ASTRONOMY 1994

EASTERN AUSTRALIAN EDITION

A PRACTICAL GUIDE
TO THE NIGHT SKY FOR 1994

GLENN DAWES PETER NORTHFIELD KEN WALLACE

1994

JANUARY

SUN	MON	TUE	WED	THUR	FRI	SAT
						1
2	3	4	5 ◐	6	7	8
9	10	11	12 ●	13	14	15
16	17	18	19	20 ◑	21	22
23	24	25	26	27 ○	28	29
30	31					

FEBRUARY

SUN	MON	TUE	WED	THUR	FRI	SAT
		1	2	3 ◐	4	5
6	7	8	9	10	11 ●	12
13	14	15	16	17	18	19 ◑
20	21	22	23	24	25	26 ○
27	28					

MARCH

SUN	MON	TUE	WED	THUR	FRI	SAT
		1	2	3	4	5 ◐
6	7	8	9	10	11	12 ●
13	14	15	16	17	18	19
20 ◑	21	22	23	24	25	26
27 ○	28	29	30	31		

APRIL

SUN	MON	TUE	WED	THUR	FRI	SAT
					1	2
3 ◐	4	5	6	7	8	9
10	11 ●	12	13	14	15	16
17	18	19 ◑	20	21	22	23
24	25	26 ○	27	28	29	30

MAY

SUN	MON	TUE	WED	THUR	FRI	SAT
1	2	3 ◐	4	5	6	7
8	9	10	11 ●	12	13	14
15	16	17	18 ◑	19	20	21
22	23	24	25 ○	26	27	28
29	30	31				

JUNE

SUN	MON	TUE	WED	THUR	FRI	SAT
			1 ◐	2	3	4
5	6	7	8	9 ●	10	11
12	13	14	15	16	17 ◑	18
19	20	21	22	23 ○	24	25
26	27	28	29	30		

JULY

SUN	MON	TUE	WED	THUR	FRI	SAT
					1 ◐	2
3	4	5	6	7	8	9 ●
10	11	12	13	14	15	16 ◑
17	18	19	20	21	22	23 ○
24	25	26	27	28	29	30 ◐
31						

AUGUST

SUN	MON	TUE	WED	THUR	FRI	SAT
	1	2	3	4	5	6
7 ●	8	9	10	11	12	13
14 ◑	15	16	17	18	19	20
21 ○	22	23	24	25	26	27
28	29 ◐	30	31			

SEPTEMBER

SUN	MON	TUE	WED	THUR	FRI	SAT
				1	2	3
4	5	6 ●	7	8	9	10
11	12 ◑	13	14	15	16	17
18	19	20 ○	21	22	23	24
25	26	27	28 ◐	29	30	

OCTOBER

SUN	MON	TUE	WED	THUR	FRI	SAT
						1
2	3	4	5 ●	6	7	8
9	10	11	12 ◑	13	14	15
16	17	18	19 ○	20	21	22
23	24	25	26	27	28 ◐	29
30	31					

NOVEMBER

SUN	MON	TUE	WED	THUR	FRI	SAT
		1	2	3 ●	4	5
6	7	8	9	10 ◑	11	12
13	14	15	16	17	18 ○	19
20	21	22	23	24	25	26 ◐
27	28	29	30			

DECEMBER

SUN	MON	TUE	WED	THUR	FRI	SAT
				1	2	3 ●
4	5	6	7	8	9	10 ◑
11	12	13	14	15	16	17
18 ○	19	20	21	22	23	24
25	26 ◐	27	28	29	30	31

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

ASTRONOMY 1994

EASTERN AUSTRALIAN EDITION

A PRACTICAL GUIDE
TO THE NIGHT SKY
FOR 1994

GLENN DAWES PETER NORTHFIELD KEN WALLACE

QUASAR PUBLISHING
1993

ISBN 0 646 15034 0

First published October 1993 by:

Quasar Publishing
PO Box 234
Strathfield NSW 2135
Australia

Fax: (02) 9636 9097
email: gdawes@s054.aone.net.au

TABLE OF CONTENTS

INTRODUCTION TO 1994 EDITION

Welcome to the new COLOUR ASTRONOMY 1994 - Eastern Australian Edition. It is hoped that the reader will find the skyview diagrams and finder charts more realistic, appealing and easier to use at night under red light. The same format has been retained from its successful predecessors ASTRONOMY's 1993 and 1992. As in the case of the 1993 publication, this book has been designed for observers in New South Wales, Victoria, Queensland, Tasmania and South Australia (the Western Australian Edition covers WA).

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. South Australians should note that all times in part 1 are Eastern Australian Standard Time. The rise/set data and skyviews, in part 1, were calculated for Sydney although the difference in time to other eastern Australian cities (including Adelaide expressed in CAST) is not much more than plus/minus 20 mins. Information has been included in the second half of the book to cover data, for other cities, which are particularly location sensitive. These are mainly rise/set times and lunar occultation predictions. Also correction factors and simple equations have been presented to help the "non city" dwellers in tailoring times for their locations. All other information, unless otherwise indicated in the relevant introduction, is common to anywhere in Australia (if not the World). Care must be taken to check for any time zone differences in particular when universal time is used.

A brief word to the novice. Astronomy, like any science, may seem to be "swamped" in jargon. Unfortunately, it is impossible to avoid such words. However, where they are necessary, astronomical terms are either 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.

This year, as for 1993, a Western Australian edition has also been produced for Perth Observatory. These two editions (Eastern and Western) represent a truly national approach in the preparation of these user-friendly yearbooks.

ACKNOWLEDGEMENTS

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

- Interactive Computing Ephemeris (US Naval Observatory)
- Astronomical Almanac for the Year 1994. (US Naval / Royal Greenwich Observatories)
- Voyager, the Interactive Desktop Planetarium (Carina Software)
- A Complete Manual of Amateur Astronomy (Sherrod)
- International Occultation Timing Association (IOTA)
- Uranometria 2000.0 (Vol II - The Southern Hemisphere to +6°)
- Uranometria 2000.0 Deep Sky Field Guide
- Hubble Guide Star Catalogue
- International Meteor Organisation (IMO) Calendar for 1994
- COMETS, Vagabonds of Space (D.A. Seargent)
- International Comet Quarterly - 1994 Handbook
- Observing Variable Stars (Levy)
- Colours of the Stars (Malin/Murdin)
- Observing Variable Stars (Bateson)

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

- Our thanks go to Ben Pawlutschenko for permission to use his Lunar map.
- Walter I. Nissen Jr. and David Dunham (IOTA)
- Greg Bryant (Proof-reading and comet information)
- Geoff McNamara(proof-reading)

The cover photograph is a Voyager spacecraft image of Jupiter (NASA/JPL).

THE ROLE OF THE AMATEUR IN THE 90'S

For thousands of years Mankind has gazed in wonder at the night sky. In fact ancient man would have had a breath taking view of the cosmos from anywhere on Earth (before he invented the light bulb!). There is no doubt that astronomy is one of the oldest pastimes. Up until the 19th century little divided the amateur from the professional. In these days of high technology, where does the amateur stand?

There are four general aspects to the unpaid sky-gazer in the 1990s.

Firstly, there are the contributions made by amateurs to scientific knowledge. At this point some people are sceptical, quickly pointing out the achievements of such telescopes as the Anglo-Australian, the Keck, Parkes Radio, Mauna Kea complex and the Hubble Space Telescope (and so on). Not to mention the computer power needed to reduce observations. Of course amateurs cannot compete with the professionals on an "aperture" or on a technology basis. However, the amateurs beat the pros in population size and numbers of telescopes. Any work on bright objects in the visual (and to a small degree, radio) part of the spectrum, involving the regular monitoring of large numbers of celestial bodies or searching the entire sky, is in the realm of the amateur. Each year, amateurs spend endless hours scanning the sky (visually or photographically) hoping to make new discoveries. There are Australian amateurs who are known internationally for their scientific contributions. Examples are Rev. Robert Evans (discovery of supernovae), William Bradfield (discovery of comets) and Paul Camilleri (discovery of novae in the Milky Way). These people and many others, using very modest equipment, owe their success to a dedication to their hobby. Other unpaid enthusiasts log thousands of hours of observations of meteor showers (which doesn't use a telescope; just the eyes) and variable stars. In fact, most of our knowledge of meteor showers comes from amateur work. The RASNZ (Royal Astronomical Society of New Zealand) and the AAVSO (American Association of Variable Star Observers) are central repositories for variable star observations and many of their members are amateurs. Professional astronomers regularly call on organizations like these to help them with their research.

Secondly, another important aspect of the amateur today, is in the area of public education and awareness. Showing a child the planet Saturn, through a small telescope and proving that you don't need an instrument from Mt. Palomar to see the rings, can have many benefits. Astronomy could actually become alive and interesting, unlike the sometimes sterile education system which wants the student to learn Kepler'sLaws to pass an exam. There may also be longer term benefits. This young person may grow up to become a politician (nobody'sperfect), one of the very people responsible for approving grants for most scientific organizations and ventures (remember the movie, The Right Stuff - "No bucks, No Buck Rogers!"). It does not hurt to get them on side at an early age; astronomers and space programmes need all the help they can get!

Considering the light pollution problems of today, it is more important than ever to point out to as many people as possible, the beauty of a dark night sky and what we are slowly losing in our suburban areas.

There are several approaches to the education issue. Examples are public field nights, radio programmes or writing magazine articles or books. These can also benefit the astronomical society, or the individual, as a revenue raiser (perhaps to buy that 20" Dobsonian?).

The third aspect of the amateur is the intellectual stimulation and aesthetic appeal. It does not matter if you are a keen observer or an armchair amateur, the comprehension of the scale of the universe and the fascinating objects, that lurk in deep space, appeal to the explorer in all of us. To gaze at a faint smudge and strain to glimpse the spiral arms of this galaxy, via weary photons that have taken millions of years to reach your telescope, can indeed stir the imagination. There are few people that would not be touched by the beauty of a winter'sevening sky, as seen from a mountain side in the country, with the Milky Way stretching from horizon to horizon.

What is the forth aspect of amateur astronomy? Well to have fun, of course! Without this aspect, is there anything else?

Wishing you clear skies and many hours of enjoyable observing.

Glenn Dawes *Peter Northfield* *Ken Wallace*

(October 1993)

PART 1

MONTHLY SECTION

GENERAL

Part 1 of this publication is designed as a quick reference section for the novice or serious amateur astronomer who wants a summary of tonight'ssky, 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.

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 which is a little sensitive to your location are the rise/set tables and the sky view diagrams (depending on the degree of accuracy required). See the notes under relevant sections later in this introduction. The information in part 1 of this handbook, has been calculated for Sydney, NSW.

Longitude = 151° 15'E, Latitude = 33° 54'S.

The writers chose Sydney because of their wish to base it on a city that is central for eastern Australia (keeping in mind the population distribution). Canberra would have also been acceptable.

TIME. The times used in part 1 are in **Eastern Australian Standard Time (EAST)**. EAST is the mean solar time on the meridian of longitude of 150° E. **No adjustments are made in this book for Daylight saving**, also known as "Summer Time". When daylight saving is in force, the time is one hour ahead of EAST. You will need to add one hour to any EAST time for the correct local time.

Observing with this Book. To help preserve your night vision it is recommended, when using any book or atlas under the night sky, that a red filter (cellophane) be placed over the end of your torch. This is the reason why submarines use red lights at night. This is to preserve their night vision if they have to surface. To achieve true dark adaptation, it can take 20 minutes. To obtain any degree of dark adaptation in built-up suburban areas, insure your observing site is shielded from any direct lights such as traffic and street lights. Sometimes a degree of diplomacy is required to request your neighbour to turn off his security lighting.

Brightness of Stars. Throughout this book the brightness of stars are given by their magnitude. See glossary for explanation.

Twilight. When twilight is referred to in the text (anywhere 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 6º below the horizon (about 30 minutes before sunrise or after sunset).

Conjunctions, Oppositions and Elongations. A conjunction of two objects is when they make their closest approach to each other as seen from Earth ie. their minimum angular separation. It is common to hear this word in reference to a planet and the Sun (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 that of the Earth. 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 (visible 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 55.

Measuring Distances Between Celestial Bodies as seen in the Sky. Whilst the need for any mathematical ability is not required to use these pages, it will aid the beginner if he/she has some 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 ["]. This is the same scale as used to define declination (see the introduction to part 2, on page 55, for an explanation of the equatorial coordinates, used by astronomers, to define a position in the sky). In fact, if two bodies have the same right ascension, their angular separation is equal to the difference between their declinations. 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'slength, using this scale, for rough estimations in the field where it may not be convenient to use the book. The average adult hand (open wide) held at arm'slength, 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 8 and 9) These diagrams have been designed to help observers to 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 which doesn'twander 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. Most people find these charts a good approximation even if they don'tlive in Sydney. If you are using a telescope, you'll soon learn to avoid trying to observe a planet close to the horizon. Turbulence in the much thicker atmosphere, at low altitudes (ie. close to rise or set), gives very poor images. If accuracy is required, you will need to refer to the specific rise/set tables, for the object of interest, in part 2 of this publication. You can also adjust for country locations using appendix E on page 112.

"JUPITER'SMOONS". Jupiter is like a miniature solar system with its 16 moons orbiting the planet. Also, like the planets, these moons all lie in a similar plane. This plane is also very close to that of the Earth'sorbit (the Ecliptic). 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'sdisc. These diagrams show the patterns the four major moons of Jupiter make as they oscillate from side-to-side. Each complete period represents one orbit of the satellite. The horizontal date line represents 10:00am EAST (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. 86 to 88). The same can be done with the occultation times ie. when the line disappears behind Jupiter. These four moons, ie. lo, Europa, Ganymede and Callisto, are certainly bright enough (in theory) to be easily seen in binoculars (or even the naked eye). Unfortunately, their proximity to Jupiter'sglare make them at least binocular objects. The moons, in particular the outer 2 ie. Ganymede and Callisto, can be seen in binoculars (at least 7x power). It is necessary to mount the binoculars on a tripod to eliminate movement. 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 early morning of January 26. The power or magnification of the binoculars will determine how close to Jupiter you can follow a moon. See page 86 for an expanded explanation.

The "Phases of the Eclipses" (below the configurations 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") the shadow of Jupiter.

The "APPEARANCE OF THE PLANETS" diagram. This provides the reader with a telescopic illustration of each planet drawn to the same scale. Under each image is the date, the planet'sangular diameter and magnitude. Phases are also shown for Mercury, Venus and Mars.

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. This section only deals with the 4 brightest asteroids. It gives the magnitude, rise, set and transit times as well as the constellation they are in for the month.

Meteor Showers On any clear night we can see about 5 to 10 shooting stars per hour, these are known as random or sporadic meteor. 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 1994; full details for all showers are given in part 2 (pp. 102 & 103). It can take great patience to watch for meteors (preferably under dark moonless skies), but the occasional fireball can make it worthwhile.

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'shappening 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 1994 (see also pages 108 - 109)

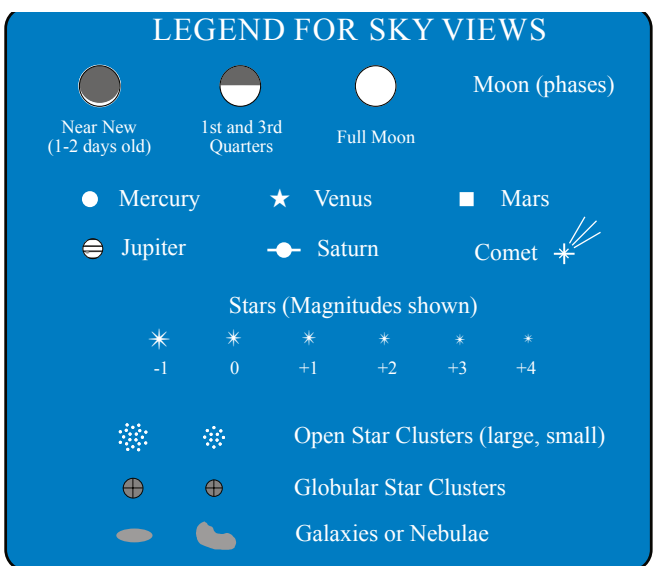
The "SKY VIEW" Diagrams. These are designed to help the novice find the planets with no other help other than these drawings. The date/time of each diagram has been carefully chosen to show the most interesting patterns of the planets and Moon which will appeal to the aesthetic taste of most amateurs. Some general "sky views" have also been presented. Often, the times chosen correspond to about one hour (or even down to 30 minutes) before sunrise (morning sky diagrams) or after sunset (evening sky diagrams). 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 for twilight times have graduated shading in the sky ie. the blue colour fades close to the horizon.

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 page 110, ie. appendix C - "Non Stellar Objects".
- The constellations are labelled (capital letters) and each represented by lines joining key stars (as per convention in some 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 considered to be naked eye objects. 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 100, would be needed to identify these outer worlds. Pluto would need at least a 20 cm telescope to glimpse this faint distant member of our Solar System. It also is not marked on the "sky views"; however suitably detailed finder charts can be found on pp 100 and 101.

These diagrams were designed for the unaided eye, but binoculars can be very useful. Binoculars can help in finding :

- stars/ planets during twilight
- fainter stars, stars dimmed by the nearby Moon, stars close to the horizon, or
- separating planets and stars during close conjunctions.

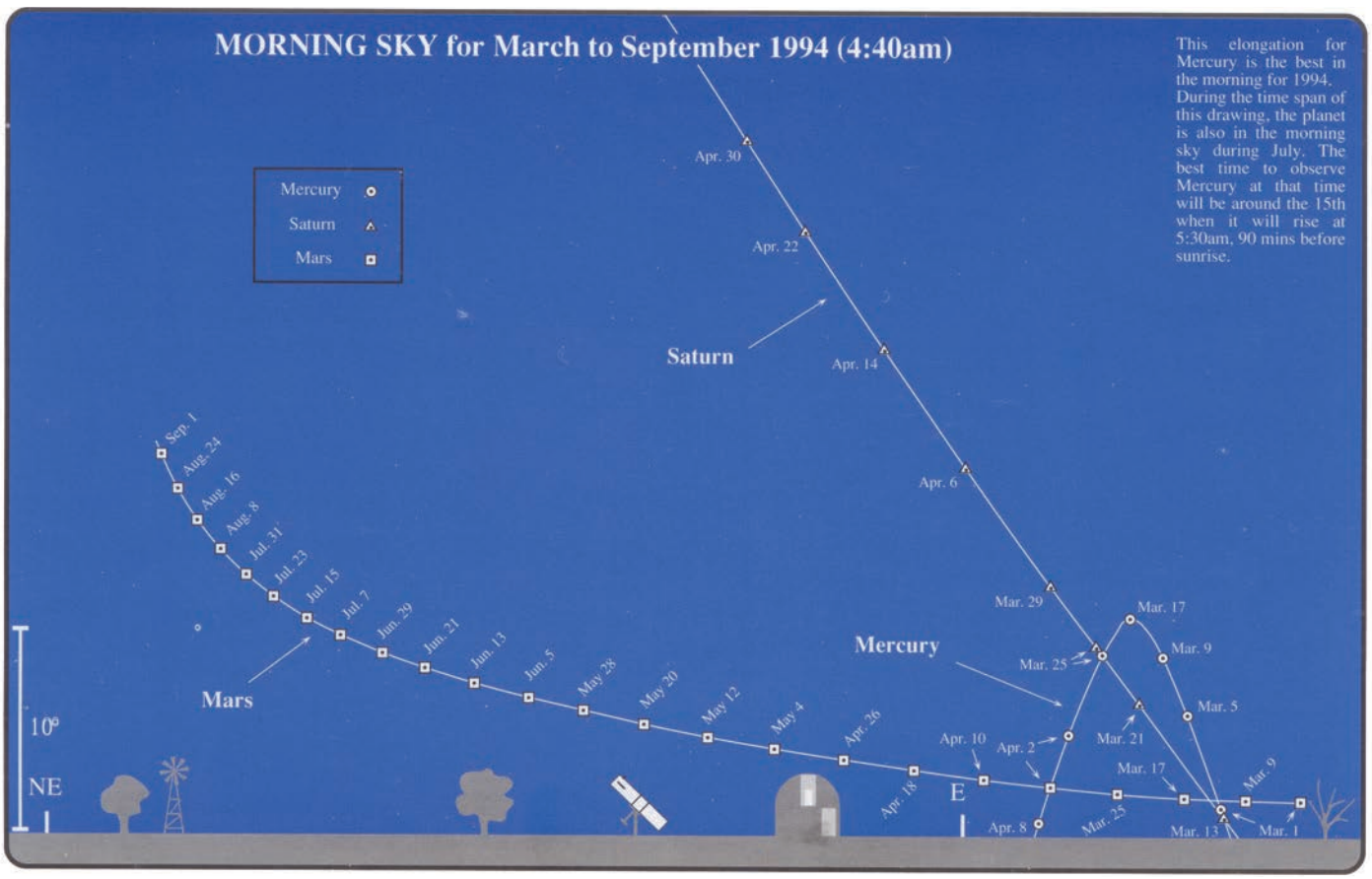
The “sky views” are useful for more than just the date/time as indicated on the drawings. On the same evening, the star pattern will move towards the west (as the Earth rotates to the east). If you are looking towards the north, the sky will appear to rotate slowly anti-clockwise, to the south - clockwise. During the year, the Sun’sapparent motion (due to the Earth orbiting the Sun) takes it once around the sky relative to the stars. This results in the stars visible (above the horizon), at any one time, being the same one month from now but 2 hours earlier (of course the planets and the Moon will have moved). Compare the sky views for June 28 (11:00 pm) with that for July 25 (9:00 pm). The "Hours of Right Ascension/ Constellations on the Meridian" diagram (see page 113) 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 June 28, at 11:00 pm, is just over 17 hours. Following this diagonal (parallel to the RA lines) shows the equivalent time for other dates.

Using the “Sky Views” for other cities in Eastern Australia.

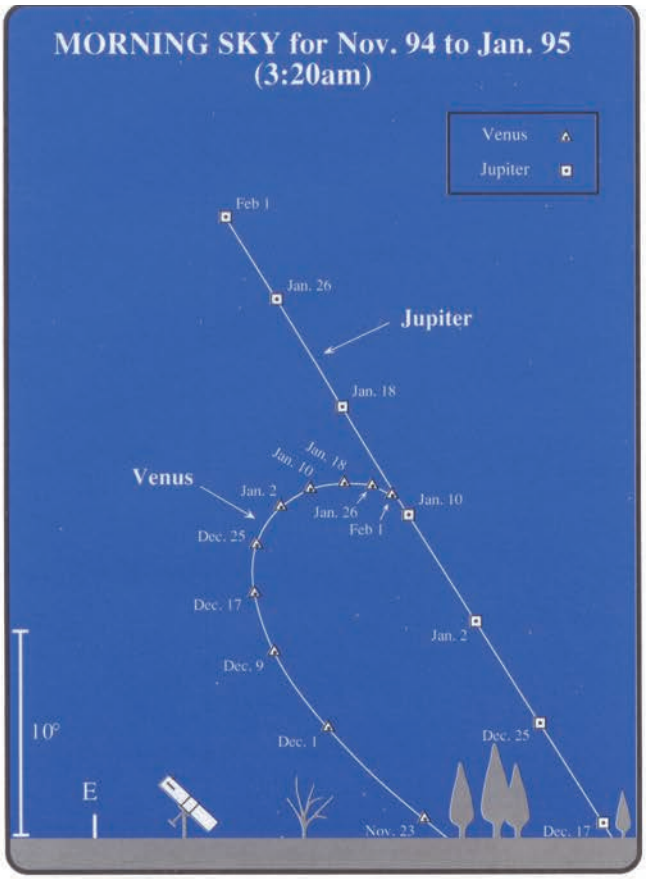
To determine an approximate time in Adelaide (Central Australian Standard Time) corresponding to these "sky views", add approximately 20 mins to the times given. This roughly allows for the change in time zone and longitude differences. Adelaide is a relatively easy example, for it has a similar latitude to Sydney. A change in latitude causes difficulties. The appearance of the sky may start 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 Sydney (latitude 33° 54' S). If you were in Brisbane (lat. 27° 30' S) you could see to the north 6º more than from Sydney (Sydney to the south would see 6º more than Brisbane). 6° being the difference in latitude.

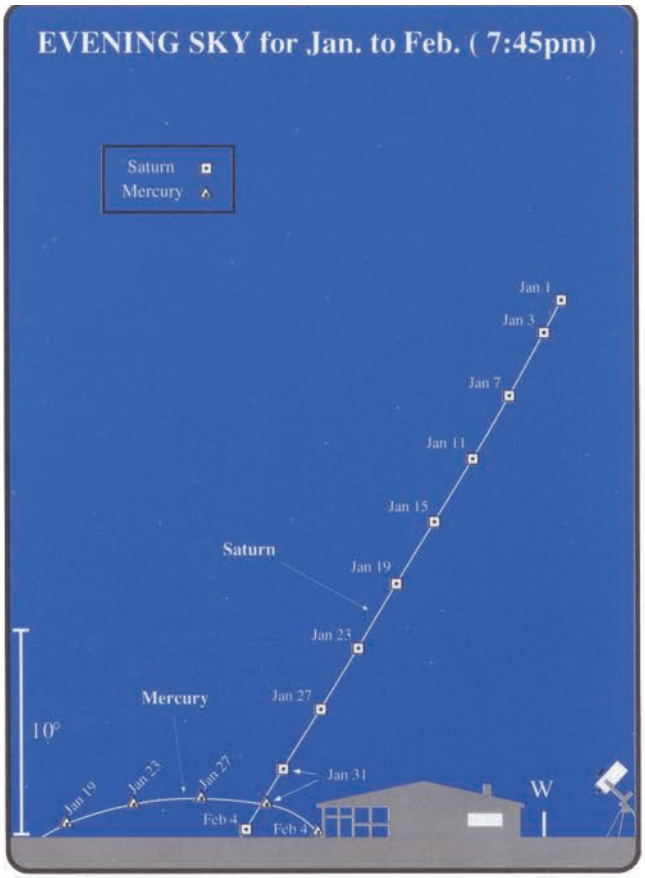
Converting to equivalent times for Brisbane, Melbourne and Hobart is a little difficult. The rise/set times will vary depending on the declination of an object of interest. This is the same with the times for sky views. The equivalent times will differ depending on which direction one is looking. To get a more accurate estimate for an eastern view, compare the rise time for your location (refer parts 2 and 3) for a planet or the Moon marked on the “sky view” to the rise time for Sydney. For western views, compare the “set” times. Add the difference in time to that of the "Sky View".

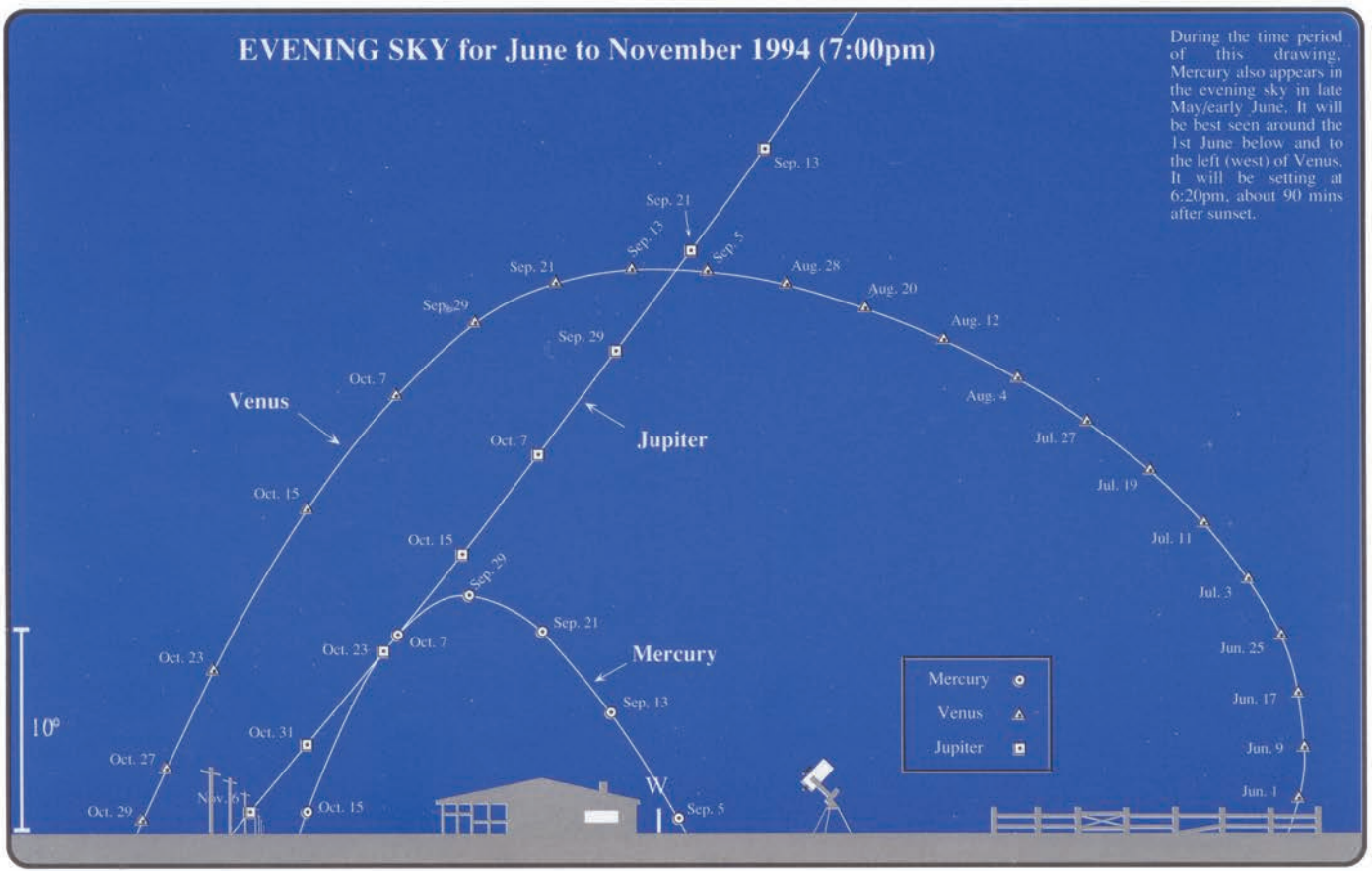
MOVEMENT OF THE PLANETS



MOVEMENT OF THE PLANETS

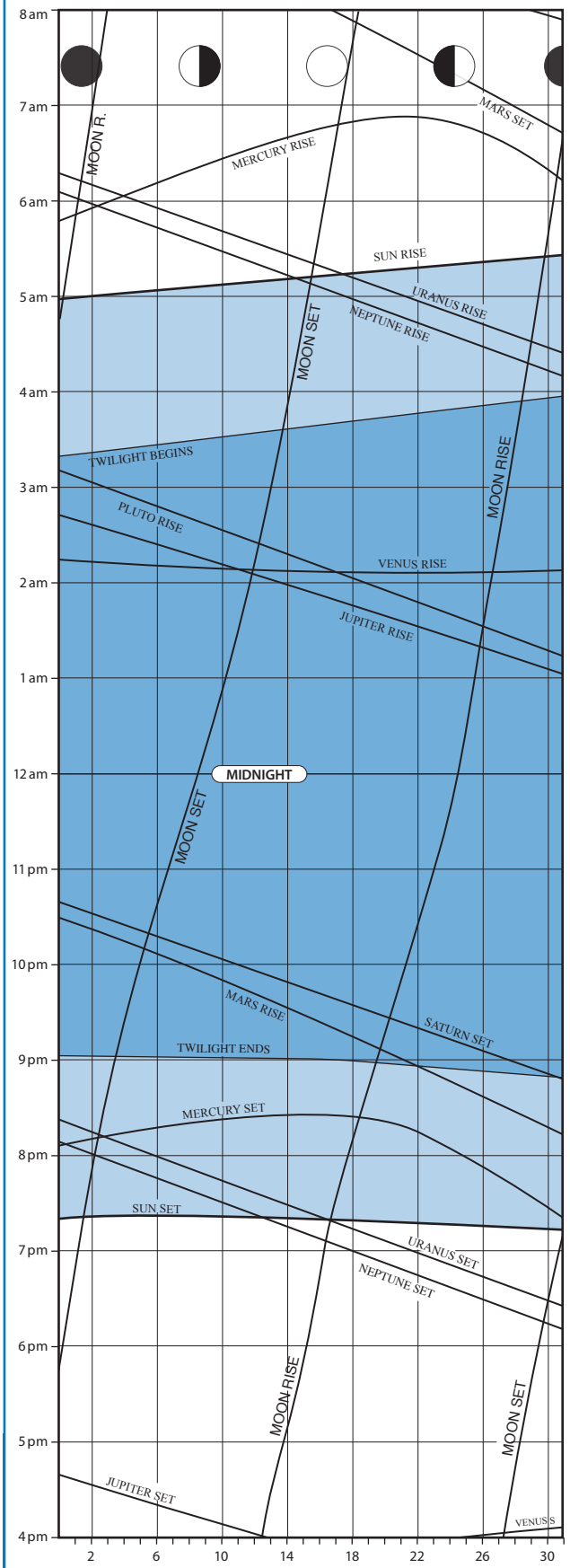






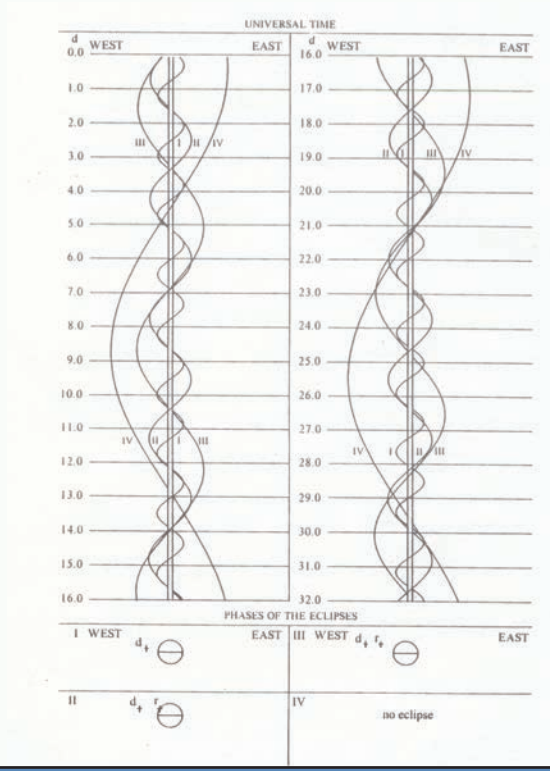
JANUARY

RISE/SET CHART



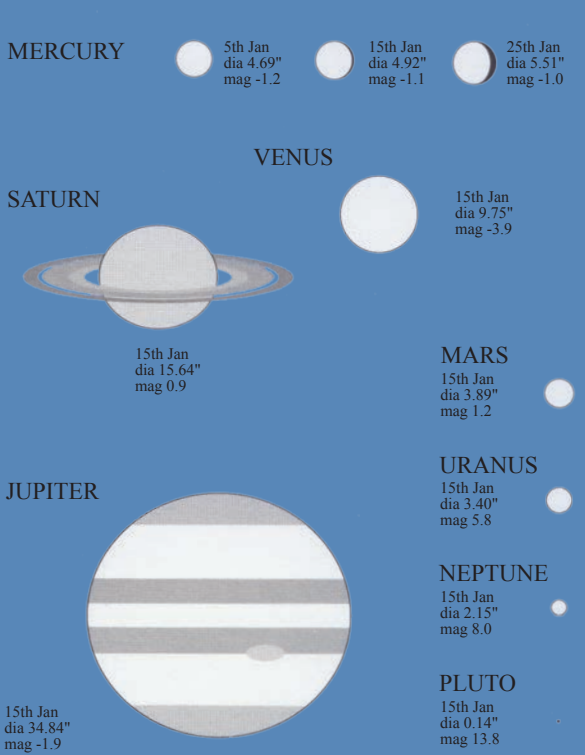
All times are AEST. For summer time (daylight saving) add 1 hour.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



JANUARY

THE MOON

5th Last quarter, 10:00am.

6th Moon at perigee (closest to Earth).

12th New Moon, 9:10am (Lunation number 879).

19th Moon at apogee (most distant from Earth).

20th First quarter, 6:27am.

27th Full Moon, 11:23pm

31st Moon at perigee (closest to Earth).

THE PLANETS

MERCURY is in superior conjunction on the 4th and is lost in the Sun'sglare. After conjunction the planet becomes an evening object, but will be difficult to see as it sets in the twilight. On the 31st at 7.30pm observers may be able to see Mercury at magnitude -0.8 with Saturn (about one magnitude fainter) less than 2° above and a little northwards; binoculars may help here with Mercury 4° above the western horizon and the Sun 6° below. See also sky view for Feb 1st.

VENUS is in superior conjunction with the Sun on the 17th and like Mercury is lost in the Sun'sbrilliance. The planet becomes an evening object after conjunction but, until the angular distance from the Sun increases, over the next few months, observation will be difficult.

MARS, after conjunction in December, becomes a morning object and stays close to the Sun in the twilight for the next two months.

JUPITER in Libra is the only planet not affected by twilight or low altitude this month, but the planetary observer will need to rise in the early morning hours. On the 7th, the 24 day old Moon will be 3.3° above the planet in the eastern morning sky (see sky view).

SATURN in Aquarius moves rapidly from the night sky into evening twilight as it heads towards conjunction in February. The only opportunity to observe the ringed planet in a dark sky, is during the first two weeks of the month when it will be seen less than 10° above the western horizon. As twilight ends, the low altitude may hamper observations.

URANUS & NEPTUNE are lost in twilight during January as both planets are in conjunction with the Sun (Uranus on the 13th, Neptune on the 11th). Throughout 1994 Uranus and Neptune stay relatively close to each other (about 2° minimum and 3° maximum), and since phenomena like conjunctions etc generally relate to both planets they have been treated under a common heading in the monthly section.

PLUTO, emerging from the morning twilight rises earlier each evening and by months end will be about 25° above the eastern horizon by 3am.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 8.6; rise 12.10pm, transit 6.02pm, set 11.53pm. In Cetus early in the month before moving into Pisces.

PALLAS: Mag. 10.2; rise 8.32am, transit 2.53pm, set 9.14pm. In Aquarius.

JUNO: Mag. 10.9; rise 11.52pm, transit 6.17am, set 12.37pm. In Virgo.

VESTA: Mag. 8.1; rise 9.34am, transit 4.00pm, set 10.25pm. In Aquarius, moving into Pisces late in the month.

METEOR SHOWERS

The **PUPPID-VELIDS** are visible from late evening till dawn and are active from September 28th through to January 26th. This complex shower has more than 10 sub-streams and therefore many sub-maxima over the period of activity. Typically swift, and often leaving long lived trains, the Puppid-Velids are generally blue, white or yellow in colour and frequently produce fireballs. A rate of 2 - 3 meteors per hour is usual over the period, with early December rates reaching 12 - 15 per hour, sometimes 20 or more! This month the substreams to look out for are the Pi Puppids II (Jan 6 - 14, with maximum activity on Jan 10th), and the Lambda Velids II (Jan 18 - 26, with max/act on Jan 21st).

The **QUADRANTIDS (BOOTIDS)** are a strong and consistent northern shower of medium speed that is difficult for southern observers. Best seen between 1st to 5th January, with maximum activity on the 3rd. The radiant is below the early morning northeastern horizon. The zenith hourly rate (ZHR) is around 110.

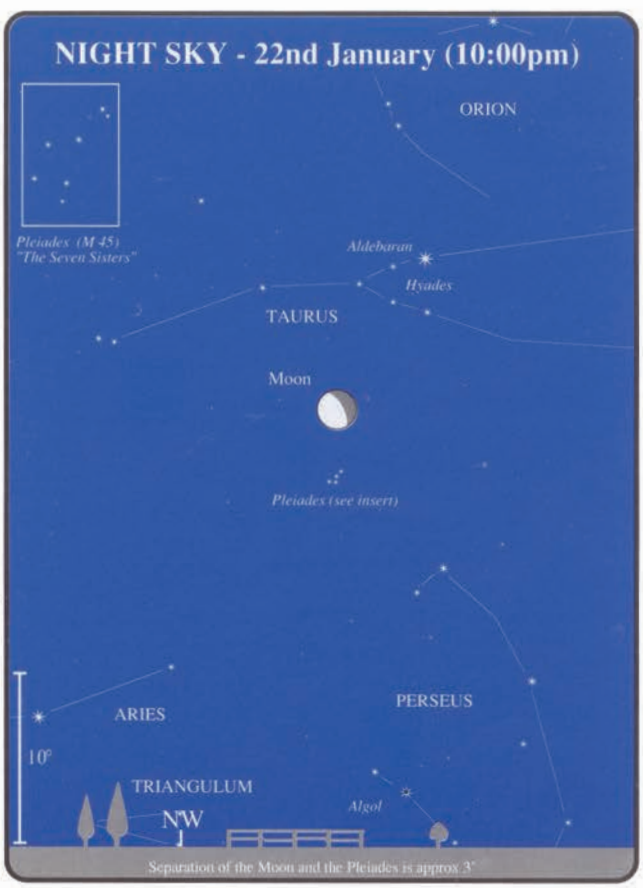
The **ALPHA CENTAURIDS** are active from 28th January through to 21st February, with maximum on the 7th of next month. Their ZHR is unpredictable, around 8 per hour at best, but high rates sometimes occur every 4 to 6 years; most recently in 1974 and 1980 when the rate exceeded 25 per hour, the increase is always transitory lasting no more than 2 or 3 hours. The shower is noted for its brightly coloured fireballs that frequently reach negative magnitudes; they are predominantly yellow or blue, but their range can cover the entire spectrum. The Alpha Centaurids are also well known for their long lasting trains (about 25 to 30 percent of the meteors) which may last from a few seconds to several minutes. Being circumpolar, the shower-is visible throughout the night.

DAILY EVENTS

2nd	4 PM	Earth at perihelion.
4th	6 AM	Mercury in superior conjunction with the Sun.
5th	10:00 AM	Last Quarter Moon.
6th	11 AM	Moon at perigee.
7th	8 AM	Jupiter 3° North of the Moon.
8th	5 AM	Transit of Venus across Sun (visible only from Mars!)
11th	6 PM	Neptune in conjunction with the Sun.
12th	09:10 AM	New Moon.
13th	3 AM	Uranus in conjunction with the Sun.
14th		Mercury at greatest latitude South (heliocentric).
15th	10 AM	Saturn 7º South of the Moon.
17th	12 PM	Venus in superior conjunction with the Sun.
19th	3 PM	Moon at apogee.
20th	06:27 AM	First Quarter Moon.
26th		Venus at aphelion.
27th	11:23 PM	Full Moon.
31st	2 PM	Moon at perigee.

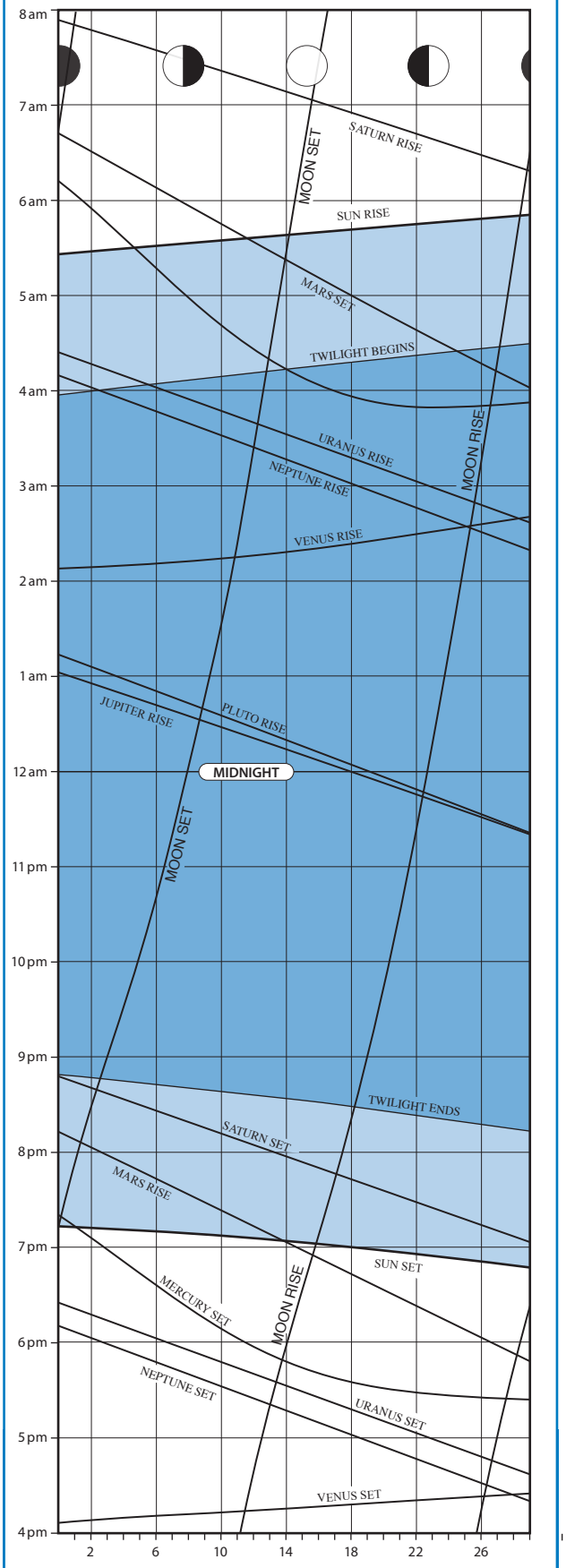
JANUARY

All times are EAST. For summer time (daylight saving) add 1 hour.



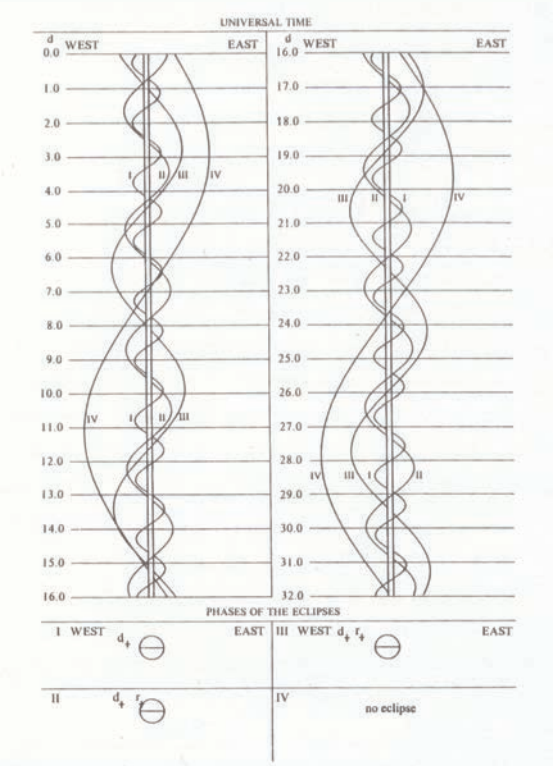
FEBRUARY

RISE/SET CHART



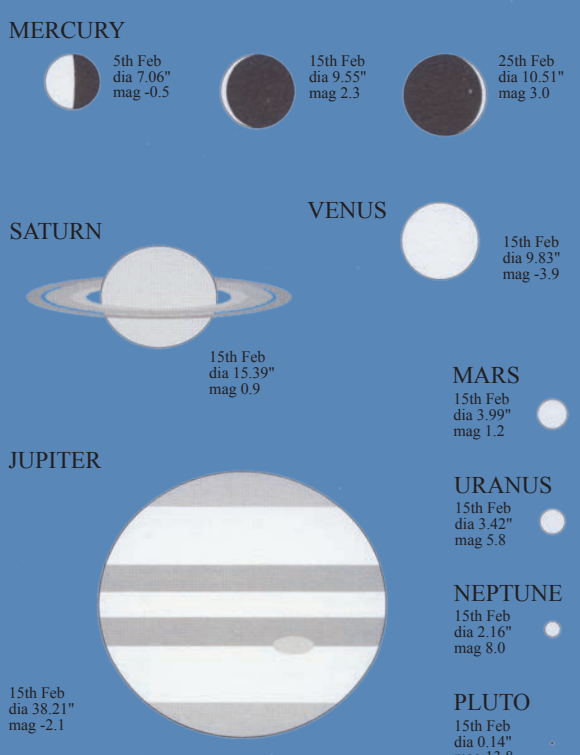
All times are EAST. For summer time (daylight saving) add 1 hour.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



FEBRUARY

THE MOON

3rd	Last Quarter, 6:06pm.
11th	New Moon, 0:30am (Lunation number 880).
16th	Moon at apogee.
19th	First quarter, 3:47am.
26th	Full Moon, 11:15am.
28th	Moon at perigee.

THE PLANETS

MERCURY reaches greatest eastern elongation from the Sun on the 5th at 18° (see the evening sky view on the 5th), and is in inferior conjunction on the 20th. On the 2nd at 7.30pm observers may be able to see Mercury 1°30' northwards of Saturn in the evening twilight; binoculars may help here with Mercury 4° above the western horizon and the Sun 6 below (see also sky view on the 1st). After inferior conjunction Mercury brightens rapidly and rises earlier each morning nearing the planet Mars. On the 28th at 5am the two planets will be 4° apart with Mercury at 2nd magnitude north of 1st magnitude Mars (see sky view).

VENUS, after superior conjunction last month, is still too close to the Sun for observation. With the planet and Sun distance slowly increasing, observers will have the opportunity to see Venus shining brilliantly toward the end of next month in the evening twilight.

MARS moves slowly away from the Sun and by month'send can be seen in the morning twilight in Capricornus prior to sunrise. On the 28th at 5am, 1st magnitude Mars will be 4° southward of 2nd magnitude Mercury.

JUPITER in Libra rises late in the evening. During the 2nd half of the month the planet will be seen within 1° of 3rd magnitude Alpha Librae. On the 3rd the 21 day old Moon will be less than 10° from Jupiter and on the following day the planet will rise with the Moon 5.5° south (see sky view).

SATURN, having moved into twilight late last month, becomes unobservable as it moves into conjunction with the Sun on the 22nd.

URANUS and **NEPTUNE**, in Sagittarius, move from twilight and into the night sky this month. On the 8th, at the beginning of astronomical twilight, the thin crescent 27 day old Moon will appear about 8° above and north of the pair.

PLUTO, situated throughout the year in Libra, is visible for half the night this month as it rises around midnight.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 9.0; rise 10.47am, transit 4.26pm, set 10.06pm. It is in Pisces early in the month, then moves into Cetus before entering Aries at the month'send.

PALLAS: Mag. 10.0; rise 7.15am, transit 1.32pm, set 7.48pm. In Aquarius.

JUNO: Mag. 10.5; rise 10.07pm, transit 4.31am, set 10.48am. In Virgo.

VESTA: Mag. 8.3; rise 8.34am, transit 2.44pm, set 8.54pm. In Pisces, moving into Cetus mid month.

METEOR SHOWERS

The **ALPHA CENTAURIDS** are active from 28th January through to 21st February, with maximum on the 7th of this month. Their zenith hourly rate (ZHR) is unpredictable, around 8 per hour at best, but high rates sometimes occur every 4 to 6 years; most recently in 1974 and 1980 when the rate exceeded 25 per hour. The increase is always transitory lasting no more than 2 or 3 hours. The shower is noted for its brightly coloured fireballs that frequently reach negative magnitudes; they are predominantly yellow or blue, but their range can cover the entire spectrum. The Alpha Centaurids are also well known for their long lasting trains (about 25 to 30 percent of the meteors) which may last from a few seconds to several minutes. Being circumpolar, the shower is visible throughout the night.

The **VIRGINIDS** extend from 1st February through to 30th May with several submaxima over the period. The rate of 1 to 5 slow meteors (and the occasional fireball) per hour can cause some difficulty in separating true Virginids from sporadic activity. Several radiants are known near the ecliptic in Leo and Virgo and the shower is best observed from late evening into the morning hours.

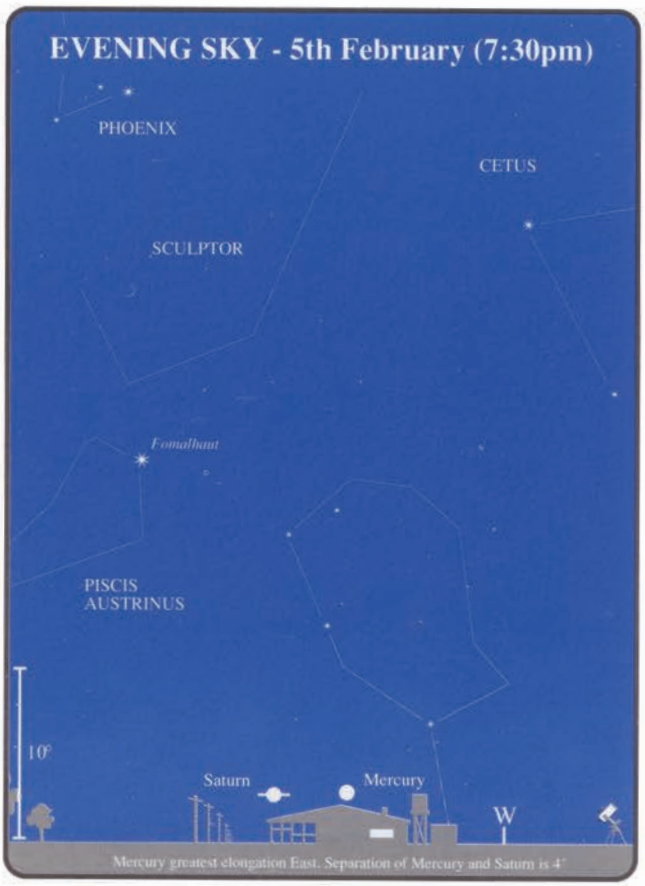
The **GAMMA NORMIDS** are active between 25th February and 22nd March. For most of the period the rate is low, and members are difficult to sort out from the background sporadic activity. Best seen a day or two on either side of maximum (14th March) when rates can reach 5 to 10 per hour. Generally, the Gamma Normids are bright and chiefly yellow, white or orange with about 15% leaving trains.

DAILY EVENTS

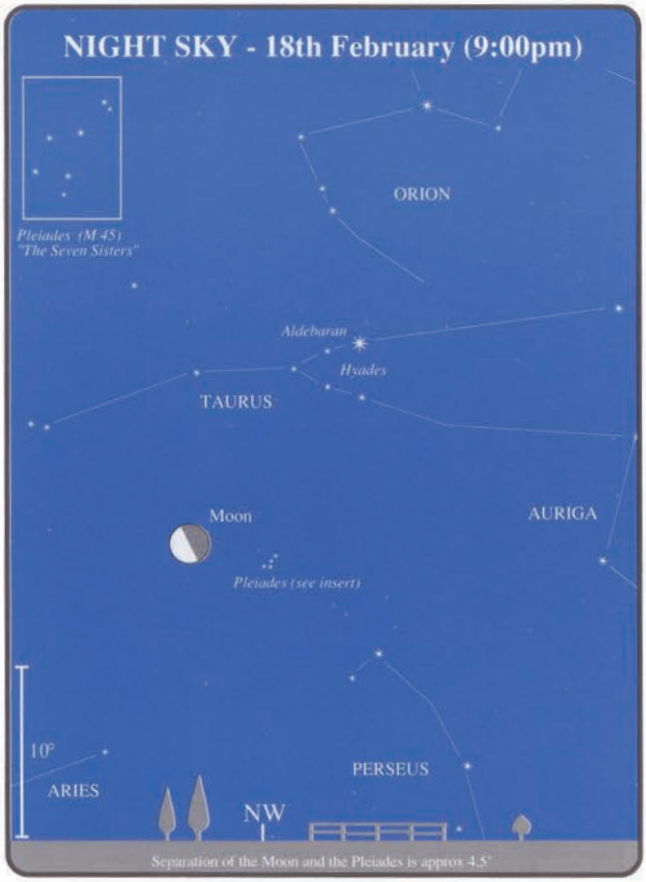
2nd		Mercury at ascending node.
2nd	2 PM	Mercury 1º.3 North of Saturn.
2nd	10 PM	Minor planet Thalia 0.5° S of NGC 2859 in Leo Minor.
3rd	6 PM	Jupiter 3° North of the Moon.
3rd	06:06 PM	Last Quarter Moon.
5th	7 AM	Mercury greatest elongation East (18°).
6th	10 PM	Minor planet Thalia 0.7° N of NGC 2832 in Lynx.
7th		Mercury at perihelion.
8th	6 PM	Neptune 3° South of the Moon.
8th	10 PM	Uranus 5° South of the Moon.
9th	9 PM	Comet West-Kohoutek-Ikemura 0°.2 South of NGC 1605 in Perseus.
11th	12:30 AM	New Moon.
11th	4 AM	Mercury stationary.
16th	12 PM	Moon at apogee.
17th		Mercury at greatest latitude North (heliocentric).
17th		Venus at greatest latitude South (heliocentric).
19th	03:47 AM	First Quarter Moon.
20th	6 PM	Mercury in inferior with the Sun.
22nd	3 AM	Saturn in conjunction with the Sun.
24th	12 AM	Juno stationary.
26th	11:15 AM	Full Moon.
27th	11 AM	Mercury 4º North of Mars.
28th	8 AM	Moon at perigee.

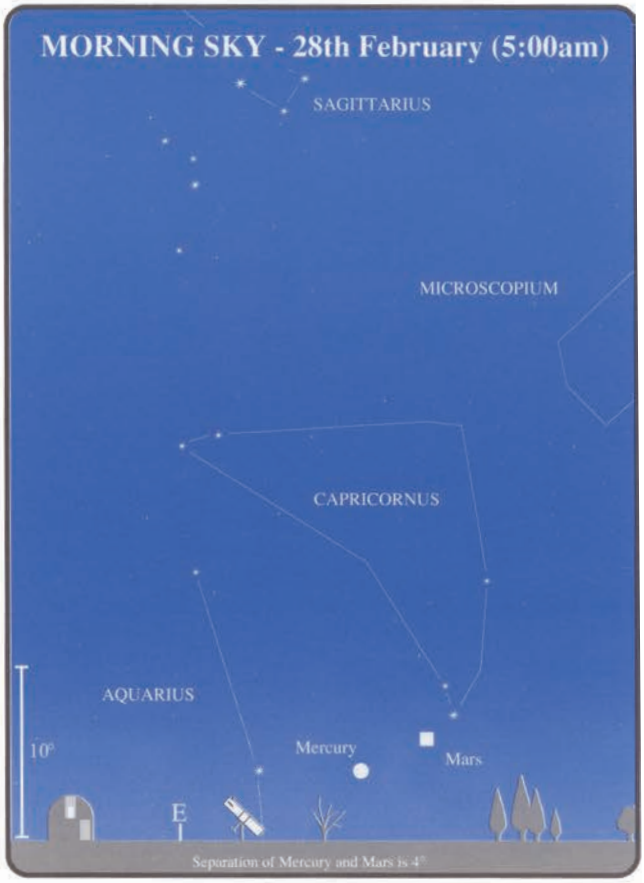
FEBRUARY

All times are EAST. For summer time (daylight saving) add 1 hour.

