerta	Lacertae	Lac	Oct 12
Leo	Leonis	Leo	Apr 15
Leo Minor	Leonis Minoris	LMi	Apr 09
Lepus	Leporis	Lep	Jan 28
Libra	Librae	Lib	Jun 23
Lupus	Lupi	Lup	Jun 23
Lynx	Lyncis	Lyn	Mar 05
Lyra	Lyrae	Lyr	Aug 18
Mensa	Mensae	Men	Jan 28
Microscopium	Microscopii	Mic	Sep 18
Monoceros	Monocerotis	Mon	Feb 19
Musca	Muscae	Mus	May 14
Norma	Normae	Nor	Jul 03
Octans	Octantis	Oct	Circum
Ophiuchus	Ophiuchi	Oph	Jul 26
Orion	Orionis	Ori	Jan 27
Pavo	Pavonis	Pav	Aug 29
Pegasus	Pegasi	Peg	Oct 16
Perseus	Persei	Per	Dec 22
Phoenix	Phoenicis	Phe	Nov 18
Pictor	Pictoris	Pic	Jan 30
Pisces	Piscium	Psc	Nov 11
Piscis Austrinus	Piscis Austrini	PsA	Oct 09
Puppis	Puppis	Pup	Feb 22
Pyxis	Pyxidis	Pyx	Mar 21
Reticulum	Reticuli	Ret	Jan 03
Sagitta	Sagittae	Sge	Aug 30
Sagittarius	Sagittarii	Sgr	Aug 21
Scorpius	Scorpii	Sco	Jul 18
Sculptor	Sculptoris	Scl	Nov 10
Scutum	Scuti	Sct	Aug 15
Serpens	Serpentis	Ser	Jul 21
Sextans	Sextantis	Sex	Apr 08
Taurus	Tauri	Tau	Jan 14
Telescopium	Telescopii	Tel	Aug 24
Triangulum	Trianguli	Tri	Dec 07
Triangulum Australe	Trianguli Australis	TrA	Jul 07
Tucana	Tucanae	Tuc	Nov 01
Ursa Major	Ursae Majoris	UMa	Apr 25
Ursa Minor	Ursae Minoris	UMi	Jun 27
Vela	Velorum	Vel	Mar 30
Virgo	Virginis	Vir	May 26
Volans	Volantis	Vol	Mar 04
Vulpecula	Vulpeculae	Vul	Sep 08

APPENDIX L

PLACES OF ASTRONOMICAL INTEREST

The following is a list of places of astronomical interest. All the locations cater to the public in regards to tours and/or displays.

WESTERN AUSTRALIA

PERTH OBSERVATORY

Situated in the Darling Ranges, 40km inland from the West coast, Perth Observatory is well located to conduct astronomical research as well as educational activities for the public of WA. Telescopes are used as part of the Observatory public education program, where visitors can come to the grounds on specific nights for viewing evenings. A substantial museum, showing instruments from the old Observatory as well as meteorites, paintings and photographs has been established to inform and educate the constant stream of tourists.

Hours: each week, a Sunday afternoon tour is provided at 3pm. Night tours and week day tours are available by appointment.

Cost: Day Tours, $4 Adults and $2 Concessions. Night Tours, $7 Adults and $4 Concessions.

Contact: (09) 293-8255, Fax (09) 293-8138. Recorded Information Line (09) 293-8109. Email:Astro@earwax.pd.uwa.au.oz

GOLDEN GROVE OBSERVATORY - ASTRO NIGHTS

This observatory is located at the Golden Grove Tourist Orchard in scenic Lower Chittering. Access is via the Tourist Drive 359 and is about one hours drive from Perth. Equipment includes; Meade DS16 and DS10 newtonian telescopes and a Celestron 8. The site has been designed with the amateur astronomer in mind and has a library and computer facility.

Hours: Open Saturday nights, 8 to 10pm (weather permitting). Other nights for special events/ groups can be arranged.

Cost: Adult $18, Child $10 and family $42 (special group rates).

Contact: Meg (09) 448-4987

NEW SOUTH WALES

THE AUSTRALIA TELESCOPE - NARRABRI ARRAY

The Australia Telescope operates in the radio region of the spectrum. It essentially uses high technology to combine the signals from a number of dishes, or elements, to obtain the performance of a single theoretical dish a number of kilometres in diameter. The "compact array", located at the CSIRO's Paul Wild Observatory near Narrabri, is the heart of the telescope. It consists of six 22m dishes which are spaced along a 3km track. Another 7th dish for the array is located a few kilometres west of Coonabarabran (on the way up to Siding Spring Observatory). The Tidbinbilla Tracking Station and Parkes Radio Telescope are also equipped to form part of the array.

The visitors centre, at Narrabri, is well located. Being adjacent to the array's track, good views of the dishes are available. There is an excellent display and video tape presentation which explains the concepts behind the telescope and Radio Astronomy in general.

Hours: 8:00am to 4:00pm every day (it is normally not staffed on weekends, except for school holidays).

Cost: There is no charge to visit the centre. There is a cost of $60 (depending on numbers) for bus tours; refreshments also available if booked in advance. There is no charge for school groups.

Contact: (067) 90-4070.

BOWEN MOUNTAIN OBSERVATORY

This observatory is operated by the Astronomical Society of NSW. It is located on Bowen Mountain, near North Richmond (north west of Sydney). It houses a 40cm Dobsonian telescope. The observatory is open on Friday and Saturday nights (not every week). Visitors are most welcome.

Contact: Adrian Saw (045) 72-1568

NEPEAN ASTRONOMY CENTRE

This observatory is located at the University of Western Sydney, Werrington Campus (near Penith, Sydney). This centre is due to open in late October, 1994. The heart of the centre is a professional 60cm telescope housed in a 6.5m dome. As well as being a university facility, the observatory will be opened to the public on a regular basis (weekly). It is the largest public access telescope in the Sydney region.

Cost: A modest fee will be charged.