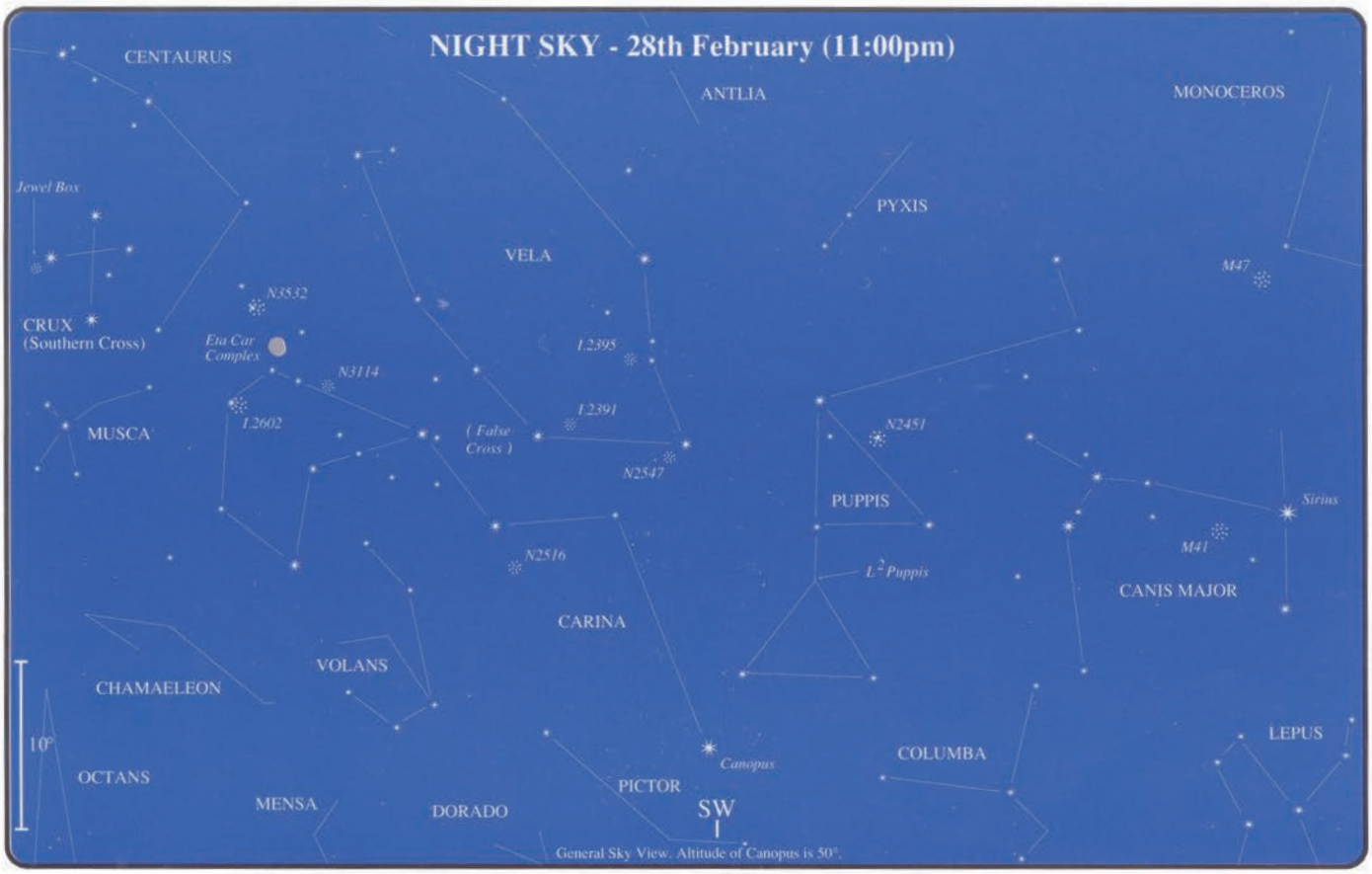


FEBRUARY



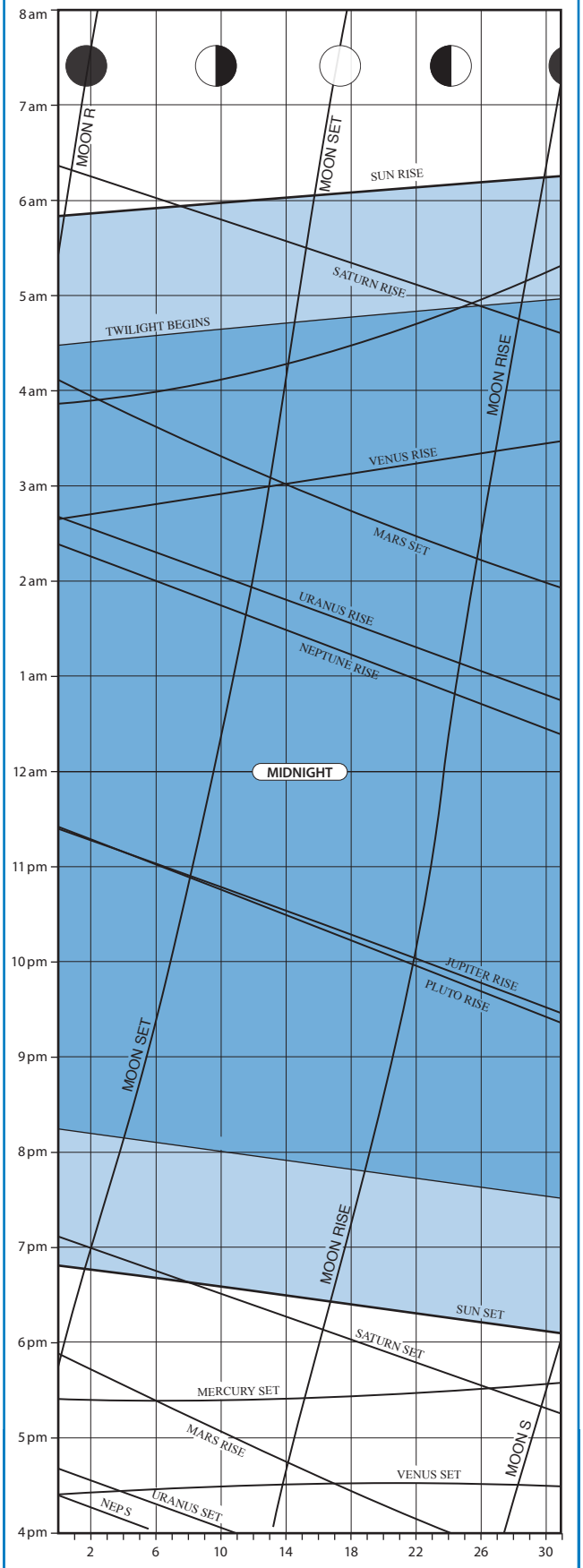


All times are EAST. For summer time (daylight saving) add 1 hour.



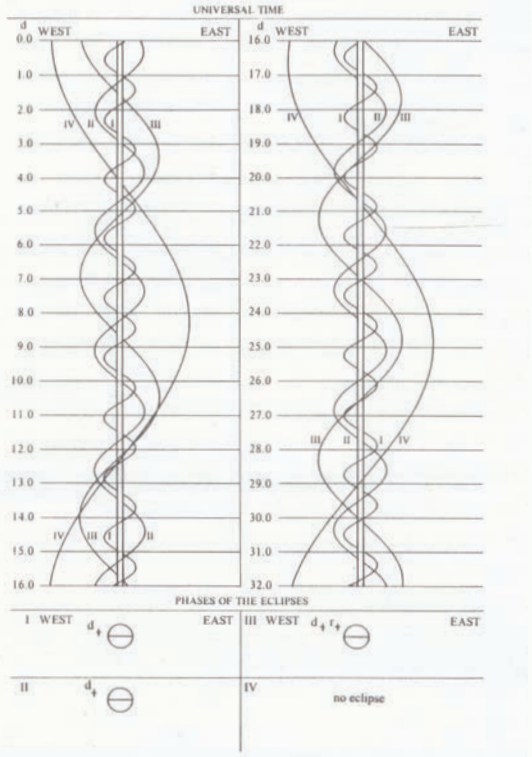
MARCH

RISE/SET CHART



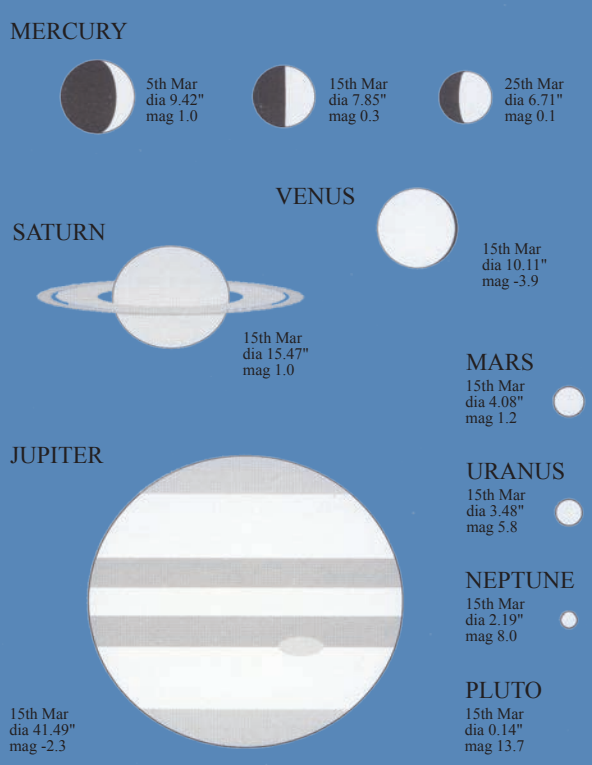
All times are EAST. For summer time (daylight saving) add 1 hour.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



MARCH

THE MOON

5th Last quarter, 2:53am.

12th New Moon, 5:05pm (Lunation number 881).

15th Moon at apogee.

20th First quarter, 10:14pm.

27th Full Moon, 9.09pm.

28th Moon at perigee.

THE PLANETS

MERCURY will be at its greatest western elongation from the Sun (28°) on the 19th (see sky view), making March and early April the most favourable time to observe the planet in the morning sky this year. For a six week period Mercury can be observed in a dark sky before the beginning of astronomical twilight, and the interactions with Mars, Saturn and the Moon will be a delight to early morning observers. On the 10th (at 5am), the 27 day old crescent Moon (altitude 14°)-will be 5° north of Mercury (see sky view). On the 25th (at 5am), Saturn will be 0.5° north of Mercury at an altitude of 13° with Mars rising less than 7° directly below (see sky view).

VENUS slowly increases its eastern elongation and by the end of the month sets about 50 minutes after the Sun. Because of the close proximity to the Sun and resultant low altitude it may be difficult to find Venus even thought the planet is bright at -3.9 magnitude. On the 14th at 6.30pm, the 2 day old thin crescent Moon will be 10° north of Venus at an altitude of 4.5° with the Sun 4° below the horizon, binoculars may help here.

MARS rises just as twilight begins, and while not a good telescope target it provides some interesting visual configurations with Mercury, Saturn and the Moon in the early morning sky during the month. If a good eastern horizon is available, on the 11th at 5am the three planets and the Moon will be visible; the 28 day old thin crescent Moon (36 hours from New Moon) will be 6° north of Saturn and Mars (both Moon and Saturn are about 4° above the horizon), 2° above Saturn is Mars and a further 9° above Mars is Mercury. On the 14th Mars will be 0.4° north of Saturn, both about 6° above the horizon, Mercury is a further 9° above the pair (see sky view).

JUPITER rises in the east soon after the end of twilight. As the planet nears opposition at the end of next month, its magnitude brightens to -2.4 and its diameter increases from 40" to 43"; the planet'sdiameter remains above 40" through to the end of June, making an ideal target for small apertures. Jupiter has three close approaches by the Moon during the month: On the 2nd, the 20 day old Moon can be seen in the east 2° from the planet (see sky view). On the 29th at 8pm, the 17 day old gibbous Moon appears 6.5° north of the rising planet (see sky view), the separation gradually decreases until, by Jam on the following morning, the distance is 3°. On the 30th, in the early evening, the Moon is 8° south of Jupiter.

SATURN rises in the morning twilight early in the month and can be observed in a dark sky after mid month when it starts to gain some altitude in the eastern sky. Saturn plays a role in the interrelation between the Moon, Mercury and Mars during the month and detail is given under both the Mercury and Mars sections. Of note is the close approach to Mercury on the 25th (5am), when Saturn will be 0.5° north of the innermost planet (see sky view).

URANUS & **NEPTUNE** rise around 1am and by the beginning of twilight are about 30° above the eastern horizon. On the 8th, the 25 day old Moon will be 5° north of the pair.

PLUTO rises around 10pm mid month, transiting the meridian at 4am.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 9.0; rise 9.43am, transit 3.11pm, set 8.38pm. In Aries.

PALLAS: Mag. 9.7; rise 6.10am, transit 12.20pm, set 6.32pm. In conjunction with the Sun on the 20th. In Aquarius, moving into Pisces mid month.

JUNO: Mag. 10.0; rise 8.21pm, transit 2.37am, set 8.48am. In Virgo.

VESTA: Mag. 8.2; rise 8.34am, transit 2.44pm, set 8.54pm. In Cetus, moving back into Pisces mid month.

METEOR SHOWERS

The **VIRGINIDS** extend from 1st February through to 30th May with several submaxima over the period. The expected rate of 1 to 5 slow meteors (and the occasional fireball) per hour can cause some difficulty in separating true Virginids from sporadic activity. Several radiants are known near the ecliptic in Leo and Virgo and the shower is best observed from late evening into the morning hours.

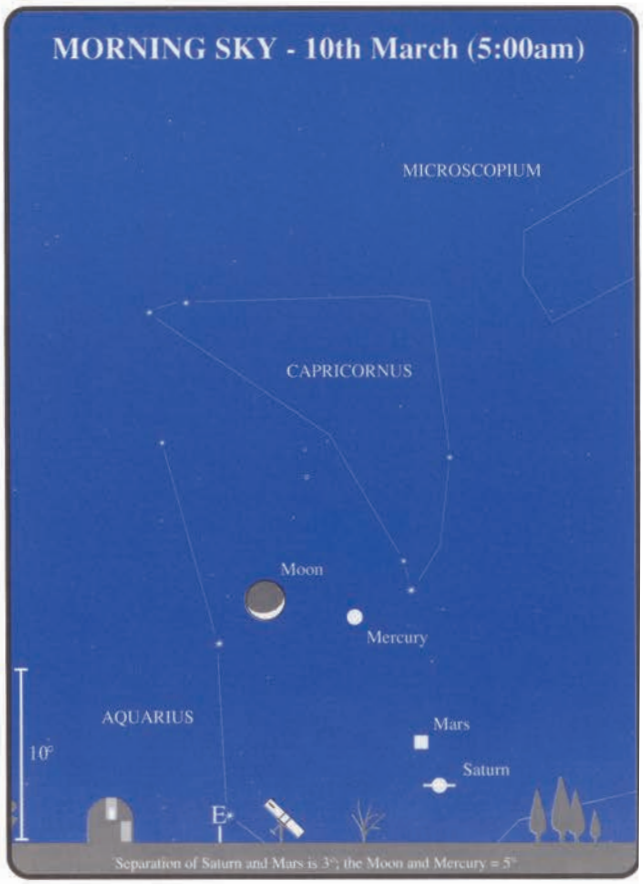
The **GAMMA NORMIDS** are active between 25th February and 22nd March. For most of the period the rate is low, and members are difficult to sort out from the background sporadic activity. Best seen a day or two on either side of maximum (14th March) when rates can reach 5 to 10 per hour. Generally; the Gamma Normids are bright and chiefly yellow, white or orange with about 15% leaving trains.

The **BETA PAVONIDS** are visible from 11th March to 16th April, and reach maxima next month on the 7th, with strong activity possible eight days either side. The ZHR is around 13 but with several submaxima the rates tend to be variable. Rich in bright swift blue-white meteors that frequently leave trains, the Delta Pavonids are best viewed in the early morning hours.

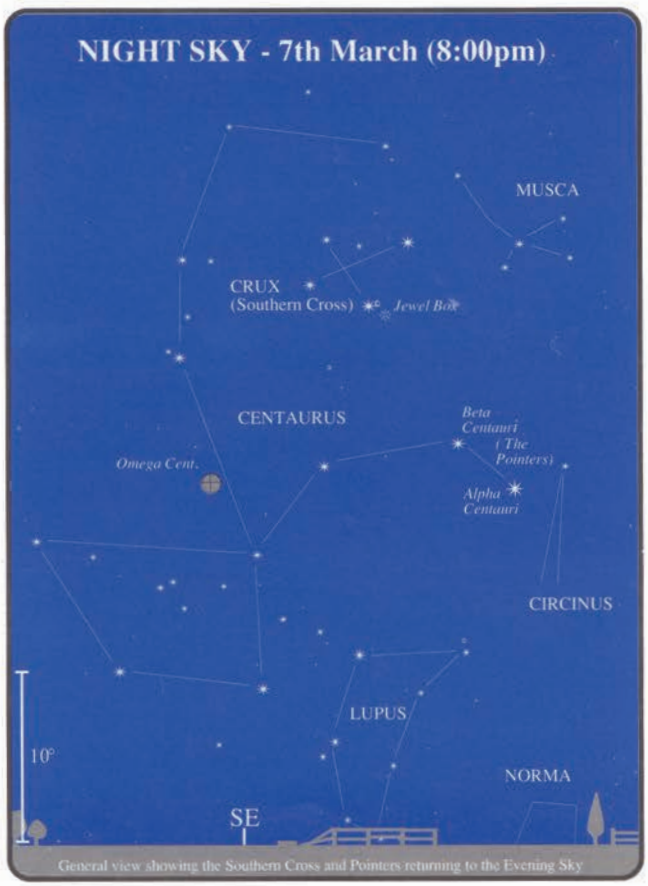
DAILY EVENTS

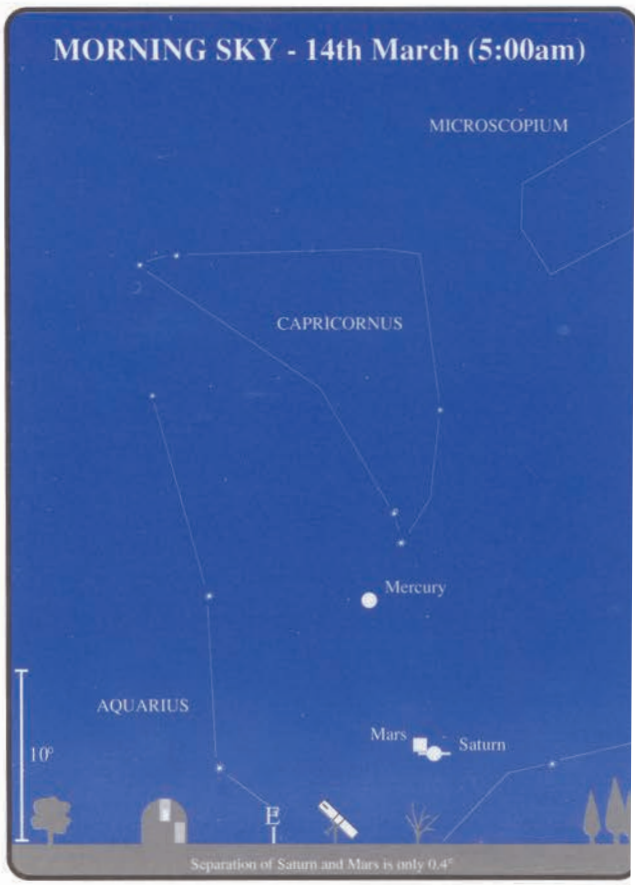
1st	7 AM	Jupiter Stationary
3rd	2 AM	Jupiter 2° North of the Moon.
4th	11 AM	Pluto Stationary.
4th	10 PM	Mercury Stationary.
5th	02:53 AM	Last Quarter Moon.
8th	2 AM	Neptune 4° South of the Moon.
8th	7 AM	Uranus 3° South of the Moon.
9th	4 AM	Comet Tempel 2 is 2° South of Mercury.
9th		Mars at greatest latitude South (heliocentric).
10th	2 PM	Mercury 5º South of the Moon.
11th	9 AM	Mars 7º South of the Moon.
11th	2 PM	Saturn 7º South of the Moon.
12th	05:05 PM	New Moon.
13th		Mercury at descending node.
14th	3 AM	Venus 5º South of the Moon.
14th	8 PM	Mars 0º.4 North of Saturn.
16th	3 AM	Moon at apogee.
19th	12 PM	Mercury greatest elongation West (28°).
20th	1 PM	Pallas in conjunction with the Sun.
20th	10:14 PM	First Quarter Moon.
21st	6 AM	Solar equinox.
22nd	4 AM	Comet Encke 2°North of M30 in Capricornus.
23rd		Mercury at aphelion.
24th	6 PM	Mercury 0º.3 South of Saturn.
25th	04:30 AM	Comet Tempel 2 is 1°.5 S of Saturn/Mercury pair
27th	09:09 PM	Full Moon.
28th	4 PM	Moon at perigee.
30th	9 AM	Jupiter 2° North of the Moon.

MARCH

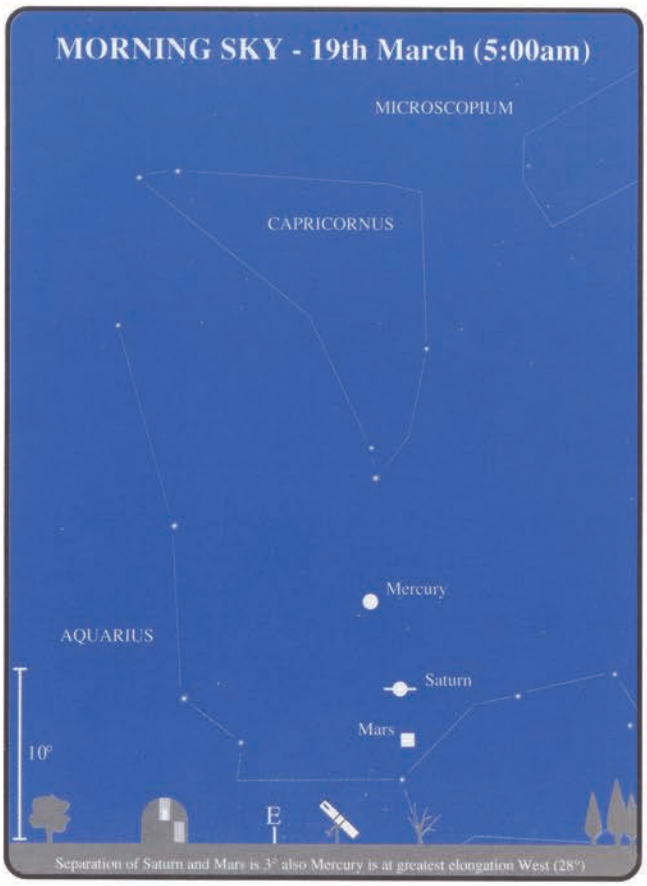


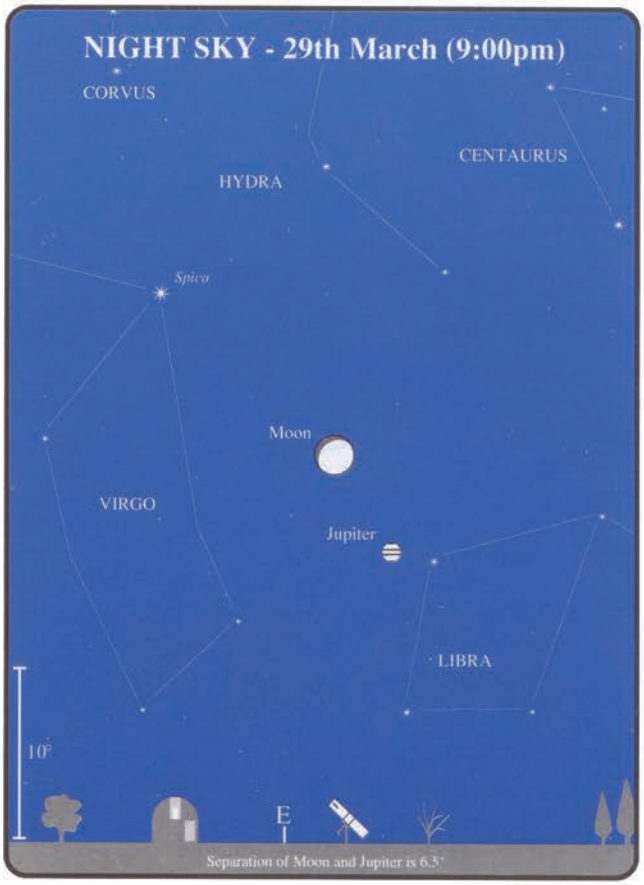
All times are EAST. For summer time (daylight saving) add 1 hour.



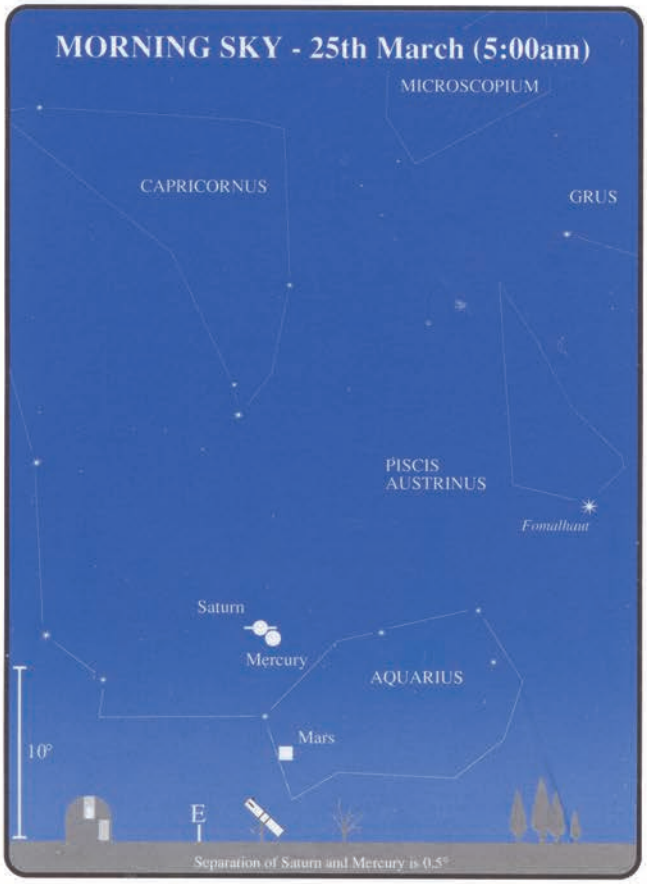


MARCH



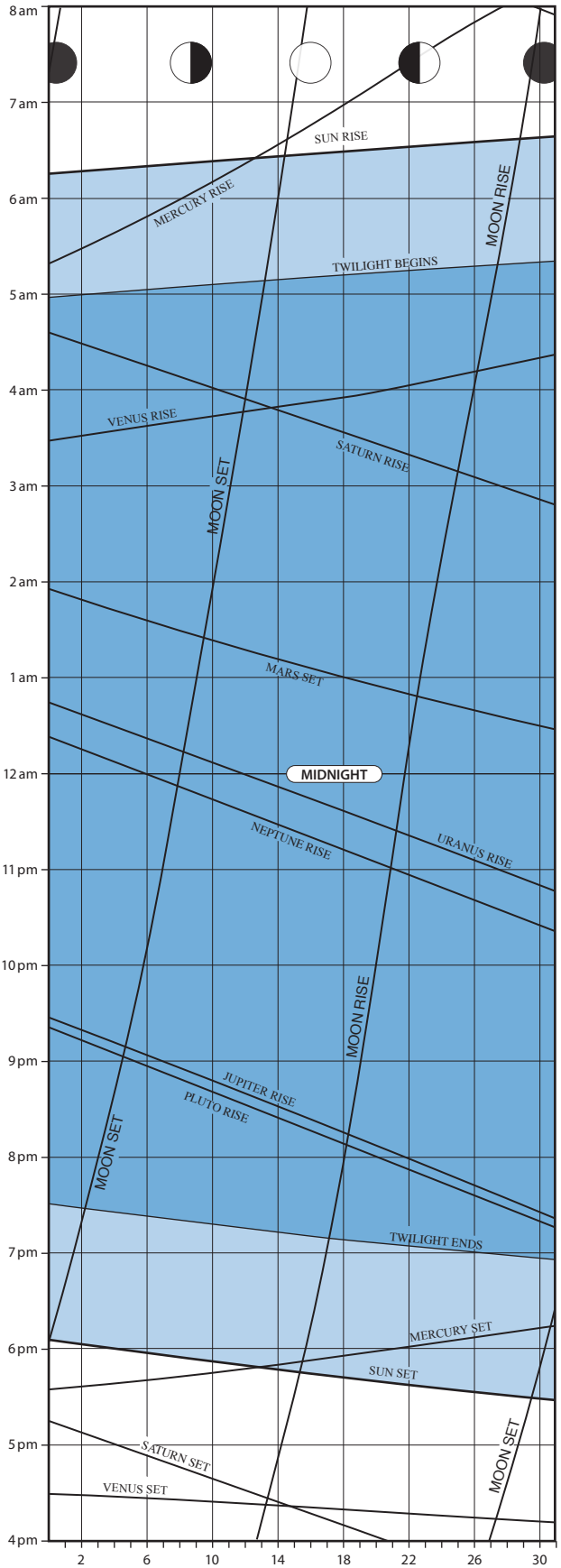


All times are EAST. For summer time (daylight saving) add 1 hour.



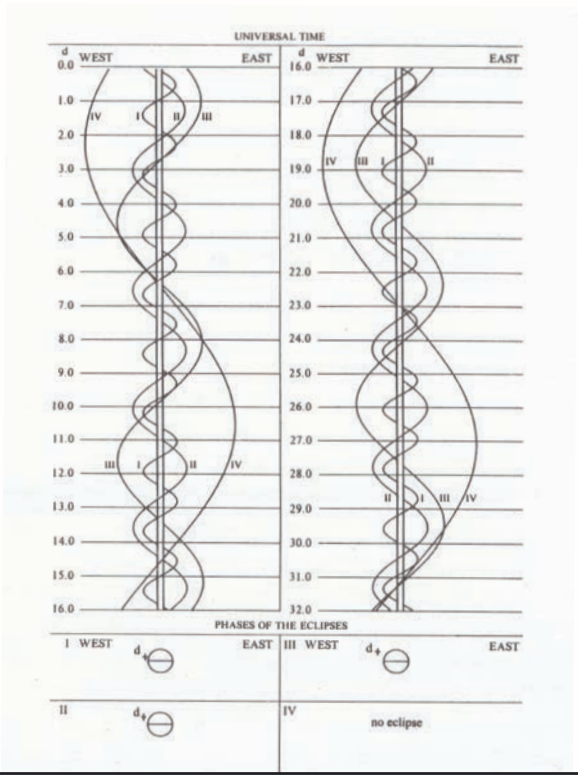
APRIL

RISE/SET CHART



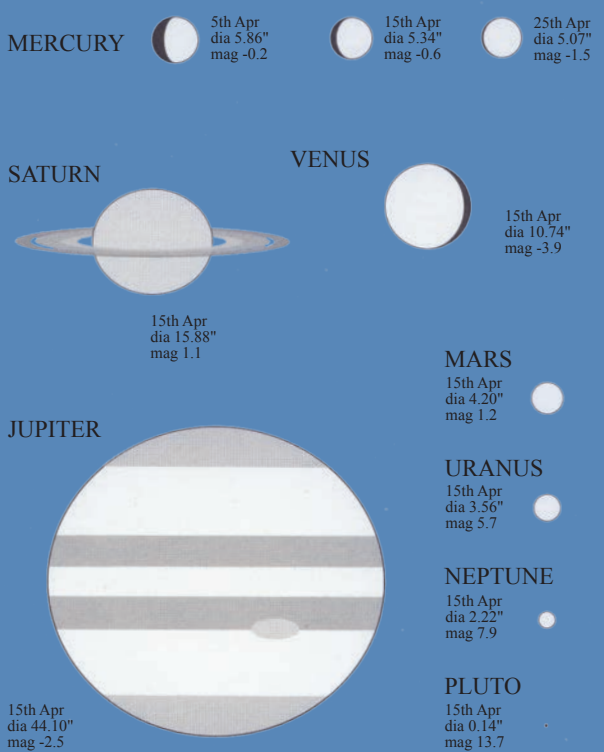
All times are EAST.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



APRIL

THE MOON

3rd	Last quarter, 12:55pm
11th	New Moon, 10:17am (Lunation number 882).
12th	Moon at apogee (most distant from Earth).
13th	Occultation of Venus by 2 day old Moon (not visible from Australia).
19th	First quarter, 12:34pm.
25th	Moon at perigee (closest to Earth).
26th	Full Moon, 5:45am.

THE PLANETS

MERCURY observers only have the first two weeks of April to see the planet in a dark sky. After this period it rapidly moves to superior conjunction on the 30th. After last month'sinteresting planetary interactions, only Mars stays, with Saturn now distancing itself from the twilight. From the 3rd to the 7th (around 5am) Mercury and Mars can be seen within 2° of each other (see sky view for the 7th), closest approach is on the 5th with a separation of 1.3°. On the 9th (5am), the 28 day old thin crescent Moon appears 8° north of Mercury (altitude is 4°).

VENUS is still slowly increasing its eastern elongation from the Sun and by the end of April, at magnitude -3.9, will stand out brilliantly against the western evening twilight. On the 13th, in the twilight the 2 day old Moon will be situated 4° north of Venus (see sky view).

MARS moves from Aquarius and into Pisces early in the month. After a close approach with Mercury between the 3rd and 7th (see Mercury), the planet soon becomes isolated with Saturn gaining altitude and Mercury moving towards the Sun. On the 9th the 28 day old thin crescent Moon appears 6° north of Mars in the early morning twilight.

JUPITER reaches opposition on the 30th, rising in the east soon after sunset and visible the entire night. The planet now is shining at magnitude -2.5 and has a disc diameter of 44". On the 26th the 15 day old Moon will be seen 5° south of Jupiter (see sky view). As the night progresses, the separation gradually increases to 10° before morning twilight. Opposition provides the ideal time to observe Jupiter, especially with small apertures. The disc remains over 40" in diameter from March to June so there is no need to panic if cloudy weather intervenes for a week or so.

SATURN remains an object for the early morning observer. However, it is not until the end of the month that the planet begins to gain enough altitude above the horizon for observation before twilight begins. Saturn has two near approaches by the Moon during the month; on the 7th the 26 day old Moon appears less than 10° away (see sky view) and on the following morning a little closer at 8°

URANUS & **NEPTUNE** rise around 11pm mid month and transit the meridian at 6am. On the 4th, the 23 day old Moon will be 4° north of Neptune, and 7° north of Uranus.

PLUTO rises around 8pm mid month and transits the meridian at 2am. Pluto is at opposition at the end of next month.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 8.9; rise 8.39am, transit 1.54pm, set 7.10pm. In Aries moving into Taurus mid month.

PALLAS: Mag. 9.8; rise 4.59am, transit 11.03am, set 5.09pm. In Pisces early in month moving into Cetus.

JUNO: Mag. 10.1; rise 6.10pm, transit 12.14am, set 6.15am. At opposition on the 15th. In Virgo.

VESTA: Mag. 8.2; rise 6.48am, transit 12.28pm, set 6.10pm. In conjunction with the Sun on the 28th. In Pisces, moving back into Cetus mid month.

METEOR SHOWERS

The **VIRGINIDS** extend from 1st February through to 30th May with several submaxima over the period. The rate of 1 to 5 slow meteors (and the occasional fireball) per hour can cause some difficulty in separating true Virginids from sporadic activity. Several radiants are known near the ecliptic in Leo and Virgo and the shower is best observed from late evening into the morning hours.

The **BETA PAVONIDS** are visible from 11th March to 16th April, and reach maxima this month on the 7th, with strong activity possible eight days either side. The ZHR is around 13 but with several submaxima the rates tend to be variable. Rich in bright swift blue-white meteors that frequently leave trains the Delta Pavonids are best viewed in the early morning hours.

The **LYRIDS**, although best from northern latitudes, are still worthy of observation. Historically the Lyrids are the oldest recorded shower, being noted by the Chinese in 687 B.C. The shower'sduration is from the 16th to 25th April with maximum activity on the 22nd, the period leading up to and after the peak has only minor activity. The ZHR is normally around 15-25 meteors per hour, however much higher rates are sometimes seen (90 per hour in 1982). The Lyrids are often missed by observers as the peak may only last an hour or two. During maxima most Lyrids will be very faint, but there are enough bright ones to keep the observer happy.

The **PI PUPPIDS**, or Grigg-Skjellerupids (after the short period comet that produced the stream), is a very young shower first observed in 1972. Best seen from the end of twilight until midnight from 15th to 28th April, with the peak of activity on the 23rd. Leading up to 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 (about 15%), large proportion of yellow meteors and occasional fireballs.

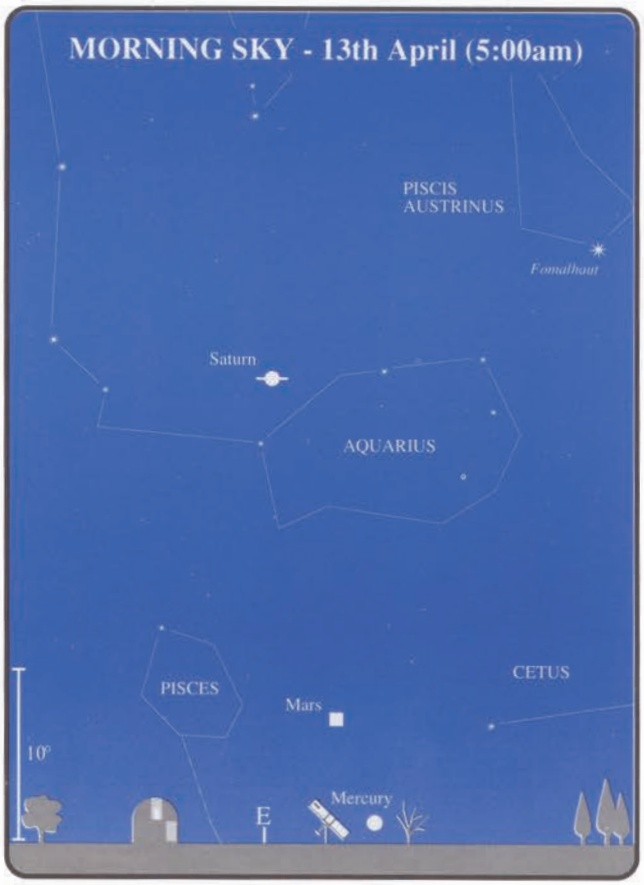
The **ETA AQUARIDS** are linked with Halley'sComet and ranks as one of the most popular of the southern hemisphere showers. Visible from 19th April to 28th May in the eastern sky from the end of evening twilight until mid morning; they peak next month on the 4th (high rates have been recorded from the 1st to 8th of May without any real peak in the period). It'susual 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 (up to 25% of the meteors), very swift speed and striking yellow colour.

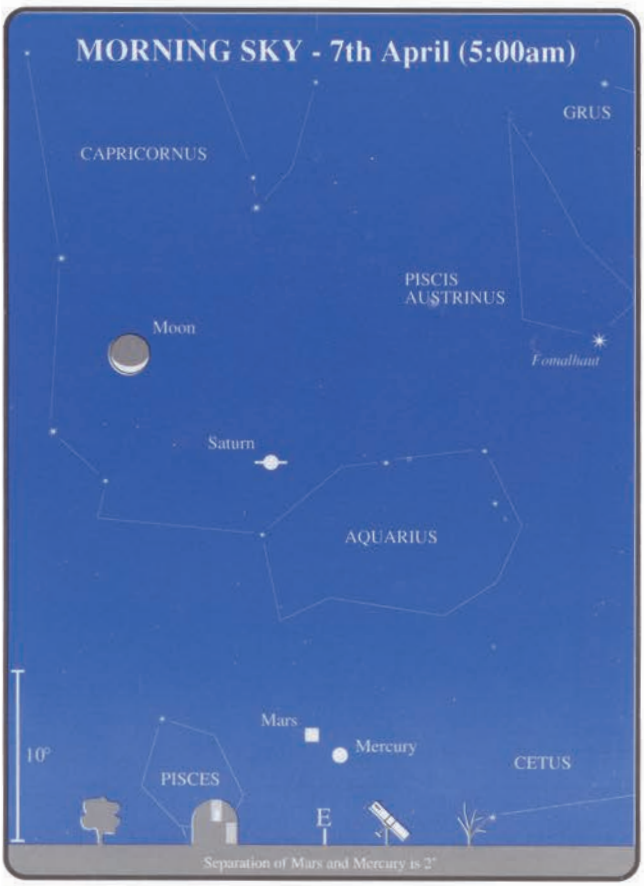
The **ALPHA SCORPIDS** and **SAGITTARIDS** occur between 15th April and 25th July and have several submaxima over the period. The radiants are very complex with early Scorpid/Sagittarids appearing in Ophiuchus and Libra; towards the end of May and early June in Scorpius; in Sagittarius in July. Rates are generally low but a maximum ZHR of 10 can sometimes occur. The shower members are often spectacular, being slow and bright with many displaying a yellow-orange colour.

APRIL

DAILY EVENTS

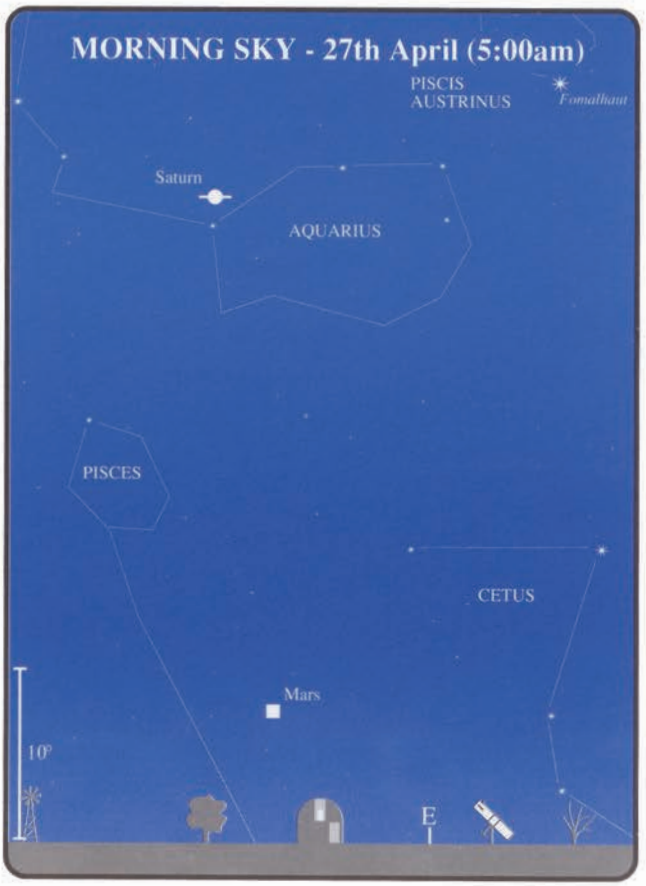
1st	10 PM	Minor planet Hygiea 0.3° South of NGC 4802 in Corvus.
3rd	12:55 PM	Last Quarter Moon.
4th	8 AM	Neptune 4° South of the Moon.
4th		Mars at perihelion.
4th	12 PM	Mercury 1º.5 South of Mars.
4th	2 PM	Uranus 5º South of the Moon.
8th	2 AM	Saturn 7º South of the Moon.
9th	12 PM	Mars 6º South of the Moon.
9th	9 PM	Mercury 7º South of the Moon.
11th	10:17 AM	New Moon.
11th	10 PM	Comet Schwassmann-Wachmann 2 is 1°North of M44 in Cancer.
12th		Moon at apogee.
12th	10 AM	Mercury at greatest latitude South (heliocentric).
13th	9 AM	Venus 1° South of the Moon.
14th		Venus at ascending node.
15th	11 AM	Juno at opposition.
19th	12:34 PM	First Quarter Moon.
22nd	10 PM	Minor planet Hygiea 0.8° North of M104 (Sombrero) in Virgo.
25th	7 PM	Neptune stationary.
26th	3 AM	Moon at perigee.
26th	5:45 AM	Full Moon.
26th	3 PM	Jupiter 3° North of the Moon.
28th	3 PM	Vesta in conjunction with the Sun.
30th	7 PM	Jupiter at opposition.
30th	8 PM	Mercury in Superior conjunction with the Sun.

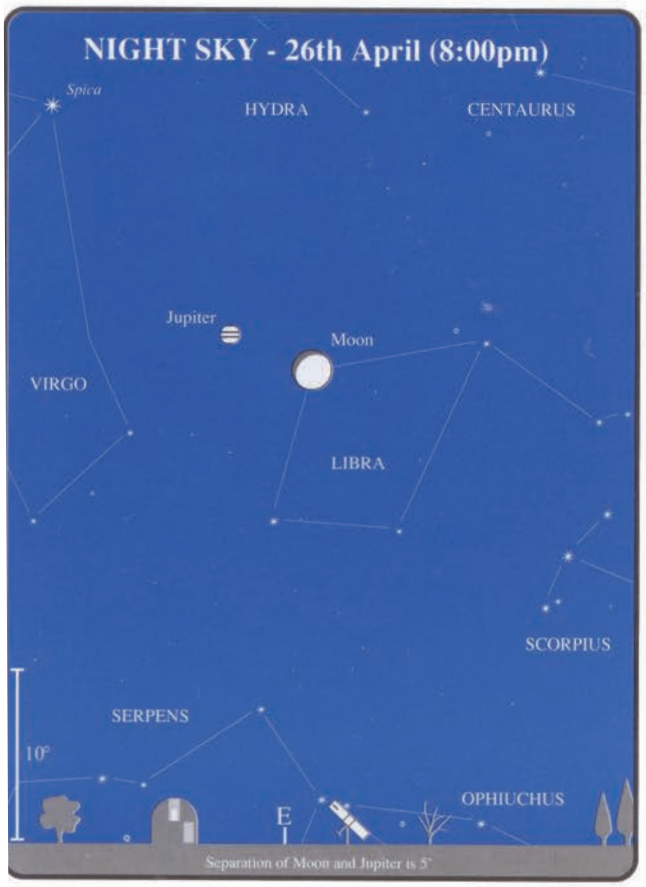




APRIL


NIGHT SKY - 16th April (8:30pm)
M41
Procyon
Sirius
CANIS MINOR
CANIS MAJOR
MONOCEROS
N2244
N2264
LEPUS
Great Neb.
Betelgeuse
Rigel
ORION
ERIDANUS
Moon
10°
W

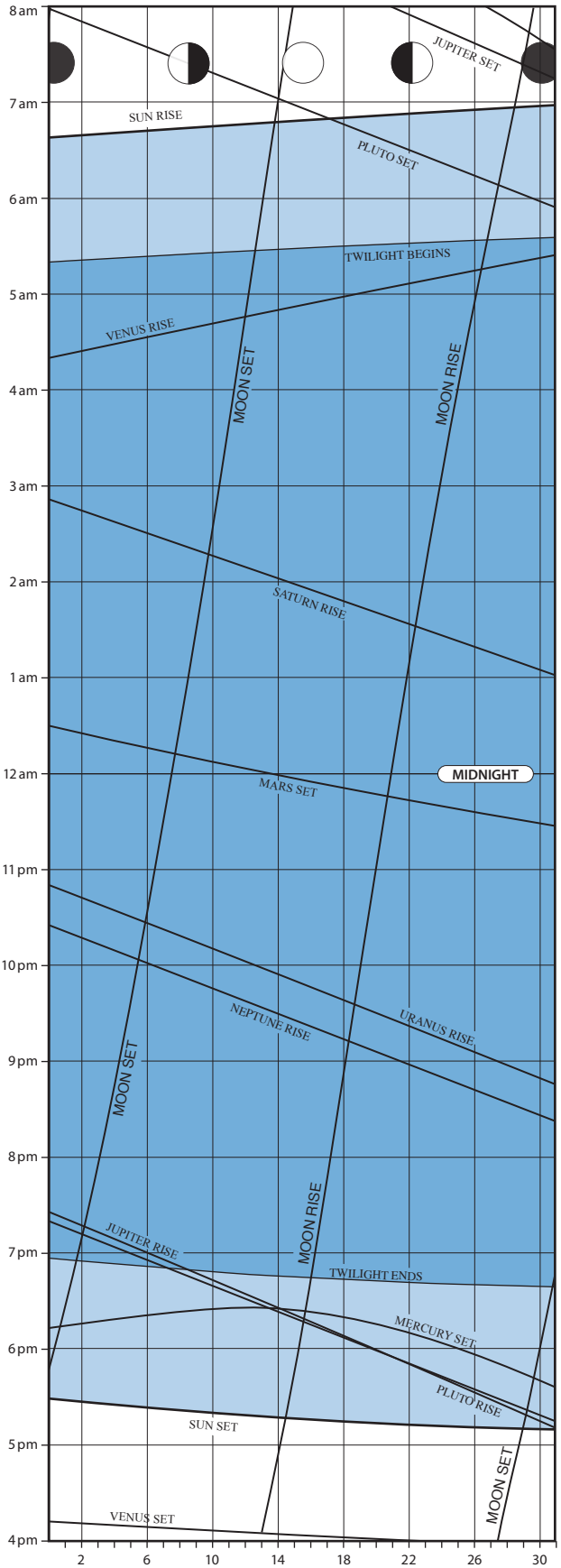

MORNING SKY - 27th April (5:00am)
PISCIS AUSTRINUS
Fomalhaut
Saturn
AQUARIUS
PISCES
CETUS
Mars
10°
E


NIGHT SKY - 26th April (8:00pm)
Spica
HYDRA
CENTAURUS
Jupiter
Moon
VIRGO
LIBRA
SCORPIUS
SERPENS
10°
E
OPHIUCHUS
Separation of Moon and Jupiter is 5°


NIGHT SKY - 30th April (10:00pm)
Arcturus
SERPENS
BOOTES
CORONA BOREALIS
10°
HERCULES
NE
General Sky View

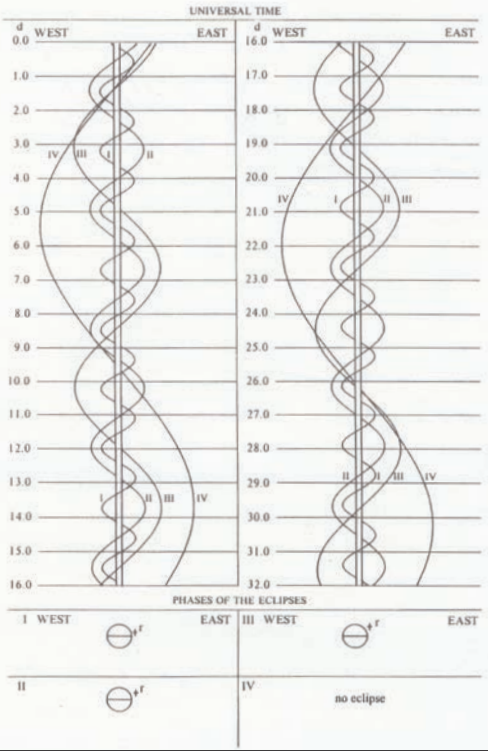
MAY

RISE/SET CHART



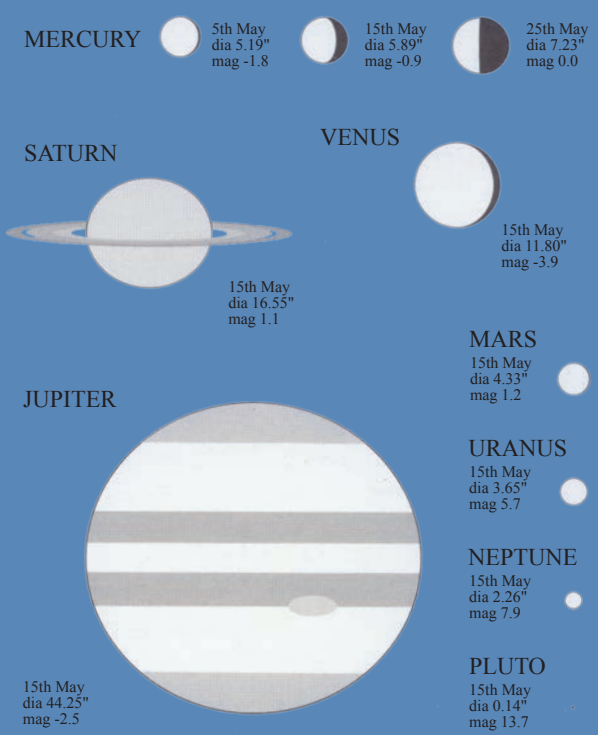
All times are EAST.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



MAY

THE MOON

3rd	Last quarter, 12:32am.
9th	Moon at apogee.
11th	New Moon, 03:07am (Lunation number 883).
	Annular eclipse of the Sun, visible only from eastern Pacific Ocean, North America, Atlantic Ocean and north west Africa.
18th	First quarter, 10:50pm.
24th	Moon at perigee.
25th	Full Moon, 1:39pm.
	Partial eclipse of the Moon, visible only from South America and western Africa.

THE PLANETS

MERCURY, after superior conjunction, returns to the evening sky early in May, but is difficult to see because of its nearness to the Sun. By mid month Mercury will be -1.0 magnitude and visible low in the western sky from about 5.30pm, and at this time the planet will be 8° below and north of 1st magnitude Aldebaran. Greatest elongation (23°) from the Sun is on the 30th (see sky view), and from then Mercury begins to move back toward the Sun and inferior conjunction next month.

VENUS begins the month low in the western evening twilight 7° below 1st magnitude Aldebaran. The planet will be 3° below and north of the 2 day old thin crescent Moon on the 13th (see sky view), and will pass within 0.3° of 3rd magnitude Epsilon Geminorum on the 29th.

MARS moves from Pisces into Aries late in the month. At magnitude 1.2, the planet will be obvious by its brightness and orange colour in an area devoid of bright stars. On the 8th, the 27 day old thin crescent Moon appears 5° north of Mars.

JUPITER, post opposition, remains at -2.5 magnitude for most of the month. The planet'sdiameter begins to shrink but stays above 40" until the end of June. On the 23rd at 9pm, the 13 day old Moon will be 3° from Jupiter (see sky view) and as the night progresses the separation gradually increases to 5° before morning twilight. In the last week of May, Jupiter moves from Libra into Virgo.

SATURN rises mid month around lam, allowing an hour or so for observation at a good altitude before the beginning of twilight. On the 5th, the 24 day old Moon will be 7º north of Saturn (see sky view).

URANUS & **NEPTUNE** rise by 9pm mid month and transit the meridian at 4am. Twice during the month the Moon appears near the planets; on the 1st the 21 day old Moon will be 6° from Uranus and 7° from Neptune, on the 28th the 19 day old Moon will be 6° from Uranus and 4° from Neptune.

PLUTO is at opposition on the 18th. From an observer'spoint of view, opposition means little with a body as small and distant as Pluto, as any difference in magnitude and size is negligible from conjunction to opposition. Because of its highly elliptical orbit, Pluto is presently closer to the Sun than Neptune. The planet regains its status as the 9th and outermost planet in 1999 (Sun-Neptune distance = 30.17 astronomical units, Sun-Pluto = 29.84 au).

THE MINOR PLANETS

Times given for 15th of the month.

CERES: Mag. 8.8; rise 7.40am, transit 12.46pm, set 5.51pm. In Taurus.

PALLAS: Mag. 9.9; rise 3.49am, transit 9.49am, set 3.50pm. In Cetus.

JUNO: Mag. 10.2; rise 3.58pm, transit 9.51pm, set 3.49am. In Virgo.

VESTA: Mag. 8.1; rise 5.53am, transit 11.21am, set 4.51 pm. In Cetus, moving into Aries early in the month, thence into Taurus late in the month.

METEOR SHOWERS

The **VIRGINIDS** extend from 1st February through to 30th May with several submaxima over the period. The rate of 1 to 5 slow meteors (and the occasional fireball) per hour can cause some difficulty in separating true Virginids from sporadic activity. Several radiants are known near the ecliptic in Leo and Virgo and the shower is best observed from late evening into the morning hours.

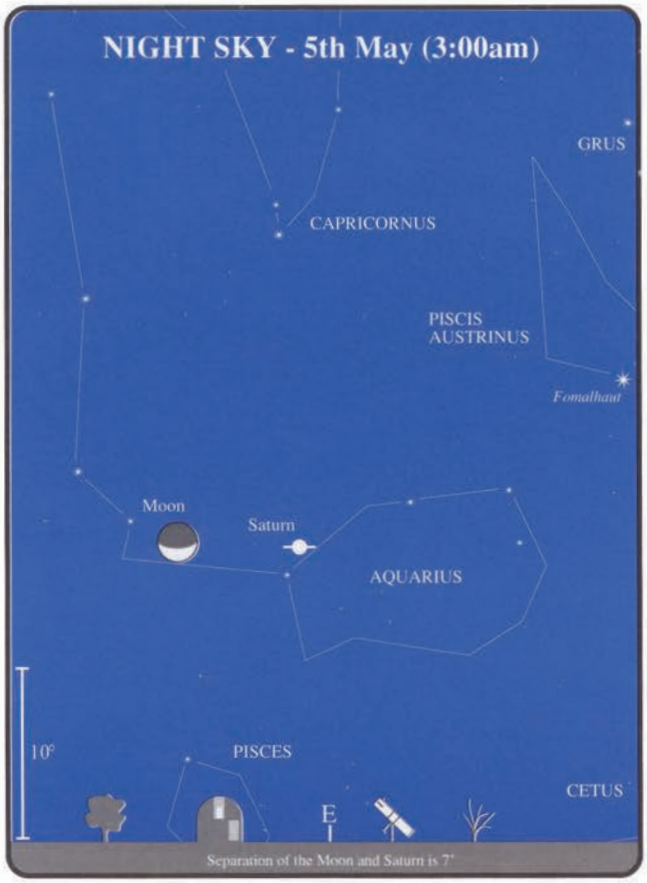
The **ETA AQUARIDS** are linked with Halley'sComet and rank as the most popular of the southern hemisphere showers. They are visible from 19th April to 28th May in the eastern sky, from the end of evening twilight until mid morning. They peak this month on the 4th (high rates have been recorded from the 1st to 8th of May without any real peak in the period). It'susual 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 (up to 25% of the meteors), very swift speed and yellow in colour.

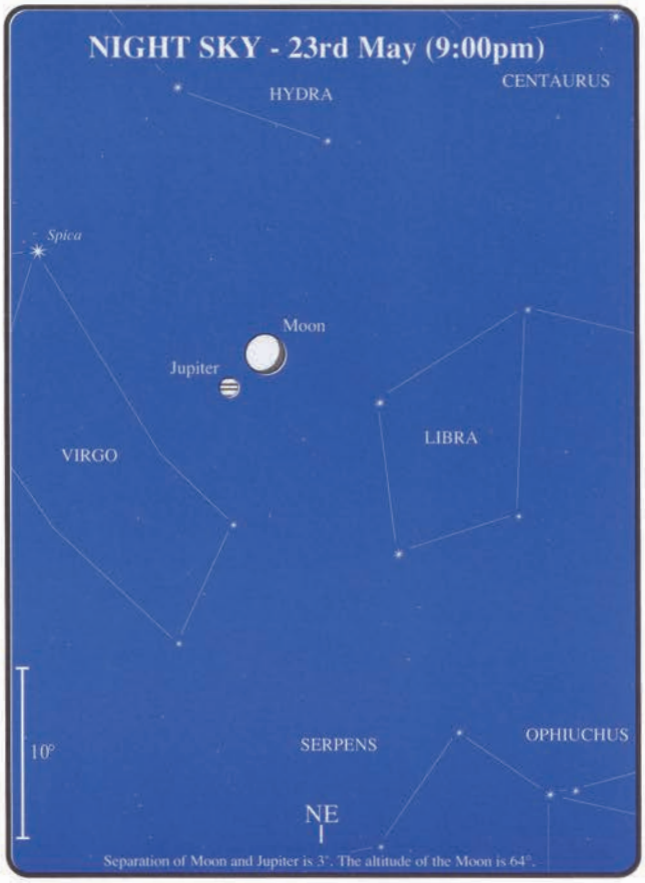
The **ALPHA SCORPIDS** and **SAGITTARIDS** occur between 15th April and 25th July and have several submaxima over the period. April and 25th July and have several submaxima over the period. The radiants are very complex with early Scorpid/Sagittarids appearing in Ophiuchus and Libra; towards the end of May and early June in Scorpius; in Sagittarius in July. Rates are generally low but a maximum ZHR of 10 can sometimes occur. The shower members are often spectacular, being slow and bright with many displaying a yellow-orange colour.

DAILY EVENTS

1st		Mercury at ascending node.
1st	11 AM	Uranus stationary.
1st	4 PM	Neptune 4° South of the Moon.
1st	10 PM	Uranus 5º South of the Moon.
3rd	12:32 AM	Last Quarter Moon.
5th	10 AM	Venus 6° North of Aldebaran
5th	1 PM	Saturn 7º South of the Moon.
6th		Mercury at perihelion.
8th	2 PM	Mars 4º South of the Moon.
9th	12 PM	Moon at apogee.
11th	03:07 AM	New Moon.
11th	4 AM	Comet Mueller (1993a) 4º East of Saturn.
13th	4 PM	Venus 4° North of the Moon.
15th	9 PM	Mercury 8° North of Aldebaran.
16th		Mercury at greatest latitude North (heliocentric).
18th	6 AM	Pluto at opposition.
18th		Venus at perihelion.
18th	10:50 PM	First Quarter Moon.
23rd	9 PM	Jupiter 3° North of the Moon.
24th	1 PM	Moon at perigee.
25th	01:39 PM	Full Moon.
29th	12 AM	Neptune 4º South of the Moon.
29th	6 AM	Uranus 5º South of the Moon.
29th	10 PM	Minor planet Iris 0.2° North of NGC 6325 in Ophiuchus.
30th	5 PM	Mercury greatest elongation East (23°).

MAY


NIGHT SKY - 5th May (3:00am)
GRUS
CAPRICORNUS
PISCIS AUSTRINUS
Fomalhaut
Moon
Saturn
AQUARIUS
10°
PISCES
CETUS
E
Separation of the Moon and Saturn is 7°

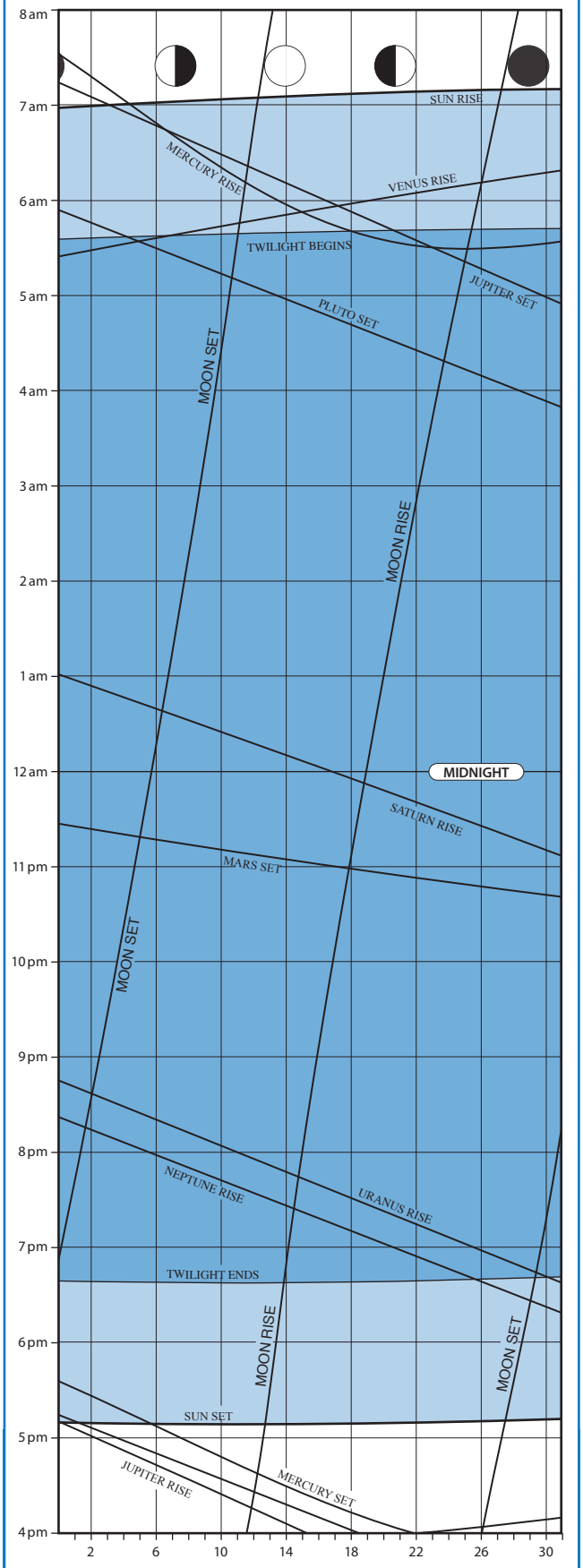

NIGHT SKY - 23rd May (9:00pm)
HYDRA
CENTAURUS
Spica
Moon
Jupiter
VIRGO
LIBRA
10°
SERPENS
OPHIUCHUS
NE
Separation of Moon and Jupiter is 3°. The altitude of the Moon is 64°.


EVENING SKY - 13th May (5:35pm)
LEPUS
MONOCEROS
Rigel
Great Neb.
Betelgeuse
ERIDANUS
ORION
GEMINI
M35
Moon
Venus
Aldebaran
Hyades
TAURUS
10°
AURIGA
Mercury
NW
Separation of the Moon and Venus is 3°. Difficult time to observe ie. only 30 mins. after Sun set.


EVENING SKY - 30th May (6:00pm)
HYDRA
MONOCEROS
CANCER
Procyon
CANIS MINOR
Praesepe (M44)
"Beehive Cluster"
Pollux
GEMINI
Venus
Castor
10°
M35
Mercury
NW
Mercury at Greatest Elongation East (23°)

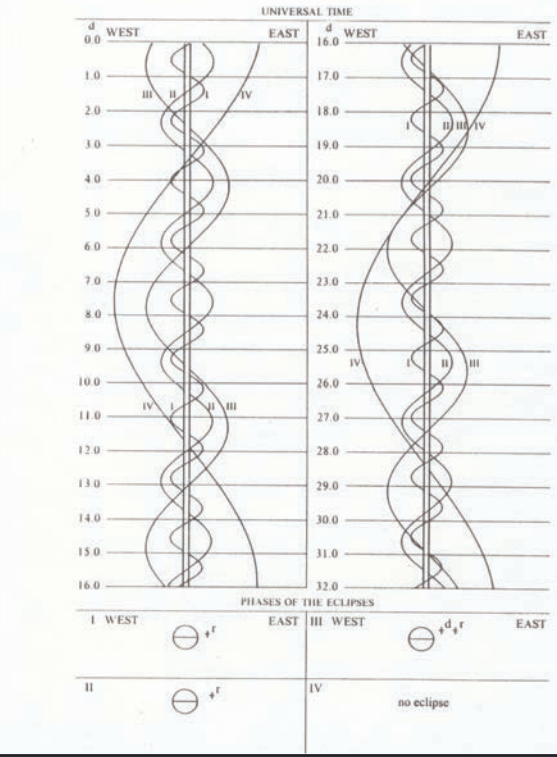
JUNE

RISE/SET CHART



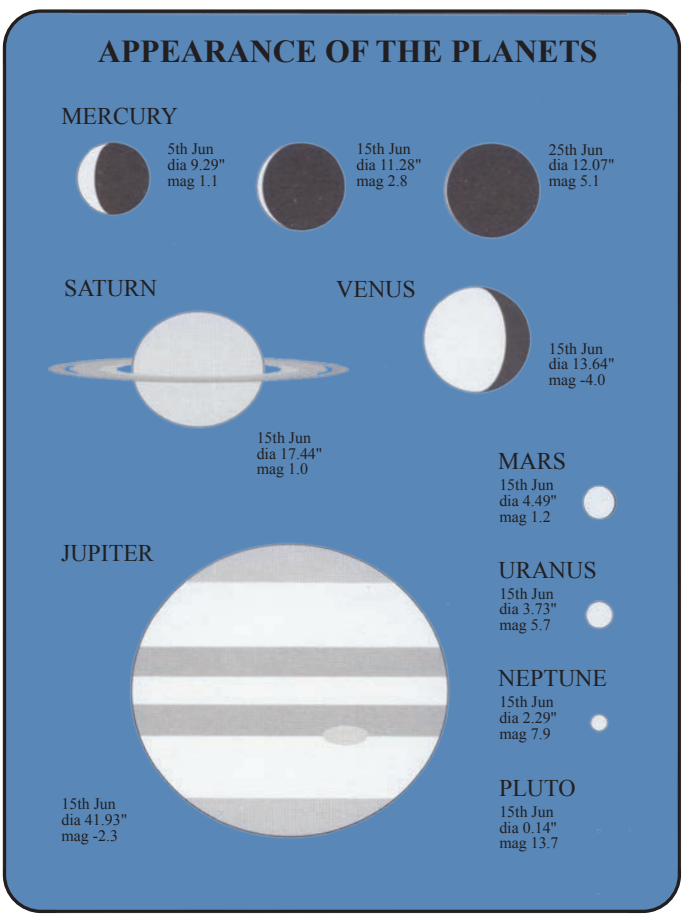
All times are EAST.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



JUNE

THE MOON

1st	Last quarter, 2:02pm.
5th	Moon at apogee.
9th	New Moon, 6:26pm (Lunation number 884).
17th	First Quarter, 5:56am.
21st	Moon at perigee.
23rd	Full Moon, 9:33pm.

THE PLANETS

MERCURY can only be observed in the first half of the month in a darkened sky, it then rapidly moves toward the Sun and into inferior conjunction on the 25th. On the 11th, the 2 day old thin crescent Moon will appear 4 30' directly above Mercury in the early western evening sky.

VENUS continues to rise in altitude each evening and will dominate the western evening sky until October. In the first half of the month, Venus can be seen near the bright stars Castor and Pollux (the two brothers of mythology). On the 12th the 3 day old thin crescent Moon will be seen 6° south of Venus, with the planet 6° above Pollux and Castor (see sky view). On the following evening the 4 day old Moon will be 12° above Venus, with Pollux and Castor below, the four bodies forming a rough vertical line. On the 21st the planet appears 0.5° from the naked eye cluster M44, the Beehive cluster (sky view).

MARS remains in Aries for the first three weeks of June before moving into Taurus. Late in the month the Pleiades will be seen rising below Mars and by month'send will be 5° north of the orange 1.2 magnitude planet. On the 6th, the 26 day old Moon will be 4° north of Mars in the early morning sky (see sky view).

JUPITER, now in Virgo is visible high in the northeastern sky after sunset, and transits the meridian around 8.30pm mid month. On the 19th at 8pm in the northeastern sky, the 10 day old Moon will be seen 4° from Jupiter (see sky view). As the night progresses the separation gradually decreases to 2.5° in the western sky before both objects set.

SATURN rises before midnight and transits the meridian around 5am. At 1st magnitude, Saturn will gradually brighten by 0.5 magnitude between now and late August as it comes to opposition. The planet has two close approaches by the Moon this month; the 22 day old Moon will be less than 10° from Saturn on the 1st and 9° distant on the following evening (see sky view), on the 28th the 20 day old Moon will be 7° from the planet (see sky view).

URANUS & **NEPTUNE** both rise soon after the end of twilight, transiting the meridian at 2am mid month. The 16 day old Moon appears 6°30' from Neptune and 9°30' from Uranus, on the following evening 10° from Neptune and 8° from Uranus.

PLUTO, now past opposition, rises before Sunset and transits the meridian at 10pm mid month.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 8.5; rise 6.42am, transit 11.39am, set 4.26pm. In conjunction with the Sun on the 8th. In Taurus.

PALLAS: Mag. 9.8; rise 2.34am, transit 8.33am, set 2.32pm. In Cetus.

JUNO: Mag. 10.8; rise 1.49pm, transit 7.42pm, set 1.39am. In Virgo.

VESTA: Mag. 8.4; rise 4.55am, transit 10.13am, set 3.32pm. In Taurus.

METEOR SHOWERS

The **ALPHA SCORPIDS** and **SAGITTARIDS** occur between 15th April and 25th July and have several submaxima over the period. The radiants are very complex with early Scorpid/Sagittarids appearing in Ophiuchus and Libra; towards the end of May and early June in Scorpius; in Sagittarius in July. Rates are generally low but a maximum zenith hourly rate (ZHR) of 10 can sometimes occur. The shower members are often spectacular, being slow and bright with many displaying a yellow-orange colour.

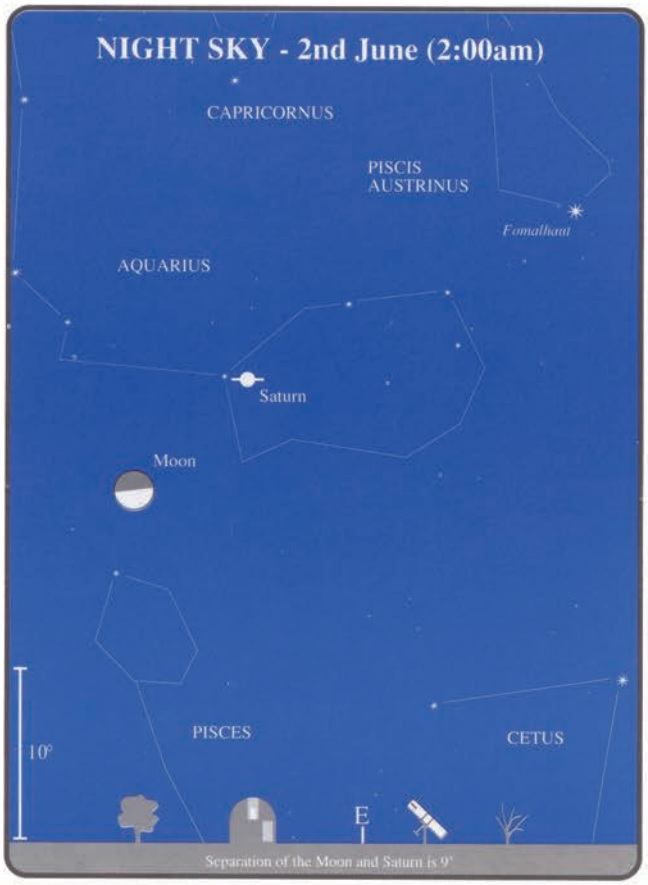
The **LYRIDS** (June) were discovered in 1966, and observed again in 1968 and 1969 (11th to 21st June, with maximum on the 16th). Hourly rates of around 9 were recorded in the sixties, but in the seventies and eighties the rates have been so low that any activity may have been caused by sporadic meteors. It'snow considered that the Lyrids (June) was a transient stream that will not cross the Earth'sorbit again.

The **BOOTIDS** (June), also known as the June-Draconids or Pons-Winneckids (after the short period Comet Pons-Winnecke), were first observed on June 28th 1916 and have only been recorded twice since then (1921 & 1927). With no activity in recent years, it appears that the Earth no longer encounters the stream.

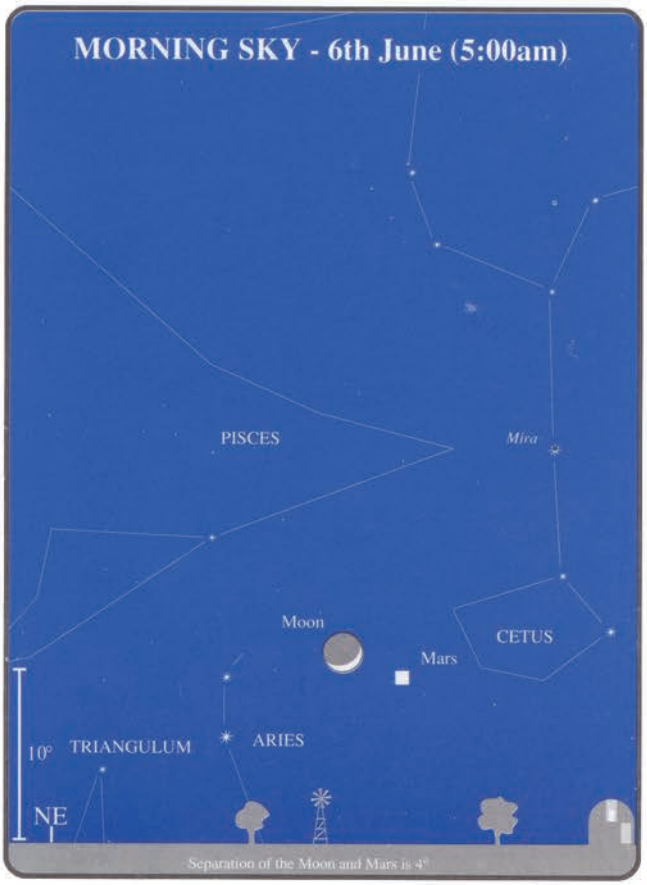
DAILY EVENTS

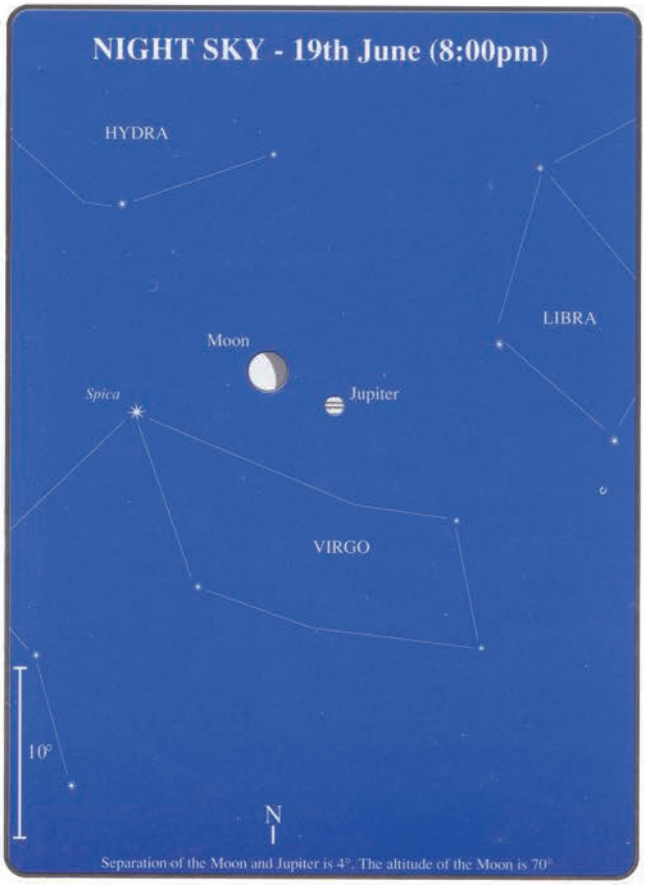
1st	02:02 PM	Last Quarter Moon.
1st	10 PM	Saturn 7º South of the Moon.
3rd	10 PM	Minor planet Hygiea 0.5° South of NGC 4487 in Virgo.
4th	4 AM	Comet Mueller (1993a) 0°.2 South of NGC 7492 in Aquarius.
5th	11 PM	Moon at apogee.
6th	3 PM	Mars 2° South of the Moon.
7th	11 PM	Comet Tempel 1 is 4° E of NGC 4753 in Virgo.
8th	1 PM	Ceres in conjunction with the Sun.
9th		Mercury at descending node.
9th		Venus at greatest latitude North (heliocentric).
9th	06:26 PM	New Moon.
10th	3 PM	Venus 5° South of Pollux.
11th	10 AM	Mercury 3° North of the Moon
11th	10 PM	Minor planet Iris 0.5° South of NGC 6287 in Ophiuchus.
12th	1 AM	Juno stationary.
12th	10 PM	Mercury stationary
12th	11 PM	Venus 7º North of the Moon.
17th	05:56 AM	First Quarter Moon
19th		Mercury at aphelion.
20th	2 AM	Jupiter 3° North of the Moon.
21st	5 PM	Moon at perigee
21st	06:30 PM	Venus 0.4° North of M44 in Cancer
22nd	1 AM	Solstice.
22nd	10 PM	Minor planet Iris 0.4° South of NGC 6235 in Ophiuchus.
23rd	09:33 PM	Full Moon.
24th	2 PM	Saturn stationary.
25th	9 AM	Neptune 4° South of the Moon.
25th	3 PM	Uranus 5º South of the Moon.
25th	8 PM	Mercury in inferior conjunction with the Sun.
29th	7 AM	Saturn 7º South of the Moon.
30th	11 PM	Comet Tempel 1 is 3°.5 NE of Spica.

JUNE

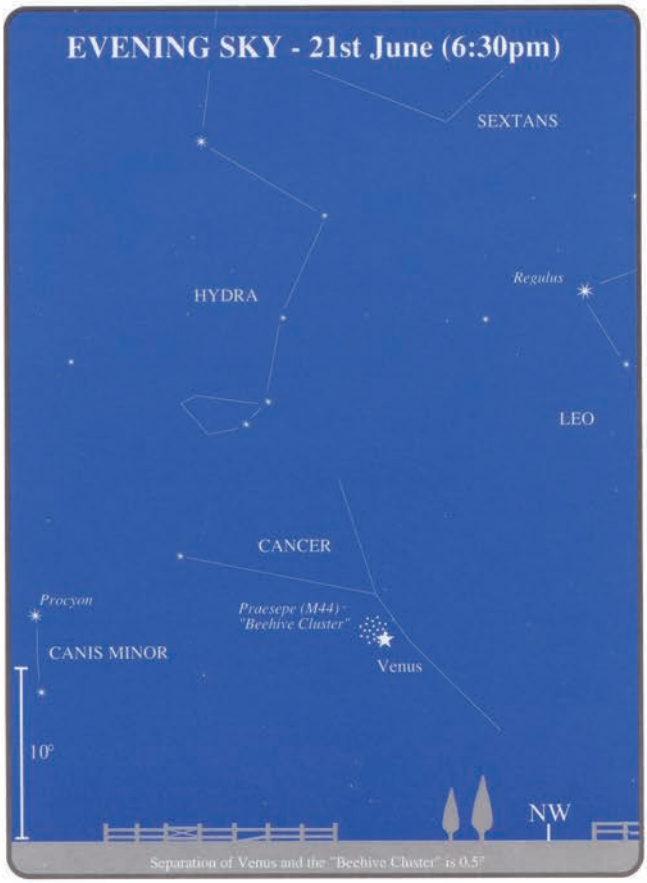

NIGHT SKY - 2nd June (2:00am)
CAPRICORNUS
PISCIS AUSTRINUS
Fomalhaut
AQUARIUS
Saturn
Moon
10°
PISCES
CETUS
E
Separation of the Moon and Saturn is 9°

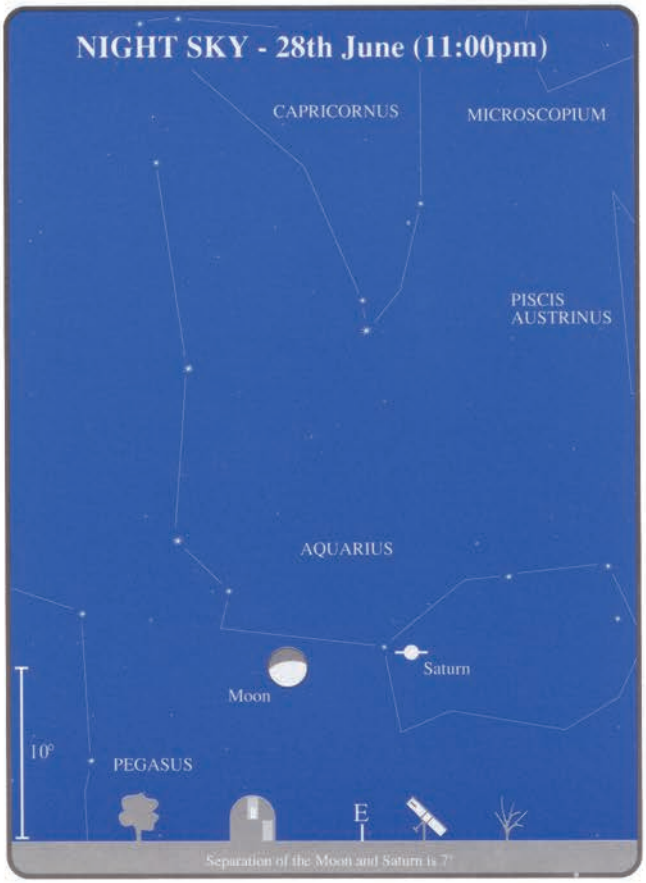

EVENING SKY - 12th June (6:00pm)
HYDRA
MONOCEROS
CANCER
Procyon
CANIS MINOR
Praesepe (M44) "Beehive Cluster"
Moon
Venus
Pollux
10°
GEMINI
Castor
Mercury
NW
Separation of the Moon and Venus is 6.5°

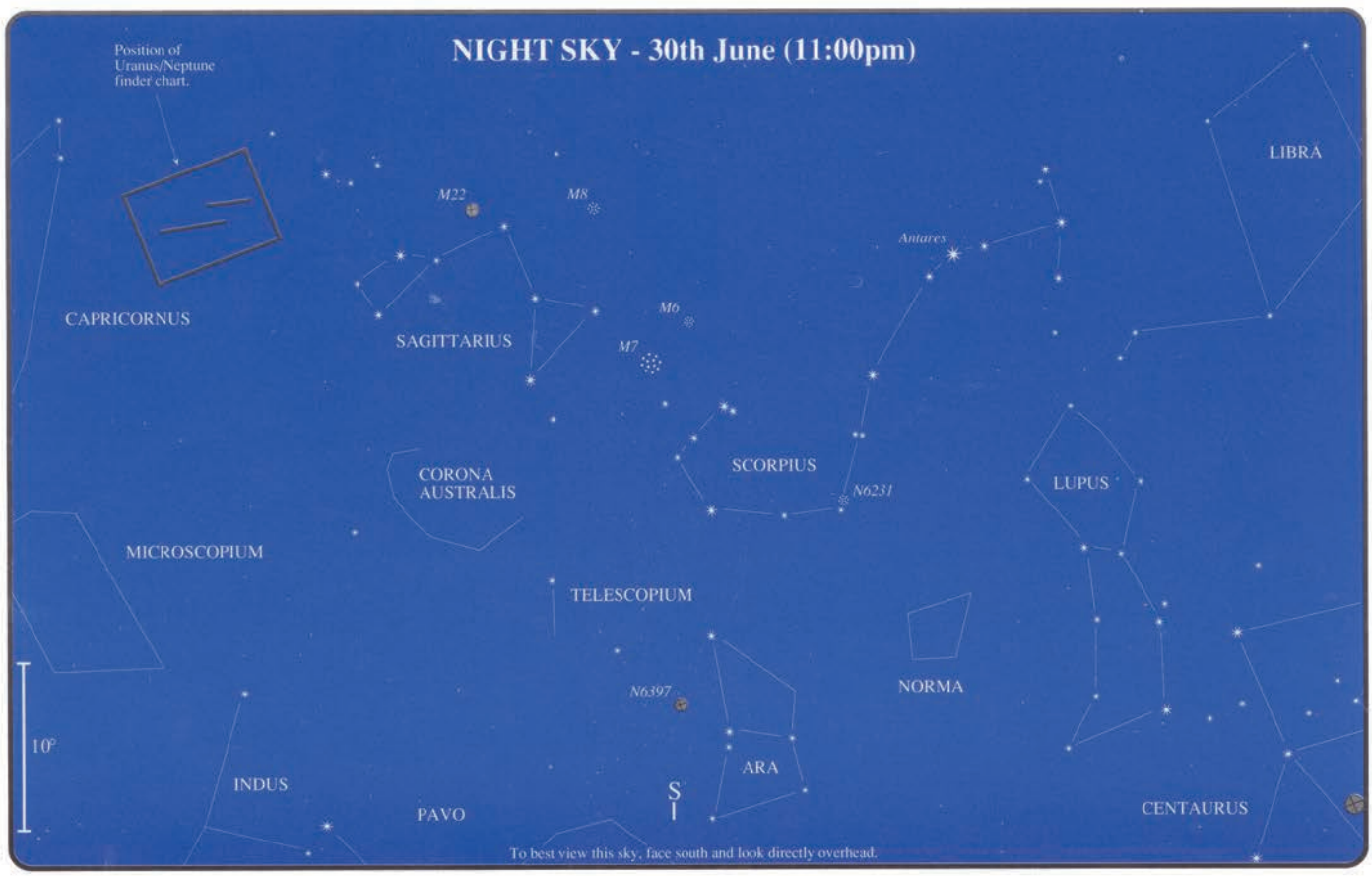

MORNING SKY - 6th June (5:00am)
PISCES
Mira
Moon
CETUS
Mars
10°
TRIANGULUM
ARIES
NE
Separation of the Moon and Mars is 4°


NIGHT SKY - 19th June (8:00pm)
HYDRA
LIBRA
Moon
Spica
Jupiter
VIRGO
10°
N
Separation of the Moon and Jupiter is 4°. The altitude of the Moon is 70°

JUNE

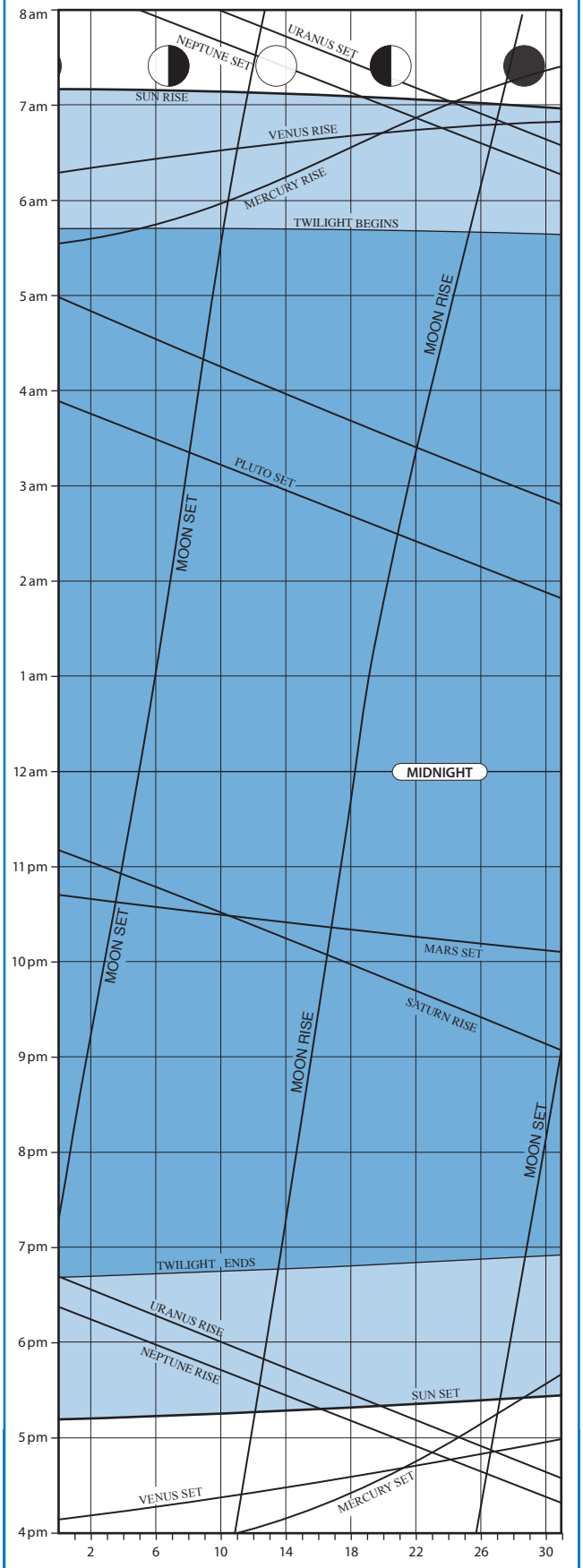

EVENING SKY - 21st June (6:30pm)
SEXTANS
HYDRA
Regulus
LEO
CANCER
Procyon
Praesepe (M44)
"Beehive Cluster"
CANIS MINOR
Venus
10°
NW
Separation of Venus and the "Beehive Cluster" is 0.5°


NIGHT SKY - 28th June (11:00pm)
CAPRICORNUS
MICROSCOPIUM
PISCIS AUSTRINUS
AQUARIUS
Moon
Saturn
10°
PEGASUS
E
Separation of the Moon and Saturn is 7°

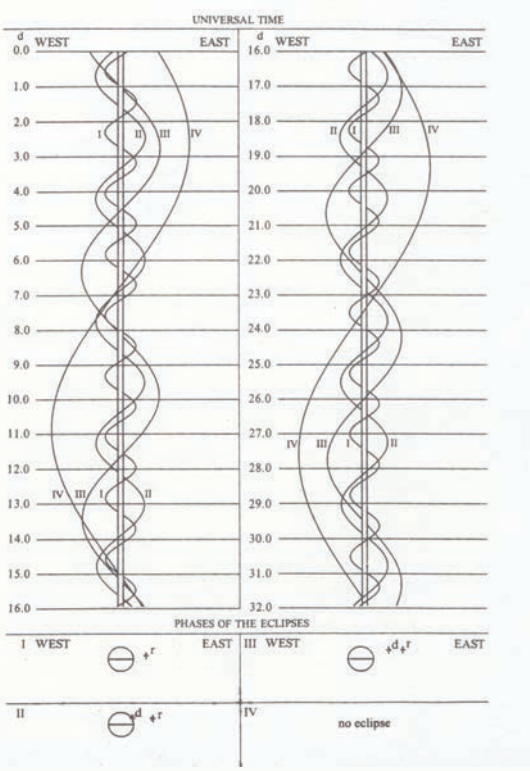

NIGHT SKY - 30th June (11:00pm)
Position of Uranus/Neptune finder chart.
LIBRA
M22
M8
Antares
CAPRICORNUS
SAGITTARIUS
M6
M7
CORONA AUSTRALIS
SCORPIUS
N6231
LUPUS
MICROSCOPIUM
TELESCOPIUM
N6397
NORMA
10°
ARA
INDUS
S
I
PAVO
CENTAURUS
To best view this sky, face south and look directly overhead.

JULY

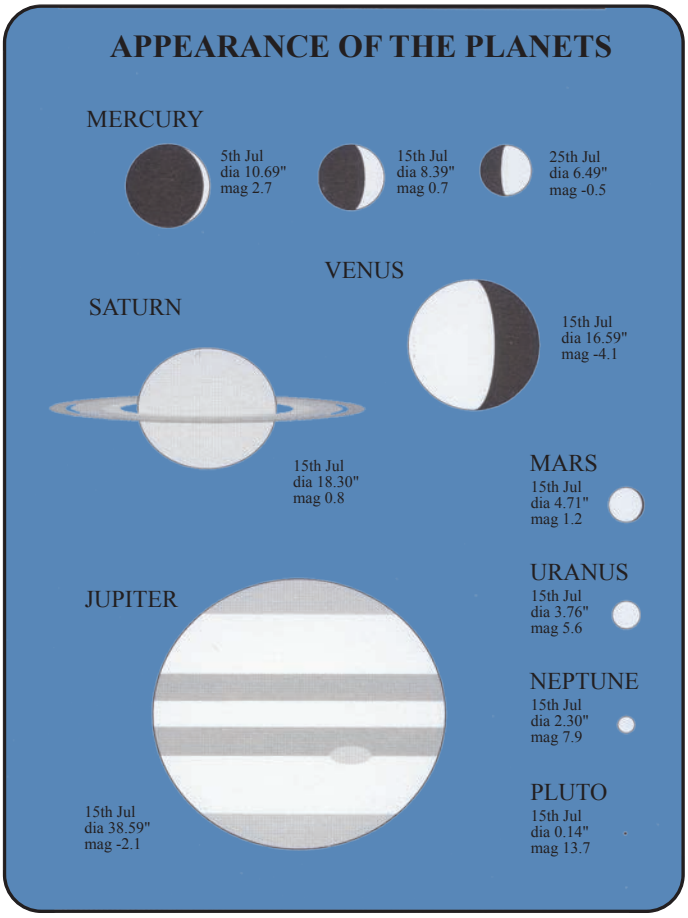
RISE/SET CHART



All times are EAST.



APPEARANCE OF THE PLANETS



JULY

THE MOON

1st Last Quarter, 5:31am.

3rd Moon at apogee.

5th Occultation of Mars by 26 day old Moon (not visible from Australia).

9th New Moon, 7:37am (Lunation number 885).

16th First Quarter, 11:12am.

19th Moon at perigee.

23rd Full Moon, 6:16am.

30th Last Quarter, 10:40pm.

31st Moon at apogee.

THE PLANETS

MERCURY, after inferior conjunction late last month, becomes a morning object and reaches its greatest western elongation (21°) on the 18th. The planet can be seen low to the horizon an hour before sunrise between the 10th and 20th (brightening during the period from 1.6 to 0.0 magnitude), and may be followed to an altitude of about 10° before the morning twilight overtakes the night. On the 7th, the 28 day old thin crescent Moon appears 8° north of Mercury and on the following day 4°40' directly below (but more difficult to see the slender lunar crescent).

VENUS, at magnitude -4 dominates the western evening sky. At the beginning of the month 1st magnitude Regulus (the brightest star in Leo) can be seen about 10° above and northwards. Venus and Regulus move closer together each night until the 11th when they are at their closest at just 1° apart, thereafter their separation increases. On the 12th, the 3 day old Moon appears 6° above and south of Venus and Regulus (see sky view).

MARS spends the month in Taurus, moving onto Gemini next month. Of interest during the month, to the unaided eye, is the close approach of Mars to the Pleiades and Hyades star clusters, by the 9th Mars will be situated midway between the two clusters. On the 18th, Mars (at 1.2 magnitude) will be 5° from 1st magnitude reddish/orange Aldebaran (see sky view), the brightest star in the Hyades (not a true cluster member). The colour and magnitude of Mars and Aldebaran should make an interesting comparison. On the 5th the 26 day old Moon will be seen 4° north of Mars, forming a triangle with the Pleiades (see sky view), and on the following evening the Moon will appear 7° below and southwards of Mars.

JUPITER transits the meridian at 6.30pm mid month and telescopic observations would be best in the early evening before too much altitude is lost. At -2.1 magnitude Jupiter is bright in the north/northwestern sky during the month, and stays within 12° of 1st magnitude Spica (the brightest star in Virgo). On the 16th the 8 day old Moon will be seen 8° from Jupiter (see sky view), and on the following evening 7° distant.

SATURN is now better placed for the evening observer, rising before 9pm mid month and transiting the meridian around 3am. On the 25th the 17 day old Moon will appear 9° above and north of the planet (see sky view) and on the 26th, 10° below and north.

URANUS & **NEPTUNE** both come to opposition this month, Uranus on the 17th and Neptune on the 15th. From an observer'spoint of view, opposition means little with Uranus and Neptune, as the difference in magnitude and size is negligible from conjunction to opposition; the only gain is that both planets are available for observation throughout the night. On the 22nd, in the evening sky the Full Moon is 5°30' from both planets forming a triangle.

PLUTO transits the meridian at 8pm mid month, therefore making July and early August the last opportunity to try to observe or photograph the planet at a reasonable altitude this year.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 8.9; rise 5.44am, transit 10.35am, set 3.28pm. In Taurus 1st week of month then into Gemini.

PALLAS: Mag. 9.5 rise 1.15am, transit 7.17am, set 1.19pm. In Cetus.

JUNO: Mag. 11.3; rise 11.55am, transit 5.54pm, set 11.51pm. In Virgo.

VESTA: Mag. 8.4; rise 3.54am, transit 9.06am, set 2.28pm. In Taurus.

METEOR SHOWERS

The **ALPHA SCORPIDS** and **SAGITTARIDS** occur between 15th April and 25th July and have several submaxima over the period. The radiants are very complex with early Scorpid/Sagittarids appearing in Ophiuchus and Libra; towards the end of May and early June in Scorpius; in Sagittarius in July. Rates are generally low but a maximum zenith hourly rate (ZHR) of 10 can sometimes occur. The shower members are often spectacular, being slow and bright with many displaying a yellow-orange colour.

The **PISCIS AUSTRINIDS** are frequently overlooked by southern observers, as the more popular Delta Aquarids are active over the same period. The Piscis Austrinids are visible from the 9th July to 17th August, and generally provide 1 or 2 meteors per hour and occasionally 3 or 4 are recorded. The 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 a few leaving trains.

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

The **DELTA AQUARIDS** (Southern) are one of the strongest and most consistent of the southern showers. The range of activity of these medium speed meteors extends from 8th July through to 19th August, with maximum this month around the 28th or 29th with a ZHR of 20 to 30. The Delta Aquarids are generally faint (bright meteors are the exception), typically white with some blue members, and occasionally leave trains (less than 10%). The shower is visible late evening in the eastern sky until dawn in the west.

The **DELTA AQUARIDS** (Northern) occur from 15th July to 25th August, reaching maximum activity next month on the 12th with a ZHR of 5. The northern branch of the Delta Aquarids are less spectacular than their southern counterpart as they produce fewer meteors, that tend to be faster and have shorter trails.

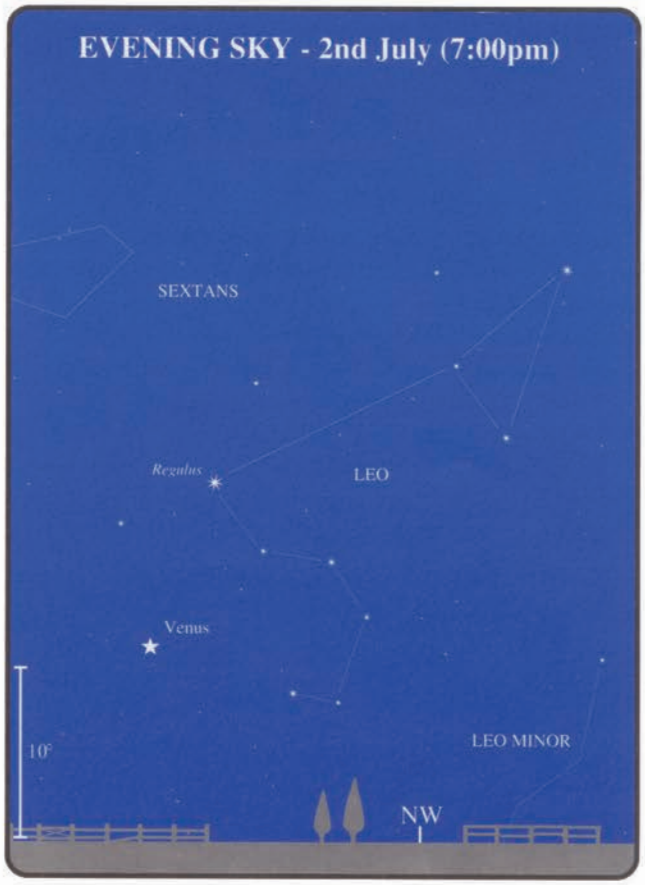
JULY

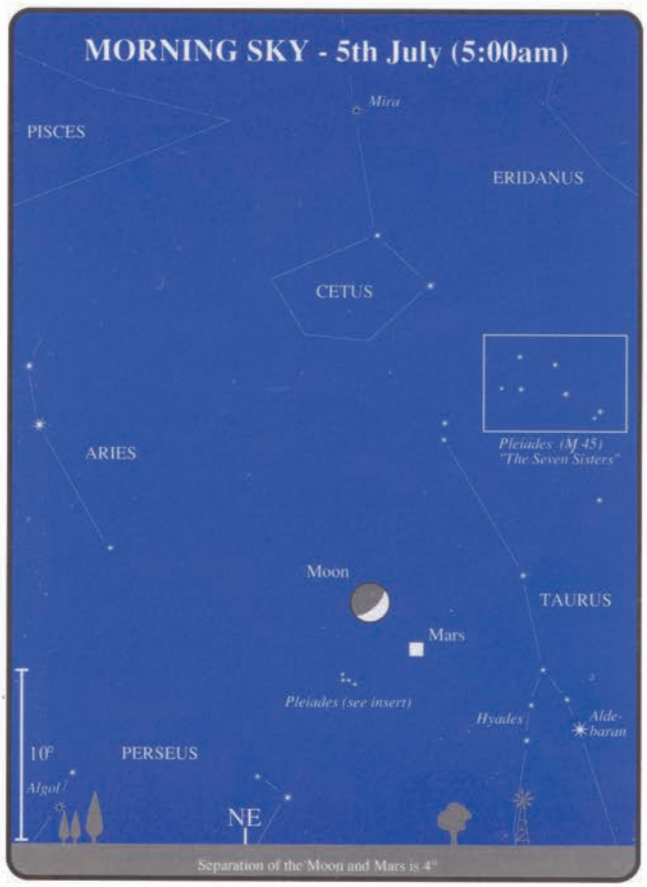
The **IOTA AQUARIDS** (South) reach maximum activity next month on the 5th with a ZHR of 3 faint, medium speed meteors (around 4th magnitude down to telescopic); they are active from 15th July to 25th August. The Iota Aquarids may be difficult to distinguish from the Southern & Northern Delta Aquarids happening about the same time.

The **PERSEIDS** are probably the best known and most dependable of the showers. Records of their activity date back over one thousand years. The duration is from 17th July through to 24th August, and maxima is reached next month on the 12th. The ZHR is 95 and the meteors are very swift. Unfortunately, the shower'snortherly declination means that the radiant is below the horizon for southern observers. The normal average ZHR was eclipsed in 1991, 1992 and 1993 by rates of 400 plus, making the Perseids the most exciting and active shower of recent times.

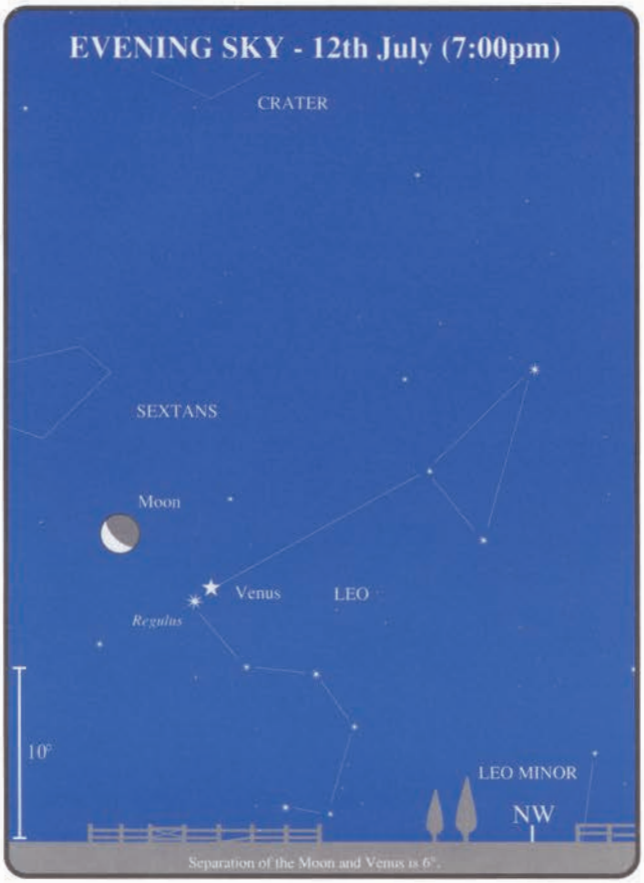
DAILY EVENTS

1st	05:31 AM	Last Quarter Moon.
3rd	2 AM	Jupiter stationary.
3rd	3 PM	Moon at apogee.
5th	3 PM	Mars 0º.3 North of the Moon
6th	5 AM	Earth at aphelion.
6th	10 PM	Minor planet Hebe 0.1° South of NGC 5838 in Virgo.
7th	6 AM	Mercury stationary.
7th	11 PM	Mercury 1º.3 South of the Moon.
9th	07:37 AM	New Moon.
9th		Mercury at greatest latitude South (heliocentric).
10th	10 PM	Minor planet Hebe 0.2° West of NGC 5846 in Virgo.
11th	3 AM	Venus 1°.1 North of Regulus.
12th	10 PM	Venus 7º North of the Moon.
15th	2 AM	Neptune at opposition.
15th	11 PM	Comet Tempel 1 is 3°.5 SW of Jupiter.
16th	11:12 AM	First Quarter Moon.
17th	9 AM	Jupiter 3º North of the Moon.
17th	2 PM	Uranus at opposition.
18th	12 AM	Mercury greatest elongation West (21°).
19th	4 AM	Moon at perigee.
19th	7 AM	Mars 5º North of Aldebaran.
22nd	5 PM	Neptune 4° South of the Moon.
22nd	10 PM	Uranus 5° South of the Moon.
23rd	06:16 AM	Full Moon.
26th	2 PM	Saturn 7° South of the Moon.
28th		Mercury at ascending node.
28th	5 PM	Transit of Mercury across Sun (visible only from Mars!)
30th	10:40 PM	Last Quarter Moon.
31st	9 AM	Moon at apogee.
31st	5 PM	Mercury 6° South of Pollux.

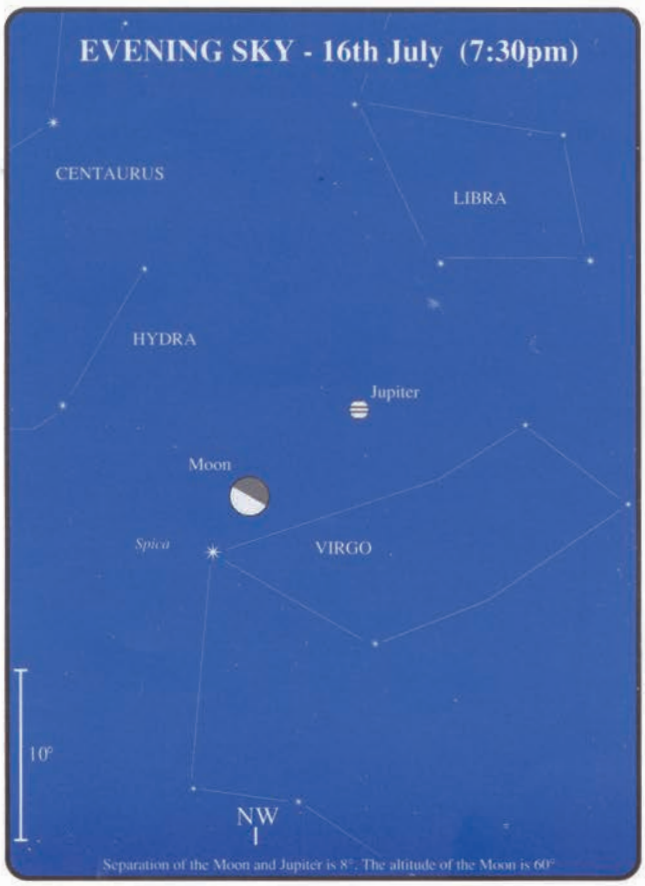


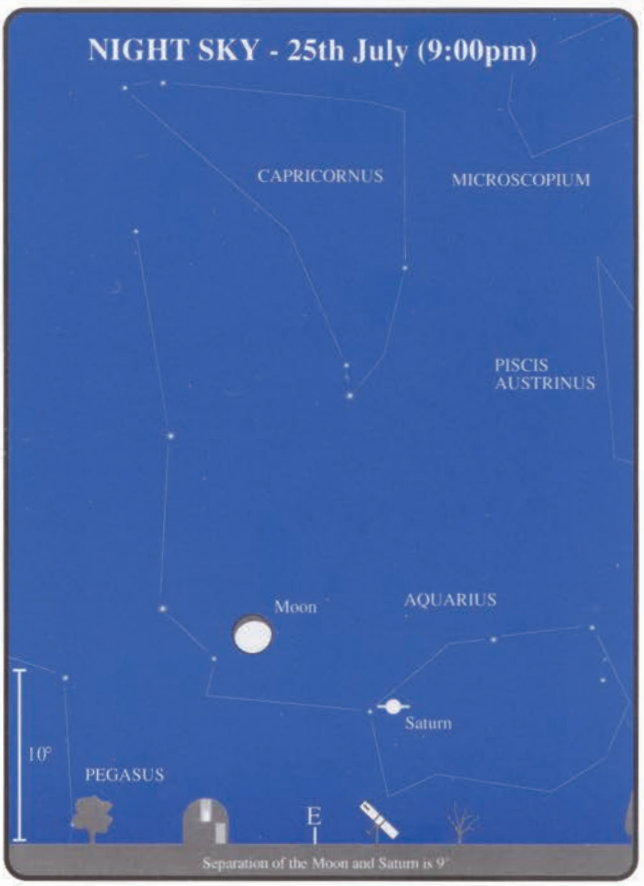


JULY


EVENING SKY - 12th July (7:00pm)
CRATER
SEXTANS
Moon
Venus
LEO
Regulus
10°
LEO MINOR
NW
Separation of the Moon and Venus is 6°.

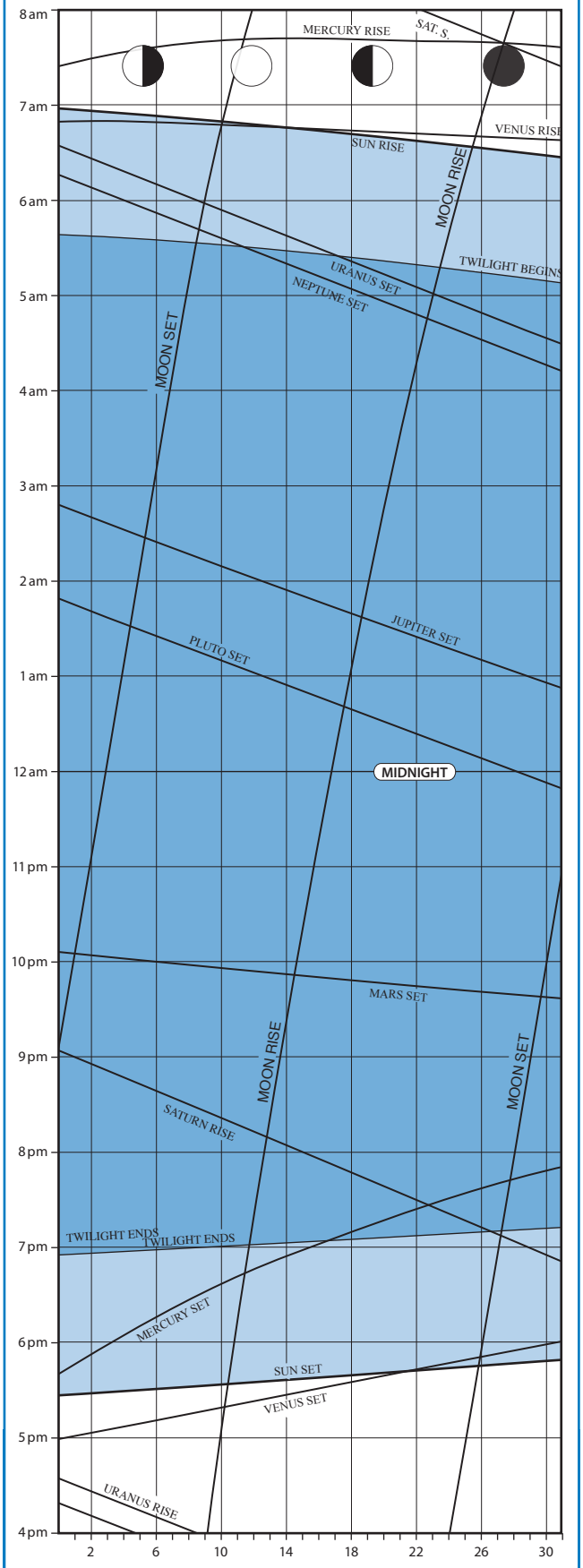

MORNING SKY - 18th July (6:00am)
ERIDANUS
LEPUS
Rigel
Great Neb.
TAURUS
Aldebaran
Hyades
ORION
Mars
Betelgeuse
10°
Mercury
M35
AURIGA
GEMINI
NE
Mercury Greatest Elongation West (21°)


EVENING SKY - 16th July (7:30pm)
CENTAURUS
LIBRA
HYDRA
Jupiter
Moon
Spica
VIRGO
10°
NW
Separation of the Moon and Jupiter is 8°. The altitude of the Moon is 60°


NIGHT SKY - 25th July (9:00pm)
CAPRICORNUS
MICROSCOPIUM
PISCIS AUSTRINUS
Moon
AQUARIUS
Saturn
10°
PEGASUS
E
Separation of the Moon and Saturn is 9°

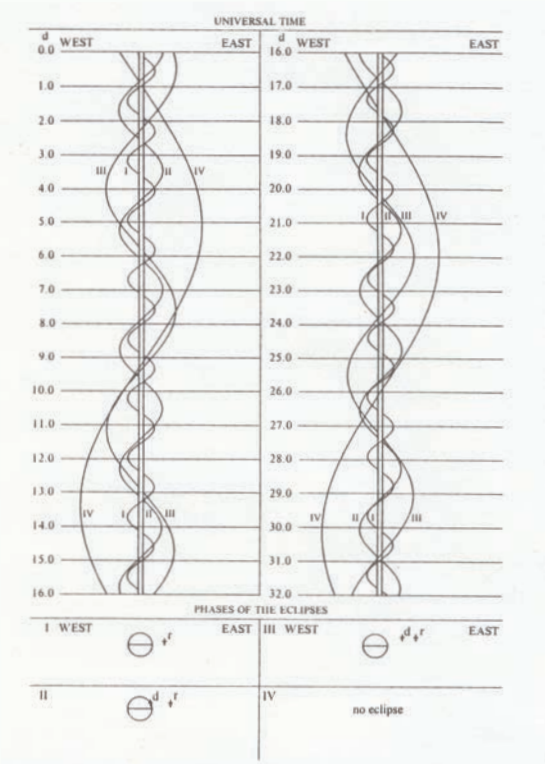
AUGUST

RISE/SET CHART



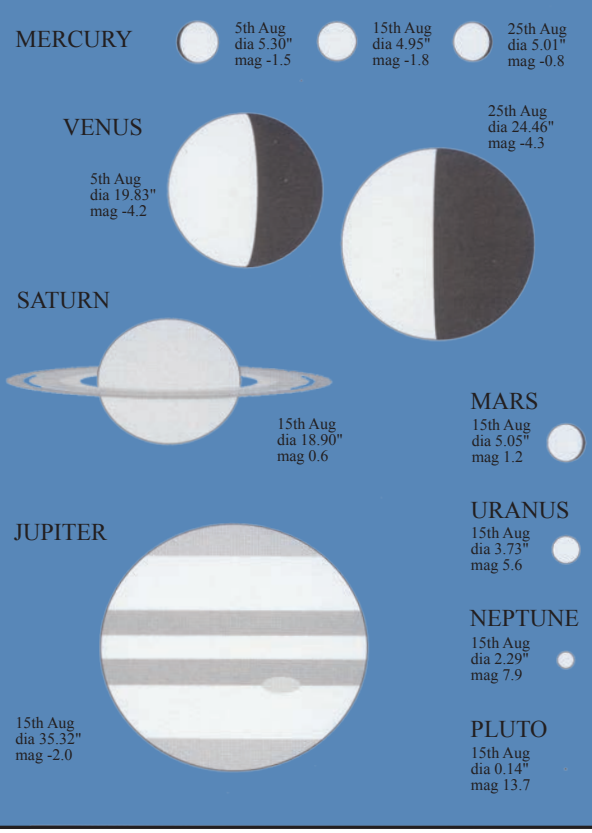
All times are EAST. For summer time (daylight saving) add 1 hour.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



AUGUST

THE MOON

7th New Moon, 6:45pm (Lunation number 886).
13th Moon at apogee (most distant from Earth).
14th First Quarter, 3:57pm.
21st Full Moon, 4:47pm.
28th Moon at perigee (closest to Earth).
29th Last Quarter, 4:41 pm.
31st Occultation of Vesta by 24 day old Moon (not visible from Australia).