Contact: (02) 678-7338 or (02) 685-9326, fax (02) 685-9351

GREEN POINT OBSERVATORY

The observatory is operated by the Sutherland Astronomical Society (SAS). Visitors are most welcome; the observatory is open on Thursday nights. The society also runs regular open nights which are very popular with the general public. Contact the SAS (under society appendix) for details.

(ACT) THE CANBERRA OBSERVATORY

This professional quality astronomy complex is located at the Downer Club in Canberra. The address is Hawdon Place, Dickson (off Antill Street). There is no charge for admission to the centre for it is sponsored by the Canberra Tradesmen's Union Club. The telescopes of the observatory are world class and include; a 41cm Newtonian-cassegrain IK6 with 17.8 cm Astro-Physics Starfire refractor (in a 5.2 metre dome) and a Celestron 14 (in a 4.2 metre dome). The astronomers staffing the observatory are members of the Canberra Astronomical Society. The next project for the observatory will be a 100 seat planetarium. Being located at a club there is also a coffee shop (open 10am - 10pm) and a bistro (hours 12.00 - 2.30pm, 6.00 - 9.00pm).

Contact: (06) 248-5333 or fax (06) 257-1256.

PARKES RADIO TELESCOPE

The observatory is located on the western plains of NSW, a few kilometres north of Parkes (just off the Newell Highway). The Parkes Telescope was indeed a pioneer in Radio Astronomy. It is still a "work horse" and functions as part of the Australia Telescope. At the observatory, public education has a high priority, hence their impressive visitors complex. As well as having a great view of the telescope, the centre offers a superbly-crafted audio/ visual presentation on Astronomy and the Universe.

Hours: 8:30am to 4:15pm - every day of the year, except for Christmas Day, Boxing Day, Good Friday and Anzac Day.

Cost: Admission to visitor's centre is free. A modest charge is made for the Audio/Visual presentation.

Contact: (068) 61-1777

SIDING SPRING OBSERVATORY

The Warrumbungle National Park indeed makes a magnificent setting for, this, one of the few world class observatories located under the beautiful southern hemisphere skies. The Observatory is located 25 kilometres west of Coonabarabran. The most prominent feature, and the first sight to greet visitors, is the tall, white dome of the Anglo-Australian Telescope (AAT). This 3.9 metre telescope is still the "flag-ship" for optical astronomy in this country. Siding Spring Mountain also is the home for a number of other telescopes such as the Australian National University's (ANU) 0.4m, 0.6m, 1.0m and the 2.2m Advanced Technology Telescope (ATT). The 1.2m Schmidt Camera is also located on the mountain. For the public, the only telescope that is made available to visitors (except for open days) is the AAT itself. A viewing gallery offers visitors an excellent view of this telescope that has contributed so much to man's knowledge of the Universe. The Visitor's Centre consists of the "Exploring the Universe" exhibition. This provides an introduction to the science and technology of modern astronomical research.

Hours: 9:30am to 4:00pm every day. (it is only closed on Christmas Day).

Cost: $5:00 Adults, $3:00 Children/concession and $12:00 Family.

Contact - (068) 42-6211.

PORT MACQUARIE OBSERVATORY

Observing nights are organised as required. Contact the Port Macquarie Astronomical Society for more information.

MT. STROMLO OBSERVATORY

For many years, Mt Stromlo was greatly responsible for the excellent worldwide reputation of Australian optical astronomical research. Since the establishment of Siding Spring Mountain Observatory much of the Astronomical breakthroughs are now being made in the dark, clear skies over the Warrumbungles. The ever increasing light pollution over Canberra is also restricting the type of research that can be conducted at Mt. Stromlo.

Mt. Stromlo is home to a multitude of telescopes. When first visiting the observatory, the number of domes, of all sizes, can be quite fascinating. None of the domes are open to the public for inspection. However, the visitors gallery, which is built onto the side of the 1.9m telescope building, gives a view of this instrument through a window. The 1.9m was the largest (most light gathering power) optical telescope in Australia before the AAT and the ATT. The visitors centre is a static display of posters and photographs which illustrates the history and work at the observatory.

Hours: 9:30am to 4:00pm - 7 days per week. Cost: There is no charge.

Contact: (06) 249-0230

SCIENCE CENTRE/ PLANETARIUM

Located at the University of Wollongong. Contact the university for details of show times/costs.

SKYWATCH NIGHT'N'DAY OBSERVATORY

This public observatory is the latest attraction in Coonabarabran (home of the Siding Spring Mountain Observatory). It is located on the Timor Road, 2km west of the Clock Tower. For the convenience of visitors all the displays including the main dome/telescope and planetarium are open during the day as well as the night. Light refreshments are also available at the complex.

Hours: 2:00pm to 10:00pm (out of hours viewing by arrangement eg. school groups)

Contact: (068) 42-2506 or fax (068) 42-2978

SYDNEY OBSERVATORY

The observatory is located in a park just a short walk from the historic "Rocks" district of Sydney. It is very close to the southern end of the Harbour Bridge. Since the Powerhouse Museum took over running the observatory, it has had a renewed interest in public education. The centre is set up for a more "hands-on" approach for visitors, with a number of displays and films on Astronomy. On weekends, visitors are invited to observe the Sun - the safe way (weather permitting). Night time tours include observations of the Moon and Planets through the observatory's historic telescopes.

Hours: 2pm to 5pm, Monday to Friday; 10am to 5pm, Saturday, Sunday and school holidays and night sessions (times are seasonal). Bookings are required for evening tours.

Cost: There is a charge for evening sessions - $5:00 Adults, $2:00 Students or concession and $12:00 for Families.

Contact: (02) 217-0485.

TIDBINBILLA TRACKING STATION

The station is located 40km southwest of Canberra, further along the same road you would take to visit Mt. Stromlo. In fact, Stromlo and Tidbinbilla would make a fascinating day trip if you were visiting or living in the ACT.

The Tidbinbilla complex is a major link in NASA's deep space tracking network. It has played a large role in nearly all of NASA's lunar and planetary probes. The Tracking Station, in the past, has also teamed up with the Parkes Radio Telescope to jointly monitor the faint signals from the distant Voyager spacecrafts as they made their historic flybys of the outer planets.