THE PLANETS

MERCURY will be invisible in the early weeks of August as it heads toward superior conjunction on the 13th. Reappearing from behind the Sun, the planet can be seen in the evening twilight towards the end of the month. The best time to observe Mercury in the evening sky this year is from September to mid-October.

VENUS, at magnitude -4.3, is very prominent in the western evening sky, and is at its greatest elongation (46°) east of the Sun on the 25th (see sky view). Throughout the month 1st magnitude Spica (the brightest star in Virgo) will be seen moving closer to the horizon and Venus each evening. Starting 30° from the planet the two end up at a close 0.6° on the 31st (see sky view), a spectacular sight! On the 10th, the 3 day old Moon appears 8° below and south of Venus and on the following evening 6.6° directly above the planet (see sky view).

MARS spends the first two weeks of August in Taurus before crossing into Gemini. Rising around 3.30am, Mars is prominent (at magnitude 1.2) in the early morning northeastern sky, but with a diameter of only 5" (not a lot more than distant Uranus), it does not present much of a telescope target. On the 3rd, the 25 day old Moon will be seen 4.4° above Mars (see sky view), and on the following evening 7° below and southwards.

JUPITER, in the northwestern evening sky, sets before midnight. Telescopic observations of the planet should be carried out early in the evening while the planet maintains a reasonable altitude above the horizon. Jupiter'smagnitude falls slightly to -1.9 and the disk shrinks to 34". On the 13th, the 6 day old Moon will appear a close 3° south of Jupiter (see sky view).

SATURN, rising at the end of twilight mid month, is visible the entire night. With opposition happening early next month, Saturn is at its brightest and largest angular diameter for the year ie at magnitude 0.5 and a 19' dia (disc). On the 22nd, the 16 day old Moon is 7.7° north of Saturn (see sky view).

URANUS & **NEPTUNE** now past opposition, can be found high (altitude 50°) in the eastern sky after twilight and remain visible throughout the night. On the 18th, the 12 day old Moon will be 4.5° from Neptune and 6°.6° from Uranus.

PLUTO sets just after midnight mid month, and attempts to observe or photograph the planet should be near the top of any observing list of difficult objects before too much altitude is lost.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 8.9; rise 4.39am, transit 9.30am, set 2.22pm. In Gemini.

PALLAS: Mag. 9.2; rise 11.37pm, transit 5.54am, set 12.06pm. Moving from Cetus into Eridanus early in month.

JUNO: Mag. 11.4; rise 10.08am, transit 4.14pm, set 10.20pm. In Virgo.

VESTA: Mag. 8.3; rise 2.45am, transit 7.53am, set 1.01pm. On the 31st there is an occultation by the 24 day old Moon (not visible from Australia). In Taurus, moving into Orion late in the month.

METEOR SHOWERS

The **PISCIS AUSTRINIDS** are frequently overlooked by southern observers, as the more popular Delta Aquarids are active over the same period. The Piscis Austrinids are visible from the 9th July to 17th August, and generally provide 1 or 2 meteors per hour and occasionally 3 or 4 are recorded. The ZHR increases to 8 or 10 meteors on the 28th of last 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 a few leaving trains.

The **ALPHA CAPRICORNIDS** are noted for their bright, slow meteors with long paths and frequent fireballs. The shower is visible from 3rd July through to 25th August with maximum activity last month on the 30th with a ZHR of 8. The low hourly rates over the shower period is generally made up by the spectacular nature of the Alpha Capricornids. Visible late evening in the eastern sky until dawn in the west.

The **DELTA AQUARIDS** (Southern) are one of the strongest and most consistent of the southern showers. The range of activity of these medium speed meteors extends from 8th July through to 19th August, with maximum last month around the 28th or 29th with a ZHR of 20 to 30. The Delta Aquarids are generally faint (bright meteors are the exception), typically white with some blue members, and occasionally leave trains (less than 10%). The shower is visible late evening in the eastern sky until dawn in the west.

The **DELTA AQUARIDS** (Northern) occur from 15th July to 25th August, reaching maximum activity this month on the 12th with a ZHR of 5. The northern branch of the Delta Aquarids are less spectacular than their southern counterpart as they produce fewer meteors, that tend to be faster and have shorter trails.

The **IOTA AQUARIDS (S)** reach maximum activity this month on the 5th with a ZHR of 3 faint, medium speed meteors (around 4th magnitude down to telescopic); they are active from 15th July to 25th August. The Iota Aquarids may be difficult to distinguish from the Southern and Northern Delta Aquarids which happen around the same time.

The **IOTA AQUARIDS (N)** span from 11th August through to 20th September, with maximum activity happening this month on the 20th. The hourly rate is 3, and the shower is visible late evening in the eastern sky until dawn in the west. Again, like the Iota Aquarids (S) they may be difficult to distinguish from the Southern and Northern Delta Aquarids which happen around the same time.

The **PERSEIDS** are probably the best known and most dependable of the showers, records of their activity date back over one thousand years. The duration is from 17th July through to 24th August, and maxima is reached this month on the 12th. The ZHR is 95 and the meteors are very swift. Unfortunately, the shower'snortherly declination means that the radiant is below the horizon for southern observers. The normal average ZHR was eclipsed in 1991, 1992 and 1993 by rates of 400 plus, making the Perseids the most exciting and active shower of recent times.

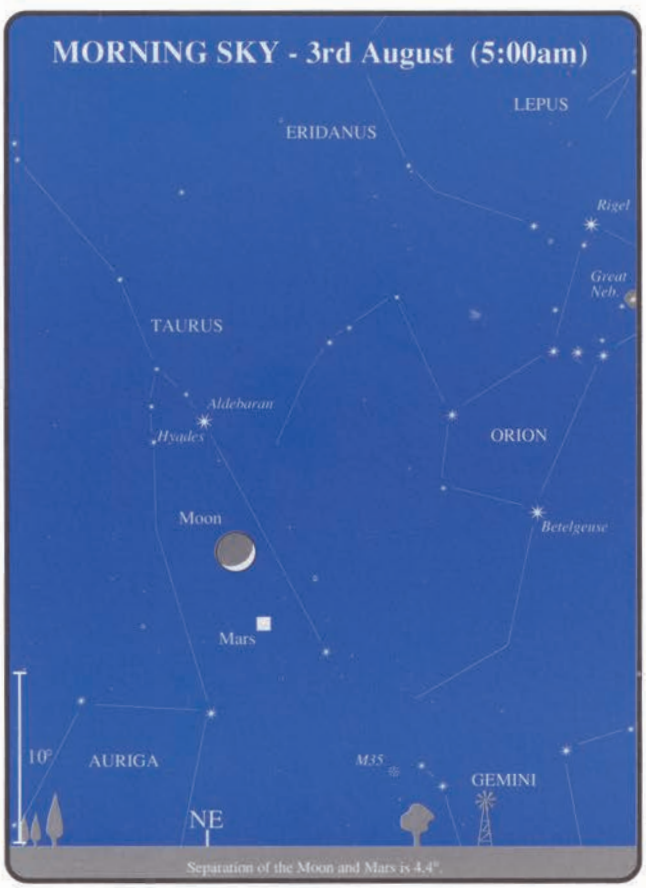
The **KAPPA CYGNIDS** suffer the same fate as the PERSEIDS with their radiant below the northern horizon for southern observers. The duration of these extremely slow moving meteors (and occasional fireballs) is from the 3rd to 31st August, with a peak ZHR of 5 on the 18th.

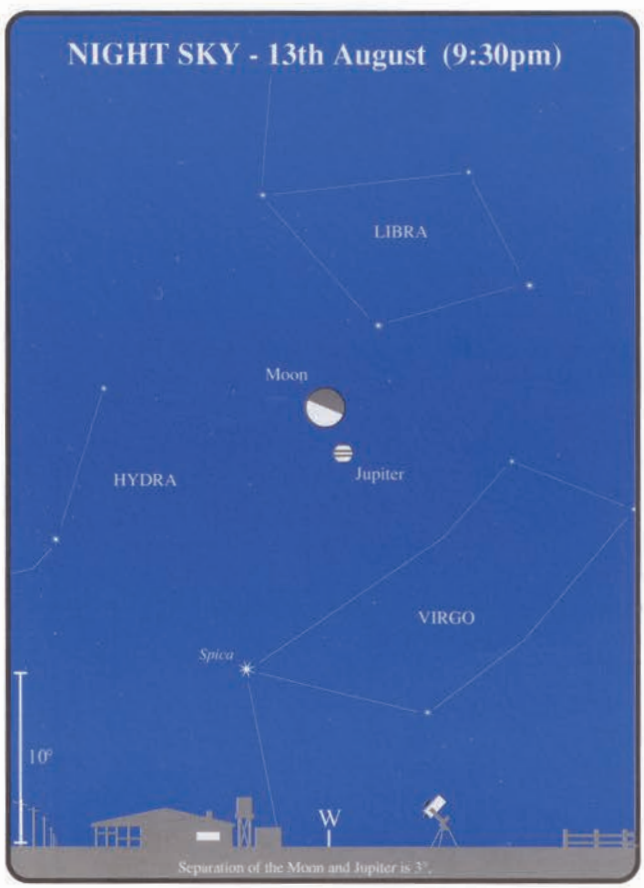
The **ALPHA AURIGIDS** stream is active from 24th August to 5th September, with a maximum ZHR of 5 very swift meteors on the 1st of next month. Short outbursts of high activity were recorded in 1935 and 1986 (ZHRs of 30 to 40 meteors per hour). With the radiant very low to the northeastern horizon, this is another shower that'sbest left to northern observers.

AUGUST

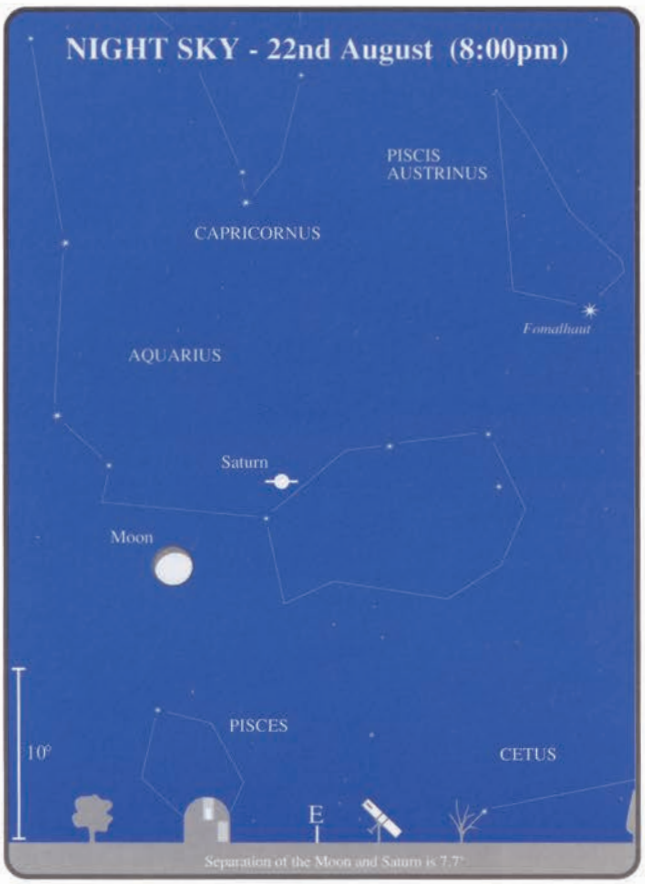
DAILY EVENTS

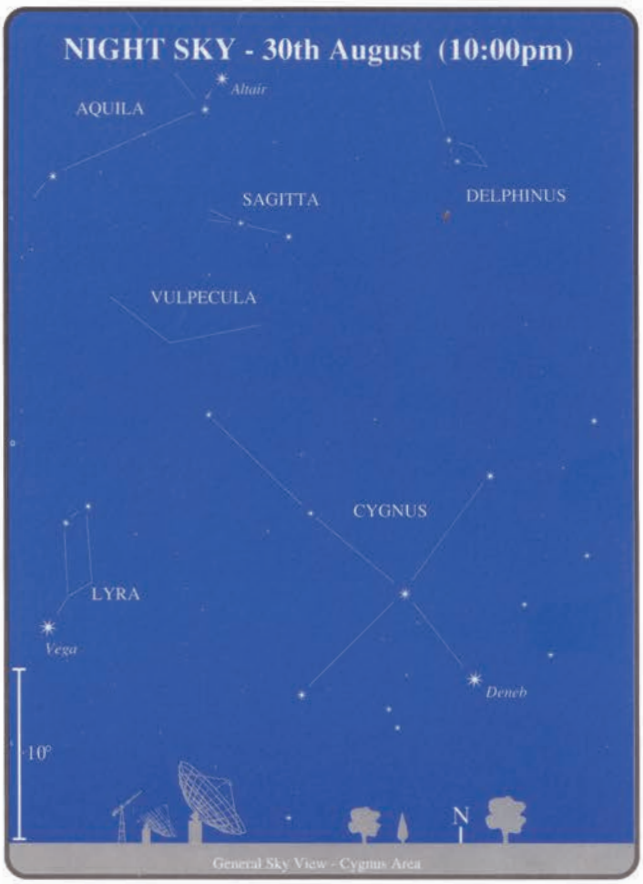
2nd		Mercury at perihelion.
3rd		Mars at ascending node:
3rd	2 PM	Mars 3° North of the Moon.
4th		Venus at descending node.
7th	06:45 PM	New Moon.
7th	11 PM	Comet Mueller (1993a) 0°.1 West of NGC 7041 in Indus.
10th	12 AM	Pluto stationary.
11th	9 AM	Venus 3° North of the Moon.
11th	11 PM	Comet Tempel 1 is 3° SW of NGC 5897 in Libra.
12th		Mercury at greatest latitude North (heliocentric).
13th	9 AM	Moon at perigee.
13th	11 AM	Mercury in superior conjunction.
13th	5 PM	Jupiter 2° North of the Moon.
14th	03:57 PM	First Quarter Moon.
17th	5 AM	Mars 0.3° South of NGC 2129 in Gemini.
19th	12 AM	Neptune 4° South of the Moon.
19th	4 AM	Uranus 5° South of the Moon.
20th	5 AM	Mars 0.7° South of M35 in Gemini.
21st	04:47 PM	Full Moon.
22nd	8 PM	Saturn 7° South of the Moon.
25th	9 AM	Venus greatest elongation east (46°).
28th	4 AM	Moon at apogee.
29th	04:41 PM	Last Quarter Moon.
31st	2 PM	Vesta 0°.7 South of the Moon

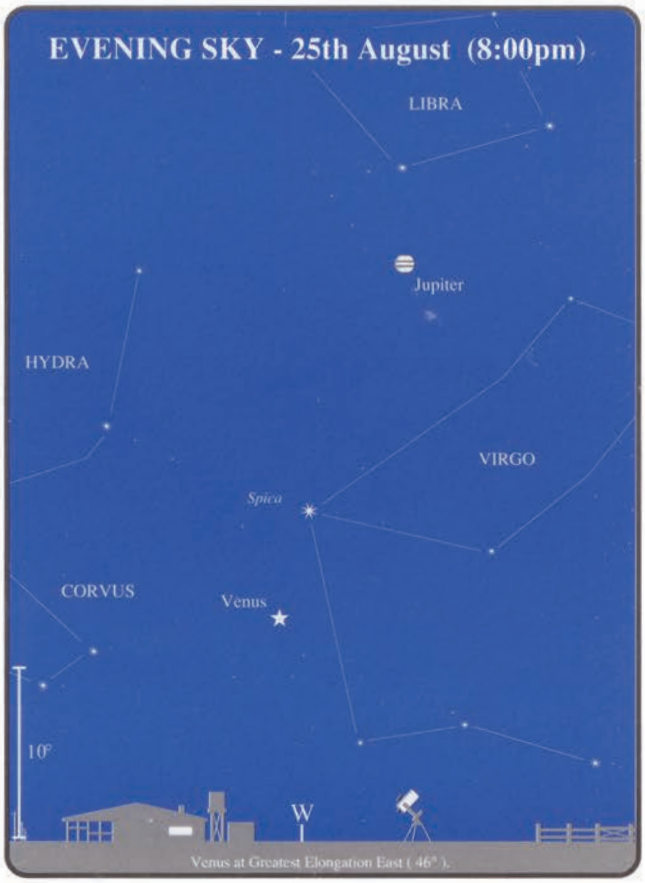




AUGUST


NIGHT SKY - 22nd August (8:00pm)
PISCIS AUSTRINUS
CAPRICORNUS
Fomalhaut
AQUARIUS
Saturn
Moon
10°
PISCES
CETUS
E
Separation of the Moon and Saturn is 7.7°

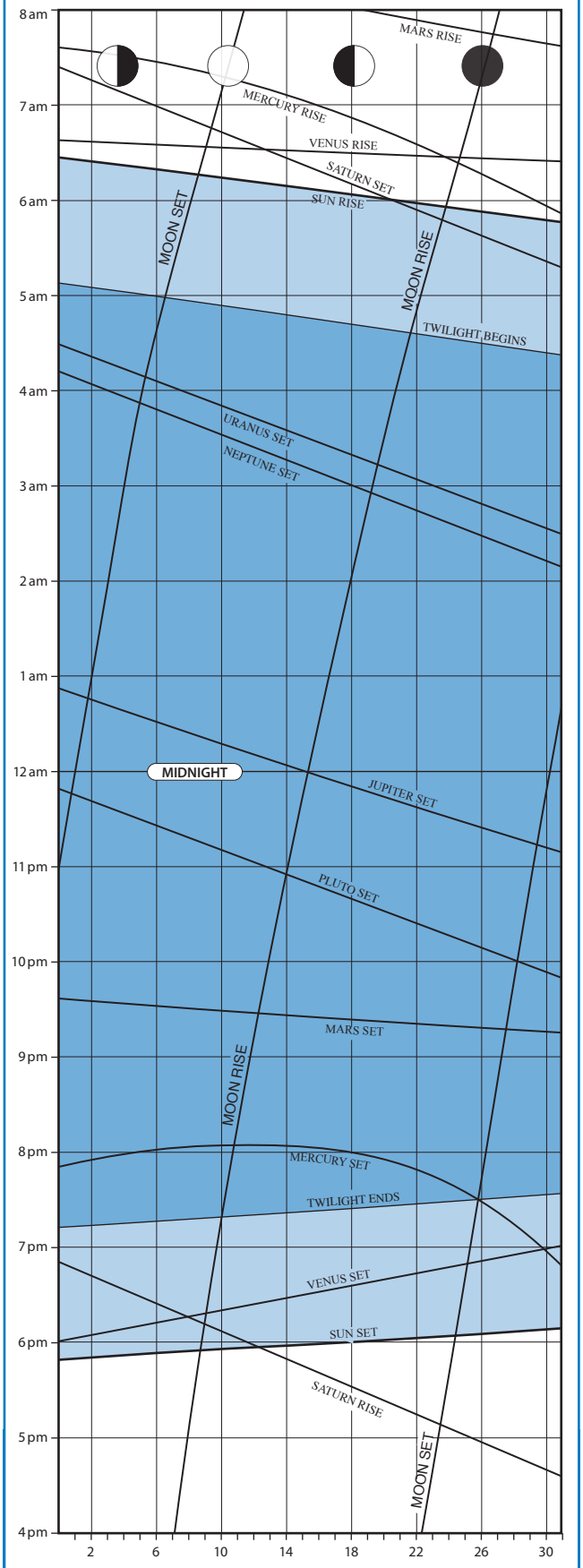

NIGHT SKY - 30th August (10:00pm)
Altair
AQUILA
SAGITTA
DELPHINUS
VULPECULA
CYGNUS
LYRA
Vega
Deneb
10°
N
General Sky View - Cygnus Area


EVENING SKY - 25th August (8:00pm)
LIBRA
Jupiter
HYDRA
VIRGO
Spica
CORVUS
Venus
10°
W
Venus at Greatest Elongation East (46°).


EVENING SKY - 31st August (8:00pm)
LIBRA
Jupiter
HYDRA
VIRGO
Spica
Venus
CORVUS
10°
W
Separation of Venus and Spica is only 0.6°.

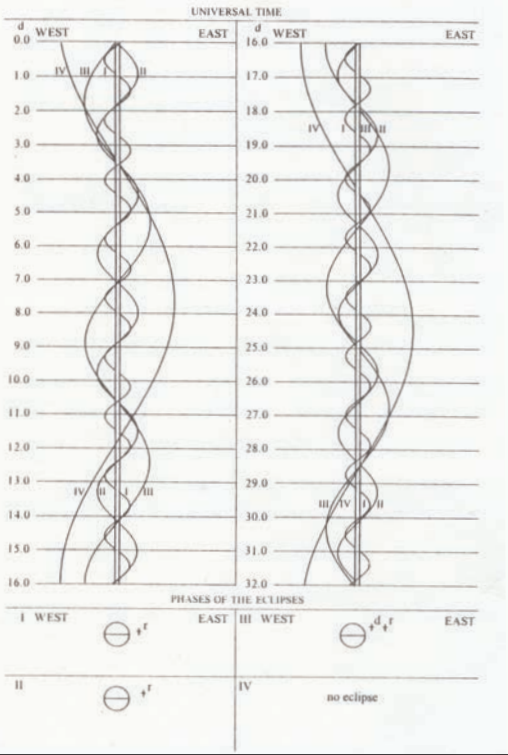
SEPTEMBER

RISE/SET CHART



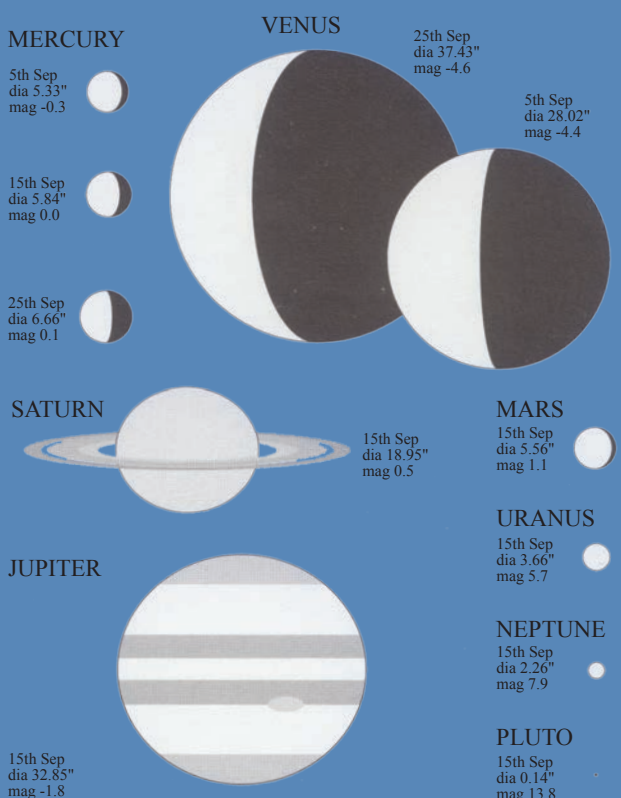
All times are EAST. For summer time (daylight saving) add 1 hour.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



SEPTEMBER

THE MOON

6th New Moon, 4:33am (Lunation number 887).
9th Moon at perigee.
12th First Quarter, 9:34pm.
20th Full Moon, 6:00am.
24th Moon at apogee.
28th Last Quarter, 10:23am.
Occultation of Vesta by 22 day old Moon (not visible from Australia).

THE PLANETS

MERCURY reaches greatest elongation east of the Sun on the 27th (26°), and is at its best for viewing in the evening sky during September and the first two weeks of October. On the 7th, Mercury will be 3° north of the 2 day old thin crescent Moon (see sky view), presenting a fine sight in the western sky around 6pm.

Mercury encounters 1st magnitude Spica (the brightest star in Virgo) under similar circumstances that happened with Venus last month. Spica will be seen moving closer to the horizon and Mercury each evening. At the beginning of the month Spica (still very close to Venus) appears about 28° above Mercury, ending up at a close 0.2° on the 21st (see sky view), a spectacular sight! By month'send an interesting line up occurs in the early evening western sky, with Mercury about 9° above Spica, Venus 13° above Mercury, and Jupiter 7° north of Venus (see sky view on the 26th).

VENUS reaches its greatest brilliancy before inferior conjunction at magnitude -4.7 on 28th September (inferior conjunction happens in early November). On the 9th, the 4 day old Moon will be situated between Venus and Jupiter; Venus 4.5° to the south and Jupiter 7° to the north (see sky view). Jupiter moves down towards Venus each night and around the last week of the month will be 6.5° from Venus. The western evening sky provides some interesting configurations of celestial bodies during the month (also see Mercury). A good example is on the 8th (around 6.30pm) when Mercury will be 10° above the horizon, the 3 day old Moon 13° above Mercury, 1st magnitude Spica 4° above the Moon, Venus 7° above Spica and lastly Jupiter 11° above Venus.

MARS spends most of September in Gemini, before crossing over into Cancer. Mars and the Moon have several close encounters in the early morning eastern sky. On the 1st the 24 day old Moon appears 5° directly above (see sky view), on the following evening 10° south, and on the 30th, 5° south (see sky view). During the month, 2nd magnitude Castor and 1st magnitude Pollux rise up beneath the planet. At month'send the trio form a straight line with Mars 7° south of Pollux (see sky view on the 30th).

JUPITER now sets around 9pm, leaving little time for telescopic observation, however the planet is active in some fine visual displays in the western evening sky during the month (see Mercury and Venus). On the 9th, the 4 day old Moon will be situated between Jupiter and Venus; Jupiter 7° to the north and Venus 4° to the south (see sky view). Jupiter moves closer towards Venus each evening and around the last week of the month will be 6° from Venus (see sky view on the 26th).

SATURN is at opposition on the 2nd, rising in the east, as the Sun sets, and visible during the entire night. On the 18th, the 13 day old Moon will appear 7° north of Saturn (see sky view). At opposition, Saturn reaches 0.5 magnitude and a disc diameter of 19".

URANUS & NEPTUNE transit the meridian around 8pm mid month, at an altitude of 78°. On the 14th the 9 day old Moon will be 6° north of Neptune and 8° north of Uranus. On the following evening, the Moon will be about 10° from both planets.

PLUTO transits the meridian around 4pm mid month leaving only a few hours for observation before setting.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 8.9; rise 3.28am, transit 8.21am, set 1.16pm. In Gemini moving into Cancer mid month.

PALLAS: Mag. 8.9; rise 9.42pm, transit 4.18am, set 10.50am. In Eridanus.

JUNO: Mag. 11.5; rise 8.29am, transit 2.43pm, set 8.58pm. In Virgo.

VESTA: Mag. 8.2; rise 1.26am, transit 6.33am, set 11.40am. On the 28th. there is an occultation by the 22 day old moon, not visible from Australia. In Orion, moving into Gemini late in the month.

METEOR SHOWERS

The **IOTA AQUARIDS (N)** span from 11th August through to 20th September, with maximum activity last month on the 20th. The hourly rate is 3, and the shower is visible late evening in the eastern sky until dawn in the west. They may be difficult to distinguish from the Southern and Northern Delta Aquarids which happen around the same time.

The **ALPHA AURIGIDS** stream is active from 24th August to 5th September, with a maximum ZHR of 5 very swift meteors on the 1st of this month. Short outbursts of high activity were recorded in 1935 and 1986 (ZHRs of 30 to 40 meteors per hour). With the radiant very low to the northeastern horizon, this is another shower that'sbest left to northern observers.

The **SIGMA ORIONIDS** are active between 10th September and 26th October. The shower starts with a rate of 1 - 2 meteors per hour, increasing to 4 - 5 in late September and early October. The maximum ZHR of 7 - 8 is achieved between October 3rd and 5th, the rate then decreases to 2 -3 for the last two weeks of activity. The Sigma Orionids are generally reliable in their performance; they are yellow-white in colour, fast and frequently leave trains. The shower is well placed for observers from midnight to dawn.

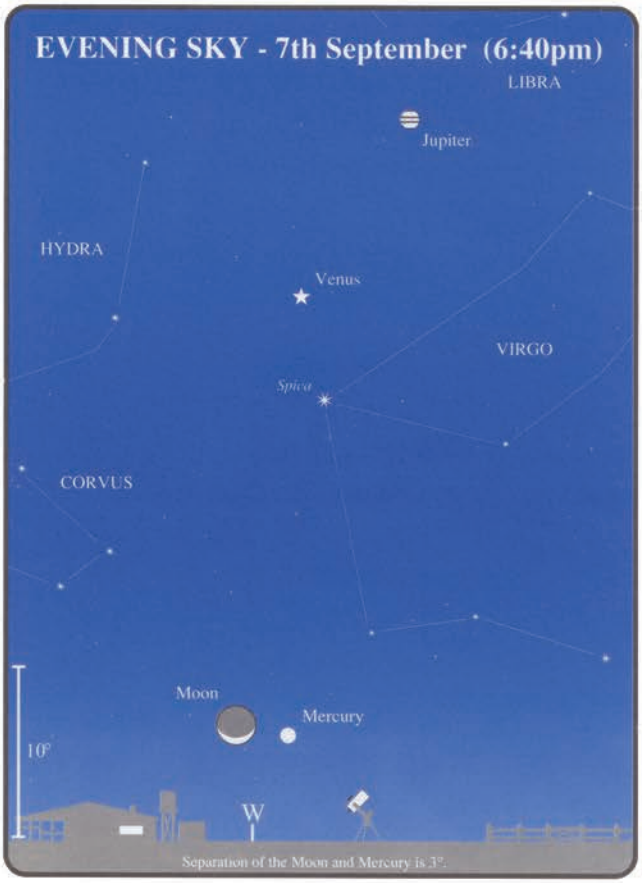
The **TAURIDS (North and South)**, associated with short period comet Encke, can be seen from about midnight to dawn. The shower is comprised of a main double radiant (North and South) and several sub-radiants. They are visible from 15th September through to 1st December. The Taurids (N and S) do not have a well defined sharp peak in activity, generally they begin with an hourly rate of 1-2. increasing to 3-4 from late October to late November. Maxima occurs on the 3rd November for the Taurids South (ZHR of 10) and on the 13th November for the Taurids North (ZHR of 8); both maxima last for about a week and provide nearly constant ZHRs. The Taurids are frequently bright, slow moving, and noted for producing colourful fireballs. The International Meteor Organization recommends the Taurids for newcomers to practice their visual meteor plotting techniques on because of their slow speed and steady activity. Their brightness also makes them an ideal target for the astrophotographer.

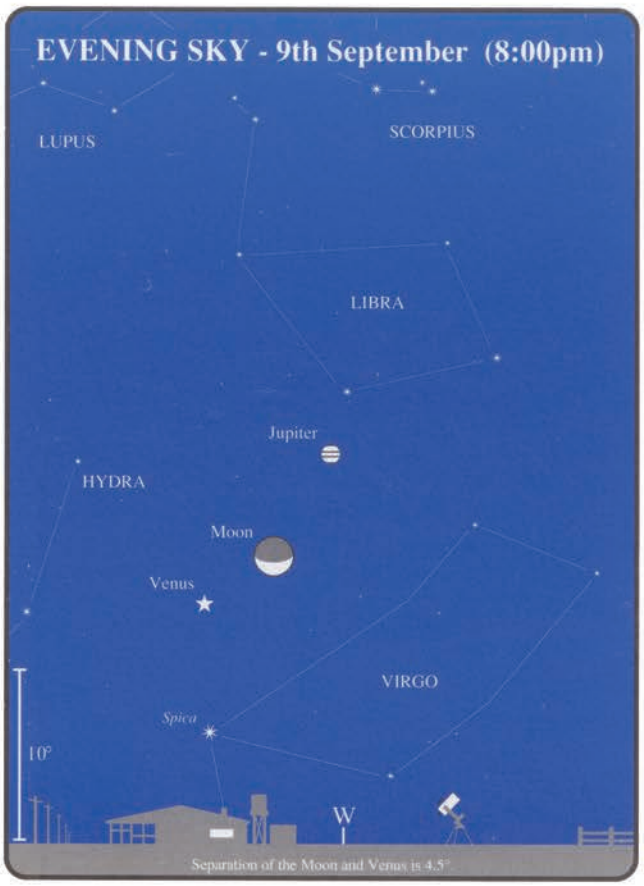
DAILY EVENTS

1st	7 AM	Venus 0º.7 South of Spica.
1st	1 PM	Mars 4° North of the Moon.
2nd	3 AM	Saturn at opposition.
4th	3 AM	Comet Borrelly 2°.5 NW of Rigel
4th	11 PM	Comet Tempel 1 is 4° SW of Antares.
5th		Mercury at descending node.
6th	04:33 AM	New Moon.
7th	7 PM	Mercury 3° North of the Moon
8th		Venus at aphelion.
9th	12 AM	Moon at perigee.

SEPTEMBER

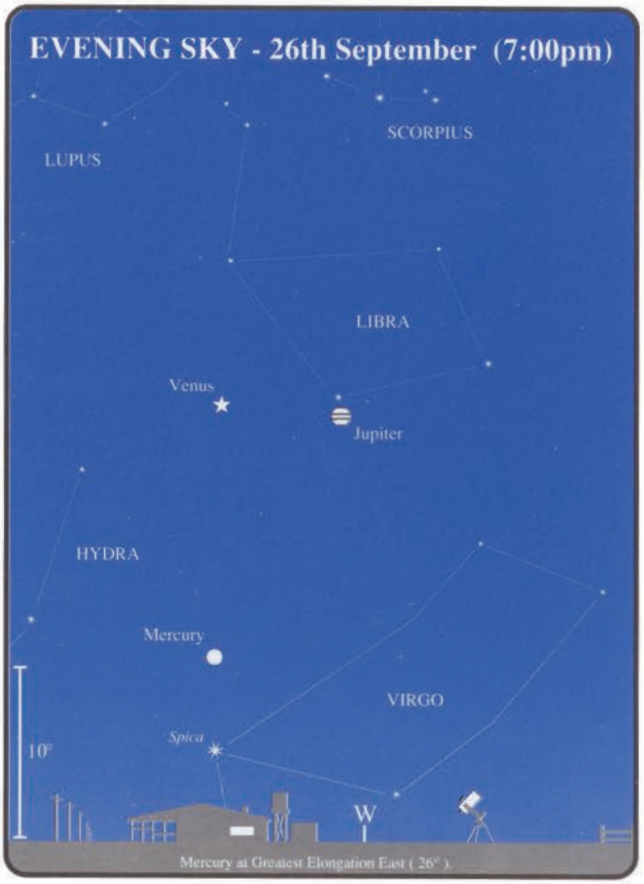
9th	11 AM	Venus 2° South of the Moon.
10th	6 AM	Jupiter 1°.4 North of the Moon.
12th	09:34 PM	First Quarter Moon.
13th	3 AM	Comet Borrelly 1°.5 NW of M42 in Orion.
15th	5 AM	Neptune 4° South of the Moon.
15th	9 AM	Uranus 5° South of the Moon.
15th		Mercury at aphelion.
16th	11 PM	Comet Tempel 1 is 1°.3 SW of M62 in Ophiuchus.
18th	11 PM	Saturn 7° South of the Moon.
20th	06:00 AM	Full Moon.
21st	11 PM	Mercury 0°.1 South of Spica.
22nd	4 AM	Mars 0.7° North of NGC 2420 in Gemini.
23rd	4 PM	Equinox.
24th	10 PM	Moon at apogee.
25th	1 AM	Mars 6º South of Pollux.
27th	2 AM	Mercury greatest elongation East (26°).
28th	10:23 AM	Last Quarter Moon.
28th	1 PM	Vesta 0°.06 North of the Moon
29th	8 AM	Venus greatest brilliancy.
30th	8 AM	Mars 6º North of the Moon.
30th		Venus at greatest latitude South (heliocentric).



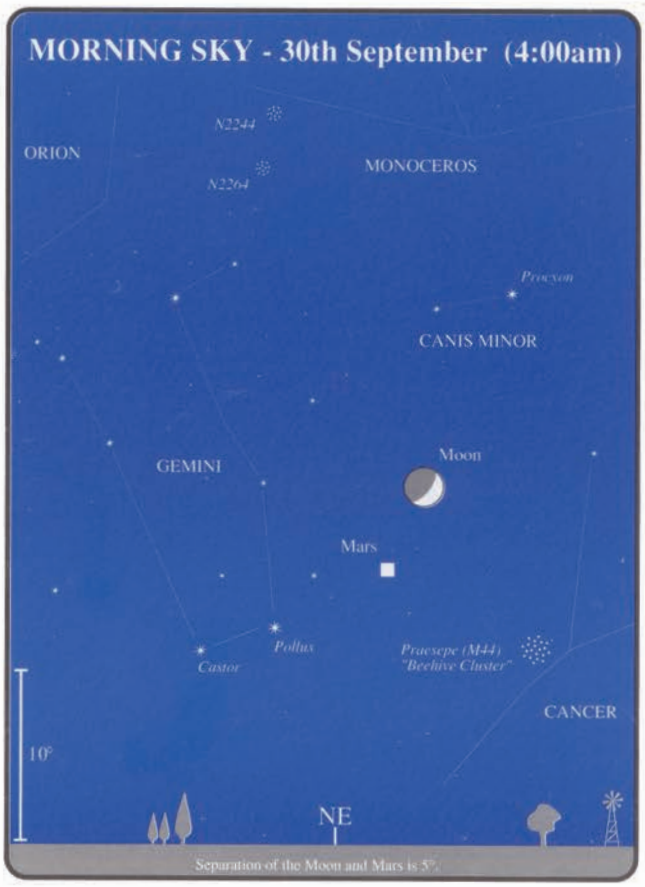


SEPTEMBER


NIGHT SKY - 18th September (9:00pm)
PISCIS AUSTRINUS
Fomalhaut
CAPRICORNUS
Saturn
AQUARIUS
Moon
PEGASUS
10°
CETUS
NE
Separation of the Moon and Saturn is 7°. Altitude of the Moon is 50°.

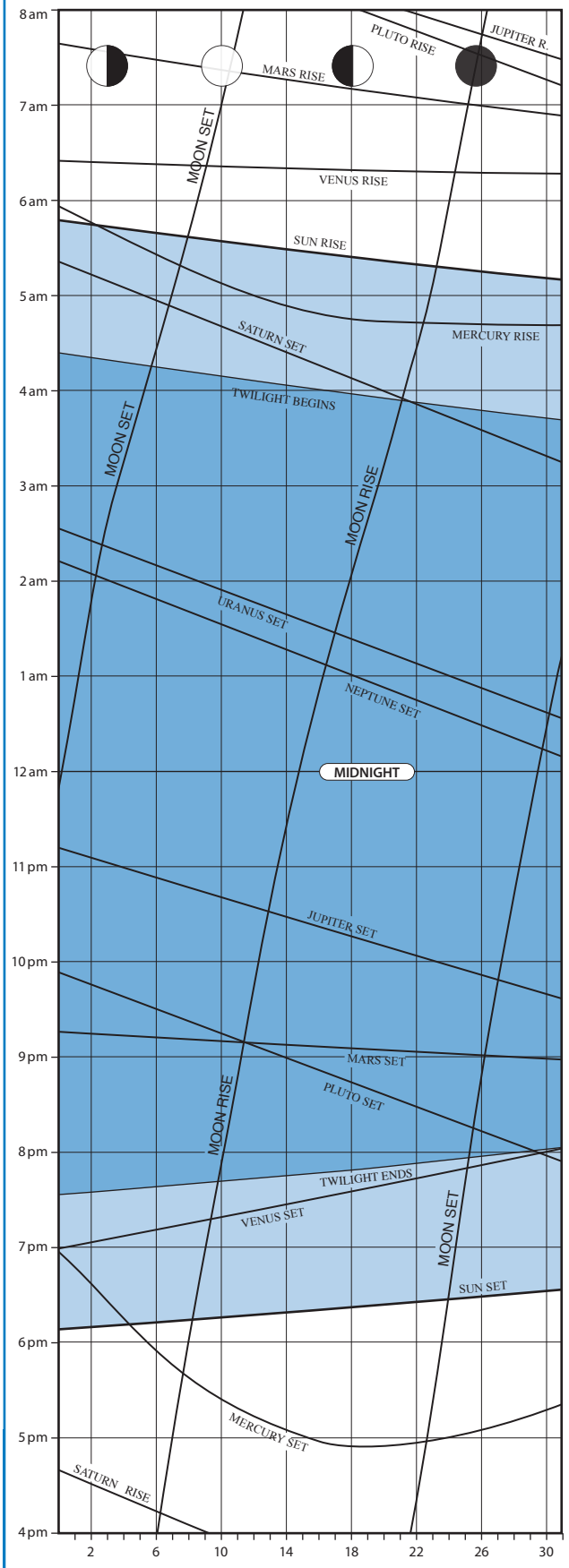

EVENING SKY - 26th September (7:00pm)
SCORPIUS
LUPUS
LIBRA
Venus
Jupiter
HYDRA
Mercury
VIRGO
Spica
10°
W
Mercury at Greatest Elongation East (26°).


EVENING SKY - 21st September (7:00pm)
LUPUS
SCORPIUS
LIBRA
Jupiter
Venus
HYDRA
VIRGO
Spica
Mercury
10°
W
Separation of Mercury and Spica is only 0.2° !.


MORNING SKY - 30th September (4:00am)
N2244
ORION
N2264
MONOCEROS
Procyon
CANIS MINOR
GEMINI
Moon
Mars
Pollux
Castor
Praesepe (M44) "Beehive Cluster"
CANCER
10°
NE
Separation of the Moon and Mars is 5°.

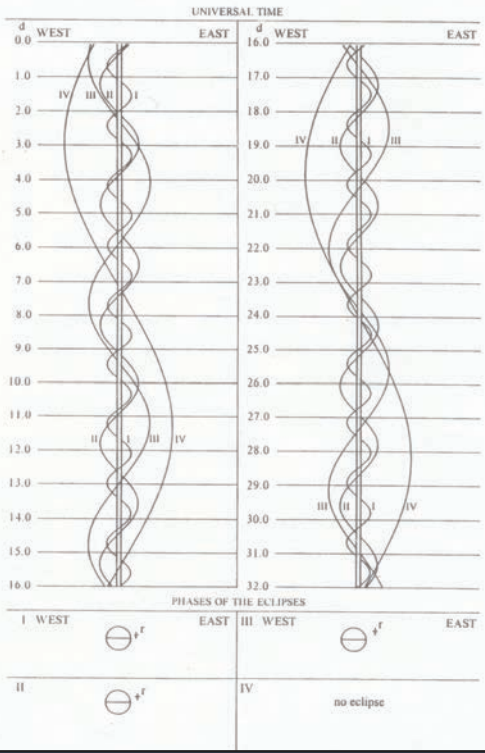
OCTOBER

RISE/SET CHART



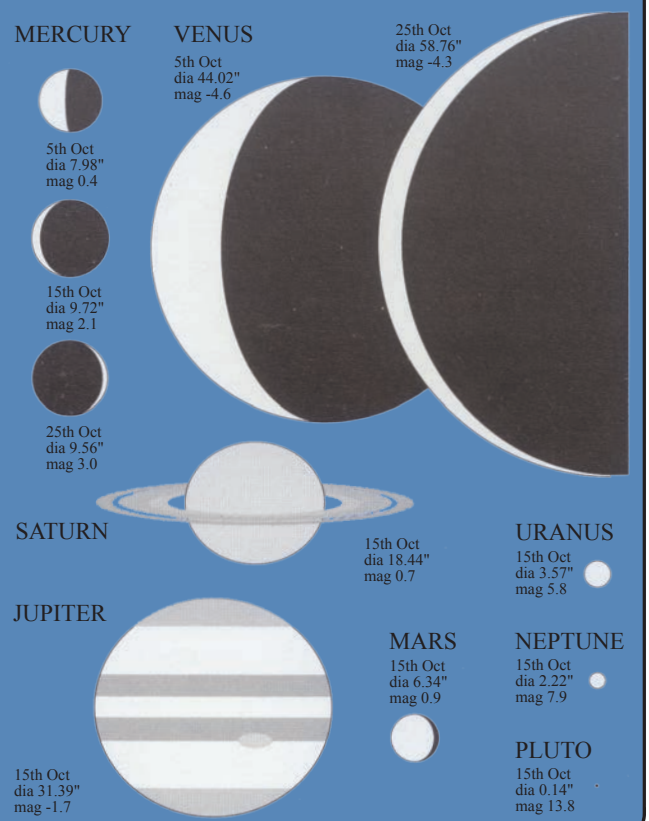
All times are EAST. For summer time (daylight saving) add 1 hour.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



OCTOBER

THE MOON

5th	New Moon, 1:55pm (Lunation number 888).
7th	Moon at perigee. Occultation of Jupiter by the 2 day old Moon (not visible from Australia).
12th	First Quarter, 5:07am.
19th	Full Moon, 10:18pm.
22nd	Moon at apogee.
26th	Occultation of Vesta by 20 day old Moon (not visible from Australia).
28th	Last Quarter, 2:44am.

THE PLANETS

MERCURY'sbest period of evening observation for the year ends within the first two weeks of October, as the planet moves to inferior conjunction on the 21st. The Moon appears near Mercury in the early western evening sky on two consecutive days during the month; on the 6th the 1 day old very thin crescent Moon will be 8° below, and on the 7th, 8° above and to the north (see sky view). Aside from Mercury at 1st magnitude, other highlights in the west include Venus (magnitude -4.6), and Jupiter (magnitude -1.7).

VENUS spends the month nearby and south of Jupiter in the western evening sky, slowly losing altitude as it moves to inferior conjunction early next month. On the 7th, the 3 day old Moon appears 7° north of Venus (Jupiter is closer to the Moon at a distance of 2.3°) (see sky view). By the end of the month Venus will be lost in a bright sky as it nears the Sun.

MARS at 1st magnitude spends October in Cancer; early in the month the planet will be seen forming a straight line with Castor and Pollux. Rising by 2 am, Mars is now high in the northeastern sky by the beginning of twilight. Oct. 18 sees a close approach by Mars to M44 the Beehive cluster (see sky view). On the 28th, the 22 day old Moon can be seen 9° above and north of Mars and on the following evening 7.5° above and south (see sky view).

JUPITER, heading for conjunction with the Sun next month, sets in the early western evening sky, and spends the month nearby and north of Venus. On the 7th (see sky view) the 3 day old Moon can be seen 2.3° below and south of Jupiter (with Venus 7º from both the Moon and Jupiter). A few hours later in the evening Jupiter is occulted by the Moon, but unfortunately, both bodies are below the horizon from Australian skies.

SATURN, now past opposition, transits the meridian around 9pm mid month at an altitude of 65°, providing the observer with comfortable evening viewing. On the 15th, the 11 day old Moon appears 7° north of Saturn (see sky view). By mid month Saturn comes within a degree of 5th magnitude Sigma Aquarii, the separation decreases slightly by month end to 0.8°.

URANUS & **NEPTUNE** transit the meridian at 6pm mid month, and are visible for more than half the night setting around lam. On the 12th, the 8 day old Moon will be 7° from both planets.

PLUTO sets about 9.30pm early in the month and by the third week the planet becomes lost in the evening twilight as it moves closer to the Sun.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 8.7; rise 2.12am, transit 7.09am, set 12.06pm. In Cancer.

PALLAS: Mag. 8.2; rise 7.22pm, transit 2.25am, set 9.25am. In Eridanus.

JUNO: Mag. 11.5; rise 6.58am, transit 1.21pm, set 7.43pm. In Virgo, moving into Libra mid month.

VESTA: Mag. 7.7; rise 11.50pm, transit 5.02am, set 10.09am. In Gemini. Occultation on the 26th by the 20 day old moon. Not visible from Australia.

METEOR SHOWERS

The **SIGMA ORIONIDS** are active between 10th September and 26th October. The shower starts with an hourly rate of 1 - 2 meteors per hour, increasing to 4 - 5 in late September and early October. The maximum ZHR of 7 - 8 is achieved between October 3rd and 5th, the rate then decreases to 2 -3 for the last two weeks of activity. The Sigma Orionids are generally reliable in their performance; they are yellow-white in colour, fast and frequently leave trains. The shower is well placed for observers from midnight to dawn.

The **TAURIDS (North and South)**, associated with short period comet Encke, can be seen from about midnight to dawn. The shower is comprised of a main double radiant (North and South) and several sub-radiants. They are visible from 15th September through to 1st December. The Taurids (N and S) do not have a well defined sharp peak in activity, generally they begin with an hourly rate of 1-2, increasing to 3-4 from late October to late November. Maxima occurs on the 3rd November for the Taurids South (ZHR of 10) and on the 13th November for the Taurids North (ZHR of 8); both maxima last for about a week and provide nearly constant ZHRs. The Taurids are frequently bright, slow moving, and noted for producing colourful fireballs. The International Meteor Organization recommends the Taurids for newcomers to practice their visual meteor plotting techniques on because of their slow speed and steady activity, their brightness also makes them an ideal target for the astrophotographer.

The **DRACONIDS** (or **GIACOBINIDS**) are a periodic shower that was first observed in 1926 with a ZHR of 17. In 1933 and 1946, activity reached an estimated rate of 5000 or more meteors per hour! The stream is associated with the short period comet Giacobini-Zinner, and activity can range from storm, modest or nonexistent. The northerly declination will see the radiant below the northeastern horizon around 7pm. The duration lasts from 6th to 10th October, with the peak expected on the 9th. The next opportunity for a good Draconids display will be in 1998 when comet Giacobini-Zinner and the Earth are in favourable positions.

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 submaxima good rates are observable between 20th to 24th October. The Orionids provide a prominent display that generally reach an intensity of 30 meteors per hour, they are typically very swift, often bright with some leaving trains. The shower was first recorded by Chinese observers in 288AD, and is associated with Halley'sComet.

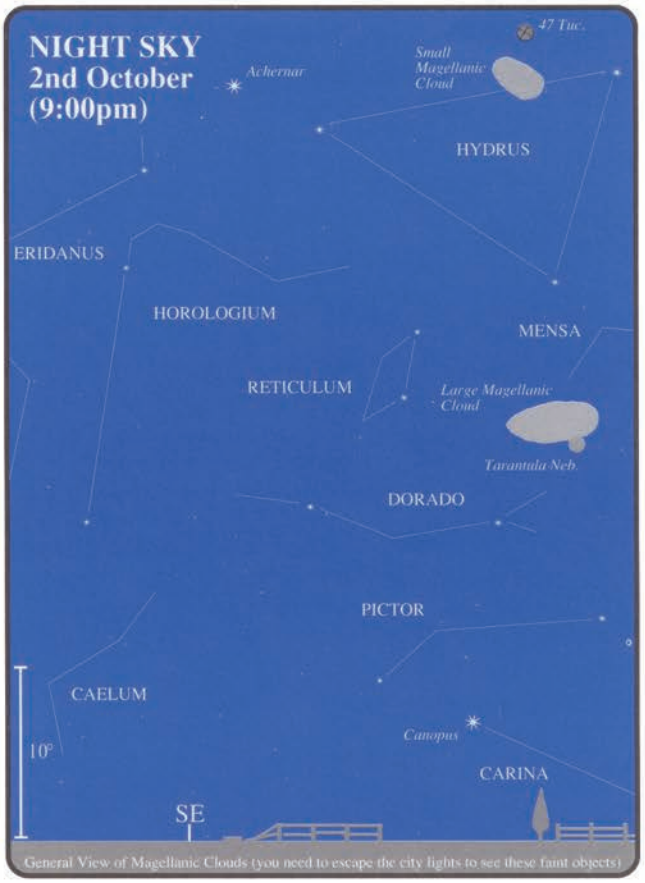
The **PUPPID-VELIDS** are visible from late evening till dawn and are active from September 28th through to January 26th. This complex shower has more than 10 sub-streams and therefore, many sub-maxima over the period of activity. Typically swift, and often leaving long lived trains, the Puppid-Velids are generally blue, white or yellow in colour and frequently produce fireballs. A rate of 2 - 3 meteors per hour is usual over the period, with early December rates reaching 12 - 15 per hour, sometimes 20 or more!

DAILY EVENTS

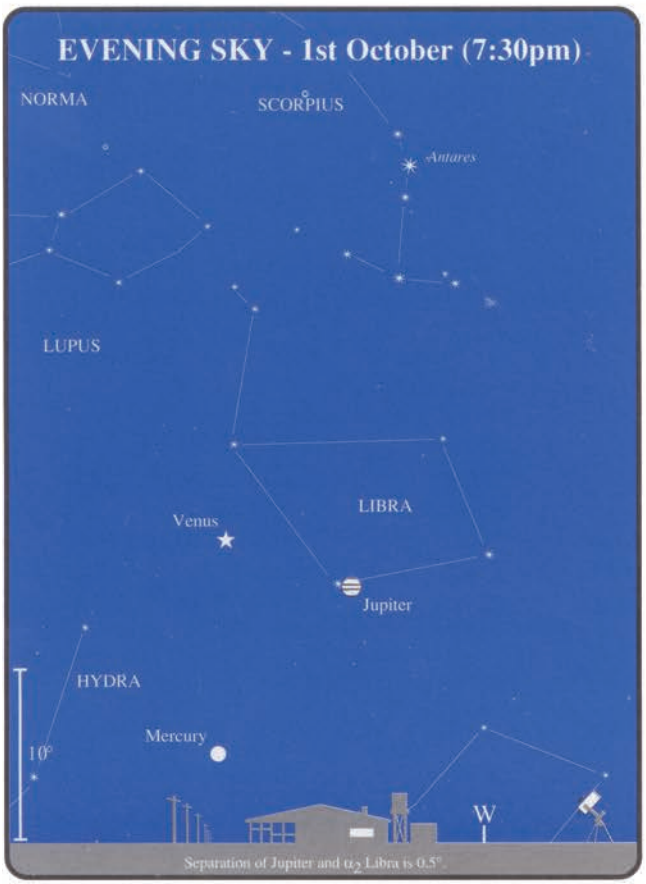
2nd	1 PM	Uranus stationary.
3rd	12 AM	Neptune stationary.
5th		Mercury at greatest latitude South (heliocentric).
5th	01:55 PM	New Moon.

OCTOBER

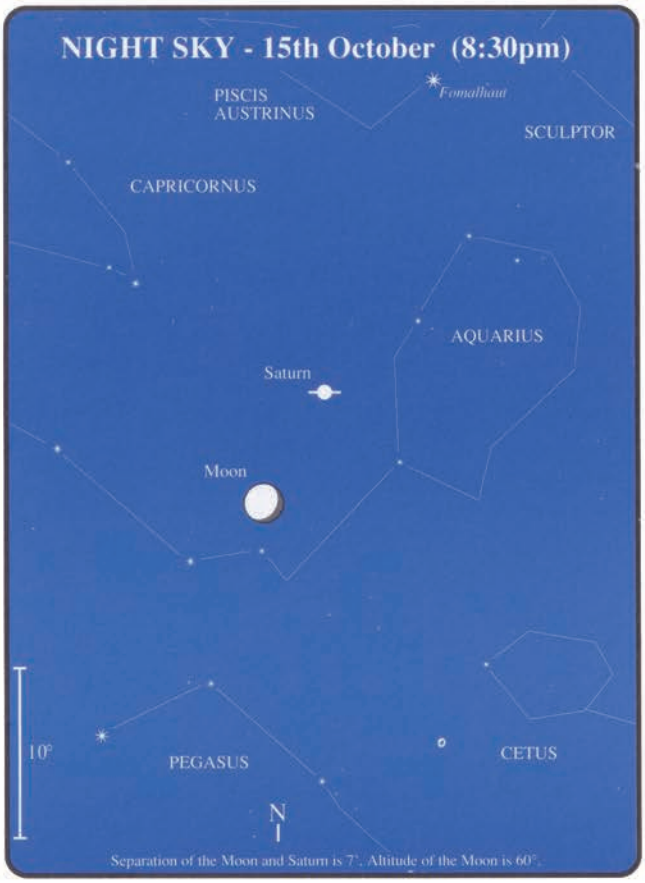
7th	12 AM	Moon at perigee.
7th	4 AM	Mercury 3° South of the Moon.
7th	3 PM	Pallas stationary.
7th	8 PM	Venus 7° South of the Moon.
7th	10 PM	Jupiter 0º.7 North of the Moon.
9th	3 AM	Comet Borrelly 2°.5 NE of NGC 2239 in Monoceros.
9th	7 PM	Mercury stationary.
12th	05:17 AM	First Quarter Moon.
12th	11 AM	Neptune 4° South of the Moon.
12th	2 PM	Uranus 5° South of the Moon.
13th	9 AM	Venus stationary.
16th	2 AM	Saturn 7º South of the Moon.
18th	03:30 AM	Mars 0.3° South of M44 in Cancer
19th	10:18 PM	Full Moon.
21st	3 PM	Mercury in inferior conjunction.
22nd	12 PM	Moon at apogee.
24th		Mercury at ascending node.
26th	5 AM	Vesta 0°.6 North of the Moon
28th	02:44 AM	Last Quarter Moon.
28th	11 PM	Mars 7° North of the Moon.
29th	3 AM	Comet Borrelly 1°.3 NE of NGC 2395 in Gemini.
29th		Mercury at perihelion.
30th	3 AM	Mercury stationary.



All times are EAST. For summer time (daylight saving) add 1 hour.



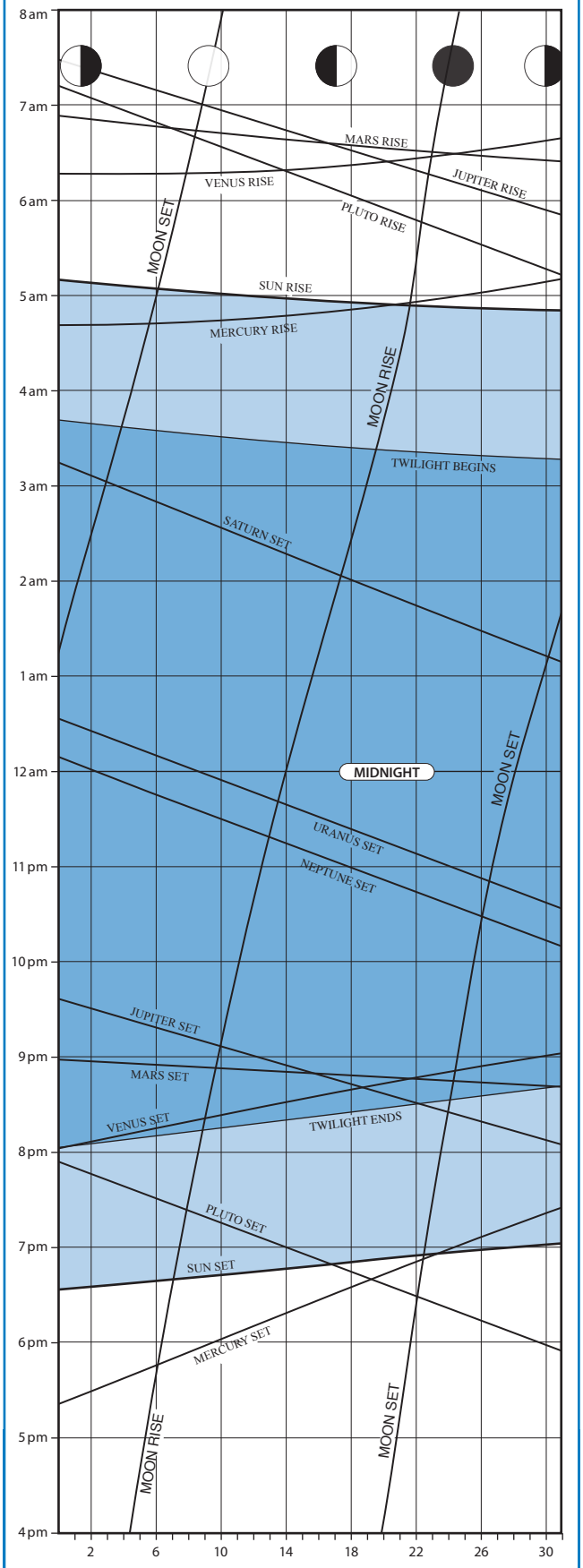
OCTOBER



All times are EAST. For summer time (daylight saving) add 1 hour.

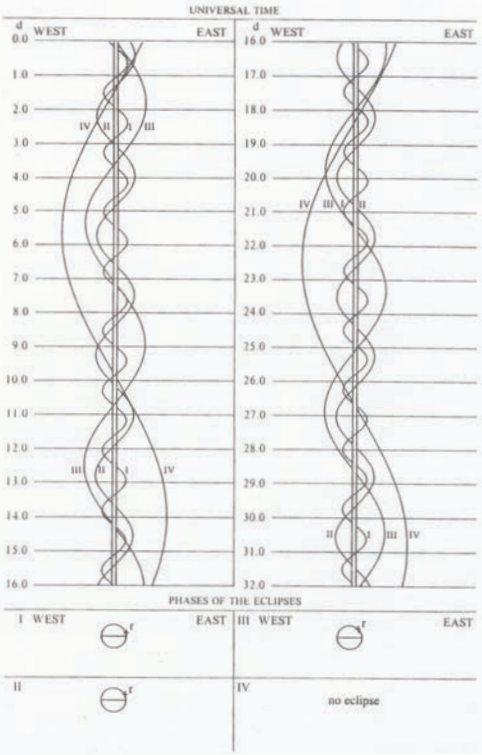
NOVEMBER

RISE/SET CHART



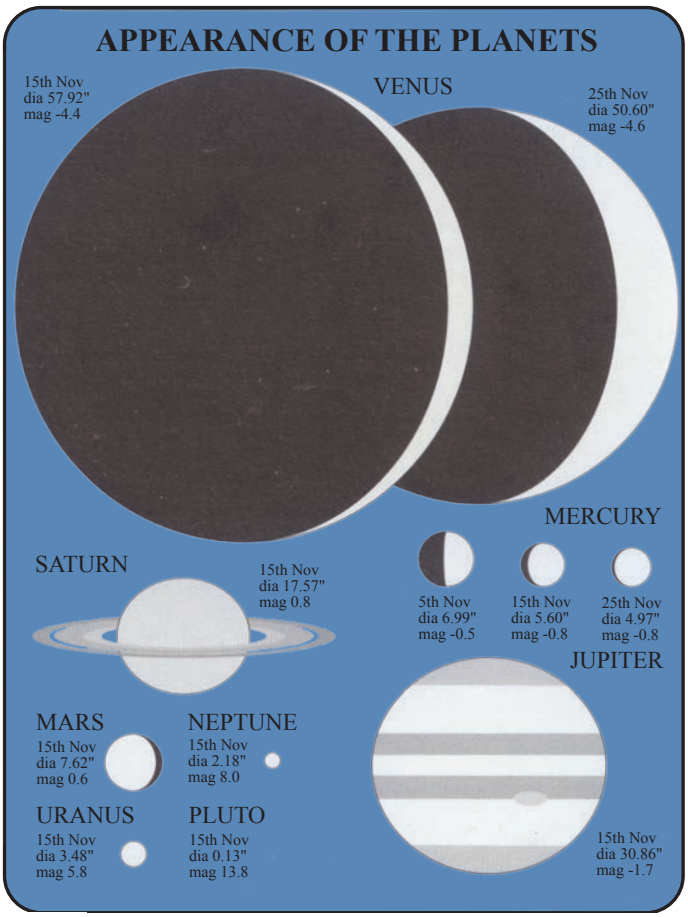
All times are EAST. For summer time (daylight saving) add 1 hour.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



NOVEMBER

THE MOON

3rd New Moon, 11:35pm (Lunation number 889).

4th Moon at perigee. Moon occults Jupiter. Not visible from SE Queensland, NSW, Victoria or Tasmania. A near miss from Adelaide. Daytime event (late Afternoon) elsewhere in Australia.

10th First Quarter, 4:14pm.

18th Full Moon, 4:57pm. Penumbral eclipse (not visible from Australia).

18th Moon at apogee.

22nd Occultation of Vesta by 18 day old Moon (not visible from Australia).

26th Last quarter, 5:04pm.

THE PLANETS

MERCURY returns to the eastern morning sky after inferior conjunction last month, and reaches its greatest elongation west (19°) on the 6th. As the Sun rises less than 45 minutes after Mercury the planet will be difficult to see in the brightening sky, despite its -0.8 magnitude. Mercury has close approaches with the 27 day old Moon (on the 2nd at 8°), 1st magnitude Spica (3rd, 4°), Venus (13th, 5.5°, also see sky view), and Jupiter (29th, 0.4°), unfortunately all under extremely unfavourable observing conditions.

VENUS is in inferior conjunction with the Sun on the 3rd, and then moves west of the Sun to become a morning object. The planet moves , away from the Sun and gains altitude each morning. By month'send Venus rises just before the beginning of twilight.

MARS moves from Cancer into Leo early in the month. During the month, 1st magnitude Regulus (the brightest star in Leo) and Mars move closer to each other, starting with a separation of 16° on the 1st and ending 4° apart on the 30th. On the 26th (see sky view), the 22 day old Moon will appear 6.7° above Mars forming a triangle with Regulus (5° from Mars).

JUPITER, in conjunction with the Sun on the 18th, moves from the evening and into the morning sky. Close proximity to the Sun will make observation impossible until next month.

SATURN'scompanion last month, 5th magnitude Sigma Aquarii, accompanies the planet during the entire month at less than 1° separation. On the 11th, the 9 day old Moon can be seen 8° north of Saturn (see sky view). By mid month the planet transits the meridian soon after sunset, and observation should be carried out early in the evening before too much altitude is lost.

URANUS & **NEPTUNE** set around 11pm mid month, leaving only a few hours to observe the planets at a reasonable altitude. On the 8th, the 5 day old Moon will be 5° from Neptune and 6° from Uranus.

PLUTO is in conjunction with the Sun on the 20th and will not be visible again until the new year in the morning sky.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 8.2; rise 12.46am, transit 5.45am, set 10.42am. Moving from Cancer into Leo after 1st week.

PALLAS: Mag. 8.1; rise 4.34pm, transit 12.06am, set 7.34am. At opposition on the 9th. In Eridanus early in month then moving into Fornax.

JUNO: Mag. 11.4; rise 5.30am, transit 11.59am, set 6.29pm. In conjunction with the Sun on the 19th. In Libra.

VESTA: Mag. 7.0; rise 9.55pm, transit 3.06am, set 8.13am. Occultation on the 22nd by the 18 day old Moon, not visible from Australia. In Gemini.

METEOR SHOWERS

The **TAURIDS** (North and South), associated with short period comet Encke, can be seen from about midnight to dawn. The shower is comprised of a main double radiant (North and South) and several sub-radiants. They are visible from 15th September through to 1st December. The Taurids (N and S) do not have a well defined sharp peak in activity, generally they begin with an hourly rate of 1-2, increasing to 3-4 from late October to late November. Maxima occurs on the 3rd November for the Taurids South (ZHR of 10) and on the 13th November for the Taurids North (ZHR of 8); both maxima last for about a week and provide nearly constant ZHRs. The Taurids are frequently bright, slow moving, and noted for producing colourful fireballs. The International Meteor Organization recommends the Taurids for newcomers to practice their visual meteor plotting techniques on because of their slow speed and steady activity, their brightness also makes them an ideal target for the astrophotographer.

The **ORIONIDS** are best seen from late evening until dawn and are visible from 2nd October through to 7th November, with maxima last month on the 22nd. The Orionids provide a prominent display that generally reach an intensity of 30 meteors per hour, they are typically very swift, often bright with some leaving trains. The shower was first recorded by Chinese observers in 288AD, and is associated with Halley'sComet.

The **PUPPID-VELIDS** are visible from late evening till dawn and are active from September 28th through to January 26th. This complex shower has more than 10 sub-streams and therefore, many sub-maxima over the period of activity. Typically swift, and often leaving long lived trains, the Puppid-Velids are generally blue, white or yellow in colour and frequently produce fireballs. A rate of 2 - 3 meteors per hour is usual over the period, with early December rates reaching 12 - 15 per hour, sometimes 20 or more!

The **LEONIDS**, after a storm of unbelievable intensity in 1833, were responsible for the change in scientists' 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, but can sometimes produce storms like the 1966 event seen by amateurs in the U.S.A. which produced an hourly rate of 140,000 for a short period! The years 1998-2000 should provide a good showing after the 1966 peak. The duration is from 14th to 21st November, with a peak on the 17th. Best observed from midnight to dawn, the years leading up to 1998-2000 are expected to show an increase in activity as the comet returns to perihelion.

The **PHOENICIDS (Dec)** were discovered in 1887 when a shower was observed from Sydney with an hourly rate of 60. They are active from 28th November through to 9th December, with maximum activity next month between the 4th and 6th. Visible throughout the night the shower is in an excellent position for southern observers and an hourly rate of 2 to 10 very slow orange/yellow meteors with long paths can be expected. The shower has produced some unexpectedly high hourly rates since first noticed in 1887; 100 in 1956, 20 in 1972 and 15 in 1985.

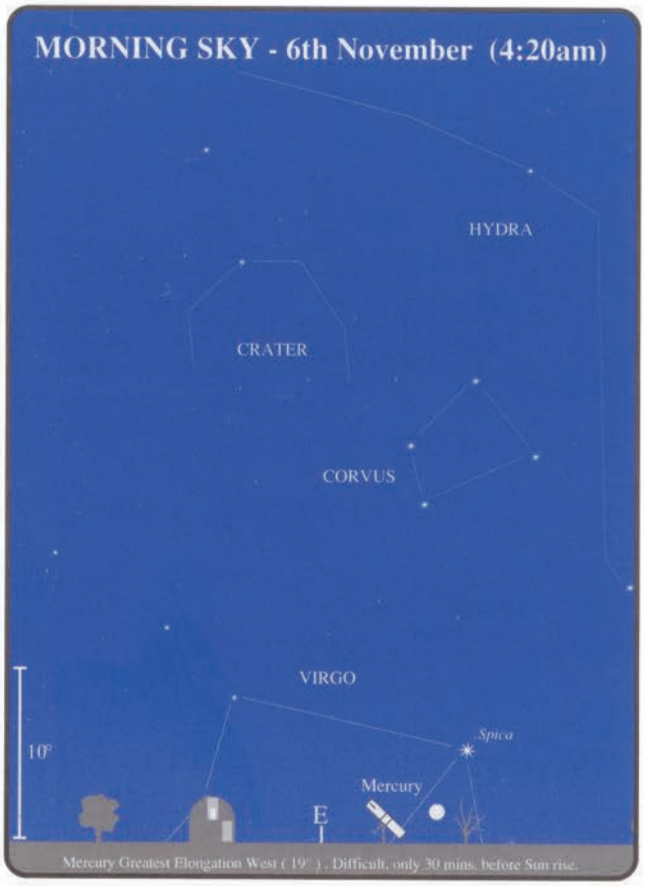
DAILY EVENTS

2nd	8 PM	Mercury 4º North of the Moon.
3rd	9 AM	Venus in inferior conjunction.
3rd	11 AM	Mercury 4º North of Spica.
3rd	11:35	PM New Moon.
4th	10 AM	Moon at perigee.
6th	11 AM	Mercury greatest elongation West (19°).

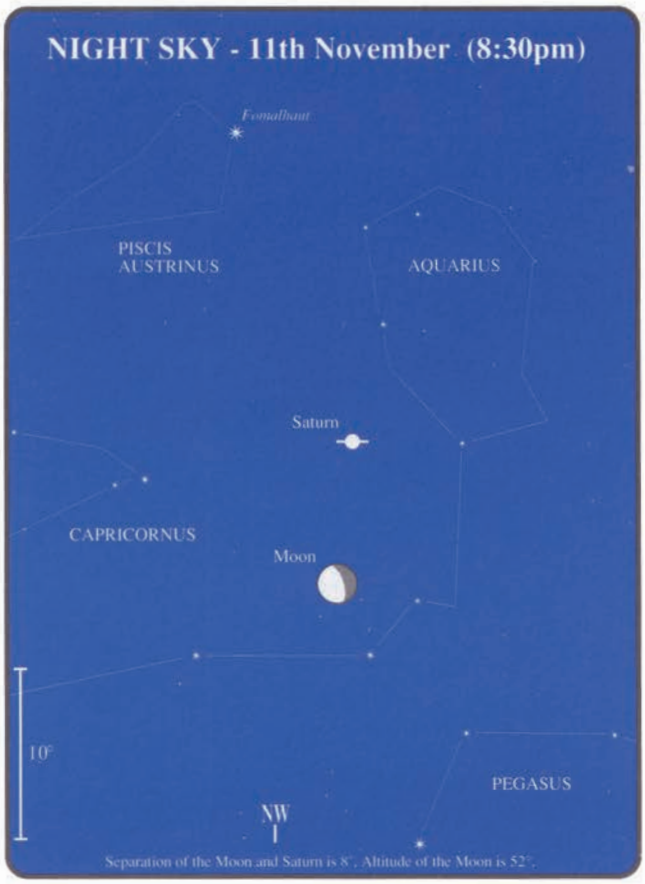
NOVEMBER

7th	1 AM	Vesta stationary.
8th		Mercury at greatest latitude North (heliocentric).
8th	6 PM	Neptune 4° South of the Moon.
8th	10 PM	Uranus 6º South of the Moon.
9th	6 AM	Pallas at opposition.
10th	7 AM	Saturn stationary.
10th	04:14 PM	First Quarter Moon.
12th	7 AM	Saturn 7º South of the Moon.
13th	4 AM	Mercury 5º North of Venus.
18th	6 AM	Jupiter in conjunction with the Sun.
18th	3 PM	Moon at apogee.
18th	04:57	PM Full Moon.
19th	3 AM	Juno in conjunction with the Sun.
20th	10 PM	Minor planet Nysa 0.2° South of NGC 7606 in Aquarius.
20th	11 PM	Pluto in conjunction with the Sun.
22nd	2 AM	Venus stationary.
22nd	10 AM	Vesta 1°.0 North of the Moon .
25th		Venus at ascending node.
26th	6 AM	Mars 8º North of the Moon.
26th	05:04 PM	Last Quarter Moon.

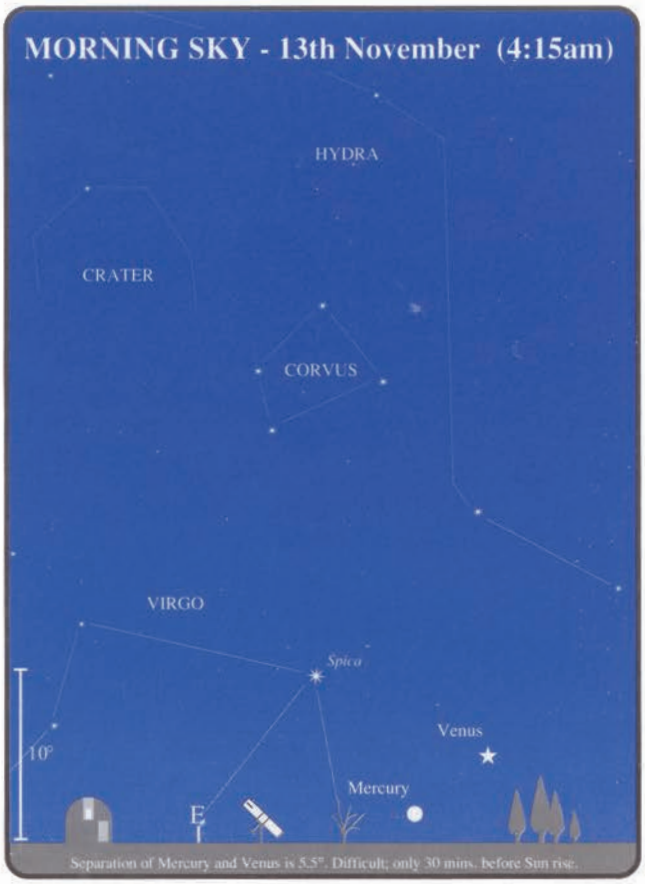
All times are EAST. For summer time (daylight saving) add 1 hour.



NOVEMBER

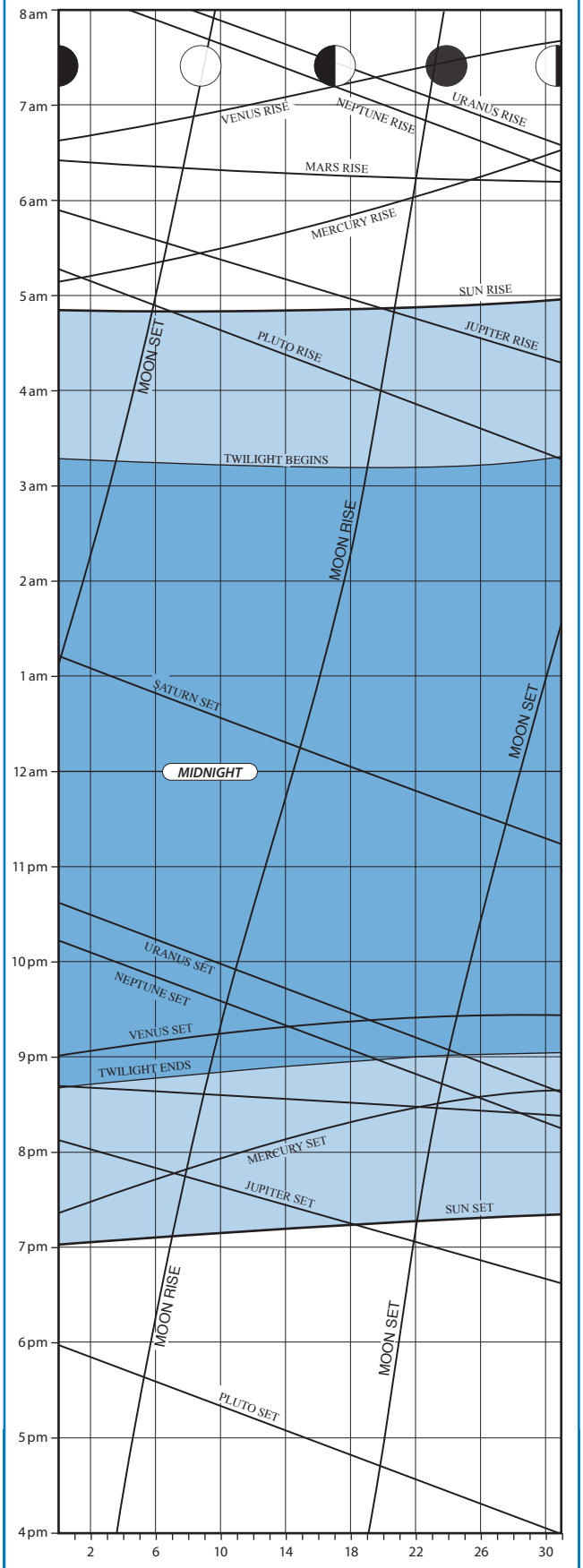


All times are EAST. For summer time (daylight saving) add 1 hour.



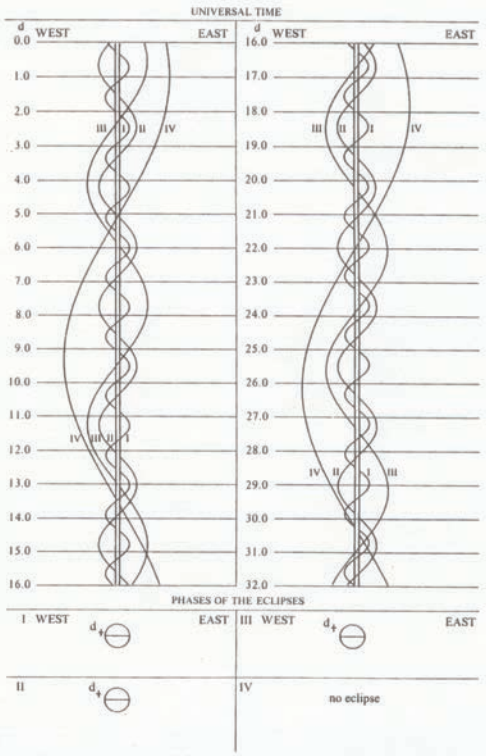
DECEMBER

RISE/SET CHART



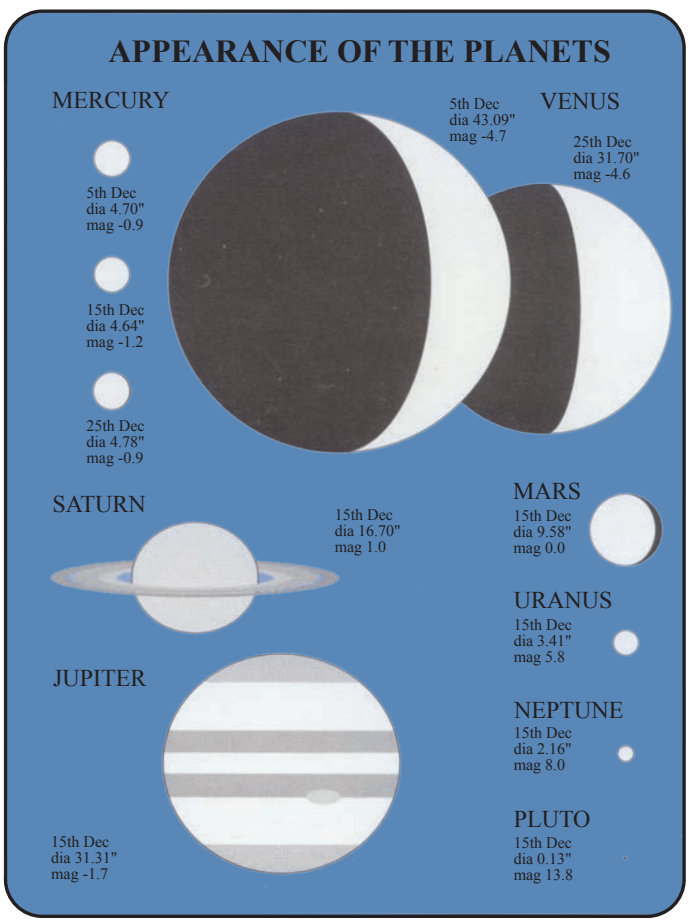
All times are EAST. For summer time (daylight saving) add 1 hour.

JUPITER'S MOONS



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

APPEARANCE OF THE PLANETS



DECEMBER

THE MOON

2nd Moon at perigee (closest to Earth).
3rd New Moon, 9:54am (Lunation number 890).
10th First Quarter, 7:06am.
15th Moon at apogee (most distant from Earth).
18th Full Moon, 12:17pm.
26th Last quarter, 5:06am.
30th Occultation of Jupiter by the 27 day old Moon (not visible from Australia).
31st Moon at perigee (closest to Earth).

THE PLANETS

MERCURY again experiences another month where observation is virtually impossible because of its proximity to the Sun. Beginning the month in the morning twilight, the planet undergoes superior conjunction on the 14th and then returns to the evening twilight for the rest of the month.

VENUS reaches its greatest brilliancy since inferior conjunction at 4.7 magnitude on the 9th (inferior conjunction happened in early November). Venus has several encounters with the Moon during the month; on the 1st the 27 day old Moon appears 3.5° south (see sky view), on the 29th the 25 day old Moon 5° to the north, and on the following evening 9° to the south.

MARS begins and ends the month 4° from 1st magnitude Regulus (the brightest star in Leo), and the pair are closest at 2° around the 8th. On the 24th, the 20 day old Moon will appear 8° above Mars forming a triangle with Regulus (3° from Mars); see sky view.

JUPITER rises in morning twilight early in the month, and moves from Libra into Scorpius mid December. On the 30th the 26 day old Moon appears less than 4° from Jupiter. An occultation of Jupiter by the Moon on this day is not visible from Australia. On the 25th, around 4am (no problem for parents with young children on Christmas morning!), Jupiter will be seen between the stars Beta and Omega Scorpii (mags 3 and 4); Beta will be a close 0.3° north of Jupiter with Omega 0.6° south (see sky view on the 24th). It is interesting to note that a rare occultation occurred between Jupiter and Beta (one of the best double stars for small apertures; separation of 13.7" and mags 3 and 5) in 1971 which added greatly to our knowledge of this multiple star system.

SATURN, transiting the meridian around 5pm mid month, can be viewed high in the early western evening sky. With Saturn moving closer to the Sun each day, December will be the last time to view the planet at a reasonable altitude for several months (conjunction occurs in February 1995). On the 8th the 6 day old Moon will be 11° from Saturn (see sky view), and on the following evening 9°.

URANUS & NEPTUNE can only be observed in a dark sky during the first half of the month, during the second half they reside in the twilight as they move toward conjunction in January. On the 5th, the 3 day old Moon will be 7° below Neptune and 10° below Uranus.

PLUTO, after conjunction last month, swings west of the Sun to become a morning object; observers will have to wait until next year when the planet moves out of the morning twilight.

THE MINOR PLANETS

Times are given for 15th of the month.

CERES: Mag. 7.6; rise 11.08pm, transit 4.05am, set 8.59am. In Leo.

PALLAS: Mag. 8.2; rise 2.07pm, transit 9.41pm, set 5.19am. In Fornax.

JUNO: Mag. 11.5; rise 4.08am, transit 10.41am, set 5.16pm. In Libra, moving into Ophiuchus mid month.

VESTA: Mag. 6.8; rise 7.41pm, transit 12.48am, set 5.51am. At opposition on the 25th. In Gemini.

METEOR SHOWERS

The **PUPPID-VELIDS** are visible from late evening till dawn and are active from September 28th through to January 26th. This complex shower has more than 10 sub-streams and therefore, many sub-maxima over the period of activity. Typically swift, and often leaving long lived trains, the Puppid-Velids are generally blue, white or yellow in colour and frequently produce fireballs. A rate of 2 - 3 meteors per hour is usual over the period, with early December rates reaching 12 - 15 per hour, sometimes 20 or more! This month the sub-streams to look out for are the Sigma Puppids II (Nov 27 - Dec 12, with max/act on Dec 6th), and the Tau Puppids (Dec 19 - 30, with max/act on Dec 23rd).

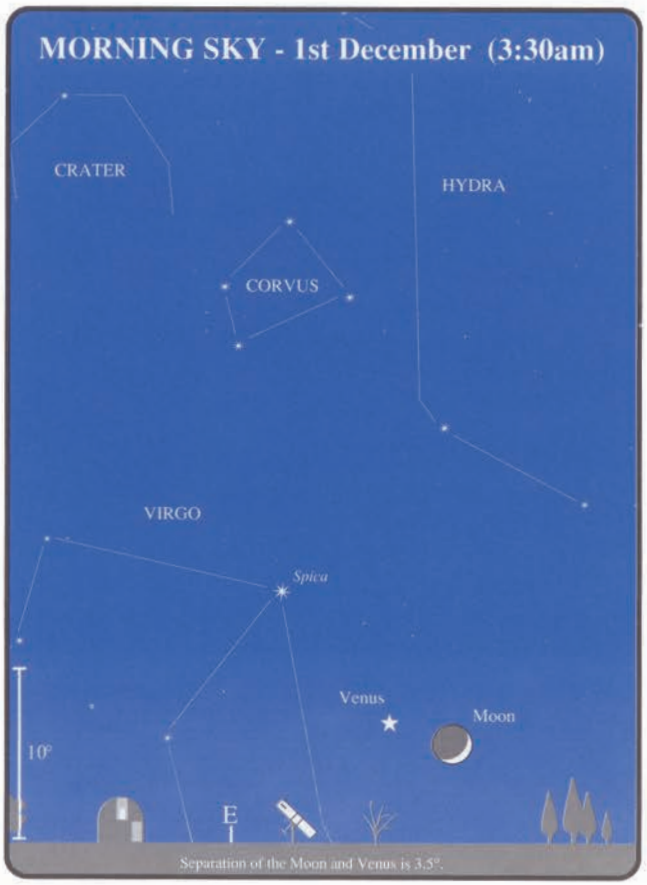
The **PHOENICIDS (Dec)** were discovered in 1887 when a shower was observed from Sydney with an hourly rate of 60. They are active from 28th November through to 9th December, with maximum activity this month between the 4th and 6th. Visible throughout the night the shower is in an excellent position for southern observers and an hourly rate of 2 to 10 very slow orange/yellow meteors with long paths can be expected. The shower has produced some unexpectedly high hourly rates since first noticed in 1887; 100 in 1956, 20 in 1972 and 15 in 1985.

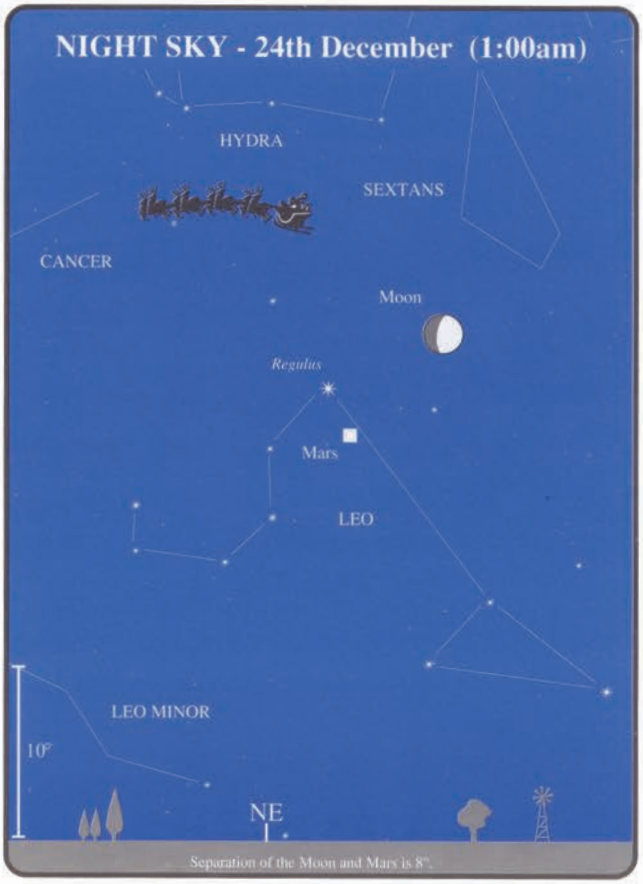
The **GEMINIDS** are regarded as the finest annual shower, they are best from about 11pm until 5am, when they are at their highest above the northern horizon. Visible from 7th to 17th December, with a maximum ZHR of 110 on the 14th. The shower is noted for its high rates and bright slow moving meteors which under good conditions will match or even surpass the Perseids display (ZHR = 95). For Australian observers, the Geminids are a better proposition than the Perseids because of their more southern declination.

DAILY EVENTS

1st	12 AM	Venus 2° North of the Moon.
2nd		Mercury at descending node.
2nd	10 PM	Moon at perigee.
3rd	09:54 AM	New Moon.
6th	5 AM	Neptune 4° South of the Moon.
6th	10 AM	Uranus 6º South of the Moon.
8th	6 PM	Mars 2° North of Regulus.
8th	10 PM	Minor planet Isis 0.5° S of NGC 864 in Cetus.
9th	3 PM	Saturn 7º South of the Moon.
9th	9 PM	Venus at greatest brilliancy.
10th	07:06 AM	First Quarter Moon.
12th		Mercury at aphelion.
14th	1 PM	Mercury in superior conjunction.
15th	6 PM	Moon at apogee.
18th	12:17 PM	Full Moon.
22nd	12 PM	Solstice.
24th	1 AM	Mars 9º North of the Moon.
25th	3 AM	Ceres stationary.
25th	12 PM	Vesta at opposition.
26th	05:06 AM	Last Quarter Moon.
27th	10 PM	Minor planet Vesta 1° N of NGC 2175 in Orion.
29th	3 PM	Venus 3° North of the Moon.
30th	10 AM	Jupiter 1°.1 South of the Moon (occ).
31st	9 AM	Moon at perigee.

DECEMBER





All times are EAST. For summer time (daylight saving) add 1 hour.

PART 2 - THE SOLAR SYSTEM

EXPLANATION

General Comments

TIME There are three time zones used in part 2 of this book. They are Eastern Australian Standard Time (EAST) ie. as used in part 1, Central Australian Standard Time (CAST) and Universal Time (UT). CAST is used only in data with has been specifically generated for Adelaide ie. the rise and set (see the individual Sun, Moon and planet sections) and lunar occultation tables (p. 73) for this city. The 24 hr clock is often used in astronomy eg. 16:00 hr is equal to 4:00 pm. 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 was 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. EAST is 10 hours ahead of UT (CAST is 9.5 hours ahead). For example, midnight UT, or 0 hr, is equal to 10:00hr or 10:00am EAST.

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 (except for 1620 Geographos daily ephemeris). 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 are mostly given in weekly intervals and correspond to Saturdays. The exceptions being the Moon, Venus, Mercury and 1620 Geographos (p. 56) which are daily.

RISE AND SET TIMES. Where listed, rise and set times for various objects are given in EAST. The only exception being the data for Adelaide which uses CAST (see above). The times given are when the upper limb of the object is coincident with the theoretical "true" horizon. Atmospheric refraction is taken into account. Like the ephemerides, the intervals used for rise/sets are weekly and the dates correspond to Saturdays. The only exception is the Moon which is daily.

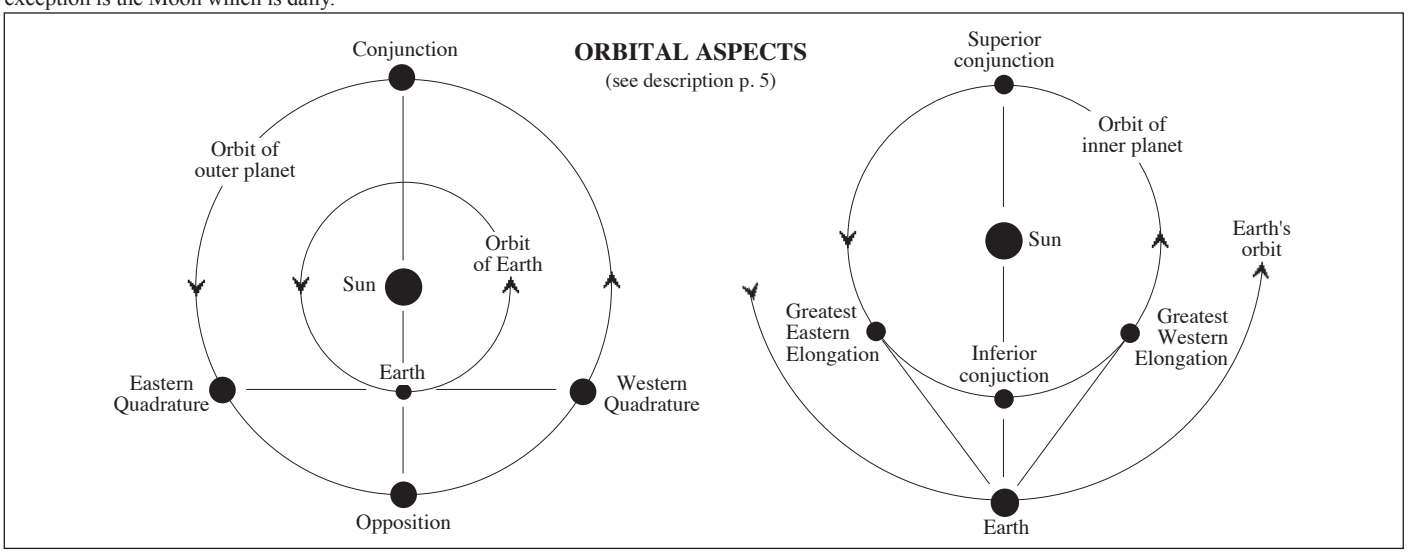
Use of Star Atlases. Over many years, the stars appear to move in the sky relative to the celestial poles. This is called "precession" and is caused by the Earth's axis slowly wobbling like a spinning top over thousands of years. "Epoch 2000.0" refers to an object's position in relation to where the 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 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 Venus, Mercury or the first three months of the year for Mars. 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 planets, 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 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. 57) illustrates the combined effects of the orbital motions of Earth and an outer planet to explain this "loop". This only applies to the period during opposition. Most of the outer planets reach opposition each year with the exception of Mars which is every 26 months (its last opposition was in Jan. 1993). Note that Mars is the only planet that does not show this loop in 1994 (p. 84). The shaded area represents the path of an outer planet against the celestial sphere. For clarity the orbits of both planets are exaggerated and are not to scale. In this example we will arbitrarily call this planet Saturn.

As the Earth moves around the Sun faster than Saturn 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, Saturn continues on its west to east path and begins to slow up to position 3 as the



Earth catches up. Between 3 and 5, Saturn 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 it continues on its west to east direction.

Because of the inclination of Saturn's orbit to the Earth's (2°29'), the apparent path of Saturn 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 1994, 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, with more detailed discussions being present on the relevant pages.

"Planetary Angular Size" Diagram (p. 60) 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".). 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 this time. The fact that Venus will be mainly in twilight will help, for there will be less glare. Try also observing Venus' crescent in binoculars. See part 1 for the the expected crescent shape.

"Meridian Passage Of The Sun And Planets" Diagram (p. 61). In this diagram, the "Y" axis represents the local mean time. It shows the time the Sun and planets cross the meridian (or culminate) for the year. When a planet culminates around midnight, it is at opposition and visible the whole night.

MOON -Rise/Set Data (pp. 66 to 69.). 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.

JUPITER and SATURN

Longitudes of Central Meridian. (pp. 90 and 92) 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 0 hrs UT (10:00am EAST) 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 2:20am EAST would be calculated as follows:

1620 Geographos (daily ephemeris)

Date 10pm EAST		R.A. h m	Dec ° '	Δ AU	R AU	Mag
1994 Aug	20	09 34.5	- 64 35	0.048	1.002	12.7
1994 Aug	21	09 37.2	- 71 03	0.043	1.007	12.2
1994 Aug	22	09 44.7	- 78 59	0.039	1.013	11.7
1994 Aug	23	11 31.1	- 88 21	0.036	1.018	11.2
1994 Aug	24	21 07.4	- 80 19	0.034	1.023	10.7
1994 Aug	25	21 18.8	- 68 23	0.033	1.029	10.3
1994 Aug	26	21 22.2	- 56 29	0.034	1.034	10.1
1994 Aug	27	21 23.9	- 45 35	0.037	1.039	10.0
1994 Aug	28	21 25.0	- 36 12	0.040	1.045	10.0
1994 Aug	29	21 25.7	- 28 27	0.044	1.050	10.0
1994 Aug	30	21 26.2	- 22 10	0.049	1.056	10.2
1994 Aug	31	21 26.7	- 17 04	0.055	1.061	10.4
1994 Sep	1	21 27.0	- 12 55	0.060	1.067	10.6
1994 Sep	2	21 27.4	- 09 31	0.067	1.072	10.8
1994 Sep	3	21 27.7	- 06 42	0.073	1.077	11.0
1994 Sep	4	21 28.1	- 04 21	0.080	1.083	11.3
1994 Sep	5	21 28.4	- 02 21	0.086	1.088	11.5
1994 Sep	6	21 28.7	+ 00 39	0.093	1.094	11.7
1994 Sep	7	21 29.1	+ 00 48	0.100	1.099	11.9
1994 Sep	8	21 29.4	+ 02 04	0.107	1.105	12.1
1994 Sep	9	21 29.8	+ 03 11	0.114	1.110	12.2

The longitude. on Mar 20 is 355.8°. To this add an adjustment. for the 16 hours since 10 am which is 225.3° and finally for the 20 mins add 12.2°. This equals 593.3°; subtracting 360° gives a final answer of 233.3°.

SATURN

The Rings. (p. 93) The appearance of the planets diagrams in part 1, show how "open" (or face-on) the rings are for 1994. 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"; this last occurred in 1980. The next such period will be in 1995. At the moment the rings are closing after being wide open in 1988.

Satellites of Saturn (pages 94 & 95). To estimate the configuration or positions of the satellites, the "Apparent Orbits" diagram (p. 94) and the times of "Greatest Eastern Elongation" are needed. For each satellite, take the previous (most recent) date of greatest eastern elongation and work out the period that has elapsed (in days/hours) since this time. Locate this time on the relevant orbit on the diagram (p. 94) and that gives the moon'sposition directly. Saturn appears to be egg shaped on this diagram due to the need to exaggerate the scale in the direction of the minor axes. This makes seeing the orbits of the satellites easier; especially the inner moons.

URANUS / NEPTUNE

Finder Chart (see p. 100). To help in locating this star field in Sagittarius, its position has been marked on the large sky view for June 30 on page 31.

SATELLITES OF URANUS (see p. 97). 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 currently face-on and nearly circular as seen from Earth (see diagram). The orbits' apparent minor axis (running east/west) is 81% that of the apparent major axis (north/south). For example, Oberon, at opposition, has a maximum elongation of 44" (see p. 59). Its minimum elongation would be 81% of this or 36". 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, II, 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. 97). 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 1994, Triton's apparent orbit as seen from Earth is a pronounced ellipse (not as circular as Uranus' satellites) with the minor axis being 73% of the major axis. Therefore Triton, at opposition, varies from 17" (see p. 59) down to 12". 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 10º). If the answer is greater than 360°, subtract 360°.

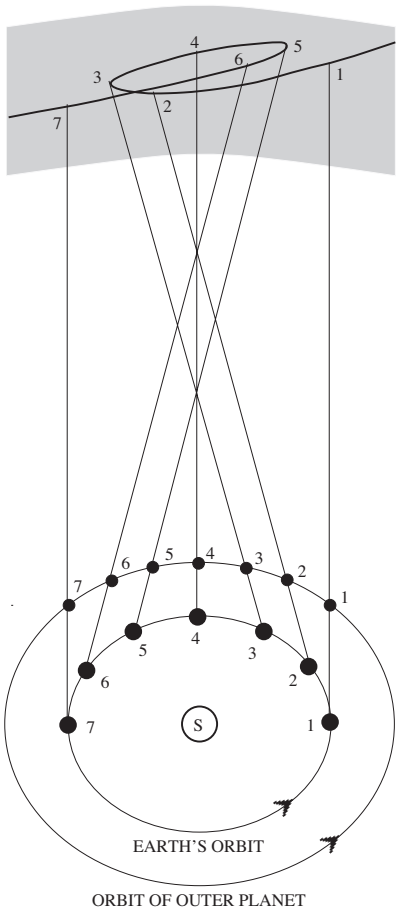
PLUTO (see pp. 100 and 101). The pointer chart (p. 100) is designed to help people find the general area for Pluto. The shaded block shows the position of the main chart (p. 101). The main finder chart shows stars down to magnitude 14.5. This is necessary to pick out the faint star-like image of Pluto (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. 104 and 105). 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.

1620 GEOGRAPHOS. As previously stated most of the asteroids are resident in the asteroid belt but there are some interesting exceptions. There are a number of minor planets whose orbits take them inside the Earth's orbit when they are near perihelion. It is these "Earth crossing bodies" which are currently the subject of an intense search by observatories all over the world. It is certain that bodies such as these have collided with the Earth in the past as they will in the future. Such an impact could kill millions of people if not render the Earth lifeless. It is likely one such collision caused the extinction of the Dinosaurs. Scientists and our governments have taken this threat seriously and hope that an early detection of such a doomsday visitor would allow us time to take corrective steps. 1620 Geographos is one of these Earth crossing asteroids and its return to perihelion in 1994 will be a case of a near miss (astronomically speaking) of only 5 million kilometres. During its close approach to the Earth in late August, it will appear to move very quickly in the sky and a weekly ephemeris would make detection difficult. The table (p. 56) gives a daily ephemeris (at 10pm EAST or 12hr UT of date) for the approach period. The Δ and R (earth and Sun distances in AU) have also been included.

RETROGRADE MOTION DIAGRAM



PART 3 - THE APPENDICES

GENERAL NOTES

Appendix A -"The Brightest Stars" Table (p. 109) 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. 119). 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 **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 H - Hours of RA/ Constellations on the Meridian (p. 113) 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. 104) in early March, has an RA of around 16 hours. From the diagram the diagonal 16 hour line, at this time of the year, crosses the meridian at approximately 5 am. This object therefore is a morning object and if possible observations (or photographs) should be made as late as possible. Another application; 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). Compare this to the sky view for Nov. 1 on page 50. 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 ($\times 10^3$ km)	(Earth = 1)	MAG at OPP	EQUATORIAL DIAMETER (km).	FLATTENING [1]	No of MOONS	MASS ($\times 10^{24}$ kg)	(Earth = 1)
Sun	-		-26.8	1392530	0	-	1989085	332946
Moon	-		-12.74 [11]	3475	0	-	0.073483	0.0123
Mercury	57856	0.387	0.16 [12]	4879	0	0	0.33022	0.055
Venus	108132	0.723	-4.07 [12]	12104	0	0	4.8690	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	0.064874	16	1898.8	317.900
Saturn	1425983	9.540	0.67	120536	0.097962	18	568.50	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	13.7	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]	INCLINATION [7]	OBLIQUITY [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	0.106	0.20562	7° 00' 00"	0° 00'
Venus	0.86	224.7 d	583.9	-243.0187	0.65	0.00681	3° 23' 38"	92° 00'
Earth	1	365.256 d	-	0.99726968	0.367	0.01681	0° 00' 00"	23° 26'
Mars	0.15	687 d	779.8	1.02595675	0.150	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	0.51	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.

58

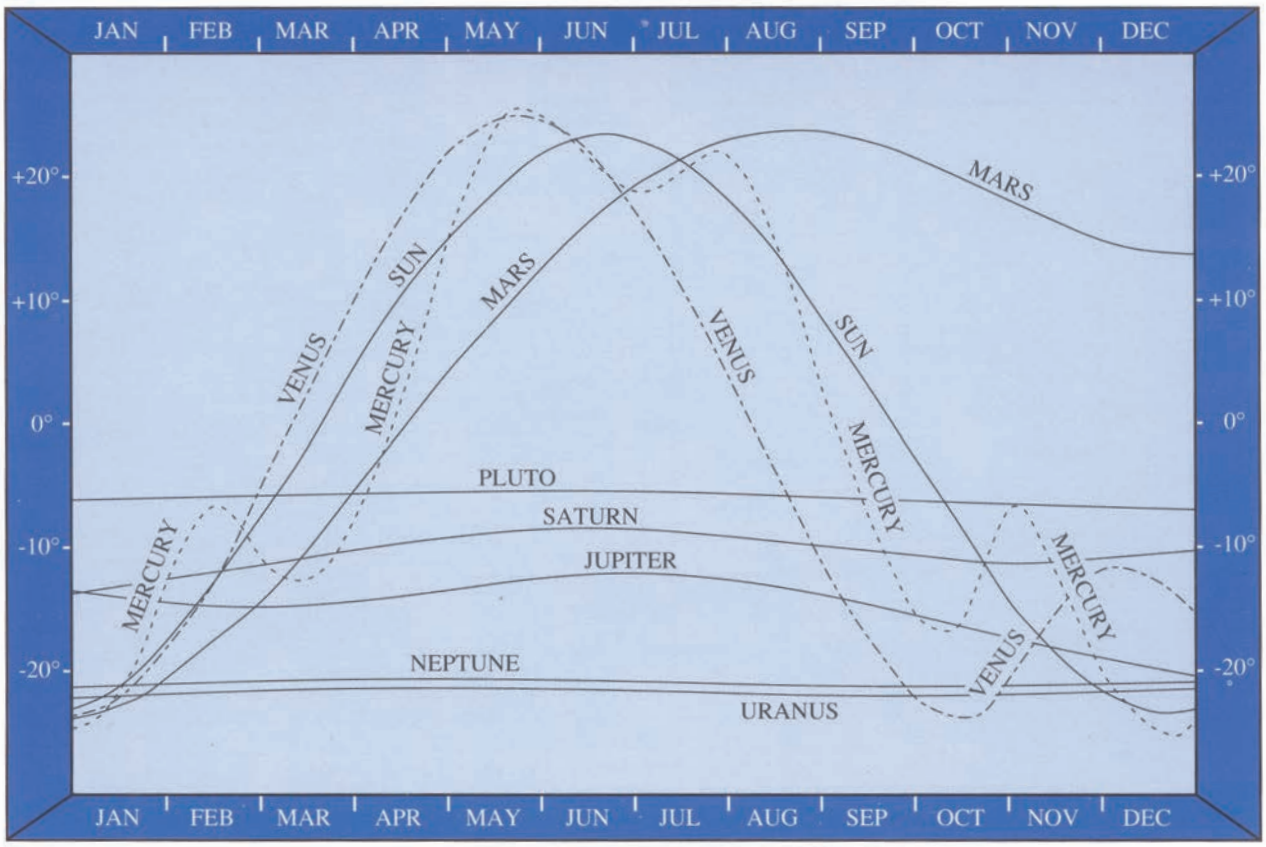
SOLAR SYSTEM DATA — SATELLITES

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 (km)	SIDEREAL PERIOD OF ROTATION (days) [4]	MAGNITUDE AT OPPOSITION
Earth										
Moon		27.321661		384.400	0.054900489	18.28-28.58	0.01230002	1737.4	S	-12.74
Mars										
Phobos	I	0.31891023	25"	9.378	0.015	1.0	$1.65x10^{-8}$	13.4x11.2x9.2	S	11.3
Deimos	II	1.2624407	1' 02"	23.459	0.0005	0.9-2.7	$3.71x10^{-9}$	7.5x6.1x5.2	S	12.40
Jupiter										
Io	I	1.769137786	2' 18"	422	0.004	0.04	$4.70x10^{-5}$	1830x1819x1815	S	5.29
Europa	II	3.551181041	3' 40"	671	0.009	0.47	$2.53x10^{-5}$	1565	S	5.29
Ganymede	III	7.15455296	5' 51"	1070	0.002	0.21	$7.80x10^{-5}$	2634	S	4.61
Callisto	IV	16.6890184	10' 18"	1883	0.007	0.51	$5.67x10^{-5}$	2403	S	5.65
Amalthea	V	0.49817905	0' 59"	181	0.003	0.40	$38x10^{-10}$	131x73x67	S	14.1
Himalia	VI	250.5662	1° 02' 46"	11480	0.15798	27.63	$50x10^{-10}$	85	0.4	14.84
Elara	VII	259.6528	1° 04' 10"	11737	0.20719	24.77	$4x10^{-10}$	40	16.77	
Pasiphae	VIII	735. R	2° 08' 26"	23500	0.378	145	$1x10^{-10}$	18		17.03
Sinope	IX	758. R	2° 09' 31"	23700	0.275	153	$0.4x10^{-10}$	14	0.548	18.3
Lysithea	X	259.22	1° 04' 04"	11720	0.107	29.02	$0.4x10^{-10}$	12	0.533	18.4
Carme	XI	692. R	2° 03' 31"	22600	0.20678	164	$0.5x10^{-10}$	15	0.433	18.0
Ananke	XII	631. R	1° 55' 52"	21200	0.16870	147	$0.2x10^{-10}$	10	0.35	18.9
Leda	XIII	238.72	1° 00' 39"	11094	0.14762	26.07	$0.03x10^{-10}$	5	20.2	
Thebe	XIV	0.6745	1' 13"	222	0.015	0.8	$4x10^{-10}$	55x45	S	15.7
Adrastea	XV	0.29826	0' 42"	129			$0.1x10^{-10}$	13x10x8	S	19.1
Metis	XVI	0.294780	0' 42"	128			$0.5x10^{-10}$	20	S	17.5
Saturn										
Mimas	I	0.942421813	0' 30"	185.52	0.0202	1.53	$6.60x10^{-8}$	209x196x191	S	12.9
Enceladus	II	1.370217855	0' 38"	238.02	0.00452	0.00	$1x10^{-7}$	256x247x245	S	11.7
Tethys	III	1.887802160	0' 48"	294.66	0.00000	1.86	$1.10x10^{-6}$	536x528x526	S	10.2
Dione	IV	2.736914742	1' 01"	377.40	0.002230	0.02	$1.93x10^{-6}$	560	S	10.4
Rhea	V	4.517500436	1' 25"	527.04	0.00100	0.35	$4.06x10^{-6}$	764	S	9.7
Titan	VI	15.94542068	3' 17"	1221.83	0.029192	0.33	$2.37x10^{-4}$	2575	S	8.28
Hyperion	VII	21.2766088	3' 59"	1481.1	0.104	0.43	$4x10^{-8}$	180x140x113		14.19
Iapetus	VIII	79.3301825	9' 35"	3561.3	0.02828	14.72	$2.8x10^{-6}$	718	S	11.1
Phoebe	IX	550.48 R	34' 51"	12952	0.16326	177 [2]	$7x10^{-10}$	110	0.4	16.45
Janus	X	0.6945	0' 24"	151.472	0.007	0.14	$3.38x10^{-9}$	97x95x77	S	14
Epimetheus	XI	0.6942	0' 24"	151.422	0.009	0.34	$9.5x10^{-10}$	69x55x55	S	15
Helene	XII	2.7369	1' 01"	377.40	0.005	0.0		18x16x15		18
Telesto	XIII	1.8878	0' 48"	294.66				15x12.5x7.5		18.5
Calypso	XIV	1.8878	0' 48"	294.66				15x8x8		18.7
Atlas	XV	0.6019	0' 22"	137.670	0.000	0.3		18.5x17.2x13.5	18	
Prometheus	XVI	0.6130	0' 23"	139.353	0.003	0.0		74x50x34		16
Pandora	XVII	0.6285	0' 23"	141.700	0.004	0.0		55x44x31		16
Pan	XVIII	0.5750	0' 21"	133.583			10			Uranus
Ariel	I	2.52037935	0' 14"	191.02	0.0034	0.3	$1.55x10^{-5}$	581x578x578	S	14.16
Umbriel	II	4.1441772	0' 20"	266.30	0.0050	0.36	$1.35x10^{-5}$	585	S	14.81
Titania	III	8.7058717	0' 33"	435.91	0.0022	0.14	$4.06x10^{-5}$	789	S	13.73
Oberon	IV	13.4632389	0' 44"	583.52	0.0008	0.10	$3.47x10^{-5}$	761	S	13.94
Miranda	V	1.41347925	0' 10"	129.39	0.0027	4.2	$0.08x10^{-5}$	240x234x233	S	16.3
Cordelia	VI	0.3350338	0' 04"	49.77	0.00026	0.08		13		24.1
Ophelia	VII	0.376400	0' 04"	53.79	0.0099	0.10		15		23.8
Bianca	VIII	0.43457899	0' 04"	59.17	0.009	0.19		21		23.0
Cressida	IX	0.46356960	0' 05"	61.78	0.0004	0.01		31		22.2
Desdemona	X	0.47364960	0' 05"	62.68	0.00013	0.11		27		22.5
Juliet	XI	0.49306549	0' 05"	64.35	0.00066	0.07	42		21.5	
Portia	XII	0.51319592	0' 05"	66.09	0.0000	0.06		54		21.0
Rosalind	XIII	0.55845953	0' 05"	69.94	0.0001	0.28		27		22.5
Belinda	XIV	0.62352747	0' 06"	75.26	0.00007	0.03		33		22.1
Puck	XV	0.76183287	0' 07"	86.01	0.00012	0.32	77		20.2	
Caliban	XVI	579R	8' 56"	7,169	0.082	139.7 [2]		30		22.4
Sycorax	XVII	1289R	15' 26"	12,214	0.509	152.7 [2]		60		20.9
Neptune										
Triton	I	5.8768541 R	0' 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		18.7
Naiad	III	0.294396	0' 02"	48.23	0.000	4.74		29		24.7
Thalassa	IV	0.311485	0' 02"	50.07	0.000	0.21		40		23.8
Despina	V	0.334655	0' 02"	52.53	0.000	0.07		74		22.6
Galatea	VI	0.428745	0' 03"	61.95	0.000	0.05		79		22.3
Larissa	VII	0.554654	0' 03"	73.55	0.00139	0.20		104x89		22.0
Proteus	VIII	1.122315	0' 06"	117.65	0.0004	0.55		218x208x201	S	20.3
Pluto										
Charon	I	6.38725	<1"	19.6	<0.001	99 [3]	0.125	593	S	16.8

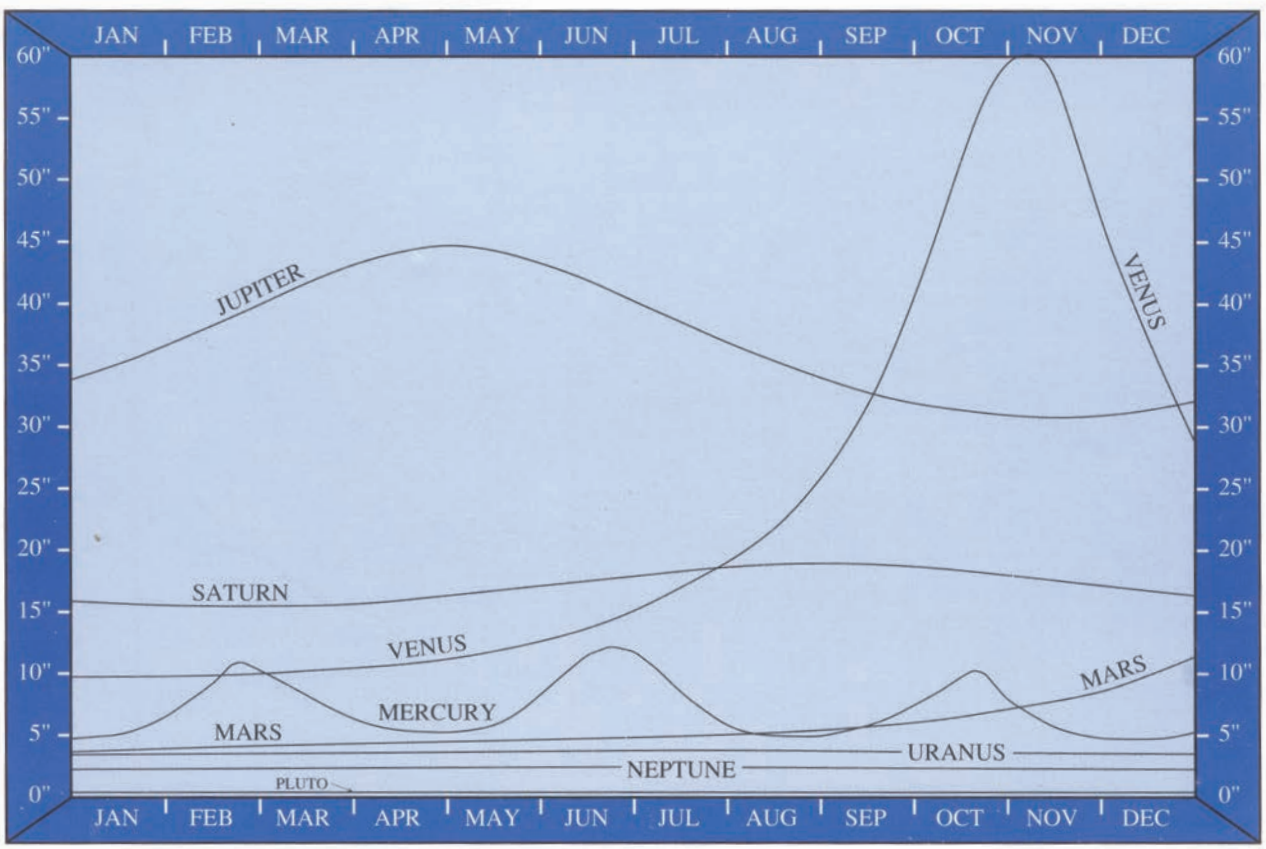
Notes: **1** - Sidereal periods, except tropical periods are given for Saturn. **2** - Relative to the ecliptic plane. **3** - Referred to the equator of 1950.0
4 - S = Synchronous, rotation period same as orbital period. i.e., keeps the same section of its surface facing its planet.