As one would expect, the visitors centre concentrates on both NASA's manned and unmanned probes. The centre incorporates audio and visual displays as well as a multi-slide production. In December 1990, an additional visitor's building was opened which has more spectacular displays and a new theatre. The visitors area offers an excellent view of the main antenna (dish). There is also the "Moon Rock Cafe" which is a well equipped souvenir and sandwich/ hot food shop.

Hours: 9:00am to 5:00pm, 7 days per week (extended hours during daylight saving).

Cost: There is no charge for the visitor's centre.

Contact: (06) 201-7800

QUEENSLAND

THE SIR THOMAS BRISBANE PLANETARIUM

The planetarium is located in the beautiful surrounds of the Mt. Cootha Botanic Gardens in Brisbane. Regular programmes are presented by a full-time curator in the Planetarium's "Cosmic Skydome". The programmes are based on specific astronomical themes and are changed regularly. The "Cosmic Skydome" consists of an artificial sky which is projected onto the interior surface of a 12.5 metre dome. This is certainly a "world class" planetarium and well worth the visit! There is also a Gallery, which surrounds the theatre, which houses an interesting collection of artefacts related to astronomy. A special feature of the Planetarium is the 15cm refractor and 44cm "deep sky" reflector. If sky conditions are suitable, on nights of operation, viewing sessions can be organised for a limited number of visitors.

Theatre Times: 3:30pm and 7:30pm - Wednesday to Friday (also 1:30pm during Queensland school holidays). 1:30pm, 3:30pm and 7:30pm on Saturday. 1:30pm and 3:30pm on Sunday. Visitors are requested to arrive 10 mins. before the starting time.

Cost: $7:50 Adults, $3:50 Children (under 15 years) and concessions of $6.00 for Students / Pensioners.

Bookings and Enquires - (07) 377-8896 - Wednesday to Sunday ONLY.

SOUTH AUSTRALIA

UNIVERSITY OF SOUTH AUSTRALIA PLANETARIUM

The planetarium was originally installed to teach surveying to students at the university. It is now available to the public.

Contact: (08) 223-1272 for details of show times and cost.

TASMANIA

LAUNCESTON PLANETARIUM

The planetarium is in the Queen Victoria Museum, Wellington St..

Show Times: Tues. to Sat., 2:00pm and 3:00pm. Also Mondays during school holidays. Group bookings by arrangement.

Cost: $2:00 Children (under 15), $3:00 Adults and $7:00 family (children under 5 years old are not admitted)

Contact: (003) 31-6777

VICTORIA

H.V.MCKAY MELBOURNE PLANETARIUM

Contact: as for Melbourne Observatory (see below), for costs and programme/timetable details for 1995.

MELBOURNE OBSERVATORY

The historic Old Melbourne Observatory is located in the Botanic Gardens at South Yarra. The observatory is very popular and it is important to make bookings. For 1995, bookings will open in January and the year is normally booked out by mid March. The dates vary and are usually set around first quarter moon. Times are 8:00pm to 10:00pm and occasionally day time demonstrations are organised. There are open days (no booking is required) on the last Sunday of each month (2-4pm) and first Saturday (8-10pm)

Contact (03) 669-9973 (at Museum of Victoria) for bookings and cost.

APPENDIX M
ASTRONOMICAL COURSES, SOURCES OF INFORMATION IN 1994

The following lists astronomy courses, events, magazines and radio programs, known to the authors, for 1995. This list is by no means intended to be exhaustive. Across the country there are no doubt many other evening courses held at various Universities and Colleges. Enquires from the general public are most welcome.

A number of the amateur astronomical societies also provide an invaluable service to public education by their lectures and open nights. You will need to contact the societies for further details.

SKY AND SPACE MAGAZINE (formerly SOUTHERN ASTRONOMY) This astronomy and space exploration magazine is produced specifically for enthusiasts in Australia and New Zealand. It covers a wide range of astronomy related topics. It caters to both the very experienced and the novice. The magazine is bi-monthly and is widely available through newsagencies or by subscription. Phone (02) 387 6666, Fax (02) 369 3366.

SOUTHERN SKY MAGAZINE This new bi-monthly magazine is specifically designed for the southern hemisphere. It is intended to appeal to a wide audience as well as providing information on a large range of topics of interest to the amateur astronomer. The magazine is available through newsagents or by subscription. Phone (06) 288 5162, Fax (06) 288 1277.

ASSOCIATION AGAINST OBTRUSIVE LIGHTING The AAOL is a non-profit organisation which aims to protect the environment, the night sky, and the public from the detrimental effects of light pollution. Contact: Qld Branch, PO Box 363, Springwood QLD 4127, Phone (07) 808 1810; Vic Branch, PO Box 1023, Croydon VIC 3136, Phone (03) 723 4356

SKY AND TELESCOPE ASTRONOMY HOTLINE "SKYLINE". Telephone 0011-1-617-497-4168.

NEW SOUTH WALES

W.E.A./ SYDNEY OBSERVATORY COURSE Sydney Observatory and the WEA will run a number of beginner astronomy courses based at the observatory during 1995. Contact WEA (02) 264-2781 or Sydney Observatory (02) 217-0485 for cost, timetable details.

SOUTH PACIFIC STAR PARTY. A national gathering of amateurs for a week of observing under country skies. This is held at the Astronomical Society of NSW's (ASNSW) property at Ilford, NSW. To be held from May 25. Contact the ASNSW (see society appendix)

PRACTICAL ASTRONOMY (SASPAC) A practical astronomy course for beginners and interested amateurs. This is an 8 week course conducted by Sutherland Astronomical Society during spring/autumn. Each 1 hour lecture is followed by observations with the society's equipment. Cost is $60. Contact Laurie Purcell (Sec.) (02) 543-4261

Venue: Green Point Observatory (Sutherland).