59

DECLINATIONS of the SUN and PLANETS

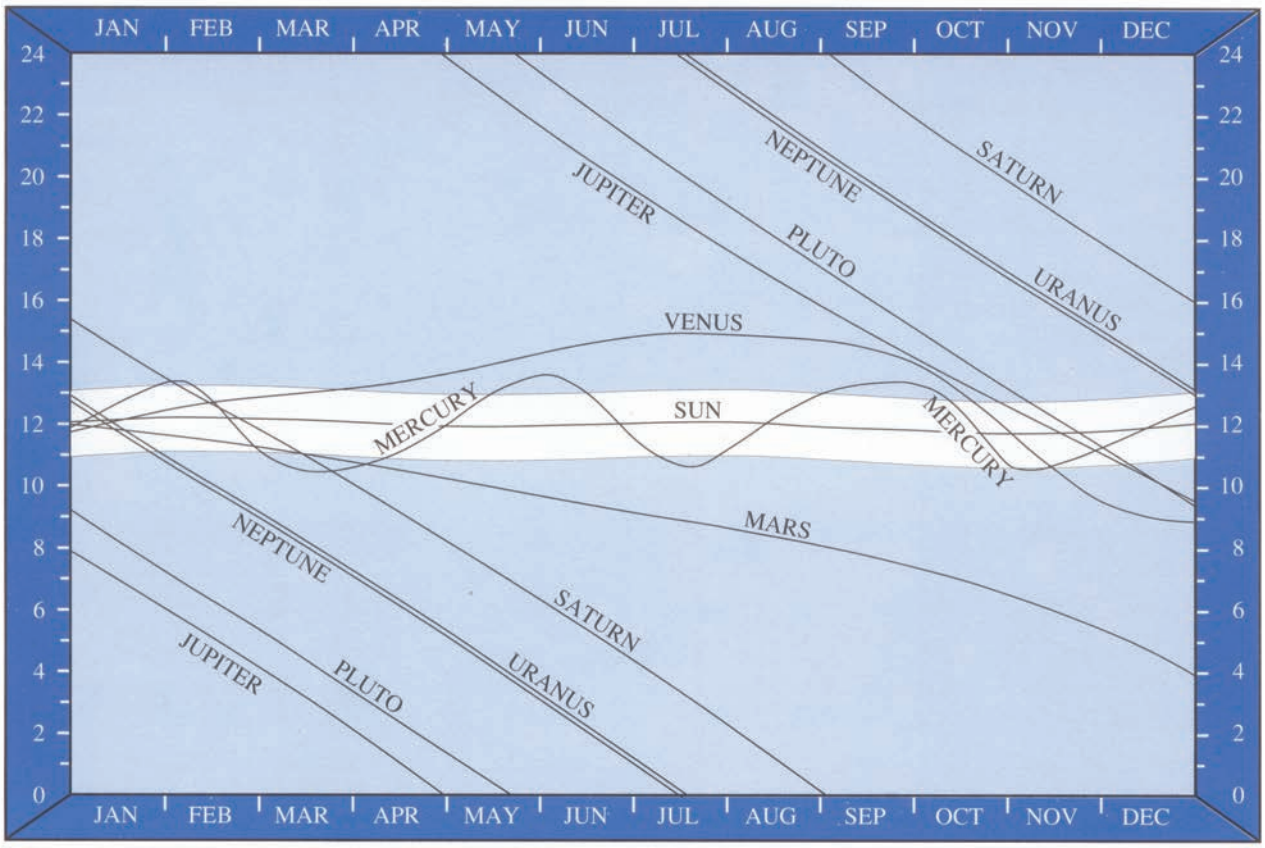


PLANETARY ANGULAR SIZE



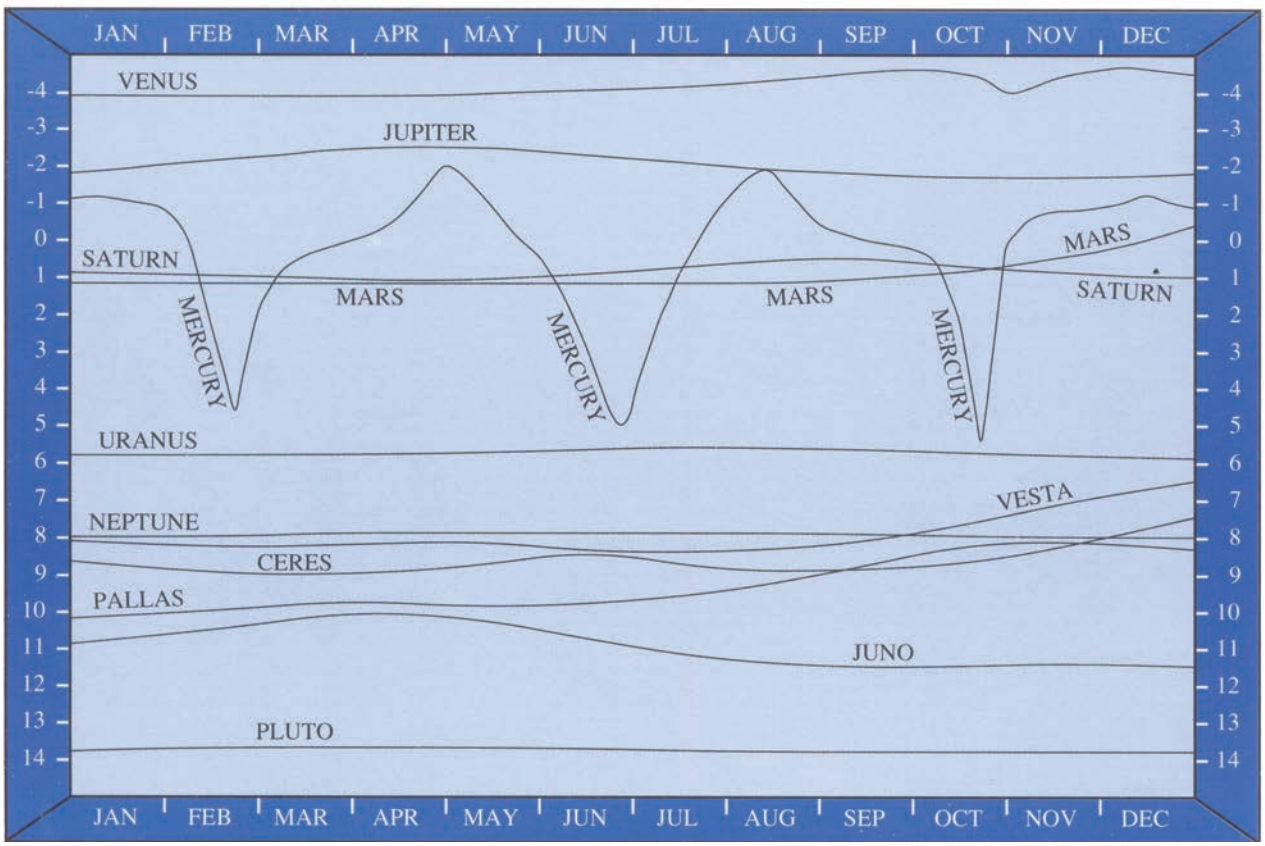
See explanation (part 2) page 56

MERIDIAN PASSAGE of the SUN and PLANETS



See explanation (part 2) page 56

MAGNITUDES of the PLANETS and MAJOR ASTEROIDS



SUN RISE, SUN SET AND ASTRONOMICAL TWILIGHT

E.A.S.T. (Adelaide C.A.S.T.)

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

SUN RISE, SUN SET AND ASTRONOMICAL TWILIGHT

E.A.S.T.

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

SUN

GEOCENTRIC POSITION (0 hr UT, Epoch 2000.0)

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

ORIENTATION OF THE SUN

DATE (0hr UT)		P°	B_o°	L_o°
Jan	1	+ 2.15	- 3.02	126.60
	8	- 1.24	- 3.81	034.41
	15	- 4.58	- 4.55	302.23
	22	- 7.80	- 5.21	210.06
	29	- 10.85	- 5.80	117.89
Feb	5	- 13.70	- 6.29	025.73
	12	- 16.30	- 6.69	293.56
	19	- 18.64	- 6.98	201.39
	26	- 20.70	- 7.17	109.19
Mar	5	- 22.45	- 7.25	016.98
	12	- 23.89	- 7.22	284.75
	19	- 25.00	- 7.08	192.49
	26	- 25.78	- 6.84	100.19
Apr	2	- 26.21	- 6.50	007.85
	9	- 26.29	- 6.06	275.48
	16	- 26.01	- 5.54	183.07
	23	- 25.37	- 4.95	090.62
	30	- 24.37	- 4.28	358.13
May	7	- 23.02	- 3.56	265.60
	14	- 21.32	- 2.79	173.05
	21	- 19.30	- 1.99	080.46
	28	- 16.98	- 1.16	347.84
Jun	4	- 14.40	- 0.32	255.21
	11	- 11.59	+ 0.53	162.57
	18	- 8.62	+ 1.36	069.91
	25	- 5.52	+ 2.18	337.25
Jul	2	- 2.35	+ 2.97	244.59
	9	+ 0.82	+ 3.72	151.95
	16	+ 3.95	+ 4.41	059.31
	23	+ 7.00	+ 5.05	326.69
	30	+ 9.91	+ 5.62	234.09
Aug	6	+ 12.67	+ 6.12	141.52
	13	+ 15.23	+ 6.53	048.97
	20	+ 17.57	+ 6.86	316.45
	27	+ 19.67	+ 7.09	223.95
Sep	3	+ 21.51	+ 7.22	131.48
	10	+ 23.08	+ 7.25	039.03
	17	+ 24.36	+ 7.18	306.61
	24	+ 25.33	+ 7.00	214.21
Oct	1	+ 25.97	+ 6.73	121.83
	8	+ 26.28	+ 6.35	029.47
	15	+ 26.23	+ 5.88	297.13
	22	+ 25.81	+ 5.33	204.80
	29	+ 25.01	+ 4.69	112.48
Nov	5	+ 23.83	+ 3.98	020.18
	12	+ 22.27	+ 3.21	287.89
	19	+ 20.33	+ 2.39	195.61
	26	+ 18.04	+ 1.53	103.34
Dec	3	+ 15.42	+ 0.64	011.09
	10	+ 12.52	- 0.25	278.85
	17	+ 9.40	- 1.15	186.62
	24	+ 6.12	- 2.02	094.40
	31	+ 2.75	- 2.87	002.20

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
1878	Jan	10.61
1879	Feb	6.96
1880	Mar	6.29
1881	Apr	2.60
1882	Apr	29.86
1883	May	27.08
1884	Jun	23.28
1885	Jul	20.48
1886	Aug	16.71
1887	Sep	12.96
1888	Oct	10.24
1889	Nov	6.53
1890	Dec	3.84
1891	Dec	31.17

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.

SOLAR & LUNAR ECLIPSES

During 1994 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. None or the eclipses are favourable from Australia. **NOTE all times in U.T.**

MAY 10th - ANNULAR ECLIPSE of the SUN

Visible from eastern Pacific Ocean, North America, and northern Atlantic Ocean.

	U.T.	Longitude	Latitude
Eclipse begins	10d14h12.2m	-125°31.5'	+04°56.9'
Central eclipse begins	10d15h23.3m	-146°07.7'	+13°33.5'
Greatest eclipse	10d17h19.8m	-080°52.0'	+42°21.8'
Central eclipse ends	10d18h59.5m	-004° 08.8'	+32°16.6'
Eclipse ends	10d20h10.6m	-025°27.6'	+23°47.5'

MAY 25th - PARTIAL ECLIPSE of the MOON

Visible from the United States, Canada, South America, Africa, Europe etc.

Moon enters penumbra	25d01h17.9m
Moon enters umbra	25d02h37.3m
Middle of eclipse	25d03h30.3m
Moon leaves umbra	25d04h23.3m
Moon leaves penumbra	25d05h42.7m

NOVEMBER 3rd - TOTAL ECLIPSE of the SUN

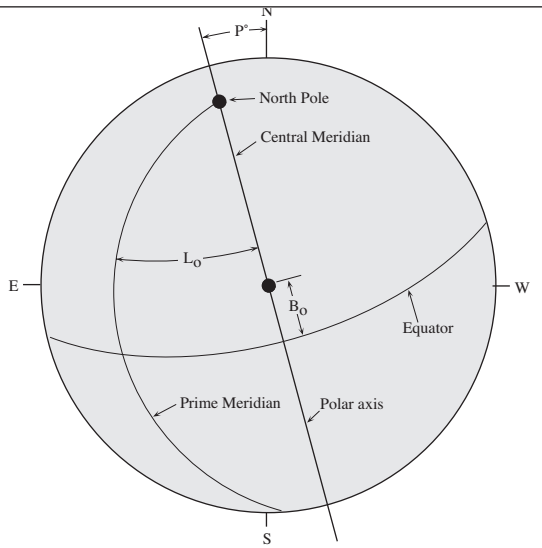
Visible from south eastern Pacific Ocean, South America, and Atlantic Ocean.

	U.T.	Longitude	Latitude
Eclipse begins	3d11h05.0m	-080°32.5'	-0 0°43.3'
Central eclipse begins	3d12h02.7m	-096°54.7'	-07°53.7'
Greatest eclipse	3d13h14.1m	-030°52.9'	-36°27.3'
Central eclipse ends	3d15h15.4m	+046°45.2'	-31°58.5'
Eclipse ends	3d16h13.1m	+029°49.4'	-24°53.2'

NOVEMBER 18th - PENUMBRAL ECLIPSE of the MOON

Visible from North America, Atlantic Ocean , Europe, Pacific Ocean etc

Moon enters penumbra	18d04h25.7m
Middle of eclipse	18d06h43.9m
Moon leaves penumbra	18d09h02.1m



MOON RISE AND SET

ADELAIDE C.A.S.T.

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

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

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

E.A.S.T. BRISBANE

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

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

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

MOON RISE AND SET

CAIRNS — E.A.S.T.

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

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

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

CANBERRA — C.A.S.T.

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

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

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

MOON RISE AND SET

HOBART E.A.S.T.

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

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

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

E.A.S.T. MELBOURNE

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

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

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

MOON RISE AND SET

SYDNEY E.A.S.T.

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

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

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

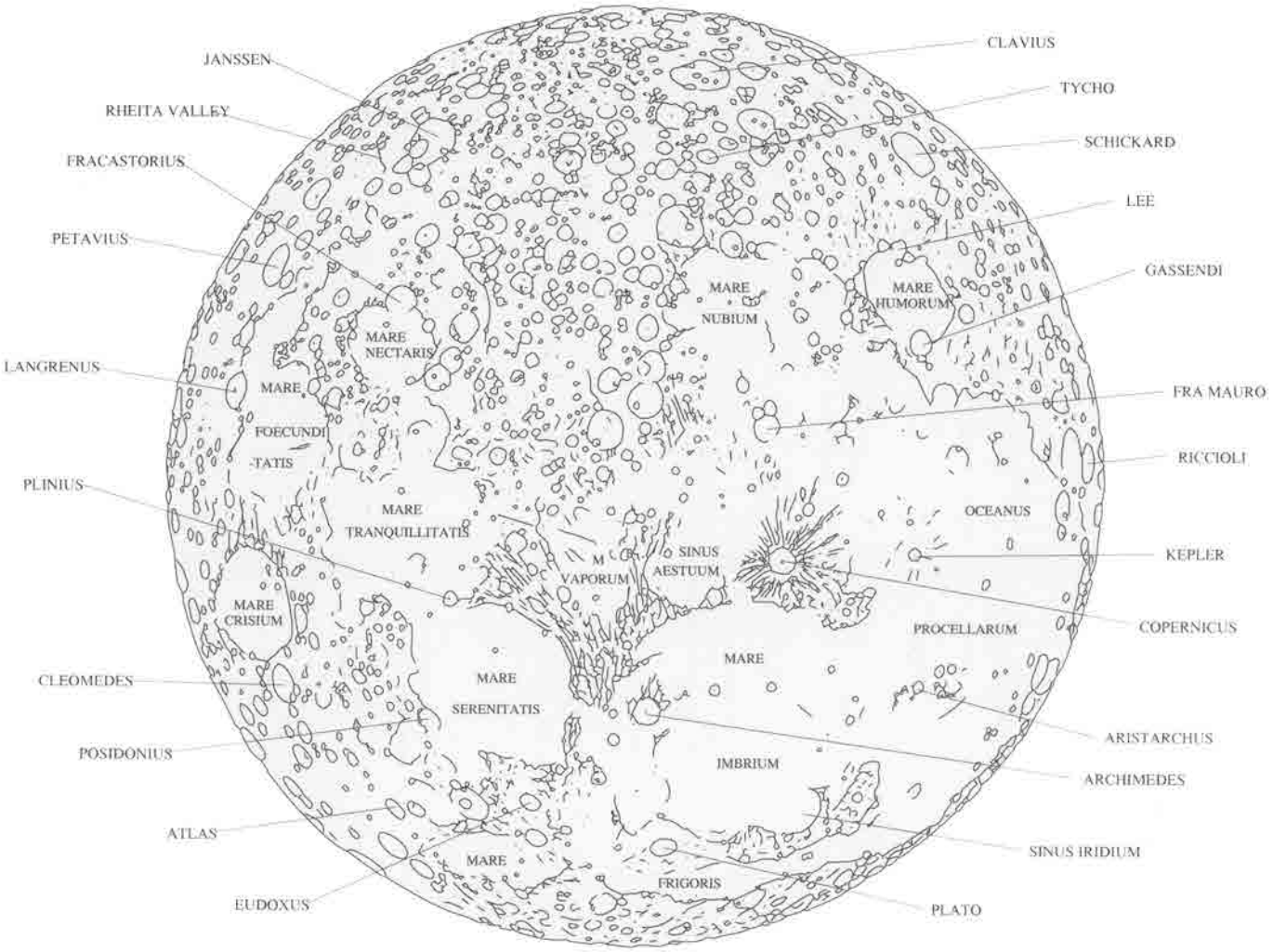
TOWNSVILLE E.A.S.T.

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

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

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

MOON



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

Lunation	New Moon			First Quarter			Full Moon			Last Quarter		
		d	h m		d	h m		d	h m		d	h m
878										Jan	05	10:01
879	Jan	12	09:10	Jan	20	06:27	Jan	27	23:23	Feb	03	18:06
880	Feb	11	00:30	Feb	19	03:47	Feb	26	11:15	Mar	05	02:53
881	Mar	12	17:05	Mar	20	22:14	Mar	27	21:10	Apr	03	12:55
882	Apr	11	10:17	Apr	19	12:34	Apr	26	05:45	May	03	00:32
883	May	11	03:07	May	18	22:50	May	25	13:39	Jun	01	14:02
884	Jun	09	18:26	Jun	17	05:57	Jun	23	21:33	Jul	01	05:31
885	Jul	09	07:37	Jul	16	11:12	Jul	23	06:16	Jul	30	22:40
886	Aug	07	18:45	Aug	14	15:57	Aug	21	16:47	Aug	29	16:41
887	Sep	06	04:33	Sep	12	21:34	Sep	20	06:01	Sep	28	10:23
888	Oct	05	13:55	Oct	12	05:17	Oct	19	22:18	Oct	28	02:44
889	Nov	03	23:36	Nov	10	16:14	Nov	18	16:57	Nov	26	17:04
890	Dec	03	09:54	Dec	10	07:06	Dec	18	12:17	Dec	26	05:06

MOON (E.A.S.T.)

APOGEE		PERIGEE	
	d hh		d hh
Jan	19 15	Jan	6 11
Feb	16 12	Jan	31 14
Mar	16 03	Feb	28 08
Apr	12 10	Mar	28 16
May	9 12	Apr	26 03
Jun	5 23	May	24 13
Jul	3 15	Jun	21 17
Jul	31 09	Jul	19 04
Aug	28 04	Aug	13 09
Sep	24 22	Sep	9 00
Oct	22 12	Oct	7 00
Nov	18 15	Nov	4 10
Dec	15 18	Dec	2 22
		Dec	31 09

MOON

GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

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

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. They also are listed in the larger "whole" sky SAO (Smithsonian Astrophysical Observatory) catalogue. This covers about 259,000 stars.

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 tables present the easier to observe occultations for 1994 as predicted for **Adelaide**, **Brisbane, Canberra, Hobart, Melbourne** and **Sydney.** 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. These vary 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!

If you require further information on timing methods for occultations it would be worthwhile contacting your local astronomical society (p. 116).

LUNAR OCCULTATION TABLES

The faintest stars, which have occultation predictions on the following pages, are approximately 8th magnitude. The actual selection criteria was as follows. All events, irrespective of whether it occurs on a bright or dark limb, are given for stars with magnitudes of approx. 5 or brighter. Stars fainter than this have been restricted to dark limb events only. They are nearly all night time events.

EXPLANATION

E.A.S.T. Is the date and time of the occultation. Hr & min are in E.A.S.T. for all tables except Adelaide which is in C.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 Z are from the USNO subset of the Smithsonian Star catalogue (SZ) for the zodiacal regions of the sky. Other letters designate special catalogues, such as P for Pleiades Catalog.

PD This is the event which consists of two letters.
The first letter is the type of Event ie. "D" = Disappearance, "R" = Reappearance and M = means the star just misses being occulted by the Moon, at the precise latitude and longitude used for the predictions, and there is a "grazing" occultation nearby. "G" = Graze.
The second letter represents: "D" = Dark limb, "B" = a bright limb event.

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 the city's table you are working from. The formula is:

Predicted Time at your location

= Time from Table + (A × n) + (B × 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.

It is best to use data for the city which you are closest to geographically.

WORKED EXAMPLE

An observer wishes to calculate a more accurate time for the disappearance of ZC 2302 on Feb. 5 for their location in Parkes (NSW) (148° 10' E, 33° 05' S), see page 112. Canberra is the closest city, therefore we start with the data from its table.

-The change in longitude from Canberra (decimal degrees)
= 149°.13 - 146°.92 = 0°.96 — 'n' (-)

-The change in latitude from Canberra (decimal degrees)
= 35°.25 - 33°.08 = 2°.17 — 'p' (–)

From the Canberra table, the time of the event is 01:50 EAST and the values of A and B are +0.2 and –2.1 respectively.

Therefore the equation becomes:-

01:50 + (0.2 * 0.96) + (–2.1 * 2.17)
= 01:50 + (0.19) + (– 4.6)
= 01:50 – 4.8 = 01:45 (approx..).

The event will be visible from Parkes approximately 5 mins earlier than Canberra, i.e., about 1:45 AM (EAST) on Feb. 5.

LUNAR OCCULTATION TABLE

ADELAIDE (34° 58' S, 138° 38'E)

C.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	AB
Jan 02 02:28	1454	RD	7.1	133	45	305	- 1.8	- 1.4
Jan 02 03:56	1457	RD	6.7	133	47	281	- 2.2	- 0.2
Jan 02 23:46	1564	RD	6.6	121	17	304	- 0.6	- 1.8
Jan 03 01:10	X16100	RD	7.5	121	33	306	- 1.1	- 1.8
Jan 18 20:36	89	DD	6.5	75	23	77	- 1.3	+ 1.6
Jan 22 22:01	586	DD	7.0	119	27	55	- 2.2	+ 1.9
Jan 25 23:08	1031	DD	7.0	155	34	75	- 2.6	+ 0.7
Jan 29 21:51	1519	RD	6.5	154	18	317	- 0.7	- 2.1
Jan 30 03:14	1546	RD	7.2	151	48	3	+ 0.3	- 4.1
Jan 31 04:20	X17230	RD	7.1	138	52	352	- 0.4	- 3.1
Feb 01 23:46	1888	RD	6.2	113	20	245	- 0.8	- 0.4
Feb 03 00:00	2021	RD	6.4	99	14	326	+ 0.2	- 2.2
Feb 04 03:59	2173	RD	7.0	84	52	333	- 0.5	- 3.2
Feb 0S 01:22	2303	RD	5.1	73	11	304	+ 0.3	- 1.7
Feb 05 01:22	2302	RD	2.9	73	11	303	+ 0.3	- 1.7
Feb 18 21:01	520	DD	7.6	87	20	133	- 1.1	- 0.5
Feb 19 20:43	665	DD	5.7	98	27	80	- 2.1	+ 1.1
Feb 21 12:43	969	DD	7.1	122	16	49	- 2.3	+ 3.2
Feb 23 22:53	1235	DD	7.4	147	38	81	- 2.6	+ 0.6
Feb 25 00:49	1364	DD	6.5	160	38	159	- 0.6	- 1.8
Mar 01 21:50	1971	RD	5.8	132	12	344	+ 0.4	- 2.7
Mar 02 00:19	X19762	RD	7.3	131	42	295	- 1.0	- 1.6
Mar 02 00:35	X19782	RD	7.0	130	45	346	- 0.1	- 3.3
Mar 04 03:01	2275	RD	5.9	102	55	338	- 0.4	- 3.9
Mar 05 02:23	2425	RD	5.9	90	37	323	- 0.2	- 2.9
Mar 07 02:10	X25896	RD	7.0	65	12	220	- 0.6	+ 0.6
Mar 07 02:52	2733	RD	6.4	64	20	234	- 0.7	0.0
Mar 19 20:58	752	DD	4.7	78	15	89	- 1.3	+ 1.1
Mar 25 01:35	1429	DD	6.8	141	21	75	- 1.3	+ 1.8
Mar 25 22:58	1546	DD	7.2	153	50	65	- 3.4	+ 1.7
Mar 26 22:43	X17230	DD	7.1	167	54	122	- 1.7	- 1.3
Mar 26 23:32	X17263	DD	7.4	167	56	72	- 3.0	+ 1.0
Mar 28 23:00	1925	DB	1.0	164	51	101	- 1.5	- 1.1
Mar 29 00:10	1925	RD	1.0	164	62	313	- 1.4	- 1.9
Mar 30 20:59	2192	RD	6.2	137	9	222	- 0.6	+ 0.7
Mar 30 23:05	2205	RD	7.6	136	34	219	- 2.3	+ 1.9
Mar 31 21:37	2353	RD	4.6	123	6	218	- 0.6	+ 0.9
Apr 03 01:01	X25414	RD	7.7	95	22	313	+ 0.1	- 2.6
Apr 03 01:10	2687	RD	6.3	95	24	323	+ 0.2	- 3.4
Apr 03 01:17	G00031	RD	6.5	95	26	290	- 0.3	- 1.7
Apr 03 01:19	X25445	RD	7.3	95	26	324	+ 0.2	- 3.5
Apr 03 03:12	2699	RD	7.2	94	49	280	- 1.4	- 1.4
Apr 03 04:13	X25588	RD	7.2	94	60	285	- 1.9	- 1.5
Apr 05 02:44	2972	RD	6.7	70	20	215	- 0.8	+ 1.0
Apr 05 03:20	2975	RD	7.0	70	27	241	- 0.9	- 0.1
Apr 05 05:26	2983	RD	7.9	69	51	208	- 1.5	+ 2.4
Apr 06 03:04	3104	RD	6.5	58	12	188	- 0.8	+ 3.7
Apr 06 05:08	3111	RD	6.9	58	37	259	- 1.3	- 0.7
Apr 08 05:31	X31054	RD	7.8	35	19	230	- 0.6	+ 0.3
Apr 16 19:28	847	DD	2.9	59	18	131	- 0.8	- 0.3
Apr 16 20:32	847	RB	2.9	59	7	251	- 1.1	+ 1.8
Apr 17 19:43	995	RB	4.1	70	23	247	- 2.1	+ 1.9
Apr 18 19:11	1114	DD	6.8	82	34	121	- 1.7	- 0.4
Apr 18 20:58	1124	DD	6.9	82	21	94	- 1.4	+ 0.9
Apr 19 22:57	1257	DD	7.5	95	13	110	- 0.6	+ 0.5
Apr 20 19:34	1364	DD	6.5	106	43	113	- 2.1	- 0.7
Apr 21 23:47	1489	DD	6.8	121	27	120	- 0.9	0.0
Apr 22 20:47	1594	DD	7.9	133	53	136	- 1.5	- 1.6
Apr 26 22:32	2132	RD	7.1	170	54	329	- 0.6	- 2.8
Apr 26 23:45	2136	RD	6.8	169	66	242	- 2.6	+ 1.0
Apr 27 02:42	2147	RD	7.0	168	61	260	- 1.9	+ 1.1
Apr 28 00:31	2302	DB	2.9	154	65	131	- 1.4	- 2.2
Apr 28 01:40	2302	RD	2.9	154	74	251	- 2.3	+ 0.8
Apr 28 01:40	2303	RD	5.1	154	74	252	- 2.3	+ 0.8
Apr 28 21:33	2446	RD	7.2	142	20	222	- 1.0	+ 0.7
Apr 28 23:12	2456	RD	6.2	141	39	241	- 1.4	0.0
Apr 29 02:34	X23171	RD	7.1	140	75	236	- 2.3	+ 1.6
Apr 29 22:46	2611	RD	6.8	128	22	279	- 0.3	- 1.3
Apr 30 01:35	2629	RD	6.3	126	56	265	- 1.7	- 0.6
Apr 30 05:28	X25003	RD	7.6	125	66	260	- 1.9	+ 1.0

C.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	AB
May 01 04:00	X26629	RD	7.9	112	69	234	- 2.0	+ 1.4
May 02 00:10	2927	RD	7.2	101	15	193	- 1.2	+ 3.4
May 02 03:15	2936	RD	6.8	100	51	235	- 1.7	+ 0.6
May 17 22:49	1341	DD	4.3	77	2	150	+ 0.2	- 1.0
May 20 18:48	X17263	DD	7.4	114	53	62	- 3.5	+ 1.2
May 20 21:19	1671	DD	7.6	115	52	178	- 0.2	- 3.9
May 21 00:46	1688	DD	6.3	117	17	142	- 0.4	- 0.7
May 21 18:23	X18381	DD	7.2	128	47	130	- 1.1	- 1.9
May 21 21:57	X18491	DD	7.8	129	57	56	- 3.4	+ 3.5
May 22 21:01	1925	DD	1.0	143	65	69	- 2.8	+ 0.8
May 22 21:55	1925	RB	1.0	143	66	343	- 0.9	- 3.2
May 26 02:27	2394	RD	6.5	173	63	251	- 1.7	+ 1.4
May 27 05:06	2561	RD	7.6	158	44	285	- 1.4	+ 0.5
May 28 03:41	2731	RD	6.5	144	69	290	- 2.5	- 0.6
May 28 03:45	X25906	RD	7.0	144	69	281	- 2.3	- 0.1
May 28 05:57	2745	RD	6.9	144	45	214	- 0.4	+ 2.8
May 28 06:02	X26026	RD	7.0	143	44	301	- 1.9	- 0.3
May 28 23:31	2876	RD	5.4	133	34	306	- 0.7	- 2.9
May 31 00:43	X29728	RD	7.7	107	24	269	- 0.7	- 1.2
Jun 02 02:34	3397	RD	7.4	83	23	200	- 0.4	+ 1.9
Jun 03 05:30	3524	RD	6.9	71	42	260	- 2.1	- 0.4
Jun 14 19:31	1410	DD	5.3	59	26	71	- 1.8	+ 2.2
Jun 14 20:19	1410	RB	5.3	59	18	343	0.0	- 1.8
Jun 17 21:20	X18118	DD	7.2	98	43	148	- 1.1	- 1.5
Jun 17 23:54	1759	DD	6.5	99	14	155	- 0.4	- 1.4
Jun 18 18:14	1868	DD	7.6	110	59	79	- 2.5	- 0.1
Jun 19 00:06	1888	DD	6.2	113	25	123	- 0.7	0.0
Jun 19 23:50	2021	DD	6.4	126	41	68	- 1.2	+ 2.1
Jun 20 19:15	2136	DD	6.8	138	57	181	+ 1.0	- 6.5
Jun 20 21:46	2147	DD	7.0	139	72	138	- 1.7	- 2.1
Jun 21 03:22	2182	DD	6.3	142	13	80	0.0	+ 1.3
Jun 21 21:30	2303	DD	5.1	153	71	129	- 1.7	- 2.1
Jun 21 21:31	2302	DD	2.9	153	71	130	- 1.7	- 2.1
Jun 21 22:41	2302	RB	2.9	153	74	249	- 2.3	+ 1.2
Jun 22 19:16	2456	DD	6.2	166	35	126	- 0.4	- 2.1
Jun 22 22:32	X23171	DD	7.1	167	72	125	- 1.9	- 2.1
Jun 25 04:56	2830	RD	6.9	162	41	251	- 0.9	+ 1.5
Jun 25 21:18	2936	RD	6.8	152	22	245	- 0.6	- 0.3
Jun 26 03:41	X28225	RD	7.4	150	62	231	- 1.5	+ 2.0
Jun 28 03:42	X30326	RD	7.9	125	61	277	- 2.9	- 0.5
Jun 29 02:57	X31054	RD	7.8	113	49	212	- 1.2	+ 1.7
Jul 03 06:20	297	RD	6.8	67	37	308	- 4.4	- 3.7
Jul 04 05:09	X03744	RD	7.4	57	21	261	- 1.3	- 0.8
Jul 04 05:39	416	RD	5.4	57	26	230	- 1.1	+ 0.4
Jul 05 04:46	X04675	RD	7.7	46	9	191	+ 0.8	+ 2.6
Jul 12 19:01	1489	DD	6.8	42	21	158	- 0.2	- 1.6
Jul 12 19:46	X15313	DD	7.8	43	13	110	- 0.5	+ 0.5
Jul 16 23:31	X19762	DD	7.3	96	19	113	- 0.5	+ 0.4
Jul 17 00:03	X19782	DD	7.0	97	13	79	- 0.1	+ 1.4
Jul 17 19:14	X20503	DD	7.9	108	71	117	- 2.0	- 1.2
Jul 18 22:13	X21647	DD	7.7	123	60	121	- 1.9	- 0.7
Jul 19 01:19	2264	DD	7.4	124	23	68	- 0.2	+ 1.7
Jul 19 02:17	X21799	DD	7.0	124	12	69	+ 0.1	+ 1.5
Jul 19 18:52	2394	DD	6.5	135	57	170	+ 0.2	- 6.9
Jul 19 19:29	2401	DD	5.6	135	63	21	- 4.5	+ 9.4
Jul 19 22:12	X22604	DD	7.6	136	70	51	- 2.0	+ 2.5
Jul 20 01:43	2425	DD	5.9	138	31	145	- 1.6	- 1.6
Jul 20 22:36	2561	DD	7.6	150	74	44	- 1.9	+ 2.6
Jul 21 00:58	X24153	DD	7.3	151	51	51	- 1.0	+ 2.3
Jul 21 21:37	X25906	DD	7.0	162	64	34	- 2.0	+ 2.5
Jul 21 23:58	2745	DD	6.9	163	71	83	- 2.1	+ 0.6
Jul 24 05:11	3054	RD	6.4	167	29	274	- 0.9	+ 1.0
Jul 26 04:43	X30803	RD	7.8	143	47	214	- 1.1	+ 2.5
Aug 03 05:51	755	RD	6.3	53	22	276	- 1.7	- 1.2
Aug 11 19:07	X18570	DD	7.8	52	33	102	- 1.1	+ 0.6
Aug 12 17:06	1925	DD	1.0	64	64	162	- 1.1	- 3.2
Aug 12 17:59	1925	RB	1.0	64	57	246	- 2.4	+ 2.3
Aug 12 21:50	X19492	DD	7.9	66	14	78	- 0.2	+ 1.5
Aug 13 21:25	2074	DD	7.1	80	32	79	- 0.8	+ 1.5
Aug 15 19:15	2353	MD	4.6	105	75	187	****	****

C.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	AB
Aug 17 22:34	X25414	DD	7.7	133	65	83	- 2.0	+ 0.9
Aug 17 22:48	G00031	DD	6.5	133	62	107	- 2.2	- 0.1
Aug 17 22:52	2687	DD	6.3	133	61	82	- 1.8	+ 1.0
Aug 17 22:55	2685	DD	7.0	133	60	24	- 0.7	+ 4.0
Aug 17 23:03	X25445	DD	7.3	133	59	86	- 1.8	+ 0.9
Aug 17 23:19	X25452	DD	7.7	133	56	58	- 1.3	+ 2.0
Aug 18 19:06	2830	DD	6.9	144	49	45	- 1.7	+ 1.1
Aug 19 01:00	X27180	DD	7.2	147	46	63	- 1.0	+ 1.8
Aug 19 01:47	2856	DD	6.6	147	37	30	- 0.2	+ 2.8
Aug 19 21:17	2972	DD	6.7	158	61	115	- 2.4	- 2.2
Aug 19 21:46	2975	DD	7.0	158	65	96	- 2.4	- 0.8
Aug 20 19:41	3104	DD	6.5	169	32	94	- 1.0	- 1.3
Aug 22 23:48	3371	RD	6.4	163	51	227	- 1.6	+ 1.2
Aug 24 22:43	68	RD	5.7	141	21	182	+ 0.3	+ 3.6
Aug 26 00:38	196	RD	6.9	129	30	303	- 3.0	- 3.6
Aug 26 01:38	203	RD	6.9	129	37	215	- 1.1	+ 1.3
Aug 27 04:00	326	RD	6.0	117	40	282	- 3.0	- 0.6
Aug 31 04:45	847	DB	2.9	73	23	55	- 1.3	+ 0.2
Sep 01 03:48	995	DB	4.1	61	8	72	- 0.6	- 0.7
Sep 01 05:00	995	RD	4.1	61	20	287	- 1.6	- 1.6
Sep 02 05:33	1114	RD	6.8	50	19	273	- 1.3	- 1.2
Sep 09 19:50	X20055	MD	7.7	49	25	191	****	****
Sep 09 20:36	2034	DD	6.7	49	16	54	0.0	+ 2.5
Sep 11 20:19	X22147	DD	7.7	76	45	62	- 1.0	+ 2.1
Sep 11 20:35	X22139	DD	6.5	76	41	162	- 2.6	- 5.2
Sep 11 20:42	2322	DD	4.3	76	40	173	****	****
Sep 11 20:51	2322	RD	4.3	76	38	187	****	****
Sep 13 20:04	X24816	DD	7.1	102	69	88	- 2.1	+ 0.5
Sep 13 22:51	X24978	DD	7.4	103	37	65	- 0.7	+ 1.8
Sep 13 22:59	X24976	DD	7.5	103	36	40	- 0.2	+ 2.6
Sep 14 00:52	2658	DD	5.2	104	14	70	+ 0.1	+ 1.5
Sep 14 22:57	2808	DD	7.4	116	46	80	- 1.3	+ 1.3
Sep 21 02:16	X00353	RD	7.2	170	43	229	- 1.7	+ 1.9
Sep 2S 04:19	519	RD	7.9	125	35	219	- 2.2	+ 2.1
Sep 28 01:13	915	RD	4.7	93	4	208	+ 0.4	+ 1.5
Sep 29 02:48	1060	RD	7.4	82	12	325	- 1.7	- 3.2
Sep 30 04:22	X11843	RD	7.5	69	21	331	- 1.7	- 3.2
Oct 07 19:58	2117	DD	5.3	31	10	102	- 0.1	+ 0.7
Oct 07 20:04	2118	DD	2.9	31	9	110	- 0.1	+ 0.5
Oct 08 19:56	X21775	DD	7.1	45	23	93	- 0.5	+ 1.0
Oct 09 21:06	2436	DD	6.1	59	22	88	- 0.3	+ 1.1
Oct 10 22:09	X24365	DD	7.6	73	21	91	- 0.4	+ 1.0
Oct 10 22:47	2596	DD	7.3	73	14	79	0.0	+ 1.3
Oct 14 00:15	X28991	DD	7.2	112	24	68	- 0.4	+ 1.6
Oct 14 00:54	3054	DD	6.4	112	16	128	- 0.9	- 0.2
Oct 16 19:44	3410	DD	7.7	146	45	77	- 1.9	- 0.3
Oct 24 23:52	X07529	RD	6.5	124	11	320	- 1.9	- 3.4
Oct 26 01:58	1025	RD	7.4	113	23	307	- 2.0	- 2.2
Oct 28 02:00	1257	RD	7.5	90	12	262	- 0.8	- 1.0
Oct 28 02:04	X12657	RD	7.4	90	13	319	- 1.1	- 2.5
Nov 04 18:26	Jupiter	MD	-1.3	11	13	183	****	****
Nov 08 19:58	X27210	DD	7.6	67	42	107	- 1.5	+ 0.5
Nov 08 20:05	2856	DD	6.6	67	41	125	- 2.0	- 0.5
Nov 09 22:46	3001	DD	7.0	81	17	1	+ 0.9	+ 4.2
Nov 09 23:23	3006	DD	7.0	81	10	65	0.0	+ 1.5
Nov 10 20:09	3128	DD	6.2	92	54	85	- 2.1	+ 0.9
Nov 12 22:09	3384	DD	7.7	117	43	55	- 1.5	+ 2.0
Nov 13 20:39	3501	RB	4.8	127	52	287	- 3.4	- 0.9
Nov 15 21:03	196	DD	6.9	150	42	14	- 0.7	+ 2.8
Nov 15 21:44	203	DD	6.9	150	44	98	- 3.0	- 0.5
Nov 20 23:06	826	RD	6.8	155	23	239	- 1.3	0.0
Nov 21 01:04	837	RD	6.1	154	33	193	- 1.7	+ 7.1
Nov 26 02:03	1440	RD	6.7	97	22	264	- 1.2	- 1.0
Nov 29 02:41	1779	RD	6.7	59	10	326	0.0	- 2.2
Dec 09 21:22	3342	DD	7.6	85	31	35	- 0.7	+ 2.5
Dec 20 03:03	X10371	RD	7.2	162	32	260	- 2.4	+ 1.1
Dec 21 01:06	X11843	RD	7.5	151	36	341	- 1.6	- 3.2
Dec 24 01:28	1519	RD	6.5	116	31	278	- 1.5	- 1.3
Dec 26 01:01	X17979	RD	7.7	92	14	254	- 0.5	- 0.8
Dec 28 03:08	X19824	RD	7.7	65	24	297	- 0.4	- 1.7

LUNAR OCCULTATION TABLE

BRISBANE (27° 30' S, 153° 01'E)

E.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	AB
Jan 01 22:56	1440	RD	6.7	135	23	268	- 1.1	- 0.9
Jan 02 03:03	1454	RD	7.1	133	54	350	- 0.6	- 3.2
Jan 03 00:11	1564	RD	6.6	121	31	329	- 0.9	- 2.5
Jan 03 01:39	X16100	RD	7.5	121	47	340	- 0.9	- 2.9
Jan 04 02:26	1688	RD	6.3	107	51	243	- 3.3	+ 1.0
Jan 07 02:46	2063	RD	6.7	67	29	244	- 1.3	+ 0.1
Jan 18 21:33	89	DD	6.5	75	10	62	- 0.6	+ 1.8
Jan 22 23:34	586	MD	7.0	119	15	1	****	****
Jan 29 01:01	14!0	RD	5.3	166	53	235	- 4.8	+ 3.0
Jan 29 22:13	1519	RD	6.5	154	31	346	- 0.7	- 3.2
Feb 02 00:23	1888	RD	6.2	113	34	282	- 1.0	- 1.2
Feb 04 00:09	2147	RD	7.0	86	11	301	+ 0.2	- 1.5
Feb 05 00:49	2296	RD	7.1	73	8	302	+ 0.3	- 1.5
Feb 05 01:06	2302	DB	2.9	73	12	35	- 1.3	+ 2.0
Feb 05 01:26	2303	RD	5.1	73	16	355	+ 1.6	- 4.9
Feb 05 01:27	2302	RD	2.9	73	16	352	+ 1.4	- 4.5
Feb 17 20:23	402	DD	6.5	76	20	110	- 1.2	+ 0.3
Feb 18 21:47	520	DD	7.6	87	12	98	- 0.8	+ 0.7
Feb 19 20:37	X05728	DD	7.5	98	30	89	- 2.1	+ 0.8
Feb 19 21:56	665	DD	5.7	98	18	45	- 2.1	+ 3.0
Feb 20 19:42	791	DD	7.8	109	40	113	- 2.6	- 0.6
Feb 20 20:38	792	DD	5.1	109	36	26	- 4.3	+ 6.1
Feb 22 19:32	1084	DD	7.3	133	40	76	- 2.6	+ 0.1
Feb 25 01:29	1364	DD	6.5	160	33	112	- 1.3	0.0
Mar 01 02:12	X18890	RD	7.8	144	72	281	- 2.4	- 0.5
Mar 01 04:36	X18945	RD	7.0	143	52	228	- 2.8	+ 4.9
Mar 02 00:45	X19762	RD	7.3	131	55	339	- 0.5	- 3.1
Mar 02 01:34	1986	RD	7.0	130	65	238	- 3.7	+ 1.8
Mar 07 02:47	X25896	RD	7.0	65	24	263	- 0.6	- 0.7
Mar 07 03:29	2733	RD	6.4	64	32	274	- 0.9	- 1.1
Mar 16 19:10	363	DD	7.3	44	11	92	- 0.8	+ 0.9
Mar 19 22:00	752	DD	4.7	78	3	43	- 1.5	+ 3.3
Mar 24 20:44	1410	DD	5.3	138	52	140	- 1.7	- 1.9
Mar 26 23:44	X17230	DD	7.1	167	61	73	- 3.3	+ 1.4
Mar 28 20:44	1908	RD	7.2	166	32	289	- 0.8	- 1.4
Mar 29 00:18	1925	MD	1.0	164	72	28	****	****
Mar 30 21:34	2192	RD	6.2	137	21	267	- 0.5	- 0.8
Mar 30 23:58	2205	RD	7.6	136	51	274	- 1.6	- 0.9
Mar 31 22:12	2353	RD	4.6	123	17	264	- 0.3	- 0.7
Apr 03 03:49	2699	RD	7.2	94	64	319	- 2.0	- 4.2
Apr 03 04:58	X25588	RD	7.2	94	77	320	- 3.1	- 4.8
Apr 05 03:31	2972	RD	6.7	70	35	251	- 1.3	- 0.2
Apr 05 04:03	2975	RD	7.0	70	42	271	- 1.5	- 1.0
Apr 06 03:56	3104	RD	6.5	58	29	232	- 1.0	+ 0.6
Apr 07 04:30	3229	RD	5.6	47	25	205	- 0.8	+ 2.0
Apr 16 20:12	847	DD	2.9	59	10	91	- 0.8	+ 0.9
Apr 17 18:54	991	DD	6.1	69	31	48	- 3.5	+ 3.5
Apr 17 19:25	995	DD	4.1	70	27	103	- 1.5	+ 0.4
Apr 17 20:41	995	RB	4.1	70	14	291	- 0.7	+ 0.2
Apr 18 20:11	1114	DD	6.8	82	29	79	- 2.1	+ 1.3
Apr 19 18:31	X12435	DD	7.8	93	47	78	- 3.2	+ 0.7
Apr 20 20:45	1364	DD	6.5	106	44	62	- 3.7	+ 2.7
Apr 22 00:35	1489	DD	6.8	121	15	78	- 0.8	+ 1.5
Apr 23 21:40	1717	DD	7.3	147	66	156	- 1.1	- 2.6
Apr 24 00:28	1727	DD	7.1	148	44	154	- 1.0	- 2.0
Apr 25 18:18	1971	DD	5.8	174	18	63	- 0.8	0.0
Apr 27 00:49	2136	RD	6.8	169	79	287	- 2.3	- 0.7
Apr 27 03:40	2147	RD	7.0	168	46	285	- 1.5	+ 0.2
Apr 27 20:17	X21799	RD	7.0	157	21	335	+ 0.5	- 2.8
Apr 27 21:01	2275	RD	5.9	156	30	255	- 1.0	- 0.4
Apr 28 01:20	2302	DB	2.9	154	82	93	- 2.4	- 0.2
Apr 28 01:22	2296	RD	7.1	155	82	261	- 2.5	+ 0.4
Apr 28 02:45	2302	RD	2.9	154	71	283	- 2.3	- 0.2
Apr 28 02:45	2303	RD	5.1	154	71	283	- 2.3	- 0.2
Apr 28 22:14	2446	RD	7.2	142	33	269	- 0.9	- 0.8
Apr 28 23:59	2456	RD	6.2	141	56	282	- 1.6	- 1.2
Apr 29 03:45	X23171	RD	7.1	140	72	262	- 2.2	+ 0.8
Apr 29 23:05	2611	RD	6.8	128	31	324	0.0	- 3.3
Apr 30 02:26	2629	RD	6.3	126	74	297	- 2.4	- 1.8
May 02 01:02	2927	RD	7.2	101	31	242	- 1.1	+ 0.2
May 02 04:18	2936	RD	6.8	100	71	254	- 2.5	+ 0.4
May 05 03:01	X30803	RD	7.8	65	21	258	- 0.8	- 0.5
May 20 18:51	X17230	DD	7.1	114	62	69	- 3.7	+ 1.1
May 20 21:50	1671	DD	7.6	115	47	126	- 1.5	- 0.7
May 21 19:09	X18381	DD	7.2	128	63	89	- 2.6	- 0.3
May 22 19:40	1914	DD	6.8	142	64	187	+ 1.1	- 6.2
May 24 18:08	2192	DD	6.2	169	23	125	- 0.1	- 1.7
May 25 18:44	2353	RD	4.6	176	18	243	- 0.7	0.0
May 26 03:28	2394	RD	6.5	173	46	266	- 1.3	+ 0.9
May 27 21:03	2699	RD	7.2	147	22	254	- 0.6	- 0.4
May 27 21:52	X25588	RD	7.2	147	32	266	- 0.9	- 0.7
May 28 00:54	2715	RD	6.0	146	71	226	- 2.3	+ 1.9
May 28 01:25	2718	RD	6.7	146	77	201	- 2.0	+ 4.8
May 28 04:43	2731	RD	6.5	144	55	297	- 2.5	- 0.7
May 28 04:47	X25906	RD	7.0	144	54	288	- 2.2	- 0.1
May 28 23:14	2870	RD	7.6	133	36	211	- 1.6	+ 2.1
May 28 23:14	2871	RD	7.1	133	36	211	- 1.6	+ 2.1
May 31 01:15	X29728	RD	7.7	107	37	299	- 1.6	- 2.9
Jun 02 03:27	3397	RD	7.4	83	42	216	- 1.1	+ 1.5
Jun 06 04:25	326	RD	6.0	39	10	237	- 0.3	+ 0.2
Jun 16 00:20	1623	DD	5.4	84	41	146	- 1.0	- 1.5
Jun 17 22:02	X18118	DD	7.2	98	32	110	- 1.1	+ 0.1
Jun 19 00:46	1888	DD	6.2	113	10	101	- 0.2	+ 0.5
Jun 19 20:19	2002	DD	6.8	124	76	161	- 1.2	- 3.6
Jun 20 00:54	2021	DD	6.4	126	22	32	+ 0.2	+ 5.5
Jun 20 19:34	2136	DD	6.8	138	69	123	- 1.7	- 1.7
Jun 20 22:37	2147	DD	7.0	139	65	103	- 2.1	- 0.1
Jun 21 21:05	2296	DD	7.1	153	77	122	- 2.0	- 1.7
Jun 21 22:23	2302	DD	2.9	153	80	94	- 2.4	0.0
Jun 21 22:24	2303	DD	5.1	153	80	94	- 2.4	0.0
Jun 21 23:47	2302	RB	2.9	153	63	277	- 2.1	+ 0.2
Jun 22 18:09	2446	DD	7.2	165	27	101	- 0.5	- 1.2
Jun 22 19:49	2456	DD	6.2	166	48	86	- 1.5	- 0.6
Jun 22 23:27	X23171	DD	7.1	167	80	95	- 2.4	- 0.1
Jun 25 21:54	2936	RD	6.8	152	36	279	- 1.1	- 1.3
Jun 26 04:44	X28225	RD	7.4	150	48	229	- 1.0	+ 2.1
Jun 27 23:15	3212	RD	7.5	127	28	250	- 1.0	- 0.2
Jun 29 04:03	X31054	RD	7.8	113	64	211	- 1.5	+ 2.5
Jul 01 00:45	X00353	RD	7.2	92	13	230	- 0.3	+ 0.5
Jul 04 03:49	407	RD	7.8	57	17	212	- 0.1	+ 1.3
Jul 05 05:29	X04675	RD	7.7	46	25	196	+ 0.2	+ 2.7
Jul 12 19:31	1489	DD	6.8	42	11	117	- 0.4	0.0
Jul 14 20:28	1717	DD	7.3	68	25	156	- 0.6	- 1.9
Jul 16 19:38	X19602	DD	7.3	94	61	166	- 1.3	- 4.0
Jul 18 23:07	X21647	DD	7.7	123	44	101	- 1.4	+ 0.4
Jul 19 19:16	2394	DD	6.5	135	70	115	- 2.0	- 1.6
Jul 19 23:31	X22604	DD	7.6	136	52	22	- 0.4	+ 5.6
Jul 20 02:23	2425	DD	5.9	138	15	135	- 0.9	- 0.8
Jul 21 01:54	X24153	DD	7.3	151	34	46	- 0.3	+ 2.3
Jul 21 18:55	2715	DD	6.0	161	39	123	- 0.8	- 2.3
Jul 21 19:40	2718	DD	6.7	162	49	137	- 1.1	- 3.5
Jul 21 22:10	X25896	DD	7.0	162	79	138	- 3.1	- 4.3
Jul 21 23:09	2733	DD	6.4	163	79	147	- 4.6	- 7.1
Jul 22 01:04	2745	DD	6.9	163	57	77	- 1.7	+ 1.2
Jul 25 21:37	3287	RD	5.8	146	24	203	- 0.6	+ 2.1
Aug 09 18:49	X16100	DD	7.5	25	6	44	- 0.6	+ 4.8
Aug 11 19:58	X18570	DD	7.8	52	17	70	- 0.5	+ 1.8
Aug 12 17:46	1925	DD	1.0	64	58	117	- 1.9	- 0.6
Aug 12 19:04	1925	RB	1.0	64	42	284	- 1.4	+ 0.2
Aug 13 22:14	2074	DD	7.1	80	15	59	0.0	+ 2.0
Aug 15 19:42	2353	DD	4.6	105	73	130	- 2.5	- 1.9
Aug 15 20:49	2353	RB	4.6	105	59	234	- 1.6	+ 2.5
Aug 17 19:04	X25224	DD	7.5	131	69	51	- 2.4	+ 1.7
Aug 17 23:36	X25414	DD	7.7	133	48	78	- 1.4	+ 1.2
Aug 17 23:48	G00031	DD	6.5	133	46	102	- 1.6	+ 0.4
Aug 17 23:53	2687	DD	6.3	133	44	78	- 1.2	+ 1.2
Aug 18 00:00	2685	DD	7.0	133	43	16	+ 0.3	+ 4.3
Aug 18 00:03	X25445	DD	7.3	133	42	82	- 1.2	+ 1.1
Aug 18 00:18	X25452	DD	7.7	133	39	54	- 0.6	+ 2.0
Aug 18 18:56	2826	DD	3.9	144	55	166	****	****
Aug 18 19:03	2826	RD	3.9	144	56	176	****	****
Aug 19 01:54	X27180	DD	7.2	147	29	63	- 0.5	+ 1.6
Aug 19 02:36	2856	DD	6.6	147	20	29	+ 0.3	+ 2.5
Aug 19 19:39	X28225	DD	7.4	157	51	22	- 1.6	+ 3.3
Aug 19 22:17	2972	DD	6.7	158	77	100	- 3.0	- 0.6
Aug 19 22:52	2975	DD	7.0	158	75	88	- 2.7	+ 0.3
Aug 20 20:26	3104	DD	6.5	169	49	70	- 1.7	+ 0.1
Aug 23 00:55	3371	RD	6.4	163	64	225	- 1.9	+ 1.9
Aug 24 23:36	68	RD	5.7	141	39	193	- 0.4	+ 2.8
Aug 26 01:37	196	RD	6.9	129	47	300	- 4.5	- 3.0
Aug 26 02:41	203	RD	6.9	129	51	210	- 1.6	+ 2.3
Aug 27 05:12	326	RD	6.0	117	42	285	- 2.9	- 0.1
Aug 30 01:58	700	RD	5.8	85	15	289	- 1.5	- 1.8
Sep 01 04:29	995	DB	4.1	61	24	66	- 1.3	0.0
Sep 09 20:10	X20055	DD	7.7	49	14	148	- 0.7	- 1.4
Sep 11 19:57	X22087	DD	7.5	75	43	21	+ 0.1	+ 6.7
Sep 11 21:14	X22139	DD	6.5	76	27	139	- 1.4	- 1.3
Sep 11 21:14	X22147	DD	7.7	76	27	48	- 0.2	+ 2.4
Sep 11 21:16	2322	DD	4.3	76	27	143	- 1.4	- 1.6
Sep 11 21:51	2322	RB	4.3	76	19	213	+ 0.5	+ 3.2
Sep 11 21:53	X22155	GD	7.5	76	19	178	****	****
Sep 13 21:08	X24816	DD	7.1	102	53	79	- 1.6	+ 1.2
Sep 13 23:39	X24978	DD	7.4	103	21	62	- 0.1	+ 1.6
Sep 13 23:48	X24976	DD	7.5	103	19	36	+ 0.3	+ 2.4
Sep 14 23:50	2808	DD	7.4	116	29	79	- 0.7	+ 1.2
Sep 15 19:25	2927	DD	7.2	127	73	115	- 3.1	- 2.0
Sep 19 21:06	3455	DD	6.4	174	47	85	- 2.2	- 0.5
Sep 21 03:24	X00353	RD	7.2	170	32	232	- 1.3	+ 2.1
Sep 28 01:53	915	RD	4.7	93	20	217	- 0.5	+ 1.4
Sep 29 03:19	1060	RD	7.4	82	27	342	- 2.8	- 5.8
Oct 08 20:36	X21775	DD	7.1	45	8	84	+ 0.1	+ 0.9
Oct 09 21:45	2436	DD	6.1	59	6	82	+ 0.1	+ 1.0
Oct 10 18:47	2571	DD	6.9	71	56	63	- 1.5	+ 1.8
Oct 11 19:40	X26026	DD	7.0	85	57	101	- 2.2	+ 0.2
Oct 16 20:48	3410	DD	7.7	146	61	76	- 2.7	+ 0.5
Oct 25 00:28	X07529	RD	6.5	124	26	329	- 3.3	- 4.9
Oct 25 01:21	X07583	RD	7.2	124	34	208	- 1.3	+ 2.9
Oct 26 02:44	1025	RD	7.4	113	38	323	- 2.7	- 3.0
Oct 28 02:32	X12657	RD	7.4	90	27	339	- 1.7	- 3.9
Oct 28 02:40	1257	RD	7.5	90	28	276	- 1.7	- 1.1
Nov 07 19:19	2686	DD	5.2	53	33	25	+ 0.1	+ 3.2
Nov 07 19:22	2685	GD	7.0	53	33	165	****	****
Nov 07 19:29	2680	RB	5.8	53	31	249	- 0.5	+ 1.5
Nov 07 19:59	2690	DD	7.0	53	25	45	0.0	+ 2.1
Nov 07 20:00	2686	RB	5.2	53	24	305	- 1.1	- 0.4
Nov 08 20:49	X27210	DD	7.6	67	25	105	- 0.9	+ 0.4
Nov 08 20:55	2856	DD	6.6	67	24	123	- 1.2	- 0.4
Nov 10 20:38	3125	DD	6.9	92	47	65	- 1.4	+ 1.7
Nov 10 21:12	3128	DD	6.2	92	40	88	- 1.5	+ 1.0
Nov 12 19:17	3371	DD	6.4	115	64	119	- 4.9	- 2.8
Nov 12 23:11	3384	DD	7.7	117	29	53	- 0.9	+ 2.0
Nov 13 20:46	3501	DD	4.8	127	57	16	- 1.0	+ 3.4
Nov 13 21:54	3501	RB	4.8	127	49	281	- 2.9	+ 0.2
Nov 15 22:10	196	DD	6.9	150	50	19	- 1.3	+ 3.3
Nov 15 22:57	203	DD	6.9	150	46	100	- 3.0	+ 0.1
Nov 20 22:56	X06989	RD	7.4	155	31	223	- 1.4	+ 1.2
Nov 21 00:05	826	RD	6.8	155	39	247	- 2.5	+ 0.5
Nov 21 02:43	837	RD	6.1	154	38	235	- 3.2	+ 2.2
Nov 22 00:06	971	RD	7.3	144	34	262	- 2.3	- 0.4
Nov 26 02:46	1440	RD	6.7	97	39	289	- 1.9	- 1.4
Nov 29 02:47	1779	RD	6.7	59	17	8	+ 0.8	- 6.1
Dec 05 19:38	2789	DD	7.3	33	12	57	+ 0.1	+ 1.6
Dec 06 20:39	2937	DD	7.6	47	10	62	+ 0.1	+ 1.4
Dec 09 22:18	3342	DD	7.6	85	15	27	- 0.2	+ 2.7
Dec 11 20:42	X00353	DD	7.2	108	46	68	- 2.2	+ 1.5
Dec 23 00:53	1410	RD	5.3	128	39	221	- 3.7	+ 3.9
Dec 24 02:11	1519	RD	6.5	116	47	308	- 1.8	- 1.9
Dec 26 01:34	X17979	RD	7.7	92	28	283	- 0.9	- 1.3
Dec 28 03:28	X19824	RD	7.7	65	34	333	- 0.2	- 2.7
Dec 29 02:00	X20652	RD	7.2	52	5	290	+ 0.2	- 1.2

LUNAR OCCULTATION TABLE

CANBERRA (35° 15' S, 149° 08'E)

E.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	AB
Jan 01 22:57	1440	RD	6.7	135	17	248	- 0.9	- 0.5
Jan 02 03:16	1454	RD	7.1	133	47	320	- 1.5	- 1.5
Jan 03 00:25	1564	RD	6.6	121	27	308	- 0.9	- 1.9
Jan 03 01:53	X16100	RD	7.5	121	41	316	- 1.3	- 2.0
Jan 18 21:17	89	DD	6.5	75	14	79	- 0.8	+ 1.5
Jan 22 22:52	586	DD	7.0	119	19	48	- 2.0	+ 2.4
Jan 26 00:05	1031	DD	7.0	155	30	62	- 2.7	+ 1.8
Jan 29 22:30	1519	RD	6.5	154	27	322	- 0.9	- 2.2
Feb 02 00:26	1888	RD	6.2	113	30	258	- 1.1	- 0.8
Feb 03 00:28	2021	RD	6.4	99	22	338	+ 0.2	- 2.7
Feb 04 00:20	2147	RD	7.0	86	12	279	0.0	- 1.2
Feb 05 01:00	2296	RD	7.1	73	10	279	+ 0.1	- 1.2
Feb 05 01:03	2302	DB	2.9	73	10	71	- 0.1	- 0.6
Feb 05 01:50	2303	RD	5.1	73	19	316	+ 0.2	- 2.1
Feb 05 01:50	2302	RD	2.9	73	19	315	+ 0.2	- 2.1
Feb 17 20:20	402	DD	6.5	76	19	137	- 1.0	- 0.9
Feb 19 20:26	X05728	DD	7.5	98	27	109	- 1.9	+ 0.2
Feb 19 21:33	665	DD	5.7	98	19	73	- 1.7	+ 1.6
Feb 20 20:06	792	DD	5.1	109	32	59	- 2.6	+ 1.4
Feb 23 23:50	1235	DD	7.4	147	32	61	- 2.9	+ 2.3
Feb 25 01:28	1364	DD	6.5	160	31	141	- 0.8	- 0.8
Mar 01 02:00	X18890	RD	7.8	144	63	245	- 3.2	+ 1.4
Mar 01 22:15	1971	RD	5.8	132	20	0	+ 0.8	- 4.0
Mar 02 01:00	X19762	RD	7.3	131	52	309	- 1.1	- 2.0
Mar 04 03:29	2275	RD	5.9	102	62	9	****	****
Mar 05 02:55	2425	RD	5.9	90	46	341	+ 0.1	- 4.8
Mar 07 02:47	X25896	RD	7.0	65	22	233	- 0.8	+ 0.1
Mar 07 03:31	2733	RD	6.4	64	30	244	- 1.0	- 0.2
Mar 19 21:39	752	DD	4.7	78	6	78	- 0.9	+ 1.6
Mar 24 20:57	1410	DD	5.3	138	44	170	- 0.7	- 3.0
Mar 26 23:32	X17230	DD	7.1	167	55	106	- 2.0	- 0.5
Mar 28 20:50	1908	RD	7.2	166	29	266	- 0.9	- 1.0
Mar 28 23:49	1925	DB	1.0	164	60	85	- 2.2	- 0.3
Mar 29 00:54	1925	RD	1.0	164	66	329	- 1.2	- 2.3
Mar 30 21:36	2192	RD	6.2	137	19	239	- 0.7	- 0.2
Mar 30 23:55	2205	RD	7.6	136	46	243	- 1.9	+ 0.2
Mar 31 22:13	2353	RD	4.6	123	16	235	- 0.6	0.0
Apr 03 01:31	X25414	RD	7.7	95	31	326	0.0	- 3.9
Apr 03 01:37	2687	RD	6.3	95	32	343	+ 0.9	- 7.4
Apr 03 01:47	X25445	RD	7.3	95	34	343	+ 0.8	- 7.6
Apr 03 01:52	G00031	RD	6.5	95	35	299	- 0.6	- 2.2
Apr 03 04:00	2699	RD	7.2	94	60	283	- 1.9	- 1.4
Apr 03 05:06	X25588	RD	7.2	94	70	284	- 2.3	- 1.1
Apr 05 03:24	2972	RD	6.7	70	30	220	- 1.1	+ 0.9
Apr 05 04:01	2975	RD	7.0	70	38	243	- 1.3	0.0
Apr 06 03:41	3104	RD	6.5	58	22	194	- 0.9	+ 2.9
Apr 16 20:05	847	DD	2.9	59	10	118	- 0.6	+ 0.3
Apr 17 19:20	995	DD	4.1	70	24	130	- 1.1	- 0.4
Apr 17 20:31	995	RB	4.1	70	14	262	- 1.3	+ 1.4
Apr 18 19:58	1114	DD	6.8	82	27	108	- 1.5	+ 0.3
Apr 18 21:41	1124	DD	6.9	82	12	79	- 1.2	+ 1.6
Apr 20 19:30	X13874	DD	7.7	106	43	48	- 4.8	+ 3.8
Apr 20 20:27	1364	DD	6.5	106	41	98	- 2.2	+ 0.2
Apr 22 00:25	1489	DD	6.8	121	18	111	- 0.7	+ 0.4
Apr 22 21:34	1594	DD	7.9	133	52	120	- 1.8	- 0.8
Apr 27 00:40	2136	RD	6.8	169	72	256	- 2.4	+ 0.7
Apr 27 03:29	2147	RD	7.0	168	50	259	- 1.4	+ 1.3
Apr 27 20:34	X21799	RD	7.0	157	22	305	0.0	- 1.8
Apr 27 20:54	2275	RD	5.9	156	27	216	- 1.9	+ 1.8
Apr 28 01:01	2296	RD	7.1	155	72	222	- 2.9	+ 3.3
Apr 28 01:19	2302	DB	2.9	154	73	123	- 1.9	- 1.6
Apr 28 02:33	2302	RD	2.9	154	71	254	- 2.1	+ 1.0
Apr 28 02:33	2303	RD	5.1	154	71	255	- 2.1	+ 1.0
Apr 28 22:14	2446	RD	7.2	142	31	239	- 1.1	0.0
Apr 28 23:58	2456	RD	6.2	141	51	253	- 1.7	- 0.2
Apr 29 03:26	X23171	RD	7.1	140	73	234	- 2.0	+ 2.1
Apr 29 23:21	2611	RD	6.8	128	32	289	- 0.5	- 1.7
Apr 30 02:25	2629	RD	6.3	126	67	267	- 2.1	- 0.4
May 01 04:50	X26629	RD	7.9	112	73	224	- 1.8	+ 2.2
May 02 00:51	2927	RD	7.2	101	25	205	- 1.1	+ 1.9
May 02 04:03	2936	RD	6.8	100	61	230	- 1.9	+ 1.3
May 05 03:00	X30803	RD	7.8	65	17	231	- 0.5	+ 0.2
May 15 18:34	X10438	DD	7.9	51	21	60	- 2.3	+ 2.6
May 16 18:15	1198	DD	6.2	63	32	74	- 2.5	+ 1.5
May 20 18:41	X17230	DD	7.1	114	53	101	- 2.1	- 0.8
May 20 21:56	1671	DD	7.6	115	44	159	- 0.8	- 2.1
May 21 01:20	1688	DD	6.3	117	7	142	- 0.2	- 0.6
May 21 19:08	X18381	DD	7.2	128	55	116	- 1.7	- 1.4
May 22 22:06	1925	DD	1.0	143	64	44	- 4.2	+ 5.6
May 22 22:32	1925	RB	1.0	143	62	5	+ 0.2	- 7.1
May 24 18:24	2192	DD	6.2	169	24	153	+ 0.3	- 2.6
May 26 03:12	2394	RD	6.5	173	52	243	- 1.2	+ 1.9
May 27 21:00	2699	RD	7.2	147	19	221	- 0.8	+ 0.7
May 27 21:51	X25588	RD	7.2	147	29	235	- 1.0	+ 0.1
May 28 04:34	2731	RD	6.5	144	58	275	- 1.9	+ 0.6
May 28 04:36	X25906	RD	7.0	144	58	268	- 1.8	+ 0.8
May 29 00:15	2876	RD	5.4	133	45	310	- 1.2	- 3.4
May 31 01:23	X29728	RD	7.7	107	34	267	- 1.2	- 1.0
Jun 02 03:08	3397	RD	7.4	83	31	187	- 0.3	+ 3.3
Jun 06 04:21	326	RD	6.0	39	3	214	+ 0.1	+ 0.8
Jun 14 20:18	1410	DD	5.3	59	15	52	- 1.7	+ 4.2
Jun 16 20:36	1623	DD	5.4	84	36	200	****	****
Jun 17 22:01	X18118	DD	7.2	98	33	141	- 0.9	- 0.9
Jun 18 19:16	1868	DD	7.6	110	64	56	- 3.8	+ 2.8
Jun 19 00:42	1888	DD	6.2	113	15	127	- 0.4	- 0.1
Jun 20 00:30	2021	DD	6.4	126	30	72	- 0.7	+ 1.8
Jun 20 18:27	2132	DD	7.1	138	50	69	- 1.9	0.0
Jun 20 19:48	2136	DD	6.8	138	65	156	- 0.8	- 3.4
Jun 20 22:35	2147	DD	7.0	139	64	133	- 1.8	- 1.4
Jun 21 21:20	2296	DD	7.1	153	71	161	- 1.1	- 4.8
Jun 21 22:21	2303	DD	5.1	153	74	123	- 2.0	- 1.5
Jun 21 22:21	2302	DD	2.9	153	74	124	- 2.0	- 1.5
Jun 21 23:33	2302	RB	2.9	153	66	250	- 1.9	+ 1.5
Jun 22 18:21	2446	DD	7.2	165	27	129	- 0.1	- 2.1
Jun 22 19:54	2456	DD	6.2	166	45	115	- 0.9	- 1.8
Jun 22 23:25	X23171	DD	7.1	167	75	125	- 2.2	- 1.7
Jun 25 05:32	2830	RD	6.9	162	31	238	- 0.4	+ 1.8
Jun 25 21:56	2936	RD	6.8	152	33	250	- 1.0	- 0.4
Jun 26 04:23	X28225	RD	7.4	150	53	214	- 0.8	+ 2.7
Jun 27 23:10	3212	RD	7.5	127	23	221	- 0.7	+ 0.7
Jun 28 04:22	X30325	RD	7.8	125	59	318	- 7.8	- 8.2
Jun 28 04:38	X30326	RD	7.9	125	58	258	- 2.2	+ 0.9
Jun 29 03:37	X31054	RD	7.8	113	55	192	- 0.7	+ 3.2
Jul 04 05:54	X03744	RD	7.4	57	29	245	- 1.5	0.0
Jul 12 19:34	1489	DD	6.8	42	12	149	- 0.2	- 0.9
Jul 13 18:14	1594	DD	7.9	55	38	136	- 1.1	- 0.8
Jul 17 00:05	X19762	DD	7.3	96	10	120	- 0.2	+ 0.2
Jul 18 23:02	X21647	DD	7.7	123	48	127	- 1.6	- 0.6
Jul 19 19:30	2394	DD	6.5	135	66	152	- 1.2	- 4.0
Jul 19 23:00	X22604	DD	7.6	136	60	58	- 1.5	+ 2.2
Jul 20 23:24	2561	DD	7.6	150	66	52	- 1.6	+ 2.2
Jul 21 01:36	X24153	DD	7.3	151	41	65	- 0.8	+ 1.8
Jul 21 22:26	X25906	DD	7.0	162	72	39	- 1.9	+ 2.4
Jul 21 22:30	2731	DD	6.5	162	72	30	- 1.8	+ 3.3
Jul 22 00:50	2745	DD	6.9	163	60	96	- 2.0	+ 0.5
Jul 23 04:34	2913	DD	5.0	175	26	120	- 1.1	+ 0.2
Jul 24 05:47	3054	RD	6.4	167	20	263	- 0.4	+ 1.3
Aug 01 05:03	480	RD	7.3	76	31	320	- 4.6	- 5.1
Aug 09 18:30	X16100	DD	7.5	25	12	88	- 0.5	+ 1.2
Aug 11 19:46	X18570	DD	7.8	52	23	101	- 0.7	+ 0.8
Aug 12 17:50	1925	DD	1.0	64	56	150	- 1.4	- 2.1
Aug 12 18:50	1925	RB	1.0	64	46	253	- 1.7	+ 1.9
Aug 13 22:01	2074	DD	7.1	80	22	86	- 0.4	+ 1.2
Aug 17 18:52	X25224	DD	7.5	131	60	81	- 1.9	- 0.3
Aug 17 23:23	X25414	DD	7.7	133	53	96	- 1.7	+ 0.6
Aug 17 23:33	2685	DD	7.0	133	51	41	- 0.8	+ 2.7
Aug 17 23:39	2687	DD	6.3	133	50	96	- 1.6	+ 0.7
Aug 17 23:41	G00031	DD	6.5	133	49	124	- 2.2	- 0.7
Aug 17 23:51	X25445	DD	7.3	133	48	100	- 1.6	+ 0.6
Aug 18 00:01	X25452	DD	7.7	133	45	71	- 1.1	+ 1.6
Aug 18 19:54	2830	DD	6.9	144	60	45	- 1.9	+ 1.5
Aug 19 01:40	X27180	DD	7.2	147	36	78	- 0.8	+ 1.4
Aug 19 02:19	2856	DD	6.6	147	28	46	- 0.2	+ 2.1
Aug 19 19:22	X28225	DD	7.4	157	43	56	- 1.4	+ 0.3
Aug 19 22:19	2972	DD	6.7	158	69	132	- 3.8	- 4.1
Aug 19 22:44	2975	DD	7.0	158	69	111	- 2.9	- 1.2
Aug 20 20:25	3104	DD	6.5	169	43	97	- 1.6	- 1.4
Aug 20 22:23	3111	DD	6.9	170	61	57	- 1.9	+ 1.0
Aug 23 00:33	3371	RD	6.4	163	56	209	- 1.3	+ 2.2
Aug 24 00:56	3501	RD	4.8	152	50	311	- 5.8	- 5.8
Aug 26 01:38	196	RD	6.9	129	38	278	- 2.6	- 1.1
Aug 26 02:17	203	RD	6.9	129	42	194	- 0.6	+ 2.8
Aug 27 04:59	326	RD	6.0	117	37	269	- 2.5	+ 0.5
Aug 28 03:28	442	GD	6.9	106	34	339	****	****
Aug 30 02:04	700	RD	5.8	85	9	270	- 0.9	- 1.2
Sep 01 04:28	995	DB	4.1	61	16	83	- 1.2	- 0.9
Sep 03 04:48	X12435	RD	7.8	38	6	279	- 0.6	- 1.4
Sep 09 21:04	2034	DD	6.7	49	8	64	+ 0.2	+ 1.9
Sep 11 19:26	X22087	DD	7.5	75	52	59	- 1.4	+ 2.3
Sep 11 20:57	X22147	DD	7.7	76	34	72	- 0.7	+ 1.6
Sep 13 20:55	X24816	DD	7.1	102	58	99	- 1.9	+ 0.4
Sep 13 23:26	X24978	DD	7.4	103	28	78	- 0.5	+ 1.4
Sep 13 23:31	X24976	DD	7.5	103	27	55	- 0.2	+ 2.0
Sep 14 00:09	2649	DD	6.6	104	19	21	+ 0.6	+ 3.3
Sep 14 01:20	2658	DD	5.2	104	6	80	+ 0.2	+ 1.2
Sep 14 23:38	2808	DD	7.4	116	35	95	- 1.0	+ 1.0
Sep 19 21:08	3455	DD	6.4	174	40	110	- 2.4	- 2.4
Sep 20 23:38	29	RD	7.2	171	48	250	- 2.2	+ 0.4
Sep 21 03:01	X00353	RD	7.2	170	35	217	- 1.3	+ 2.4
Sep 28 01:31	X08159	RD	6.9	94	9	318	- 1.7	- 3.1
Sep 29 03:37	1060	RD	7.4	82	22	314	- 1.9	- 2.5
Sep 30 03:37	1184	RD	7.8	70	16	302	- 1.3	- 2.0
Oct 07 20:28	2117	DD	5.3	31	2	112	+ 0.1	+ 0.4
Oct 07 20:34	2118	DD	2.9	31	1	121	0.0	+ 0.2
Oct 08 20:29	X21775	DD	7.1	45	14	104	- 0.2	+ 0.7
Oct 09 21:38	2436	DD	6.1	59	13	100	- 0.1	+ 0.8
Oct 10 21:35	G00024	DD	6.9	72	25	13	+ 0.9	+ 4.4
Oct 10 22:42	X24365	DD	7.6	73	12	103	- 0.2	+ 0.7
Oct 11 19:33	X26026	DD	7.0	85	59	126	- 2.7	- 1.3
Oct 14 00:48	X28991	DD	7.2	112	15	77	- 0.2	+ 1.4
Oct 14 22:23	3166	DD	4.8	123	49	12	- 0.3	+ 3.7
Oct 16 20:38	3410	DD	7.7	146	52	94	- 2.7	- 0.7
Oct 25 00:43	X07529	RD	6.5	124	20	304	- 2.0	- 2.3
Oct 26 02:51	1025	RD	7.4	113	31	302	- 2.3	- 1.7
Oct 28 02:41	1257	RD	7.5	90	21	258	- 1.3	- 0.8
Oct 28 02:48	X12657	RD	7.4	90	22	315	- 1.5	- 2.3
Nov 07 19:43	2690	DD	7.0	53	32	62	- 0.5	+ 1.8
Nov 07 19:55	2686	RB	5.2	53	29	284	- 0.8	+ 0.7
Nov 08 20:44	X27210	DD	7.6	67	30	126	- 1.5	- 0.3
Nov 08 21:01	2856	MD	6.6	67	27	161	****	****
Nov 09 23:09	3001	DD	7.0	81	10	18	+ 0.4	+ 2.8
Nov 10 20:20	3125	DD	6.9	92	50	78	- 1.7	+ 1.3
Nov 10 21:00	3128	DD	6.2	92	43	103	- 1.9	+ 0.6
Nov 12 22:53	3384	DD	7.7	117	33	67	- 1.2	+ 1.8
Nov 13 20:20	3501	DD	4.8	127	51	32	- 1.4	+ 2.1
Nov 13 21:40	3501	RB	4.8	127	47	267	- 2.4	+ 0.8
Nov 15 21:44	196	DD	6.9	150	43	34	- 1.6	+ 1.9
Nov 15 22:48	203	DD	6.9	150	41	117	- 3.3	- 0.9
Nov 19 23:10	700	RD	5.8	166	29	324	- 3.6	- 4.1
Nov 20 23:52	826	RD	6.8	155	29	228	- 1.7	+ 0.7
Nov 22 00:01	971	RD	7.3	144	25	245	- 1.7	- 0.1
Nov 26 02:49	1440	RD	6.7	97	32	268	- 1.7	- 1.0
Nov 29 03:13	1779	RD	6.7	59	18	332	- 0.2	- 2.5
Dec 06 20:28	2937	DD	7.6	47	17	76	- 0.2	+ 1.4
Dec 09 21:58	3342	DD	7.6	85	21	44	- 0.5	+ 2.2
Dec 11 20:23	X00353	DD	7.2	108	44	81	- 2.3	+ 1.0
Dec 24 02:16	1519	RD	6.5	116	40	287	- 1.8	- 1.3
Dec 26 01:39	X17979	RD	7.7	92	24	261	- 0.9	- 1.0
Dec 29 02:09	X20652	RD	7.2	52	6	269	+ 0.1	- 1.0
Dec 29 02:50	2122	RD	7.8	52	13	339	+ 0.5	- 2.7

LUNAR OCCULTATION TABLE

HOBART (42° 48' S, 147° 13'E)

E.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	AB
Jan 01 22:57	1440	RD	6.7	135	13	224	- 0.8	+ 0.3
Jan 03 00:37	1564	RD	6.6	121	24	294	- 0.9	- 1.7
Jan 03 02:04	X16100	RD	7.5	121	36	300	- 1.3	- 1.5
Jan 05 00:44	X18491	RD	7.8	95	16	327	- 0.1	- 2.2
Jun 18 21:04	89	DD	6.5	75	14	93	- 0.9	+ 1.4
Jan 22 22:34	586	DD	7.0	119	17	67	- 1.7	+ 1.6
Jan 25 23:52	1031	DD	7.0	155	24	83	- 1.9	+ 0.8
Jan 29 22:43	1519	RD	6.5	154	24	307	- 0.9	- 1.8
Feb 02 00:28	1888	RD	6.2	113	28	233	- 1.5	0.0
Feb 02 02:41	1900	RD	7.2	112	49	8	+ 1.1	- 5.5
Feb 03 00:46	2021	RD	6.4	99	24	318	- 0.1	- 2.1
Feb 04 00:29	2147	RD	7.0	86	14	262	- 0.1	- 1.1
Feb 05 01:09	2296	RD	7.1	73	12	261	0.0	- 1.0
Feb 05 01:10	2302	DB	2.9	73	12	90	0.0	- 1.2
Feb 05 02:05	2303	RD	5.1	73	22	295	- 0.1	- 1.7
Feb 05 02:05	2302	RD	2.9	73	22	295	- 0.1	- 1.7
Feb 06 02:07	2456	RD	6.2	60	13	324	+ 0.6	- 2.4
Feb 19 20:22	X05728	DD	7.5	98	22	127	- 1.6	- 0.1
Feb 19 21:20	665	DD	5.7	98	16	91	- 1.5	+ 1.1
Feb 23 23:36	1235	DD	7.4	147	28	88	- 1.9	+ 0.7
Feb 25 22:05	1468	MD	4.9	172	34	26	****	****
Mar 01 03:45	1859	RD	6.8	143	53	348	- 0.7	- 3.0
Mar 01 22:38	1971	RD	5.8	132	23	333	+ 0.1	- 2.4
Mar 02 01:01	1X19762	RD	7.3	131	49	289	- 1.2	- 1.4
Mar 02 01:32	X19782	RD	7.0	130	51	336	- 0.6	- 2.8
Mar 03 23:29	X21647	RD	7.7	104	16	252	- 0.3	- 0.9
Mar 04 04:04	2275	RD	5.9	102	62	317	- 1.2	- 2.5
Mar 05 00:10	X22604	RD	7.6	91	14	327	+ 0.5	- 2.5
Mar 05 03:18	2425	RD	5.9	90	47	306	- 0.8	- 2.3
Mar 07 02:34	X25896	RD	7.0	65	19	187	- 3.2	+ 8.2
Mar 07 03:26	2733	RD	6.4	64	28	212	- 1.2	+ 1.2
Mar 19 21:27	752	DD	4.7	78	5	99	- 0.7	+ 1.1
Mar 25 02:01	1429	DD	6.8	141	12	95	- 0.6	+ 1.2
Mar 25 23:41	1546	DD	7.2	153	40	76	- 2.2	+ 1.2
Mar 26 20:47	1649	DD	6.3	165	35	36	- 4.9	+ 5.0
Mar 26 23:35	X17230	DD	7.1	167	48	129	- 1.4	- 1.0
Mar 27 00:17	X17263	DD	7.4	167	46	83	- 2.1	+ 0.7
Mar 28 23:52	1925	DB	1.0	164	54	108	- 1.5	- 1.1
Mar 29 01:04	1925	RD	1.0	164	58	303	- 1.5	- 1.2
Mar 31 22:04	2353	MD	4.6	123	14	191	****	****
Apr 03 01:51	X25414	RD	7.7	95	33	293	- 0.6	- 2.0
Apr 03 02:03	2687	RD	6.3	95	36	301	- 0.6	- 2.4
Apr 03 02:04	G00031	RD	6.5	95	36	273	- 0.8	- 1.4
Apr 03 02:14	X25445	RD	7.3	95	37	300	- 0.7	- 2.4
Apr 03 04:03	2699	RD	7.2	94	56	256	- 1.7	- 0.3
Apr 03 05:05	X25588	RD	7.2	94	63	258	- 1.9	+ 0.1
Apr 04 00:21	2830	RD	6.9	84	7	268	+ 0.1	- 1.2
Apr 05 03:55	2975	RD	7.0	70	34	213	- 1.1	+ 1.1
Apr 05 05:14	X28412	RD	7.9	69	46	321	- 1.9	- 6.2
Apr 07 05:14	X30326	RD	7.9	46	26	288	- 1.0	- 2.3
Apr 16 20:04	847	DD	2.9	59	7	143	- 0.2	- 0.3
Apr 17 19:23	995	DD	4.1	70	19	155	- 0.4	- 1.1
Apr 17 20:13	995	RB	4.1	70	13	235	- 1.9	+ 2.7
Apr 18 19:55	1114	DD	6.8	82	22	129	- 1.1	- 0.1
Apr 18 21:31	1124	DD	6.9	82	11	104	- 0.8	+ 0.9
Apr 20 19:15	X13874	DD	7.7	106	35	78	- 2.3	+ 0.3
Apr 20 20:24	1364	DD	6.5	106	34	119	- 1.5	- 0.3
Apr 22 00:24	1489	DD	6.8	121	17	138	- 0.4	- 0.3
Apr 22 21:40	1594	DD	7.9	133	45	143	- 1.2	- 1.3
Apr 25 00:34	1859	DD	6.8	162	50	70	- 2.0	+ 1.7
Apr 25 18:30	1971	DD	5.8	174	17	104	- 0.2	- 1.5
Apr 26 23:29	2132	RD	7.1	170	59	316	- 1.1	- 2.1
Apr 27 20:46	X21799	RD	7.0	157	24	285	- 0.2	- 1.5
Apr 28 01:35	2302	DB	2.9	154	67	158	- 1.2	- 4.2
Apr 28 02:14	2302	RD	2.9	154	67	218	- 2.1	+ 3.6
Apr 28 02:15	2303	RD	5.1	154	67	220	- 2.1	+ 3.4
Apr 28 05:32	X22139	RD	6.5	153	40	326	- 1.5	- 1.5
Apr 28 05:34	2322	RD	4.3	153	40	322	- 1.4	- 1.1
Apr 28 23:51	2456	RD	6.2	141	47	219	- 1.9	+ 1.5
Apr 29 01:59	X23112	RD	7.9	140	65	301	- 1.6	- 1.7
Apr 29 23:30	2611	RD	6.8	128	32	265	- 0.7	- 1.1
Apr 30 02:21	2629	RD	6.3	126	60	240	- 1.8	+ 0.6
Apr 30 02:28	X24816	RD	7.1	126	61	349	****	****
May 01 04:22	X26629	RD	7.9	112	64	188	- 0.9	+ 6.0
May 01 04:55	2808	RD	7.4	112	65	331	- 4.1	- 9.1
May 02 03:45	2936	RD	6.8	100	53	197	- 1.3	+ 3.3
May 03 00:09	3054	RD	6.4	90	6	285	+ 0.2	- 1.7
May 05 02:53	X30803	RD	7.8	65	13	199	- 0.3	+ 1.5
May 15 18:18	X10438	DD	7.9	51	19	86	- 1.6	+ 1.2
May 16 18:04	1198	DD	6.2	63	27	97	- 1.8	+ 0.5
May 20 18:46	X17230	DD	7.1	114	46	121	- 1.5	- 1.3
May 20 19:37	X17263	DD	7.4	114	48	71	- 2.6	+ 0.8
May 21 19:18	X18381	DD	7.2	128	49	136	- 1.1	- 1.8
May 21 22:32	X18491	DD	7.8	129	47	79	- 1.9	+ 1.3
May 22 21:48	1925	DD	1.0	143	58	84	- 2.0	+ 0.3
May 22 22:53	1925	RB	1.0	143	54	323	- 1.3	- 1.5
May 27 21:40	X25588	RD	7.2	147	26	193	- 2.1	+ 4.6
May 28 04:24	2731	RD	6.5	144	57	255	- 1.5	+ 1.3
May 28 04:24	X25906	RD	7.0	144	57	248	- 1.4	+ 1.5
May 29 00:30	2876	RD	5.4	133	44	278	- 1.2	- 1.4
May 29 01:28	2880	RD	5.1	132	53	295	- 1.7	- 2.2
May 31 01:26	X29728	RD	7.7	107	31	241	- 0.9	- 0.2
Jun 03 06:13	3524	RD	6.9	71	40	226	- 1.4	+ 0.9
Jun 13 17:57	X13003	DD	7.7	46	23	183	+ 0.9	- 3.8
Jun 14 19:59	1410	DD	5.3	59	16	89	- 1.0	+ 1.4
Jun 17 22:14	X18118	DD	7.2	98	29	182	- 0.2	- 4.7
Jun 18 19:05	1868	DD	7.6	110	56	89	- 2.0	- 0.1
Jun 19 00:46	1888	DD	6.2	113	16	158	- 0.5	- 1.4
Jun 20 00:18	2021	DD	6.4	126	33	99	- 0.9	+ 0.9
Jun 20 18:29	2132	DD	7.1	138	47	93	- 1.2	- 1.1
Jun 20 22:55	2147	DD	7.0	139	58	178	- 1.1	- 8.7
Jun 21 03:44	2182	DD	6.3	142	10	110	- 0.1	+ 0.7
Jun 21 22:36	2303	DD	5.1	153	67	161	- 1.4	- 4.7
Jun 21 22:37	2302	DD	2.9	153	67	163	- 1.4	- 5.0
Jun 21 23:10	2302	RB	2.9	153	65	212	- 1.9	+ 5.0
Jun 22 01:45	2322	DD	4.3	155	42	50	- 0.7	+ 2.7
Jun 22 01:46	X22139	DD	6.5	155	42	47	- 0.6	+ 2.8
Jun 22 02:03	X22155	DD	7.5	155	39	60	- 0.7	+ 2.2
Jun 22 20:10	2456	DD	6.2	166	46	144	- 0.5	- 3.1
Jun 25 05:15	2830	RD	6.9	162	35	222	- 0.3	+ 2.3
Jun 25 21:54	2936	RD	6.8	152	30	221	- 0.9	+ 0.5
Jun 26 03:58	X28225	RD	7.4	150	54	191	- 0.2	+ 3.9
Jun 28 04:26	X30326	RD	7.9	125	52	242	- 1.7	+ 1.2
Jun 28 04:29	X30325	RD	7.8	125	52	285	- 2.6	- 0.3
Jun 28 06:22	3235	RD	7.5	124	40	279	- 1.8	+ 0.9
Jun 29 01:09	3342	RD	7.6	114	29	300	- 1.6	- 3.4
Jul 04 05:51	X03744	RD	7.4	57	22	228	- 1.0	+ 0.2
Jul 04 06:07	416	RD	5.4	57	23	190	0.0	+ 2.3
Jul 13 18:23	1594	DD	7.9	55	33	167	- 0.4	- 2.1
Jul 15 19:37	1834	DD	7.9	81	45	64	- 2.0	+ 2.5
Jul 16 21:50	1971	DD	5.8	95	36	51	- 1.0	+ 3.6
Jul 17 00:05	X19762	DD	7.3	96	12	148	- 0.4	- 0.7
Jul 17 00:26	X19782	DD	7.0	97	9	110	- 0.1	+ 0.7
Jul 18 23:13	X21647	DD	7.7	123	45	168	- 2.2	- 5.8
Jul 19 01:41	2264	DD	7.4	124	19	99	- 0.3	+ 1.0
Jul 19 20:00	2401	DD	5.6	135	63	59	- 2.0	+ 1.0
Jul 19 22:45	X22604	DD	7.6	136	60	84	- 1.6	+ 0.9
Jul 20 23:09	2561	DD	7.6	150	64	77	- 1.7	+ 0.9
Jul 21 01:23	X24153	DD	7.3	151	44	84	- 1.0	+ 1.3
Jul 21 22:13	X25906	DD	7.0	162	64	68	- 1.8	+ 0.5
Jul 21 22:13	2731	DD	6.5	162	64	61	- 1.8	+ 0.9
Jul 22 00:46	2745	DD	6.9	163	58	120	- 2.2	- 0.7
Jul 23 04:41	2913	GD	5.0	175	26	160	****	****
Jul 24 05:35	3054	RD	6.4	167	23	250	- 0.4	+ 1.7
Aug 01 05:18	480	RD	7.3	76	24	294	- 2.4	- 1.7
Aug 11 19:42	X18570	DD	7.8	52	24	127	- 0.6	0.0
Aug 13 20:35	2069	DD	7.3	79	38	44	- 0.9	+ 4.0
Aug 13 21:53	2074	DD	7.1	80	25	109	- 0.6	+ 0.7
Aug 17 18:56	X25224	DD	7.5	131	56	108	- 1.5	- 1.6
Aug 17 23:14	2685	DD	7.0	133	53	63	- 1.2	+ 1.8
Aug 17 23:18	X25414	DD	7.7	133	52	119	- 1.9	- 0.3
Aug 17 23:33	2687	DD	6.3	133	50	118	- 1.8	- 0.1
Aug 17 23:46	X25445	DD	7.3	133	48	123	- 1.8	- 0.3
Aug 17 23:49	X25452	DD	7.7	133	47	90	- 1.3	+ 1.1
Aug 18 19:46	2830	DD	6.9	144	54	73	- 1.6	- 0.2
Aug 19 01:28	X27180	DD	7.2	147	38	93	- 1.0	+ 1.1
Aug 19 02:03	2856	DD	6.6	147	32	61	- 0.5	+ 1.9
Aug 19 19:22	X28225	DD	7.4	157	39	83	- 1.1	- 1.0
Aug 19 23:03	2975	MD	7.0	158	61	158	****	****
Aug 20 20:41	3104	DD	6.5	169	41	134	- 1.8	- 4.9
Aug 20 22:16	3111	DD	6.9	170	53	79	- 1.8	- 0.2
Aug 21 02:27	3128	DD	6.2	171	40	61	- 1.0	+ 1.8
Aug 21 20:15	3229	RD	5.6	174	26	203	- 0.7	+ 1.5
Aug 23 00:11	3371	RD	6.4	163	47	185	- 0.3	+ 3.4
Aug 24 01:05	3501	RD	4.8	152	43	281	- 2.5	- 0.9
Aug 26 01:39	196	RD	6.9	129	31	259	- 1.8	- 0.5
Aug 27 04:50	326	RD	6.0	117	31	256	- 2.1	+ 0.7
Aug 28 03:52	442	RD	6.9	106	28	299	- 2.8	- 1.6
Aug 30 02:01	700	RD	5.8	85	5	253	- 0.6	- 0.9
Aug 31 05:30	847	DB	2.9	73	22	78	- 1.7	- 0.5
Sep 01 04:35	995	DB	4.1	61	11	98	- 1.2	- 1.4
Sep 01 04:41	991	RD	6.1	62	12	353	****	****
Sep 09 20:53	2034	DD	6.7	49	13	89	- 0.1	+ 1.3
Sep 11 19:11	X22087	DD	7.5	75	53	86	- 1.5	+ 1.1
Sep 11 20:45	X22147	DD	7.7	76	38	94	+ 0.9	+ 1.1
Sep 13 00:40	2497	DD	6.6	91	7	22	+ 0.9	+ 3.1
Sep 13 20:52	X24816	DD	7.1	102	56	125	- 2.1	- 0.8
Sep 13 23:15	X24978	DD	7.4	103	32	95	- 0.7	+ 1.2
Sep 13 23:16	X24976	DD	7.5	103	31	72	- 0.5	+ 1.7
Sep 13 23:49	2649	DD	6.6	104	25	43	0.0	+ 2.3
Sep 14 01:12	2658	DD	5.2	104	11	95	0.0	+ 1.1
Sep 14 23:30	2808	DD	7.4	116	37	113	- 1.3	+ 0.5
Sep 19 20:57	3453	DD	4.9	174	32	93	- 1.5	- 1.4
Sep 20 23:30	29	RD	7.2	171	40	234	- 1.5	+ 0.7
Sep 21 02:39	X00353	RD	7.2	170	33	202	- 1.0	+ 2.6
Sep 24 23:30	497	RD	6.4	127	8	293	- 1.3	- 2.3
Sep 29 03:50	1060	RD	7.4	82	17	298	- 1.5	- 1.8
Sep 30 03:48	1184	RD	7.8	70	12	287	- 1.1	- 1.7
Oct 07 20:27	2117	DD	5.3	31	6	134	- 0.2	0.0
Oct 07 20:35	2118	DD	2.9	31	4	146	- 0.2	- 0.4
Oct 08 20:25	X21775	DD	7.1	45	18	125	- 0.5	+ 0.3
Oct 09 21:33	2436	DD	6.1	59	17	119	- 0.4	+ 0.5
Oct 10 21:12	G00024	DD	6.9	72	31	41	- 0.1	+ 2.6
Oct 10 22:36	X24365	DD	7.6	73	16	122	- 0.4	+ 0.5
Oct 10 23:09	2596	DD	7.3	73	11	105	0.0	+ 0.9
Oct 11 21:51	X26138	DD	7.8	86	33	11	+ 0.5	+ 4.1
Oct 14 00:37	X28991	DD	7.2	112	18	90	- 0.4	+ 1.4
Oct 14 21:59	3166	DD	4.8	123	49	30	- 0.9	+ 2.5
Oct 16 20:45	3410	DD	7.7	146	45	121	- 3.3	- 2.9
Oct 25 00:53	X07529	RD	6.5	124	15	287	- 1.6	- 1.6
Oct 25 02:16	881	RD	5.9	124	23	339	- 2.7	- 4.2
Oct 26 02:58	1025	RD	7.4	113	24	287	- 1.9	- 1.2
Oct 28 02:44	1257	RD	7.5	90	16	241	- 1.1	- 0.6
Oct 28 03:01	X12657	RD	7.4	90	18	300	- 1.3	- 1.8
Nov 09 22:51	3001	DD	7.0	81	16	36	+ 0.1	+ 2.2
Nov 09 23:41	3006	DD	7.0	81	7	85	+ 0.1	+ 1.3
Nov 10 20:55	3128	DD	6.2	92	42	124	- 2.4	- 0.5
Nov 11 21:22	3260	DD	6.4	104	41	11	- 0.3	+ 3.3
Nov 12 22:38	3384	DD	7.7	117	33	79	- 1.3	+ 1.5
Nov 13 21:29	3501	RB	4.8	127	42	253	- 1.9	+ 1.0
Nov 15 21:30	196	DD	6.9	150	35	49	- 1.6	+ 1.0
Nov 17 01:01	326	DD	6.0	162	24	27	- 1.5	+ 2.7
Nov 19 23:23	700	RD	5.8	166	23	301	- 2.3	- 1.7
Nov 20 23:42	826	RD	6.8	155	21	207	- 0.9	+ 1.5
Nov 26 02:52	1440	RD	6.7	97	26	251	- 1.6	- 0.7
Dec 09 21:41	3342	DD	7.6	85	24	57	- 0.7	+ 2.0
Dec 24 02:21	1519	RD	6.5	116	34	270	- 1.8	- 1.0
Dec 26 01:43	XI7979	RD	7.7	92	21	241	- 1.0	- 0.6
Dec 29 02:16	X20652	RD	7.2	52	8	251	0.0	- 0.8
Dec 29 03:08	2122	RD	7.8	52	16	317	+ 0.1	- 2.0

LUNAR OCCULTATION TABLE

MELBOURNE (37° 50' S, 145° 00'E)

E.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	AB
Jan 01 22:55	1440	RD	6.7	135	13	240	- 0.7	- 0.4
Jan 02 03:13	1454	RD	7.1	133	44	308	- 1.6	- 1.2
Jan 03 00:26	1564	RD	6.6	121	23	301	- 0.8	- 1.8
Jan 03 01:53	X16100	RD	7.5	121	37	306	- 1.3	- 1.8
Jun 18 21:09	89	DD	6.5	75	17	84	- 1.0	+ 1.5
Jan 22 22:39	586	DD	7.0	119	21	58	- 1.9	+ 1.9
Jan 25 23:05	11031	DD	7.0	155	29	75	- 2.4	+ 1.0
Jan 29 22:32	1519	RD	6.5	154	24	314	- 0.9	- 2.0
Jan 30 03:53	1546	RD	7.2	151	42	8	+ 0.7	- 4.6
Feb 02 00:24	1888	RD	6.2	113	26	245	- 1.1	- 0.5
Feb 03 00:35	2021	RD	6.4	99	20	326	+ 0.1	- 2.3
Feb 04 00:23	2147	RD	7.0	86	10	270	0.0	- 1.1
Feb 05 01:04	2296	RD	7.1	73	8	270	+ 0.1	- 1.0
Feb 05 01:05	2302	DB	2.9	73	8	82	+ 0.1	- 0.9
Feb 05 01:56	2303	RD	5.1	73	18	304	+ 0.1	- 1.8
Feb 05 01:56	2302	RD	2.9	73	18	303	+ 0.1	- 1.8
Feb 06 01:55	2456	RD	6.2	60	8	340	+ 1.1	- 3.2
Feb 17 20:21	402	DD	6.5	76	19	153	- 0.8	- 3.4
Feb 18 21:38	520	DD	7.6	87	13	136	- 0.6	- 0.4
Feb 19 20:17	X05728	DD	7.5	98	27	117	- 2.0	- 0.1
Feb 19 21:22	665	DD	5.7	98	21	82	- 1.8	+ 1.2
Feb 23 23:36	1235	DD	7.4	147	33	78	- 2.3	+ 1.0
Feb 25 01:28	1364	DD	6.5	160	31	157	- 0.5	- 1.4
Mar 01 22:25	1971	RD	5.8	132	19	343	+ 0.3	- 2.7
Mar 02 01:00	X19762	RD	7.3	131	48	297	- 1.1	- 1.7
Mar 02 01:15	X19782	RD	7.0	130	50	349	- 0.1	- 3.6
Mar 04 03:46	2275	RD	5.9	102	61	335	- 0.8	- 3.8
Mar 05 03:04	2425	RD	5.9	90	44	321	- 0.5	- 3.0
Mar 07 02:43	X25896	RD	7.0	65	18	217	- 0.8	+ 0.8
Mar 07 03:27	2733	RD	6.4	64	26	231	- 0.9	+ 0.2
Mar 19 21:31	752	DD	4.7	78	9	89	- 1.0	+ 1.3
Mar 25 02:07	1429	DD	6.8	141	15	79	- 0.9	+ 1.7
Mar 25 23:43	1546	DD	7.2	153	45	60	- 3.3	+ 2.5
Mar 26 23:27	X17230	DD	7.1	167	53	119	- 1.7	- 1.0
Mar 27 00:17	X17263	DD	7.4	167	52	69	- 2.8	+ 1.5
Mar 28 23:43	1925	DB	1.0	164	55	99	- 1.7	- 0.9
Mar 29 00:54	1925	RD	1.0	164	63	314	- 1.4	- 1.7
Mar 30 21:33	2192	RD	6.2	137	15	222	- 0.9	+ 0.7
Mar 30 23:45	2205	RD	7.6	136	41	221	- 2.4	+ 1.7
Mar 31 22:09	2353	RD	4.6	123	12	217	- 0.9	+ 0.9
Apr 03 01:39	X25414	RD	7.7	95	29	309	- 0.2	- 2.6
Apr 03 01:49	2687	RD	6.3	95	31	318	- 0.2	- 3.2
Apr 03 01:55	G00031	RD	6.5	95	33	287	- 0.6	- 1.7
Apr 03 01:59	X25445	RD	7.3	95	33	318	- 0.2	- 3.3
Apr 03 03:56	2699	RD	7.2	94	55	273	- 1.7	- 1.0
Apr 03 04:59	X25588	RD	7.2	94	65	275	- 2.1	- 0.8
Apr 05 03:16	2972	RD	6.7	70	25	205	- 1.0	+ 1.8
Apr 05 03:56	2975	RD	7.0	70	33	233	- 1.1	+ 0.2
Apr 16 20:02	847	DD	2.9	59	11	131	- 0.5	- 0.1
Apr 17 19:17	995	DD	4.1	70	24	143	- 1.0	- 0.8
Apr 17 20:20	995	RB	4.1	70	16	248	- 1.7	+ 2.0
Apr 18 19:52	1114	DD	6.8	82	28	120	- 1.4	- 0.1
Apr 18 21:33	1124	DD	6.9	82	15	93	- 1.1	+ 1.1
Apr 20 19:11	X13874	DD	7.7	106	40	69	- 2.9	+ 0.7
Apr 20 20:18	1364	DD	6.5	106	40	110	- 1.9	- 0.3
Apr 22 00:22	1489	DD	6.8	121	21	123	- 0.7	+ 0.1
Apr 25 00:43	1859	DD	6.8	162	54	44	- 3.3	+ 5.6
Apr 26 23:15	2132	RD	7.1	170	59	330	- 0.8	- 2.8
Apr 27 00:28	2136	RD	6.8	169	68	239	- 2.6	+ 1.5
Apr 27 03:19	2147	RD	7.0	168	54	249	- 1.6	+ 1.8
Apr 27 20:38	X21799	RD	7.0	157	20	294	- 0.1	- 1.6
Apr 28 01:17	2302	DB	2.9	154	69	136	- 1.5	- 2.4
Apr 28 02:21	2302	RD	2.9	154	72	243	- 2.2	+ 1.5
Apr 28 02:21	2303	RD	5.1	154	72	244	- 2.2	+ 1.4
Apr 28 05:49	X22155	RD	7.5	152	39	340	- 2.2	- 4.0
Apr 28 22:08	2446	RD	7.2	142	26	221	- 1.3	+ 0.8
Apr 28 23:51	2456	RD	6.2	141	46	238	- 1.6	+ 0.2
Apr 29 03:12	X23171	RD	7.1	140	73	223	- 2.0	+ 2.7
Apr 29 23:23	2611	RD	6.8	128	29	277	- 0.5	- 1.3
Apr 30 02:18	2629	RD	6.3	126	61	257	- 1.9	- 0.1

E.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	A	B
May 02 03:52	2936	RD	6.8	100	55	222	- 1.7	+ 1.4	
May 05 02:57	X30803	RD	7.8	65	12	222	- 0.4	+ 0.5	
May 20 18:36	X17730	DD	7.1	114	49	113	- 1.7	- 1.3	
May 20 19:37	X17263	DD	7.4	114	53	56	- 3.9	+ 2.4	
May 20 22:01	1671	DD	7.6	115	44	179	- 0.1	- 4.0	
May 21 01:21	1688	DD	6.3	117	10	153	- 0.2	- 1.1	
May 21 19:06	X18381	DD	7.2	128	51	128	- 1.3	- 1.7	
May 21 22:37	X1849!	DD	7.8	129	51	59	- 2.7	+ 3.0	
May 22 21:46	1925	DD	1.0	143	63	69	- 2.7	+ 1.2	
May 22 22:40	1925	RB	1.0	143	61	341	- 1.0	- 2.9	
May 26 03:02	2394	RD	6.5	173	56	237	- 1.3	+ 2.2	
May 27 21:46	X25588	RD	7.2	147	25	220	- 1.0	+ 0.7	
May 28 04:25	2731	RD	6.5	144	61	272	- 1.9	+ 0.6	
May 28 04:27	X25906	RD	7.0	144	61	265	- 1.8	+ 0.9	
May 28 06:17	2745	RD	6.9	144	42	190	+ 0.5	+ 4.5	
May 29 00:18	2876	RD	5.4	133	42	296	- 1.1	- 2.3	
May 29 01:07	2880	RD	5.1	132	50	324	- 1.6	- 5.9	
May.11 01:21	X29728	RD	7.7	107	30	258	- 1.0	- 0.8	
Jun 02 02:57	3397	RD	7.4	83	25	174	+ 0.3	+ 5.9	
Jun 03 06:13	3524	RD	6.9	71	44	242	- 1.8	+ 0.5	
Jun 14 20:05	1410	DD	5.3	59	19	73	- 1.4	+ 2.1	
Jun 17 22:01	X18118	DD	7.2	98	35	154	- 0.8	- 1.6	
Jun 18 00:32	1759	DD	6.5	99	7	174	- 0.4	- 3.2	
Jun 18 19:00	1868	DD	7.6	110	60	77	- 2.6	+ 0.4	
Jun 19 00:41	1888	DD	6.2	113	18	135	- 0.5	- 0.3	
Jun 20 00:22	2021	DD	6.4	126	35	81	- 0.9	+ 1.5	
Jun 20 18:22	2132	DD	7.1	138	45	83	- 1.4	- 0.8	
Jun 20 19:59	2136	DD	6.8	138	62	181	+ 0.8	- 7.2	
Jun 20 22:33	2147	DD	7.0	139	65	146	- 1.6	- 2.3	
Jun 21 03:48	2182	DD	6.3	142	9	94	0.0	+ 0.9	
Jun 21 22:18	2303	DD	5.1	153	72	136	- 1.7	- 2.2	
Jun 21 22:18	2302	DD	2.9	153	72	137	- 1.7	- 2.3	
Jun 21 23:20	2302	RB	2.9	153	69	239	- 2.0	+ 2.0	
Jun 22 19:56	2456	DD	6.2	166	42	128	- 0.6	- 2.3	
Jun 22 23:21	X23171	DD	7.1	167	73	137	- 2.0	- 2.6	
Jun 25 05:25	2830	RD	6.9	162	35	236	- 0.5	+ 1.9	
Jun 25 21:53	2936	RD	6.8	152	29	239	- 0.9	- 0.1	
Jun 26 04:12	X28225	RD	7.4	150	56	213	- 0.9	+ 2.7	
Jun 28 04:12	X30325	RD	7.8	125	58	316	- 6.4	- 6.8	
Jun 28 06:20	3235	RD	7.5	124	45	297	- 2.7	- 0.3	
Jun 29 03:27	X31054	RD	7.8	113	50	190	- 0.6	+ 3.1	
Jul 04 05:49	X03744	RD	7.4	57	24	244	- 1.3	- 0.2	
Jul 04 06:13	416	RD	5.4	57	27	212	- 0.8	+ 1.1	
Jul 12 19:37	1489	DD	6.8	42	14	165	0.0	- 1.8	
Jul 12 20:17	X15313	DD	7.8	43	7	116	- 0.2	+ 0.4	
Jul 17 00:03	X19762	DD	7.3	96	14	127	- 0.4	0.0	
Jul 17 00:30	X19782	DD	7.0	97	9	93	0.0	+ 1.0	
Jul 18 22:57	X21647	DD	7.7	123	51	135	- 1.7	- 1.2	
Jul 19 01:46	2264	DD	7.4	124	19	83	- 0.2	+ 1.3	
Jul 19 20:05	2401	DD	5.6	135	67	35	- 2.8	+ 3.7	
Jul 19 22:48	X22604	DD	7.6	136	64	65	- 1.7	+ 1.7	
Jul 20 23:12	2561	DD	7.6	150	68	59	- 1.8	+ 1.7	
Jul 21 01:28	X24153	DD	7.3	151	46	68	- 1.0	+ 1.7	
Jul 21 22:13	X25906	DD	7.0	162	67	49	- 1.9	+ 1.6	
Jul 21 22:16	2731	DD	6.5	162	67	40	- 1.9	+ 2.1	
Jul 22 00:41	2745	DD	6.9	163	63	99	- 2.1	+ 0.2	
Jul 23 04:29	2913	DD	5.0	175	31	121	- 1.3	+ 0.1	
Jul 24 05:42	3054	RD	6.4	167	24	261	- 0.5	+ 1.4	
Aug 01 04:58	480	RD	7.3	76	26	318	- 4.0	- 4.6	
Aug 11 19:42	X18570	DD	7.8	52	26	110	- 0.8	+ 0.5	
Aug 12 17:52	1925	DD	1.0	64	57	167	- 0.9	- 3.5	
Aug 12 18:36	1925	RB	1.0	64	50	237	- 2.1	+ 3.2	
Aug 13 21:56	2074	DD	7.1	80	26	92	- 0.6	+ 1.1	
Aug 17 18:46	X25224	DD	7.5	131	55	92	- 1.6	- 0.9	
Aug 17 23:14	X25414	DD	7.7	133	57	99	- 1.9	+ 0.4	
Aug 17 23:22	2685	DD	7.0	133	55	45	- 1.0	+ 2.5	
Aug 17 23:31	2687	DD	6.3	133	54	98	- 1.7	+ 0.6	
Aug 17 23:34	G00031	DD	6.5	133	53	128	- 2.4	- 1.1	
Aug 17 23:42	X25445	DD	7.3	133	52	103	- 1.7	+ 0.5	
Aug 17 23:52	X25452	DD	7.7	133	50	74	- 1.2	+ 1.5	