INTRODUCTION TO ASTRONOMY Course (A. James). 8 weeks (16 hrs), .Cost: $64 ,Venue: Strathfield Evening College (02) 764-1499

THE SKY THIS WEEK Radio show, conducted by Geoff McNamara, describing the events in the night sky over the coming week. "The Sky this Week" also looks at the nature of the objects visible in the night sky as well as other related topics. Time: Tuesday 7:10pm on 2SER FM (107.3 MHz).

VICTORIA

SKYLINE This is a prerecorded information service run by the Astronomical Society of Victoria. It is designed to cover the latest astronomical discoveries. The cost is only for the telephone call. Phone (03) 888-7130.

THE SPACE SHOW This Melbourne radio programme is run by Andrew Rennie & Mark Hillyer, Wed. Even. (1 hr) on 3SCB FM (88.3MHz).

W.E.A. COURSES Beginners and advanced courses are run each semester. Contact the W.E.A. for costs and dates. Phone (08) 223-1272.

AMATEUR ASTRONOMY SHORTWAVE STATION (VK3 EKH). This station is run by members of the Astronomical Society of Victoria. It broadcasts to Australia on Fridays (from 10pm) on 3.543MHz (LSB).

QUEENSLAND

WEEKEND ASTRONOMY COURSES. Held at the South Brisbane College of TAFE. Course is 17 hours (including 4 hours of practical at Manly Observatory). For further details contact (07) 844-1471 or J. Barclay (07) 396-1391.

TASMANIA

The "Adult Education Department" (Hobart) occasionally run Astronomy courses. Phone (003) 44-7100.

APPENDIX N
ASTRONOMICAL SOCIETIES

The following is a list of the amateur societies in Australia. A common philosophy within all these organisations, is the emphasis they place on public education. Enquiries from anyone, with an interest in astronomy, are most welcome. Where given, annual fees are correct as of printing (Sep. 1994). The authors of this publication are keen to keep the information in this section "evergreen". It would be appreciated if any significant change occurs (especially new organisations) that the society write to the authors c/o Quasar's PO box (the deadline for ASTRONOMY 1996 will be early Sep. 95).

WESTERN AUSTRALIA

ASTRONOMICAL SOCIETY OF WA

The objectives of the Society are the stimulation of a popular interest in astronomy, the association of observing astronomers, especially the possessors of small telescopes, for mutual help and their organisation in the work of astronomical observation.To this end the Society provides a regular forum to enable Members to meet, share ideas, and discuss the latest advances and discoveries. Assists and encourages Members with their astronomical projects such as telescope construction, astro-photography, radio-astronomy, deep sky observing etc. Promotes public awareness of astronomy by holding regular viewing nights for the public, and by providing speakers to schools, clubs and community groups. Conducts regular "astro-camps" at remote locations with good accommodation and very dark skies.

The Society meets at 8 pm on the 2nd Monday of every month at the gymnasium of Wesley College situated on the corner of Coode and Angelo Streets South Perth, visitors are most welcome.

The Society owns a wealth of astronomical apparatus for use (and in some cases for loan) by Members, from binoculars and star maps to a range of powerful reflecting telescopes up to 17.5" diameter mirror.

A library is maintained which includes a large selection of Astronomical books magazines and other material which may be beyond the budget of an individual. Members are encouraged to borrow from the library for their research and interest.

The SIDEREAL TIMES is a Journal of the Society. Published bi-monthly it contains information regarding current and future astronomical phenomena, gleanings from lectures and publications of astronomical organisations around the world, and details of past and future activities within the Society.

The Society Conducts regular "astrocamps" at remote locations with good accommodation and very dark skies. These provide an ideal opportunity for members and guests to get to know each other, and share ideas and plans beneath a perfect night sky.

The establishment of special-interest groups called Sections is encouraged, to enable those who specialise in particular aspects of astronomy to share their ideas, their plans and their successes. At present the Society supports Sections dedicated to Planets, Comets, Meteors, Deep Sky Objects, Radio-Astronomy, Astro-Photography and Astro-Computing.

Courses in astronomy are conducted and classes are held monthly.

Membership of the Society is open to all. Fees consist of a once only nomination fee and an annual subscription paid on 1 July each year as follows; Inquiries can be made by ringing ASWA on (09) 458 8462.

Fees: Ordinary Member, $10 Nom $30 Sub; Associate Member, $6 Nom $15 Sub; Junior Member (under 18), $6 Nom $15 Sub.

Address: P.O.Box 421 Subiaco WA 6008

Contact: (09) 458-8462.

NEWMAN ASTRONOMICAL SOCIETY

Newman Contact: (091) 75-2660

PILBARA ASTRONOMICAL SOCIETY

Sth Hedland Contact: (091) 40-1512

MURDOCH ASTRONOMICAL SOCIETY

The Murdoch Astronomical Society is a very active body based at Murdoch University. Membership is open to the general public and no extensive knowledge of astronomy is required, only an interest in astronomy. Meetings are conducted each month at the University and feature talks by members on various topics, slides taken by members and professional observatories, and observing (if the weather is suitable). During the warmer month, meetings are preceded by a barbeque at Murdoch University. At present the society owns two telescopes - 15cm and 30cm Newtonians. The 15cm is available for loan to members, while the 30cm is mounted at the University. Also, many members have their own equipment, some of which is very sophisticated. In addition to the meetings, the society has been very active in taking astronomy to the public via viewing nights, and conducts annual camps for members at Meeline Station near Mount Magnet. As well as having access to the University library, the society has its own small library of magazines and slides available to members.

Fees: Murdoch Students $ 6, Non Students $12
Address: c/- Murdoch University, School of Mathematical and Physical Sciences, Murdoch WA 6150
Contact: T.Belcher (09) 332-661

ASTRONOMICAL SOCIETY OF THE SOUTH WEST

The main aim of the Astronomical Society of the South West Inc (ASSW) is to increase public awareness of the heavens and the beauty contained therein, as well as the more technical aspects of astronomical research.The ASSW owns a 50cm Newtonian (modified Dobsonian) telescope which has now been installed in their new observatory - a brick building with a dome. At our monthly meetings you will usually see us out of doors on good nights, observing objects of special interest. We also advise on buying a telescope, and offer our services to clubs and schools conducting classes in astronomy.

Address: P.O.Box 1100 Bunbury WA 6230
Contact: (09) 95-8516

NEW SOUTH WALES

ASTRONOMICAL SOCIETY OF COONABARABRAN

Meets on the third Thursday of each month at the Tourist Information Centre.

Fees: $10
Address: C/- AAO Private Bag, Coonabarabran NSW 2357
Contact: Paul Cass (068) 42-2994

ASTRONOMICAL SOCIETY OF THE HUNTER

Meetings are held at the Kurri TAFE College on the first Friday of each month at 7:30pm.

Fees: $20 adult, $25 family
Address: PO Box 69, Kurri Kurri NSW 2327
Contact: George Livanos (049) 69-2313

ASTRONOMICAL SOCIETY OF NSW

The society holds meetings twice per month at the "Catholic College of Education", 179 Albert St, Strathfield.

Fees $34 Full, $29 Associate, $10 Student (under 18) and $26 Student (over 18). There is no joining fee.
Address: PO Box 208, Eastwood NSW 2122
Contact: Tony Buckley (President) (02) 874-2070.

BRITISH ASTRONOMICAL ASSOCIATION - NSW BRANCH

The BAA meets at Sydney Observatory on the third Wednesday of each month, commencing at 7:45pm.

Address: Sydney Observatory, Watson Rd., Sydney 2000
Fees: $35 Full, $17.50 Junior (no joining fee) and there are family concessions available. There is 50% Joining Fee.
Contact: Michael Chapman (02) 949-1058

(ACT) CANBERRA ASTRONOMICAL SOCIETY

Hold meetings at the ANU Jaeger Building on the 3rd Thursday of each month (except Dec/Jan) at 8:00pm.

Fees: $25 adult, $15 student/ pensioner and $20 country.
Address: PO Box 1338, Woden ACT 2606
Contact: Patrick Purcell (06) 288-7394

HAWKESBURY ASTRONOMICAL ASSOCIATION

Meetings are held at Windsor library on the 2nd Wednesday of month.

Fees: $20 adult, $30 family and $10 student.
Address: PO Box 670 Windsor NSW 2756
Contact: Adrian Saw, (045) 72-1568

ILLAWARRA ASTRONOMICAL SOCIETY

Meetings are held at the Uni. of Wollongong Science Centre, Fairy Meadow, on the second Tuesday of each month at 7:30pm.

Fees: $15 adult, $10 junior.
Address: PO Box 1814, Wollongong NSW 2500
Contact: Peter MacKinnon (042) 29-6696

NORTHERN DISTRICTS SOCIETY OF AMATEUR ASTRONOMERS

Meetings are held at Riverview Observatory (St. Ignatius College), Lane Cove on the 3rd Tuesday of each month at 7:30pm. The society has a quarterly journal.

Fees: $30 adult
Contact: Gordon Stott (pres.) (02) 871-7838 or Tony White (sec.) (02) 44-4690

PARKES ASTRONOMY CLUB

The club has infrequent meetings but holds regular observing nights.

Fees: None
Address: Australia Telescope, PO Box 276, Parkes NSW 2870
Contact: Ian McGovern (068) 62-3677

PORT MACQUARIE ASTRONOMICAL ASSOCIATION

Meets at the Port Macquarie Observatory, open to organised groups on Wed. & Sun

Address: PO Box 1453, Port Macquarie NSW 2444
Fees: $5
Contact: Jim Daniel (065) 83-1933

SHOALHAVEN ASTRONOMERS

Meet at the library, Falls Creek Public School on the third Friday of each month at 7:30pm. They also have a monthly journal.

Fees: $20 adult and $10 junior.
Address: PO Box 388, Nowra NSW 2541
Contact: David Hawksworth (044) 41-5866

SUTHERLAND ASTRONOMICAL SOCIETY

The SAS meets every Thursday at 8:00pm (visitors welcome).

Fees: $25 Full, $15 Student/Associate, $10 Junior/ Pensioners $35 families. Joining fee - Full/Family $15, others $5.
Address: PO Box 31, Sutherland NSW 2232.
Contact: Laurie Purcell (02) 543-4261

TAREE ASTRONOMICAL SOCIETY

The society meets at the Community Centre, Mabiac on the second Thursday of each month at 7:30pm.

Fees: $20 adult, $10 student and $30 family.
Address: PO Box 111, Taree NSW 2430
Contact: Mr. Jim Ross (065) 50-2213

WESTERN SYDNEY AMATEUR ASTRONOMICAL SOCIETY

The society meets 3rd Wednesday of the month at the Nepean Astronomy Centre, Uni. of Western Sydney, Werrington Campas.

Fees: $20 Full, $15 Student/Concession and $30 family
Address: PO Box 400, Kingswood NSW 2747
Contact: John Jarman (047) 30-1588

QUEENSLAND

MT. ISA ASTRONOMY GROUP

Contact: (077) 43-5385

ASTRONOMICAL ASSOCIATION OF QLD (AAQ)

Meetings are held on the Saturday nearest to full moon at 7:30pm at the association's clubhouse at 25 Elgar St., Holland Park. They hold regular Astrocamps, public field nights and publish a monthly journal and Annual Proceedings.

Fees: $35 adult, $23 student and pensioner.
Address: PO Box 101, St. Lucia QLD 4067
Contact: Stephen Hutcheon (07) 206-4338

BRISBANE ASTRONOMICAL SOCIETY

Meet on the second Friday of each month at 7:30pm. Venue is Kelvin Grove State High..
Fees: $25 adult, $30 family and $15 student and pensioner (plus $5 joining fee).
Address: PO Box 204, Morningside QLD 4170
Contact: Darryl Mitchell (07) 349-8393

BUNDABERG ASTRONOMICAL SOCIETY

Meetings are held at Alloway Observatory on every Friday of each month at 7:30pm.
Fees: $30 adult and $15 junior. (also joining fee except country members and juniors)
Address: PO Box 586, Bundaberg QLD 4670
Contact: Karlene Galway (071) 59-9674

CAIRNS ASTRONOMY GROUP

Hold monthly meeting at Bob's place (see below)
Fees: $12
Address: 18 Yurongi St., Caravonica QLD 4878
Contact: Bob Dollery (070) 58-1180

SOUTH EAST QUEENSLAND ASTRONOMICAL SOCIETY

The society meets at the Teachers Training College, Kedron High on the third Monday of each month.
Address: 17 Enchelmaier St., Dayboro QLD 4521
Contact: John Stewart (07) 425-1640

SOUTHERN ASTRONOMICAL SOCIETY

Meetings are held at Pimpama State School on the second Saturday of each month at 7:30pm.
Fees: $28 adult and $21 student.
Address: PO Box 867, Beenleigh QLD 4207
Contact: Ray Suckling (075) 78-3795

SUN COAST ASTRONOMICAL SOCIETY

Meets monthly at Caloundra State High (except Dec/Jan.) at 7:30pm.
Address: PO Box 166, Kenilworth QLD 4574
Contact: Col Blumson (074) 46-7449 or Ron Knight (074) 46 0908

TOWNSVILLE ASTRONOMY GROUP

Meets on last Wednesday of each month at 7pm at Kirwan State High.
Fees: $15
Address: 21 Gladys St., Kelso QLD 4815.
Contact: Richard Free (077) 89-2214

TASMANIA

ASTRONOMICAL SOCIETY OF TASMANIA (AST)

Meetings are held at the Hutchins School, Sandy Bay, on the last Tuesday of each month (except December).
Fees: $29 family, $27 full, $24 country (joining fee $5) and $17 concession (joining fee $2).
Address: c/o Norwood Ave. PO, Launceston TAS 7250
Contact: Karen Barnes (003) 44-7100

VICTORIA

ALBURY WODONGA ASTRONOMICAL SOCIETY

The society has occasional meetings at Wodonga High and holds regular viewing nights at the observatory at the school.
Fees: $12 adult, $15 family
Address: 1 Poplar St., Wodonga VIC 3690
Contact: John Hawkin (060) 24-5535

ASTRONOMICAL SOCIETY OF FRANKSTON

Meets at the Peninsula Church of England School, Mt Eliza, on the 3rd Wednesday of each month at 8pm.
Fees: $20 adult, $15 concession/ junior and $30 family.
Address: PO Box 596, Frankston VIC 3199
Contact: Don Leggett (059) 85-4927

ASTRONOMICAL SOCIETY OF GEELONG

Holds a general meeting the last Friday of each month, plus meetings every other Friday. The venue is the Belmont Common (Breakwater Rd., Breakwater).
Fees: $30 adult, $45 family and $15 junior and concession.
Address: PO Box 1799, Geelong VIC 3220
Contact: Miles Charlesworth (Pres.) (052) 21-7484 or Robert Cowdell (Sec.) (052) 55-2702.

ASTRONOMICAL SOCIETY OF VICTORIA (ASV)

Meetings are held on the 2nd Wednesday of each month (except Jan.) at the Herbarium, Botanic Gardens in Melbourne.
Fees: $35 ordinary members, $40 family, $24 junior (under 18), senior (65+), country (> 50 km) and various other rates (also $20 joining fee).
Address: GPO Box 1059J, Melbourne VIC 3001
Contact: Ms. Linda Mockridge (Pub. Rel.) (03) 596-5884

BALLARAT ASTRONOMICAL SOCIETY

The society meets at the Ballarat Municipal Observatory on the second Friday of each month at 8pm.
Fees: $18 adult and $12 junior.
Address: PO Box 284, Ballarat VIC 3353
Contact: Ian Thompson (053) 39-6698

THE BENDIGO DISTRICT ASTRONOMICAL SOCIETY

Meet on the 4th Wednesday of each month.
Address PO Box 123, Golden Square, Bendigo VIC 3551
Contact: Lisa Hewitt (054) 74-8220

LATROBE VALLEY ASTRONOMICAL SOCIETY

Meets at Monash Uni. College, Churchill, on the 2nd Tuesday of each month at 7:30pm.
Fees: $25 adult and $13 associate
Address: PO Box 329, Glengarry VIC 3854
Contact: Geoff Thomas (051) 92-4347

SOUTH AUSTRALIA

ASTRONOMICAL SOCIETY OF FLINDERS UNIVERSITY

Contact: (08) 201-2954

BOWMAN PARK ASTRONOMICAL SOCIETY

The society meets twice monthly.
Fees: $20 adult, $30 family and $10 student
Contact: Justin Tilbarook (088) 42-3741 or David Clarke (086) 36-2446

ELEANORA CENTRE ASTRONOMY GROUP

Noarlunga Downs : Contact (08) 382-1490

ASTRONOMICAL SOCIETY OF SOUTH AUSTRALIA

Meetings are held on the 1st Wednesday of each month (except Jan.) at the Uni. of South Australia, Levels Campus.
Fees: $32 adult (metropolitan), $10 spouse and $26 concession (student, country, pensioner)
Address: GPO Box 199, Adelaide SA 5001
Contact: Dr. Tony Beresford (Sec.) (08) 338-1231

NORTHERN TERRITORY

ASTRONOMICAL SOCIETY OF ALICE SPRINGS

The society holds meetings on the 2nd Monday of each month at the Motor Registry Office "Metal Centre".
Fees: $20 full, $25 family
Address: Box 739, Alice Springs NT 0871
Contact: Karl Kramer (Pres.) (089) 52-6426

DARWIN ASTRONOMY GROUP

Observing nights are held during the dry season. There are occasional meetings.
Address: GPO Box 3043, Darwin NT 0801
Contact: Robert Lang (089) 81-1985

GLOSSARY

Albedo The ratio of light reflected from a solar system object to that received by it. (A complete reflection gives an albedo of 1.0 or 100 percent).

Algol A variable star of a class known as eclipsing variables. Algol's brightness fluctuates every 69 hours as it is eclipsed by its invisible companion.

Almanac A set of tables giving positions of Sun, moon & planets at various times, plus other astronomical information; an Ephemeris.

Altazimuth co-ordinates The angular height (altitude) of an object above or below the horizon and its angular direction (azimuth) from north measured towards the east.

Altitude The angular elevation of an object above or below the horizon.

Angular diameter The apparent diameter of an object measured in degrees or radians.

Angular separation The angular distance between two celestial bodies measured in degrees.

Aphelion The point in an orbit of a comet, planet or minor planet most distant from the Sun. It is opposite to ***Perihelion***.

Apogee The point at which a body in orbit around the Earth reaches its farthest distance from the Earth.

Asteroid See ***Minor Planet***.

Astronomical unit The average distance from Earth to the Sun, approx. 149.6 million km, which equals 1 AU.

Azimuth Horizontal co-ordinate of an object's position in the sky. Derived by drawing an imaginary vertical line from the object to the horizon below. The position is then expressed in degrees east from the north point.

C.A.S.T. Central Australian Standard Time.

Celestial equator A projection of the Earth's equator onto the celestial sphere.

Celestial poles Points on the celestial sphere directly above the Earth's poles about which all the stars seem to rotate; known as the north and south celestial poles (NCP and SCP).

Celestial sphere Imaginary sphere of infinite size surrounding the Earth and to which celestial bodies seem to be attached.

Circumpolar stars Stars which never set. To determine which stars are circumpolar from a particular place subtract the observers latitude from 90°, this provides the minimum declination a star must have to be considered circumpolar.

Colour index The difference in the magnitudes of an object measured at two different wavelengths. It is a measure of the colour (temperature) of a star.

Coma The head of a comet, usually the brightest part.

Comet Small icy bodies that orbit the Sun and produce tails of gas and dust when approaching the Sun.

Conjunction An alignment of two bodies; their least angular separation as seen from Earth. When a superior planet is said to be in conjunction it is with the sun (unless stated otherwise).

Conjunction - Inferior When the Earth, an inferior planet (Mercury or Venus) and the Sun are in a line in that order.

Conjunction - Superior When the Earth, and an inferior planet (Mercury or Venus), are situated on opposite sides of the Sun.

Constellation A pattern of stars identified by name, usually of mythological gods, people, animals, or objects.

Cosmology The study of the large-scale structure and evolution of the whole universe.

Culmination The instant when a celestial body crosses the ***meridian***; an object culminates when it reaches its highest point above the observers horizon.

Declination (Dec) One part of the equatorial coordinate system used to specify the location of an object in the sky. It is the angular distance of a body north (+) or south (-) of the celestial equator and is similar to lines of latitude on the Earth.

Diurnal motion The daily motion of the sky produced by rotation of the Earth, causing the rising and setting of the Sun, Moon, planets and stars.

E.A.S.T. Eastern Australian Standard Time.

Eccentricity A measure of how "long or thin" an ellipse is. If the eccentricity equals zero, you have a circle.

Eclipse When one object passes into the shadow of another.

Eclipse of the Moon When the Moon passes into the shadow cone of the Earth. It is a total eclipse when the Moon is immersed in the umbral shadow, partial if only partly covered by the umbra, and penumbral if the Moon passes only through the penumbra of the Earth's shadow.

Eclipse of the Sun When the Moon passes in front of the Sun. Total when the Moon has a larger angular diameter than the Sun and completely covers the disc, annular if smaller (leaving a ring of sunlight surrounding the Moon), and partial if only partly covered.

Ecliptic The plane of the Earth's orbit projected onto the celestial sphere. It can also be defined as the Sun's path against the stars.

Ellipse An oval. The shape of the orbit of the planets. The axes of an ellipse are called the minor axis and major axis.

Elongation The angular separation of two bodies. The greatest elongation of Mercury and Venus occur when the planets are at their most angular distance from the Sun, as viewed from the Earth.

Emission nebula A cloud of glowing gas excited by ultraviolet radiation from hot stars.

Epoch A date chosen as a reference point for observations. ASTRONOMY 1995 uses Epoch 2000.0 for all co-ordinate data and is compatible with modern star atlases.

Equation of Time The difference between apparent and mean solar time.

Equinox The two times of the year when the Sun crosses the ***celestial equator***; vernal or spring equinox occurs about March 21st, and autumnal or fall equinox about September 22nd.

Galactic equator The great circle along the line of the Milky Way, marking the central plane of our ***galaxy***.

Galaxy A large disk or ball of billions of stars and ***nebulae***. They are the largest individual structures in the universe.

Galilean satellites The four brightest satellites of Jupiter; Io, Europa, Ganymede, and Callisto, named after their discoverer, Galileo Galilei (also known as the Jovian satellites).

Geocentric As viewed or measured from the centre of the Earth.

Globular Cluster A huge sphere containing thousands of stars. They surround our galaxy and other nearby galaxies.

Heliocentric As viewed or measured from the centre of the Sun.

Hour Angle The angular measure of the distance of an object from the local ***meridian***.

Inclination The angle that the plane of the orbit of one astronomical body makes with the plane of the orbit of another. Usually the reference is the *ecliptic*.

Julian date The number of days since noon on 1st January 4713 B.C. It is useful for astronomical observations as it saves confusion with other calendars. The starting date chosen was arbitrary but far enough back in time for there to be no astronomical records prior to then.

Large Magellanic Cloud Satellite ***galaxy*** to our own Milky way system, appearing to the unaided eye as a large nebulous patch situated in the ***constellation*** of Dorado. From mid southern latitudes the LMC is ***circumpolar***.

Light year The distance that light traverses in a vacuum during one year (approximately 9,460,529,700,000 kms).

Lunation The period of time between two consecutive New Moons.

Magnitude Brightness scale of stellar objects. From one magnitude to the next the ratio of brightness is the 5th root of 100, or approximately 2.52. The lower the number the brighter the star. The brightest stars as seen from Earth are magnitude -1 (except for the Sun which is -26). The faintest visible to the unaided are 6 (in dark skies).

Magnitude - absolute The apparent magnitude a star would have if it were placed at a distance of 10 ***parsecs*** (32.6 light years).

Meridian The local meridian is an imaginary line running directly overhead from north to south. The right ascension on the meridian equals local ***sidereal*** time.

Meteor (also Shooting or Falling Star) A small particle striking the Earth's atmosphere that is heated to incandescence by friction with air molecules.

Meteor shower A group of ***meteors*** that appear to originate from a small region of the sky (the radiant).

Meteor swarm (or stream) ***Meteoroids*** grouped in a localised region of an orbit around the Sun (the source of ***meteor showers***).

Meteorite A ***meteor*** that survives its trip through the atmosphere and reaches the ground.

Meteoroid A small solid particle moving in orbit about the Sun.

Minor planet Small rocky objects which revolve around the Sun. Most lie between the orbits of Mars and Jupiter in the asteroid belt.

Minute of arc An angular measure (each degree is divided in 60 minutes of arc).

Mira A variable star in the constellation of Cetus, with a range in brightness from 2nd to 10th magnitude, and a mean period of 331 days. Known as Mira the Wonderful, it is the brightest and most famous of the long period pulsating variables.

Nadir The point on the ***celestial sphere*** directly opposite the ***zenith.***

Nebula A bright cloud of interstellar gas and dust. See also ***emission, reflection*** and ***planetary nebulae.***

Node One of two points at which an orbit passes through a reference plane (usually the ***ecliptic***).

Oblateness The ratio of a planet's polar to its equatorial diameter.

Obliquity The degree of inclination (or tilt) of a planet's equator to its orbital plane.

Occultation The disappearance of one celestial body behind another.

Omega Centauri A globular star cluster in the constellation of Centaurus. Globulars are made up of tens of thousands of stars and form a shell around our galaxy. Omega Centauri and 47 Tucanae are two of the finest examples of these objects.

Open Star Cluster A loose association of stars numbering from a few dozen to hundreds.

Opposition When a celestial body is opposite the Sun in the sky.

Orbit The path followed by one body as it moves around another.

Parallax An apparent shift in the positions of nearby stars (relative to more distant ones) from the changing position of the Earth in its orbit around the Sun. The size of the shift can be used to measure the distances to the nearer stars.

Parsec A unit of distance used by astronomers which is equal to 3.26 ***light years***. A parsec is defined as the distance to a celestial body whose ***parallax*** is one arc second.

Penumbra Area of partial illumination in the shadow of a planet surrounding the Umbra. Also zone of intermediate brightness between a sunspot and the solar photosphere.

Perigee The point at which a body in orbit around the Earth most closely approaches the Earth.

Perihelion The point in an orbit closest to the Sun, of a comet, planet or minor planet. It is opposite to ***Aphelion***.

Perturbation Small changes in the motion of a body caused by the gravitational effects of another body.

Planetary Nebula An expanding shell of gas ejected from a star. Thought to be the outer layers of a red giant during its latter stages of evolution, the core of which becomes a white dwarf.

Planisphere A handheld aid used to identify which constellations are visible to an observer on any particular date and time.

Polar Axis The axis around which a celestial body rotates.

Proper motion The small change in position of nearby stars due to motion across the line of sight (measured in seconds of arc per year).

Quadrature A configuration that two celestial bodies have apparent longitudes that differ by 90° as viewed from a third body.

Retrograde motion 1. An actual motion contrary to the general direction of the bodies in the solar system. An example of actual retrograde motion is Neptune's satellite Triton.
2. Apparent retrograde motion is the westward motion of a planet with respect to the stars which occurs near opposition (outer planets) or near inferior conjunction (inner planets).

Right ascension (R.A.) Part of the equatorial coordinate system used to specify the location of an object in the sky. It is the angular distance of an object from an imaginary line in the sky. It is similar to lines of longitude on the Earth but is measured in hours (24hrs = 360°).

Second of arc An angular measure. Each degree contains 3600 seconds of arc, and each ***minute of arc*** contains 60 seconds.

Sidereal time A method of keeping time which uses the motion of the stars rather than the Sun. One sidereal day is equal to 23hrs56m4s of normal solar time.

Small Magellanic Cloud Satellite galaxy to our own Milky way system, appearing to the unaided eye as a nebulous patch in the constellation of Tucana. From mid southern latitudes the SMC is circumpolar.

Solstice The time when the Sun is farthest from the ***celestial equator***. In the southern hemisphere around June 21st marks the shortest day of the year, and around December 21st marks the longest day.

Spectral type A star's spectral classification determined by its spectrum.

Synodic period The period of a planet's orbit with respect to the Earth.

Transit The passage of Mercury or Venus in front of the Sun's disc or the passage of a satellite or its shadow across the face of its primary.

Transit the Meridian or Meridian passage The passage of a heavenly body across the *meridian*.

Twilight The short period of time before sunrise and after sunset during which there is not complete darkness.

Twilight - astronomical Astronomical twilight ends (in the evening sky) or begins (in the morning sky) when the Sun is 18° below the horizon.

Twilight - civil Civil twilight ends or begins when the Sun is 6° below the horizon.

Twilight - Nautical Nautical twilight ends or begins when the Sun is 12° below the horizon.

Umbra Zone of maximum darkness in the shadow of a planet. Also the darkest part of a sunspot.

Universal time A time system measured on the Meridian of Greenwich, it is 10 hours less than Eastern Australian Standard Time.

W.A.S.T. Western Australian Standard Time.

Zenith The point directly overhead, i.e. 90° in altitude.

Zenith Hourly Rate A general guide to the expected intensity of any given meteor shower. It is a theoretical rate, assuming a radiant at the *zenith* with a sky limiting magnitude of 6.5.

Zodiac The traditional twelve constellations that lie across the *ecliptic* (astrologers ignore Ophiuchus, which is very much a part of the Zodiac).

GREEK ALPHABET

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

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