E.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	A	B
Aug 18 19:44	2830	DD	6.9	144	54	55	- 1.7	+ 0.7	
Aug 19 01:32	X27180	DD	7.2	147	40	79	- 1.0	+ 1.4	
Aug 19 02:12	2856	DD	6.6	147	32	47	- 0.3	+ 2.2	
Aug 19 19:16	X28225	DD	7.4	157	38	66	- 1.2	- 0.2	
Aug 19 22:17	2972	DD	6.7	158	65	144	- 4.6	- 8.5	
Aug 19 22:36	2975	DD	7.0	158	66	116	- 2.8	- 1.8	
Aug 20 20:23	3104	DD	6.5	169	38	106	- 1.4	- 2.0	
Aug 20 22:13	3111	DD	6.9	170	56	61	- 1.8	+ 0.6	
Aug 23 00:22	3371	RD	6.4	163	52	208	- 1.2	+ 2.0	
Aug 24 00:48	3501	RD	4.8	152	46	309	- 4.7	- 5.0	
Aug 26 01:31	196	RD	6.9	129	34	277	- 2.3	- 1.2	
Aug 26 02:08	203	RD	6.9	129	37	193	- 0.5	+ 2.5	
Aug 27 04:48	326	RD	6.0	117	36	268	- 2.5	+ 0.4	
Aug 28 03:27	442	RD	6.9	106	30	330	****	****	
Aug 30 02:04	700	RD	5.8	85	5	268	- 0.7	- 1.2	
Aug 31 05:25	847	DB	2.9	73	25	67	- 1.7	- 0.2	
Sep 01 04:26	995	DB	4.1	61	12	85	- 1.0	- 1.1	
Sep 01 05:45	995	RD	4.1	61	23	277	- 1.8	- 1.2	
Sep 04 05:28	X13874	RD	7.7	26	3	274	- 0.4	- 1.3	
Sep 09 21:00	2034	DD	6.7	49	12	71	0.0	+ 1.7	
Sep11 19:15	X22087	DD	7.5	75	57	68	- 1.6	+ 1.8	
Sep 11 20:50	X22147	DD	7.7	76	39	77	- 0.9	+ 1.5	
Sep 13 20:46	X24816	DD	7.1	102	61	104	- 2.0	+ 0.1	
Sep 13 23:20	X24978	DD	7.4	103	32	80	- 0.6	+ 1.4	
Sep 13 23:25	X24976	DD	7.5	103	31	57	- 0.3	+ 2.0	
Sep 14 00:03	2649	DD	6.6	104	24	24	+ 0.4	+ 3.2	
Sep 14 01:18	2658	DD	5.2	104	10	82	+ 0.1	+ 1.2	
Sep 14 23:31	2808	DD	7.4	116	40	96	- 1.2	+ 0.9	
Sep 19 20:49	3453	DD	4.9	174	32	74	- 1.3	- 0.5	
Sep 19 21:05	3455	DD	6.4	174	35	116	- 2.2	- 3.0	
Sep 20 23:28	29	RD	7.2	171	43	250	- 2.0	+ 0.2	
Sep 21 02:49	X00353	RD	7.2	170	37	216	- 1.3	+ 2.4	
Sep 29 03:36	1060	RD	7.4	82	17	310	- 1.6	- 2.3	
Sep 30 03:37	1184	RD	7.8	70	12	298	- 1.1	- 1.9	
Oct 07 20:27	2117	DD	5.3	31	6	116	- 0.1	+ 0.4	
Oct 07 20:34	2118	DD	2.9	31	5	125	- 0.1	+ 0.1	
Oct 08 20:26	X21775	DD	7.1	45	19	108	- 0.4	+ 0.6	
Oct 09 21:35	2436	DD	6.1	59	18	103	- 0.3	+ 0.8	
Oct 10 21:27	G00024	DD	6.9	72	30	18	+ 0.5	+ 4.0	
Oct 1Q 22:39	X24365	DD	7.6	73	17	106	- 0.3	+ 0.8	
Oct 10 23:13	2596	DD	7.3	73	10	92	0.0	+ 1.0	
Oct 14 00:43	X28991	DD	7.2	112	19	79	- 0.3	+ 1.5	
Oct 14 01:35	3054	MD	6.4	112	9	160	****	****	
Oct 14 22:12	3166	DD	4.8	123	52	12	- 0.4	+ 3.6	
Oct 16 20:30	3410	DD	7.7	146	48	96	- 2.5	- 1.0	
Oct 25 00:41	X07529	RD	6.5	124	16	301	- 1.7	- 2.2	
Oct 26 02:46	1025	RD	7.4	113	26	297	- 2.1	- 1.6	
Oct 28 02:38	1257	RD	7.5	90	16	253	- 1.1	- 0.8	
Oct 28 02:48	X12657	RD	7.4	90	18	310	- 1.3	- 2.2	
Nov 08 20:38	X27210	DD	7.6	67	35	128	- 1.7	- 0.4	
Nov 08 20:55	2856	MD	6.6	67	31	161	****	****	
Nov 09 23:04	3001	DD	7.0	81	15	22	+ 0.3	+ 2.7	
Nov 10 20:10	3125	DD	6.9	92	53	79	- 1.8	+ 1.2	
Nov 10 20:50	3128	DD	6.2	92	47	104	- 2.1	+ 0.5	
Nov 12 22:43	3384	DD	7.7	117	37	68	- 1.4	+ 1.7	
Nov 13 21:28	3501	RB	4.8	127	47	267	- 2.4	+ 0.6	
Nov 15 21:33	196	DD	6.9	150	40	34	- 1.4	+ 1.6	
Nov 15 22:36	203	DD	6.9	150	40	118	- 3.4	- 1.2	
Nov 17 01:14	326	DD	6.0	162	27	11	- 1.5	+ 4.2	
Nov 19 23:06	700	RD	5.8	166	25	320	- 3.1	- 3.5	
Nov 20 23:44	826	RD	6.8	155	24	225	- 1.4	+ 0.6	
Nov 21 23:55	971	RD	7.3	144	21	241	- 1.3	- 0.2	
Nov 26 02:44	1440	RD	6.7	97	27	260	- 1.5	- 0.9	
Nov 29 03:18	1779	RD	6.7	59	16	323	- 0.2	- 2.2	
Dec 09 21:50	3342	DD	7.6	85	25	47	- 0.7	+ 2.2	
Dec 21 01:54	X11843	RD	7.5	151	35	339	- 1.4	- 2.6	
Dec 24 02:12	1519	RD	6.5	116	35	277	- 1.7	- 1.2	
Dec 26 01:38	X17979	RD	7.7	92	20	251	- 0.8	- 0.8	
Dec 28 03:46	X19824	RD	7.7	65	30	297	- 0.5	- 1.7	
Dec 29 02:12	X20652	RD	7.2	52	4	260	+ 0.1	- 0.8	

LUNAR OCCULTATION TABLE

SYDNEY (33° 54' S, 151° 15'E)

E.A.S.T.	CATALOG		PD	Mag	Elg	Alt	PA	AB
Jun 01 22:59	1440	RD	6.7	135	19	252	- 1.0	- 0.6
Jan 02 03:17	1454	RD	7.1	133	48	327	- 1.3	- 1.8
Jan 03 00:24	1564	RD	6.6	121	29	312	- 1.0	- 2.0
Jan 03 01:53	X16100	RD	7.5	121	44	322	- 1.3	- 2.1
Jan 07 02:34	2063	MD	6.7	67	25	202	****	****
Jan 18 21:21	89	DD	6.5	75	12	76	- 0.7	+ 1.6
Jan 22 23:00	586	DD	7.0	119	18	42	- 2.0	+ 2.9
Jan 26 00:14	1031	DD	7.0	155	29	53	- 3.0	+ 2.6
Jan 29 22:29	1519	RD	6.5	154	29	326	- 0.9	- 2.3
Feb 02 00:28	1888	RD	6.2	113	33	264	- 1.1	- 0.9
Feb 03 00:24	2021	RD	6.4	99	23	346	+ 0.4	- 3.0
Feb 04 00:18	2147	RD	7.0	86	13	284	0.0	- 1.3
Feb 05 00:58	2296	RD	7.1	73	11	285	+ 0.1	- 1.3
Feb 05 01:03	2302	DB	2.9	73	11	65	- 0.3	- 0.4
Feb 05 01:47	2303	RD	5.1	73	20	323	+ 0.3	- 2.4
Feb 05 01:47	2302	RD	2.9	73	20	322	+ 0.3	- 2.3
Feb 17 20:21	402	DD	6.5	76	18	131	- 1.0	- 0.5
Feb 19 20:30	X05728	DD	7.5	98	27	105	- 1.9	+ 0.4
Feb 19 21:38	665	DD	5.7	98	18	68	- 1.7	+ 1.8
Feb 20 19:43	791	DD	7.8	109	34	130	- 2.3	- 1.2
Feb 20 20:13	792	DD	5.1	109	32	54	- 2.7	+ 1.7
Feb 24 00:02	1235	DD	7.4	147	31	47	- 3.9	+ 4.3
Feb 25 01:29	1364	DD	6.5	160	30	134	- 0.9	- 0.6
Mar 01 02:07	X18890	RD	7.8	144	65	256	- 2.8	+ 0.7
Mar 02 01:00	X19762	RD	7.3	131	54	316	- 1.0	- 2.2
Mar 03 23:21	X21647	RD	7.7	104	16	277	- 0.1	- 1.2
Mar 05 02:44	2425	RD	5.9	90	45	1	****	****
Mar 07 02:49	X25896	RD	7.0	65	23	240	- 0.8	- 0.1
Mar 07 03:32	2733	RD	6.4	64	32	251	- 1.0	- 0.4
Mar 19 21:43	752	DD	4.7	78	5	71	- 0.9	+ 1.8
Mar 24 20:56	1410	DD	5.3	138	46	161	- 1.0	- 2.5
Mar 26 23:36	X17230	DD	7.1	167	56	99	- 2.2	- 0.2
Mar 28 20:50	1908	RD	7.2	166	31	272	- 0.9	- 1.1
Mar 28 23:54	1925	DB	1.0	164	63	76	- 2.5	+ 0.2
Mar 29 00:53	1925	RD	1.0	164	67	338	- 1.0	- 2.8
Mar 30 21:37	2192	RD	6.2	137	21	246	- 0.7	- 0.4
Mar 30 23:59	2205	RD	7.6	136	49	251	- 1.8	- 0.2
Mar 31 22:14	2353	RD	4.6	123	17	242	- 0.5	- 0.3
Apr 03 01:24	X25414	RD	7.7	95	31	340	+ 0.7	- 6.4
Apr 03 01:50	G00031	RD	6.5	95	37	307	- 0.6	- 2.6
Apr 03 04:02	2699	RD	7.2	94	63	288	- 2.0	- 1.6
Apr 03 05:09	X25588	RD	7.2	94	73	289	- 2.5	- 1.3
Apr 05 03:27	2972	RD	6.7	70	33	227	- 1.1	+ 0.7
Apr 05 04:04	2975	RD	7.0	70	40	248	- 1.4	- 0.2
Apr 06 03:47	3104	RD	6.5	58	25	203	- 0.9	+ 2.1
Apr 16 20:06	847	DD	2.9	59	9	112	- 0.6	+ 0.5
Apr 17 18:35	991	DD	6.1	69	29	75	- 2.4	+ 1.3
Apr 17 19:22	995	DD	4.1	70	24	123	- 1.2	- 0.1
Apr 17 20:35	995	RB	4.1	70	13	269	- 1.1	+ 1.1
Apr 18 20:02	1114	DD	6.8	82	27	101	- 1.6	+ 0.5
Apr 18 21:46	1124	DD	6.9	82	11	70	- 1.2	+ 2.0
Apr 19 18:25	X12435	DD	7.8	93	40	97	- 2.4	- 0.2
Apr 20 19:48	X13874	MD	7.7	106	43	28	****	****
Apr 20 20:32	1364	DD	6.5	106	41	90	- 2.3	+ 0.6
Apr 22 00:27	1489	DD	6.8	121	16	104	- 0.6	+ 0.6
Apr 22 21:37	1594	DD	7.9	133	53	113	- 1.9	- 0.6
Apr 25 18:20	1971	DD	5.8	174	18	83	- 0.4	- 0.9
Apr 27 00:46	2136	RD	6.8	169	73	263	- 2.3	+ 0.4
Apr 27 03:34	2147	RD	7.0	168	48	263	- 1.4	+ 1.2
Apr 27 20:32	X21799	RD	7.0	157	24	311	0.0	- 2.0
Apr 27 20:59	2275	RD	5.9	156	29	229	- 1.4	+ 0.6
Apr 28 01:10	2296	RD	7.1	155	75	232	- 2.6	+ 2.2
Apr 28 01:21	2302	DB	2.9	154	75	116	- 2.0	- 1.3
Apr 28 02:39	2302	RD	2.9	154	71	259	- 2.1	+ 0.9
Apr 28 02:39	2303	RD	5.1	154	70	260	- 2.1	+ 0.8
Apr 28 22:16	2446	RD	7.2	142	33	246	- 1.1	- 0.3
Apr 29 00:01	2456	RD	6.2	141	54	259	- 1.7	- 0.4
Apr 29 03:33	X23171	RD	7.1	140	72	239	- 2.0	+ 1.8
Apr 29 23:20	2611	RD	6.8	128	33	296	- 0.5	- 1.9
Apr 30 02:29	2629	RD	6.3	126	70	272	- 2.2	- 0.5

E.A.S.T.	CATALOG	PD	Mag	Elg	Alt	PA	A	B
May 01 04:57	X26629	RD	7.9	112	73	227	- 1.8	+ 2.1
May 02 00:56	2927	RD	7.2	101	28	214	- 1.1	+ 1.3
May 02 04:09	2936	RD	6.8	100	65	233	- 2.0	+ 1.2
May 05 03:01	X30803	RD	7.8	65	19	235	- 0.6	+ 0.1
May 15 18:44	X10438	DD	7.9	51	20	48	- 2.8	+ 3.9
May 16 18:23	1198	DD	6.2	63	31	65	- 2.8	+ 2.2
May 20 18:45	X17230	DD	7.1	114	55	94	- 2.4	- 0.5
May 20 21:55	1671	DD	7.6	115	44	150	- 1.0	- 1.6
May 21 19:10	X18381	DD	7.2	128	58	109	- 1.9	- 1.2
May 22 22:22	1925	MD	1.0	143	63	24	****	****
May 24 18:20	2192	DD	6.2	169	25	145	+ 0.1	- 2.3
May 26 03:17	2394	RD	6.5	173	49	246	- 1.1	+ 1.8
May 27 21:03	2699	RD	7.2	147	21	230	- 0.8	+ 0.3
May 27 21:53	X25588	RD	7.2	147	31	243	- 1.0	- 0.1
May 28 04:39	2731	RD	6.5	144	56	277	- 1.9	+ 0.5
May 28 04:41	X25906	RD	7.0	144	56	269	- 1.7	+ 0.8
May 29 00:13	2876	RD	5.4	133	46	320	- 1.3	- 4.7
May 31 01:24	X29728	RD	7.7	107	36	271	- 1.3	- 1.2
Jun 02 03:13	3397	RD	7.4	83	34	191	- 0.4	+ 2.9
Jun 06 04:22	326	RD	6.0	39	6	216	0.0	+ 0.7
Jun 14 20:34	14!0	MD	5.3	59	11	25	****	****
Jun 16 20:25	1623	DD	5.4	84	37	179	- 0.1	- 4.0
Jun 17 22:02	X18118	DD	7.2	98	32	134	- 0.9	- 0.6
Jun 18 19:38	1868	MD	7.6	110	64	28	****	****
Jun 19 00:43	1888	DD	6.2	113	13	123	- 0.4	0.0
Jun 20 00:34	2021	DD	6.4	126	28	67	- 0.6	+ 2.0
Jun 20 18:32	2132	DD	7.1	138	53	59	- 2.4	+ 0.7
Jun 20 19:46	2136	DD	6.8	138	67	147	- 1.2	- 2.8
Jun 20 22:37	2147	DD	7.0	139	63	127	- 1.9	- 1.1
Jun 21 21:18	2296	DD	7.1	153	73	150	- 1.4	- 3.5
Jun 21 22:23	2303	DD	5.1	153	75	117	- 2.1	- 1.1
Jun 21 22:23	2302	DD	2.9	153	75	118	- 2.1	- 1.2
Jun 21 23:39	2302	RB	2.9	153	64	254	- 1.9	+ 1.3
Jun 22 18:19	2446	DD	7.2	165	28	122	- 0.2	- 1.9
Jun 22 19:53	2456	DD	6.2	166	47	108	- 1.1	- 1.5
Jun 22 23:27	X23171	DD	7.1	167	76	119	- 2.3	- 1.3
Jun 25 05:35	2830	RD	6.9	162	28	238	- 0.3	+ 1.8
Jun 25 21:58	2936	RD	6.8	152	35	255	- 1.1	- 0.5
Jun 26 04:28	X28225	RD	7.4	150	51	214	- 0.7	+ 2.6
Jun 27 23:12	3212	RD	7.5	127	25	226	- 0.8	+ 0.5
Jun 28 04:28	X30325	RD	7.8	125	59	318	- 8.2	- 8.4
Jun 29 03:43	X31054	RD	7.8	113	57	193	- 0.8	+ 3.2
Jul 04 05:58	X03744	RD	7.4	57	31	245	- 1.7	+ 0.1
Jul 12 19:33	1489	DD	6.8	42	11	142	- 0.2	- 0.7
Jul 18 23:05	X21647	DD	7.7	123	46	123	- 1.6	- 0.4
Jul 19 19:28	2394	DD	6.5	135	68	142	- 1.5	- 3.2
Jul 19 23:06	X22604	DD	7.6	136	57	54	- 1.4	+ 2.4
Jul 20 02:34	2425	MD	5.9	138	16	174	****	****
Jul 20 23:31	2561	DD	7.6	150	64	49	- 1.5	+ 2.4
Jul 21 01:40	X24153	DD	7.3	151	39	63	- 0.7	+ 1.8
Jul 21 19:21	2715	DD	6.0	161	43	168		
Jul 21 22:34	X25906	DD	7.0	162	74	35	- 1.8	+ 2.9
Jul 22 00:55	2745	DD	6.9	163	59	94	- 1.9	+ 0.6
Jul 23 04:37	2913	DD	5.0	175	24	119	- 1.0	+ 0.2
Jul 24 05:50	3054	RD	6.4	167	17	264	- 0.3	+ 1.2
Aug 01 05:06	480	RD	7.3	76	33	321	- 5.1	- 5.6
Aug 09 18:33	X16100	DD	7.5	25	10	82	- 0.5	+ 1.5
Aug 11 19:49	X18570	DD	7.8	52	21	96	- 0.6	+ 0.9
Aug 12 17:50	1925	DD	1.0	64	56	142	- 1.5	- 1.6
Aug 12 18:56	1925	RB	1.0	64	43	260	- 1.5	+ 1.5
Aug 13 22:04	2074	DD	7.1	80	20	82	- 0.3	+ 1.3
Aug 14 18:26	2192	MD	6.2	91	72	193	****	****
Aug 15 20:04	2353	DD	4.6	105	67	175	****	****
Aug 15 20:16	2353	RB	4.6	105	65	191	****	****
Aug 17 18:56	X25224	DD	7.5	131	63	76	- 2.1	0.0
Aug 17 23:27	X25414	DD	7.7	133	51	95	- 1.6	+ 0.7
Aug 17 23:38	2685	DD	7.0	133	48	40	- 0.7	+ 2.7
Aug 17 23:44	2687	DD	6.3	133	47	94	- 1.5	+ 0.8
Aug 17 23:45	G00031	DD	6.5	133	47	122	- 2.1	- 0.5
Aug 17 23:55	X25445	DD	7.3	133	45	99	- 1.5	+ 0.7

E.A.S.T.	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Aug 18 00:05	X25452	DD	7.7	133	43	70	- 1.0	+ 1.6
Aug 18 20:00	2830	DD	6.9	144	64	40	- 1.9	+ 2.0
Aug 19 01:43	X27180	DD	7.2	147	33	77	+ 0.7	+ 1.4
Aug 19 02:22	2856	DD	6.6	147	25	45	- 0.1	+ 2.1
Aug 19 19:25	X28225	DD	7.4	157	45	51	- 1.5	+ 0.7
Aug 19 22:22	2972	DD	6.7	158	70	128	- 3.7	- 3.3
Aug 19 22:49	2975	DD	7.0	158	70	109	- 2.9	- 1.0
Aug 20 20:27	3104	DD	6.5	169	45	93	- 1.7	- 1.1
Aug 20 22:28	3111	DD	6.9	170	64	55	- 1.9	+ 1.2
Aug 23 00:38	3371	RD	6.4	163	57	209	- 1.3	+ 2.3
Aug 24 01:00	3501	RD	4.8	152	52	312	- 6.4	- 6.0
Aug 26 01:42	196	RD	6.9	129	41	278	- 2.8	- 1.0
Aug 26 02:23	203	RD	6.9	129	44	194	- 0.7	+ 2.9
Aug 27 05:05	326	RD	6.0	117	38	270	- 2.5	+ 0.6
Aug 28 03:33	442	MD	6.9	106	36	339	****	****
Aug 30 02:05	700	RD	5.8	85	12	272	- 1.0	- 1.2
Sep 01 04:30	995	DB	4.1	61	19	81	- 1.3	- 0.8
Sep 03 04:48	X12435	RD	7.8	38	8	281	- 0.7	- 1.4
Sep 09 21:06	2034	DD	6.7	49	5	61	+ 0.3	+ 1.9
Sep 11 19:32	X22087	DD	7.5	75	50	55	- 1.2	+ 2.5
Sep 11 21:01	X22147	DD	7.7	76	32	70	- 0.6	+ 1.7
Sep 13 21:00	X24816	DD	7.1	102	55	97	- 1.8	+ 0.5
Sep 13 23:29	X24978	DD	7.4	103	25	77	- 0.4	+ 1.4
Sep 13 23:34	X24976	DD	7.5	103	24	53	- 0.1	+ 2.0
Sep 14 00:12	2649	DD	6.6	104	17	19	+ 0.8	+ 3.3
Sep 14 01:21	2658	DD	5.2	104	4	79	+ 0.3	+ 1.1
Sep 14 23:42	2808	DD	7.4	116	33	94	- 0.9	+ 1.0
Sep 15 19:49	2927	MD	7.2	127	70	160	****	****
Sep 19 21:10	3455	DD	6.4	174	42	107	- 2.5	- 2.1
Sep 20 23:43	29	RD	7.2	171	50	250	- 2.3	+ 0.6
Sep 21 03:07	X00353	RD	7.2	170	33	218	- 1.2	+ 2.5
Sep 28 01:30	X08159	RD	6.9	94	11	320	- 1.8	- 3.3
Sep 29 03:38	1060	RD	7.4	82	24	317	- 2.0	- 2.6
Sep 30 03:37	1184	RD	7.8	70	18	305	- 1.4	- 2.1
Oct 08 20:30	X21775	DD	7.1	45	12	102	- 0.2	+ 0.7
Oct 09 21:40	2436	DD	6.1	59	11	98	- 0.1	+ 0.8
Oct 10 21:39	G00024	DD	6.9	72	22	10	+ 1.2	+ 4.9
Oct 10 22:43	X24365	DD	7.6	73	10	102	- 0.1	+ 0.7
Oct 11 19:37	X26026	DD	7.0	85	57	123	- 2.6	- 1.0
Oct 11 00:50	X28991	DD	7.2	112	12	76	- 0.1	+ 1.4
Oct 14 22:29	3166	DD	4.8	123	47	11	- 0.3	+ 3.7
Oct 16 20:43	3410	DD	7.7	146	54	93	- 2.8	- 0.5
Oct 25 00:44	X07529	RD	6.5	124	23	305	- 2.2	- 2.3
Oct 26 02:54	1025	RD	7.4	113	33	305	- 2.4	- 1.8
Oct 28 02:43	1257	RD	7.5	90	24	261	- 1.5	- 0.8
Oct 28 02:48	X12657	RD	7.4	90	24	318	- 1.5	- 2.5
Nov 07 19:46	2690	DD	7.0	53	30	61	- 0.4	+ 1.8
Nov 07 19:57	2686	RB	5.2	53	27	286	- 0.8	+ 0.6
Nov 08 20:46	X27210	DD	7.6	67	28	125	- 1.3	- 0.2
Nov 08 21:04	2856	MD	6.6	67	24	161	****	****
Nov 10 20:26	3125	DD	6.9	92	48	78	- 1.6	+ 1.3
Nov 10 21:04	3128	DD	6.2	92	41	103	- 1.8	+ 0.6
Nov 12 22:57	3384	DD	7.7	117	31	66	- 1.1	+ 1.8
Nov 13 20:26	3501	DD	4.8	127	52	32	- 1.4	+ 2.3
Nov 13 21:46	3501	RB	4.8	127	46	267	- 2.4	+ 0.8
Nov 15 21:50	196	DD	6.9	150	45	34	- 1.6	+ 2.1
Nov 15 22:53	203	DD	6.9	150	41	116	- 3.2	- 0.7
Nov 19 23:12	700	RD	5.8	166	32	327	- 3.9	- 4.6
Nov 20 23:57	826	RD	6.8	155	32	230	- 1.9	+ 0.8
Nov 21 02:17	837	RD	6.1	154	35	206	- 3.5	+ 5.0
Nov 22 00:04	971	RD	7.3	144	28	247	- 1.8	- 0.1
Nov 26 02:51	1440	RD	6.7	97	34	273	- 1.8	- 1.1
Nov 29 03:10	1779	RD	6.7	59	20	338	- 0.1	- 2.7
Dec 06 20:30	2937	DD	7.6	47	15	75	- 0.1	+ 1.3
Dec 09 22:02	3342	DD	7.6	85	19	43	- 0.4	+ 2.2
Dec 11 20:29	X00353	DD	7.2	108	44	81	- 2.3	+ 1.0
Dec 24 02:18	1519	RD	6.5	116	42	292	- 1.9	- 1.4
Dec 26 01:40	X17979	RD	7.7	92	26	266	- 1.0	- 1.0
Dec 29 02:08	X20652	RD	7.2	52	7	273	+ 0.1	- 1.0
Dec 29 02:45	2122	RD	7.8	52	14	347	+ 0.7	- 3.2

MERCURY

RISE AND SET TIMES (E.A.S.T. except Adelaide C.A.S.T.)

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

MERCURY

GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

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

VENUS

RISE AND SET TIMES (E.A.S.T. except Adelaide C.A.S.T.)

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

VENUS

GEOCENTRIC POSITION (0hr UT, Epoch 2000.0)

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

MARS

RISE AND SET TIMES (E.A.S.T. except Adelaide C.A.S.T.)

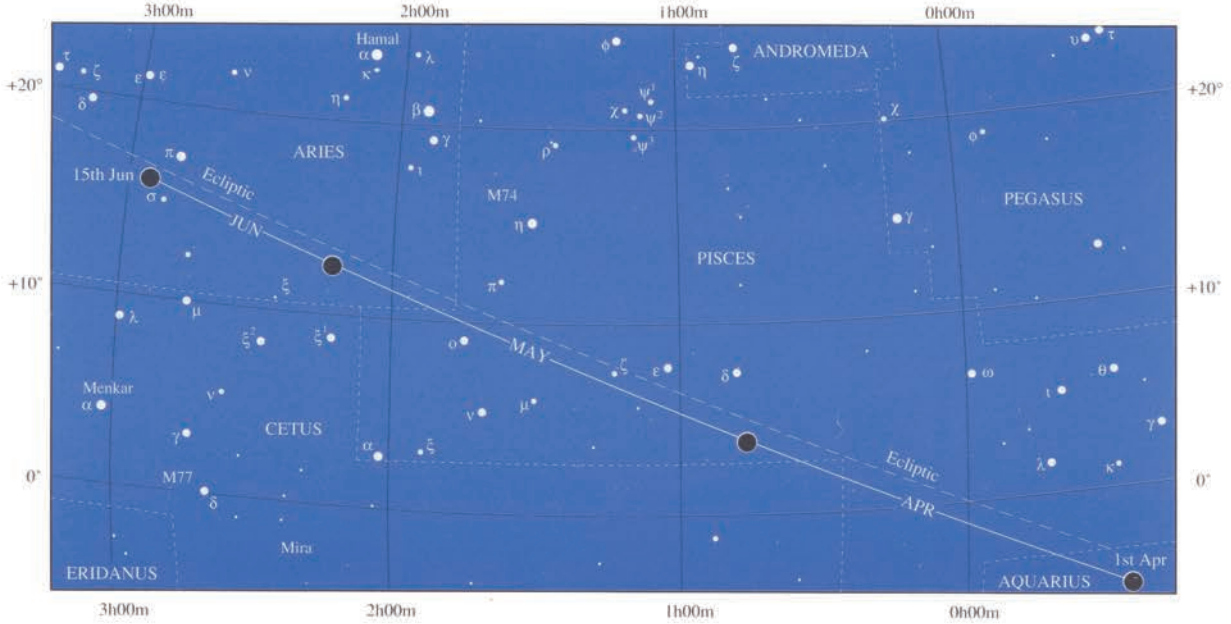
	Adelaide		Brisbane		Cairns		Canberra		Hobart		Melbourne		Sydney		Townsville	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
Jan 1	04:58	19:29	04:50	18:42	05:41	18:48	04:45	19:18	04:28	19:50	04:54	19:42	04:41	19:05	05:33	18:49
8	04:56	19:23	04:47	18:37	05:38	18:43	04:42	19:12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

POSITION

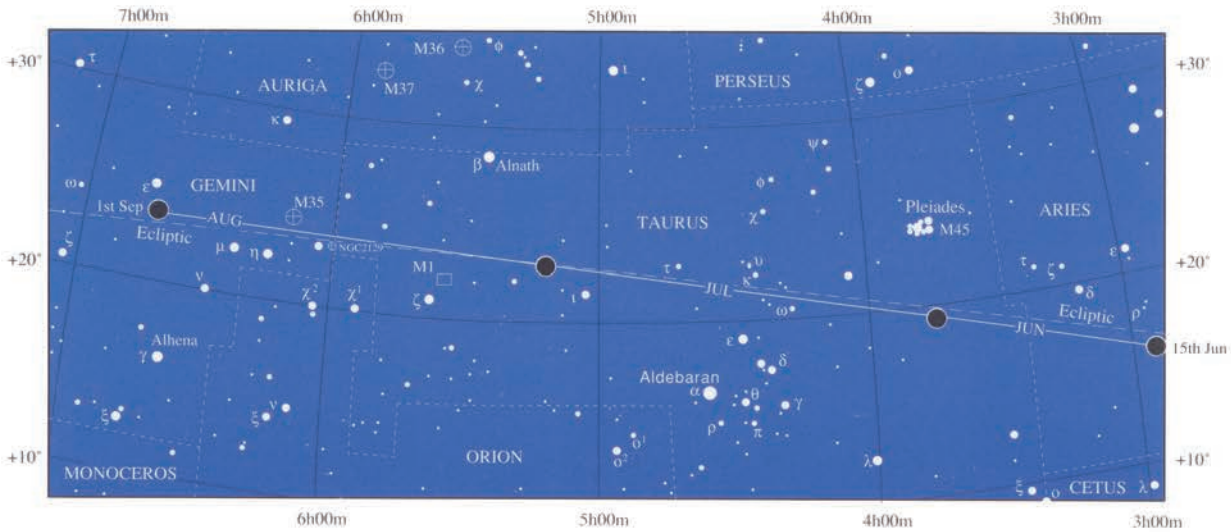
(0hrs UT Epoch 2000.0)

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

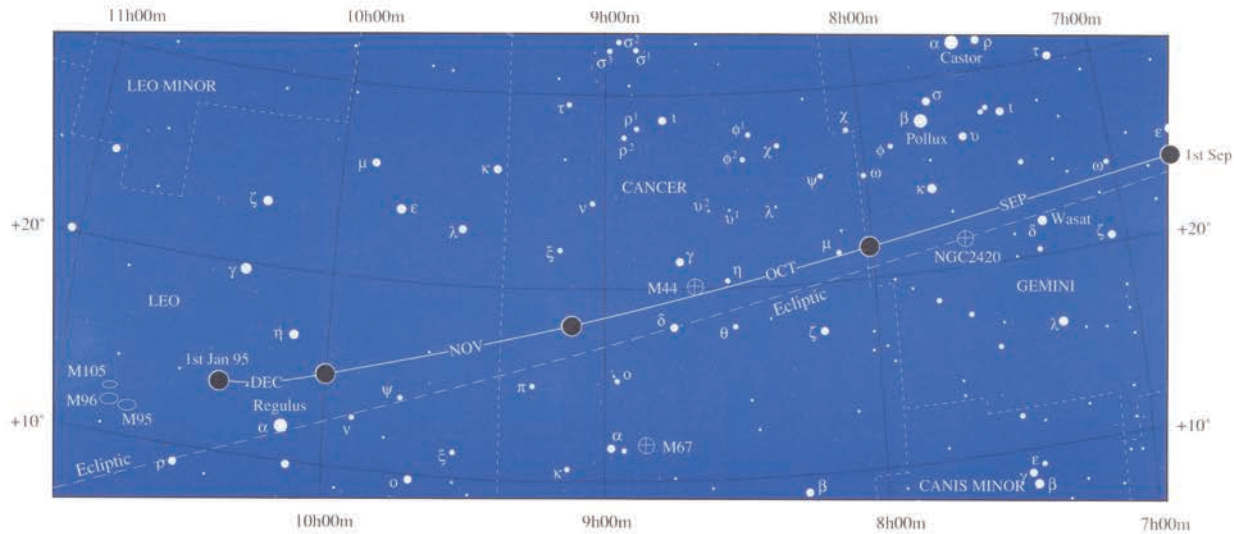
MARS FINDER CHARTS



1st April to 15th June 1994



15th June to 1st September 1994



1st September to 1st January 1995

JUPITER

RISE AND SET TIMES (E.A.S.T. except Adelaide C.A.S.T.)

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

POSITION

(0hrs UT Epoch 2000.0)

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

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 discoverer, Galileo (who proposed them to be called the 'Medicean Stars'), are bright enough to be visible to the smallest of 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 of this publication. All the moons orbit in roughly the same plane, which is very close to that of the Earth (plane of the ecliptic). 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:-

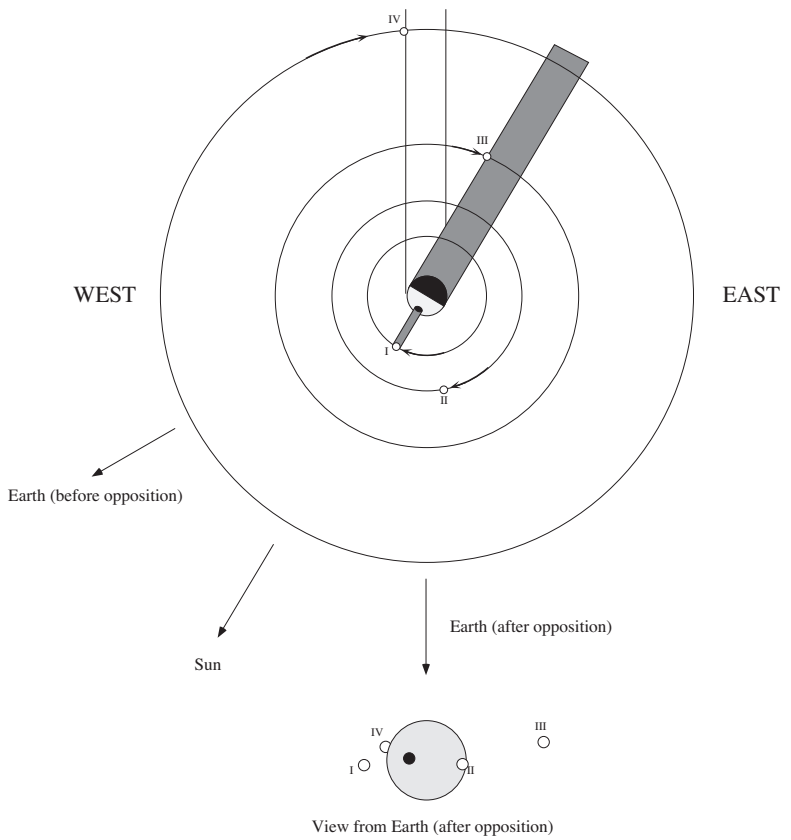
1 The satellite can appear to move across the face of Jupiter as it passes in front of the planet. This is called a **Satellite Transit.**

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 1994 is April 30.

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'scentre, is presented in tabular form on page 89.



View from Earth (after opposition)

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 1994

JUPITER SATELLITE EVENT TABLES (following 2 pages)

Legend

Column 1 Date & time (in EAST). 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 EAST)

JANUARY

1	01:11	I	Tr I
	02:17	I	Sh E
	03:21	I	Tr E
7	02:28	III	Sh E
	03:16	II	Sh I
	04:48	I	Ec D
	04:51	III	Tr I
8	02:01	I	Sh I
	03:08	I	Tr I
	04:11	I	Sh E
9	02:29	II	Oc R
	02:33	I	Oc R
14	04:11	III	Sh I
15	03:54	I	Sh I
16	00:23	II	Ec D
	01:09	I	Ec D
	02:46	II	Ec R
	02:49	II	Oc D
	04:28	I	Oc R
17	00:33	I	Sh E
	01:43	I	Tr E
18	01:11	III	Oc R
23	02:59	II	Ec D
	03:01	I	Ec D
24	00:16	I	Sh I
	01:29	I	Tr I
	02:26	I	Sh E
	03:38	I	Tr E
	23:58	II	Sh E
25	00:02	II	Tr I
	00:28	III	Ec R
	00:52	I	Oc R
	02:19	II	Tr E
	03:17	III	Oc D
30	04:54	I	Ec D
31	02:10	I	Sh I
	03:24	I	Tr I
	04:19	I	Sh E
	23:22	I	Ec D

FEBRUARY

1	00:11	II	Sh I
	02:10	III	Ec D
	02:30	II	Sh E
	02:37	II	Tr I
	02:45	I	Oc R
	04:25	III	Ec R
	04:53	II	Tr E
2	00:01	I	Tr E
	23:44	II	Oc R
7	04:03	I	Sh I
	05:17	I	Tr I
8	01:15	I	Ec D
	02:43	II	Sh I
	04:38	I	Oc R
	05:03	II	Sh E
	05:09	II	Tr I
	23:45	I	Tr I
9	00:41	I	Sh E
	01:54	I	Tr E
	23:06	I	Oc R
	23:50	II	Ec R
10	00:00	II	Oc D
	02:18	II	Oc R
12	01:11	III	Tr I
	02:56	III	Tr E
15	03:08	I	Ec D
	05:16	II	Sh I
16	00:25	I	Sh I
	01:37	I	Tr I
	02:34	I	Sh E
	03:46	I	Tr E
17	00:03	II	Ec D
	00:57	I	Oc R
	02:25	II	Ec R
	02:33	II	Oc D
	04:50	II	Oc R
18	23:10	II	Tr E
19	00:00	III	Sh I
	02:10	III	Sh E
	05:03	III	Tr I
22	05:01	I	Ec D
23	02:18	I	Sh I
	03:29	I	Tr I
	04:28	I	Sh E
	05:37	I	Tr E
	23:29	I	Ec D
24	02:39	II	Ec D
	02:47	I	Oc R
	05:01	II	Ec R
	05:03	II	Oc D
	21:56	I	Tr I
	22:56	I	Sh E
25	00:04	I	Tr E
	23:22	II	Tr I
	23:25	II	Sh E
26	01:37	II	Tr E
	03:57	III	Sh I

MARCH

1	22:44	III	Oc D
2	00:24	III	Oc R
	04:12	I	Sh I
	05:19	I	Tr I
3	01:22	I	Ec D
	04:37	I	Oc R
	05:14	II	Ec D
	22:40	I	Sh I
	23:46	I	Tr I
4	00:50	I	Sh E
	01:54	I	Tr E
	23:04	I	Oc R
	23:38	II	Sh I
5	01:48	II	Tr I
	01:58	II	Sh E
	04:02	II	Tr E
6	23:01	II	Oc R
8	21:56	III	Ec D
9	00:07	III	Ec R
	02:24	III	Oc D
	04:02	III	Oc R
10	03:15	I	Ec D
11	00:34	I	Sh I
	01:35	I	Tr I
	02:43	I	Sh E
	03:43	I	Tr E
	21:43	I	Ec D
12	00:52	I	Oc R
	02:11	II	Sh I
	04:11	II	Tr I
	04:31	II	Sh E
	21:12	I	Sh E
	22:10	I	Tr E
13	21:08	II	Ec D
14	01:26	II	Oc R
16	01:55	III	Ec D
	04:05	III	Ec R
17	05:08	I	Ec D
18	02:27	I	Sh I
	03:22	I	Tr I
	04:37	I	Sh E
	05:30	I	Tr E
	23:36	I	Ec D
19	02:39	I	Oc R
	04:44	II	Sh I
	20:55	I	Sh I
	21:16	III	Tr E
	21:49	I	Tr I
	23:05	I	Sh E
	23:57	I	Tr E
20	21:05	I	Oc R
	23:43	II	Ec D
21	03:48	II	Oc R
22	20:21	II	Sh E
	21:57	II	Tr E
23	05:52	III	Ec D
25	04:20	I	Sh I
	05:09	I	Tr I
26	01:29	I	Ec D
	04:25	I	Oc R
	19:48	III	Sh I
	21:55	III	Sh E
	22:49	I	Sh I
	23:11	III	Tr I
	23:35	I	Tr I
27	00:43	III	Tr E
	00:59	I	Sh E
	01:43	I	Tr E
	19:58	I	Ec D
	22:51	I	Oc R
28	02:19	II	Ec D
	06:08	II	Oc R
	20:10	I	Tr E
29	21:34	II	Sh I
	22:01	II	Tr I
	22:54	II	Sh E
30	00:15	II	Tr E

APRIL

2	03:23	I	Ec D
	06:10	I	Oc R
	23:45	III	Sh I
3	00:42	I	Sh I
	01:21	I	Tr I
	01:53	III	Sh E
	02:36	III	Tr I
	02:52	I	Sh E
	03:29	I	Tr E
	04:08	III	Tr E
	21:51	I	Ec D
4	00:36	I	Oc R
	04:54	II	Ec D
	19:11	I	Sh I
	19:47	I	Tr I
	21:21	I	Sh E
	21:55	I	Tr E
5	23:07	II	Sh I
6	00:18	II	Tr I
	01:28	II	Sh E
	02:32	II	Tr E
7	21:35	II	Oc R
9	05:16	I	Ec D
10	02:36	I	Sh I
	03:06	I	Tr I
	03:44	III	Sh I
	04:46	I	Sh E
	05:14	I	Tr E
	05:51	III	Sh E
	05:57	III	Tr I
	23:44	I	Ec D
11	02:21	I	Oc R
	21:05	I	Sh I
	21:32	I	Tr I
	23:15	I	Sh E
	23:40	I	Tr E
12	20:47	I	Oc R
13	01:41	II	Sh I
	02:34	II	Tr I
	04:02	II	Sh E
	04:48	II	Tr E
	21:13	III	Oc R
14	20:47	II	Ec D
	23:51	II	Oc R
17	04:30	I	Sh I
	04:50	I	Tr I
18	01:38	I	Ec D
	04:05	I	Oc R
	22:58	I	Sh I
	23:16	I	Tr I
19	01:08	I	Sh E
	01:24	I	Tr E
	20:06	I	Ec D
	22:31	I	Oc R
20	04:15	II	Sh I
	04:48	II	Tr I
	19:37	I	Sh E
	19:50	I	Tr E
	21:43	III	Ec D
21	00:32	III	Oc R
	23:23	II	Ec D
22	02:06	II	Oc R
23	17:56	II	Tr I
	19:54	II	Sh E
	20:10	II	Tr E
24	06:24	I	Sh I
25	03:32	I	Ec D
	05:49	I	Oc R
26	00:52	I	Sh I
	01:00	I	Tr I
	03:02	I	Sh E
	03:08	I	Tr E
	22:00	I	Ec D
27	00:15	I	Oc R
	19:21	I	Sh I
	19:26	I	Tr I
	21:31	I	Sh E
	21:34	I	Tr E
28	01:41	III	Ec D
	03:50	III	Oc R
	18:41	I	Oc R
29	01:58	II	Ec D
	04:21	II	Oc R
30	20:07	II	Sh I
	20:10	II	Tr I
	22:25	II	Tr E
	22:28	II	Sh E

MAY

1	17:25	III	Tr E
	17:44	III	Sh E
2	05:24	I	Oc D
	17:38	II	Ec R
3	02:44	I	Tr I
	02:46	I	Sh I
	04:52	I	Tr E
	04:56	I	Sh E
	23:50	I	Oc D
4	02:04	I	Ec R
	21:10	I	Tr I
	21:15	I	Sh I
	23:18	I	Tr E
	23:25	I	Sh E
5	05:26	III	Oc D
	18:16	I	Oc D
	20:33	I	Ec R
6	04:20	II	Oc D
	17:44	I	Tr E
	17:53	I	Sh E
7	22:24	II	Tr I
	22:42	II	Sh I
8	00:40	II	Tr E
	01:03	II	Sh E
	19:01	III	Tr I
	19:37	III	Sh I
	20:43	III	Tr E
	21:42	III	Sh E
9	17:28	II	Oc D
	20:13	II	Ec R
10	04:28	I	Tr I
	04:41	I	Sh I
11	01:34	I	Oc D
	03:58	I	Ec R
	22:54	I	Tr I
	23:09	I	Sh I
12	01:02	I	Tr E
	01:19	I	Sh E
	20:00	I	Oc D
	22:27	I	Ec R

JUPITER SATELLITE EVENTS (Times are EAST)

13	17:20	I	Tr I
	17:38	I	Sh I
	19:28	I	Tr E
	19:48	I	Sh E
15	00:39	II	Tr I
	01:17	II	Sh I
	02:55	II	Tr E
	03:39	II	Sh E
	22:17	III	Tr I
	23:35	III	Sh I
16	00:03	III	Tr E
	01:40	III	Sh E
	19:43	II	Oc D
	22:48	II	Ec R
18	03:18	I	Oc D
19	00:38	I	Tr I
	01:03	I	Sh I
	02:47	I	Tr E
	03:13	I	Sh E
	21:45	I	Oc D
20	00:21	I	Ec R
	19:05	I	Tr I
	19:32	I	Sh I
	21:13	I	Tr E
	21:42	I	Sh E
21	18:50	I	Ec R
22	02:55	II	Tr I
	03:53	II	Sh I
23	01:34	III	Tr I
	03:25	III	Tr E
	03:34	III	Sh I
	21:59	II	Oc D
24	01:24	II	Ec R
25	17:10	II	Sh I
	18:20	II	Tr E
	19:32	II	Sh E
26	02:23	I	Tr I
	02:58	I	Sh I
	04:32	I	Tr E
	17:11	III	Oc R
	17:36	III	Ec D
	19:41	III	Ec R
	23:30	I	Oc D
27	02:16	I	Ec R
	20:50	I	Tr I
	21:27	I	Sh I
	22:59	I	Tr E
	23:36	I	Sh E
28	17:56	I	Oc D
	20:44	I	Ec R
29	17:25	I	Tr E
	18:05	I	Sh E
31	00:17	II	Oc D
	03:59	II	Ec R

JUNE

1	18:21	II	Tr I
	19:46	II	Sh I
	20:39	II	Tr E
	22:08	II	Sh E
2	04:09	I	Tr I
	18:39	III	Oc D
	20:37	III	Oc R
	21:34	III	Ec D
	23:39	III	Ec R
3	01:16	I	Oc D
	17:17	II	Ec R
	22:36	I	Tr I
	23:21	I	Sh I
4	00:45	I	Tr E
	01:30	I	Sh E
	19:42	I	Oc D
	22:39	I	Ec R
5	17:03	I	Tr I
	17:50	I	Sh I
	19:12	I	Tr E
	19:59	I	Sh E
6	17:08	I	Ec R
7	02:36	II	Oc D
8	20:41	II	Tr I
	22:22	II	Sh I
	23:00	II	Tr E
9	00:44	II	Sh E
	22:05	III	Oc D
10	00:06	III	Oc R
	01:33	III	Ec D
	03:03	I	Oc D
	03:38	III	Ec R
	19:52	II	Ec R
11	00:23	I	Tr I
	01:16	I	Sh I
	02:32	I	Tr E
	03:25	I	Sh E
	21:30	I	Oc D
12	00:34	I	Ec R
	18:50	I	Tr I
	19:44	I	Sh I
	20:59	I	Tr E
	21:53	I	Sh E
13	17:34	III	Sh E
	19:03	I	Ec R
15	23:04	II	Tr I
16	00:59	II	Sh I
	01:23	II	Tr E
17	01:35	III	Oc D
	18:08	II	Oc D
	22:27	II	Ec R
18	02:12	I	Tr I
	23:18	I	Oc D
19	02:29	I	Ec R
	20:39	I	Tr I
	21:39	I	Sh I
	22:48	I	Tr E
	23:48	I	Sh E
20	17:24	III	Tr E
	17:45	I	Oc D
	19:30	III	Sh I
	20:57	I	Ec R
	21:32	III	Sh E
21	17:15	I	Tr E
	18:16	I	Sh E
23	01:28	II	Tr I
24	20:32	II	Oc D
25	01:02	II	Ec R
26	01:07	I	Oc D
	17:02	II	Tr E
	19:16	II	Sh E
	22:28	I	Tr I
	23:33	I	Sh I
27	00:37	I	Tr E
	01:42	I	Sh E
	18:56	III	Tr I
	19:35	I	Oc D
	21:03	III	Tr E
	22:52	I	Ec R
	23:29	III	Sh I
28	01:30	III	Sh E
	18:02	I	Sh I
	19:05	I	Tr E
	20:11	I	Sh E
29	17:21	I	Ec R

JULY

1	22:58	II	Oc D
3	17:09	II	Tr I
	19:31	II	Tr E
	19:31	II	Sh I
	21:53	II	Sh E
4	00:19	I	Tr I
	01:28	I	Sh I
	21:26	I	Oc D
	22:37	III	Tr I
5	00:47	III	Tr E
	00:48	I	Ec R
	18:47	I	Tr I
	19:57	I	Sh I
	20:56	I	Tr E
	22:05	I	Sh E
6	19:16	I	Ec R
8	17:31	III	Ec D
	19:34	III	Ec R
9	01:26	II	Oc D
10	19:40	II	Tr I
	22:02	II	Tr E
	22:08	II	Sh I
11	00:30	II	Sh E
	23:18	I	Oc D
12	17:08	II	Ec D
	19:30	II	Ec R
	20:39	I	Tr I
	21:51	I	Sh I
	22:48	I	Tr E
13	00:00	I	Sh E
	17:46	I	Oc D
	21:12	I	Ec R
14	17:16	I	Tr E
	18:29	I	Sh E
15	18:37	III	Oc R
	21:30	III	Ec D
	23:33	III	Ec R
17	22:12	II	Tr I
18	00:35	II	Tr E
	00:45	II	Sh I
19	17:12	II	Oc D
	19:35	II	Oc R
	19:42	II	Ec D
	22:04	II	Ec R
	22:32	I	Tr I
	23:46	I	Sh I
20	00:41	I	Tr E
	19:40	I	Oc D
	23:07	I	Ec R
21	18:15	I	Sh I
	19:09	I	Tr E
	20:23	I	Sh E
22	17:36	I	Ec R
	20:13	III	Oc D
	22:31	III	Oc R
26	17:26	III	Sh E
	19:45	II	Oc D
	22:09	II	Oc R
	22:17	II	Ec D
27	00:26	I	Tr I
	21:34	I	Oc D
28	18:54	I	Tr I
	19:03	II	Sh E
	20:10	I	Sh I
	21:03	I	Tr E
	22:18	I	Sh E
29	19:31	I	Ec R
30	00:10	III	Oc D

AUGUST

2	19:25	III	Sh I
	21:25	III	Sh E
	22:20	II	Oc D
3	23:30	I	Oc D
4	19:07	II	Tr E
	19:19	II	Sh I
	20:49	I	Tr I
	21:40	II	Sh E
	22:04	I	Sh I
	22:58	I	Tr E
5	17:59	I	Oc D
	21:26	I	Ec R
6	17:27	I	Tr E
	18:41	I	Sh E
9	18:10	III	Tr I
	20:29	III	Tr E
	23:24	III	Sh I
11	19:23	II	Tr I
	21:47	II	Tr E
	21:56	II	Sh I
	22:45	I	Tr I
12	19:55	I	Oc D
	23:22	I	Ec R
13	18:28	I	Sh I
	19:06	II	Ec R
	19:24	I	Tr E
	20:36	I	Sh E
14	17:50	I	Ec R
16	22:16	III	Tr I
18	22:04	II	Tr I
19	21:53	I	Oc D
20	19:11	I	Tr I
	19:30	III	Ec R
	20:22	I	Sh I
	21:21	I	Tr E
	21:41	II	Ec R
	22:31	I	Sh E
21	19:46	I	Ec R
27	18:59	III	Oc R
	19:35	II	Oc D
	21:09	I	Tr I
	21:27	III	Ec D
	22:17	I	Sh I
28	18:20	I	Oc D
	21:41	I	Ec R
29	17:48	I	Tr E
	18:53	II	Sh E
	18:54	I	Sh E

SEPTEMBER

3	20:51	III	Oc D
	22:17	II	Oc D
4	20:19	I	Oc D
5	18:40	I	Sh I
	19:08	II	Sh I
	19:21	II	Tr E
	19:46	I	Tr E
	20:49	I	Sh E
	21:31	II	Sh E
6	18:05	I	Ec R
12	19:35	I	Tr I
	19:42	II	Tr I
	20:34	I	Sh I
	21:45	I	Tr E
	21:45	II	Sh I
13	20:00	I	Ec R
14	18:42	II	Ec R
	19:19	III	Sh I
	21:19	III	Sh E
20	18:49	I	Oc D
21	18:14	I	Tr E
	19:06	I	Sh E
	19:32	III	Tr I
	21:16	II	Ec R
27	20:50	I	Oc D
28	18:04	I	Tr I
	18:52	I	Sh I
	19:51	II	Oc D
	20:14	I	Tr E
	21:01	I	Sh E
29	18:19	I	Ec R
30	18:42	II	Sh E

OCTOBER

2	19:25	III	Ec R
5	20:04	I	Tr I
6	20:14	I	Ec R
7	18:55	II	Sh I
	19:59	II	Tr E
9	18:37	III	Oc D
13	19:22	I	Oc D
14	18:45	I	Tr E
	19:18	I	Sh E
16	18:17	II	Ec R
21	18:35	I	Tr I
	19:03	I	Sh I
22	18:32	I	Ec R
27	19:11	III	Sh I

NOVEMBER

1	18:28	II	Sh E
8	18:40	II	Sh I
14	18:44	I	Ec R
26	04:33	I	Sh I
	04:41	I	Tr I

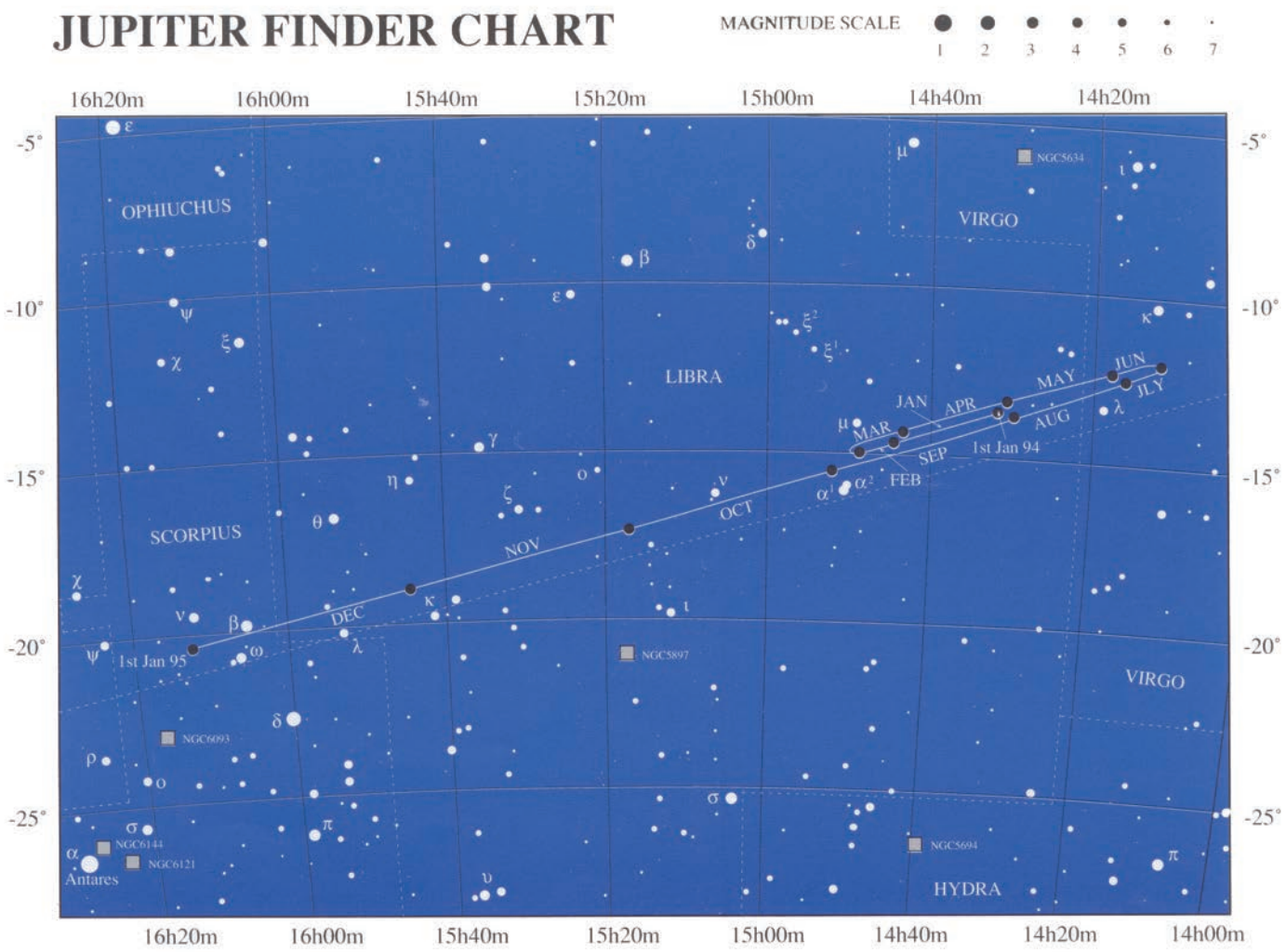
DECEMBER

19	04:43	I	Sh I
23	04:20	II	Ec D
24	02:57	III	Sh I
25	03:09	II	Tr E
27	03:57	I	Ec D
28	03:15	I	Sh E
	03:54	I	Tr E

JUPITER ECLIPSE CO-ORDINATES

MONTH	I Ec D	I Ec R	2 Ec D	2 Ec R	3 Ec D	3 Ec R
Jan	1.9W - 0.3S	—	2.4W - 0.6S	0.8 W - 0.6S	3.2W - 0.8S	2.0W - 0.8S
Feb	2.0W - 0.3S	—	2.5W - 0.6S	0.9W - 0.6S	3.3 W - 0.8S	2.1W - 0.8S
Mar	1.7W - 0.3S	—	2.1W - 0.6S	—	2.7W - 0.8S	1.5W - 0.8S
Apr	1.2W - 0.3S	—	1.3W - 0.65	—	1.5W - 0.8S	—
May	—	1.3E - 0.3S	—	1.3E - 0.6S	—	1.2E - 0.85
Jun	—	1.8E - 0.3S	—	2.2E - 0.5S	1.6E - 0.8S	2.7E - 0.85
Jul	—	2.0E - 0.3S	0.9E - 0.5S	2.5E - 0.5S	2.2E - 0.7S	3.3E - 0.7S
Aug	—	2.0E - 0.3S	0.9E - 0.5S	2.5E - 0.5S	2.2E - 0.7S	3.3E - 0.7S
Sep	—	1.8E - 0.3S	—	2.2E - 0.5S	1.5E - 0.7S	2.6E - 0.7S
Oct	—	1.4E - 0.3S	—	1.6E - 0.5S	—	1.7E - 0.7S
Nov	—	1.0E - 0.3S	—	0.9E - 0.5S	—	0.7E - 0.7S
Dec	1.3W - 0.3S	—	1.5W - 0.5S	—	1.5W - 0.7S	—

The co-ordinates to the left are offsets from the centre of Jupiter. The units are"Jupiter Radii". These figures are graphically represented at the bottom of the "Jupiter'sMoons" diagrams. (see part 1).



JUPITER — LONGITUDE OF CENTRAL MERIDIAN

SYSTEM I (0hr UT)

DATE	JAN °	FEB °	MAR °	APR °	MAY °	JUN °	JUL °	AUG °	SEP °	OCT °	NOV °	DEC °	DATE
1	278.6	132.2	234.5	092.8	153.9	011.7	068.4	279.6	128.5	178.4	025.9	076.3	1
2	076.4	290.1	032.4	250.8	312.0	169.6	226.2	077.3	286.1	336.1	183.6	234.0	2
3	234.2	088.0	190.4	048.8	110.0	327.6	024.0	235.1	083.8	133.8	341.2	031.7	3
4	032.1	245.9	348.4	206.9	268.0	125.5	181.8	032.8	241.5	291.4	138.9	189.4	4
5	189.9	043.8	146.4	004.9	066.0	283.4	339.7	190.5	039.2	089.1	296.6	347.1	5
6	347.7	201.7	304.4	163.0	224.1	081.4	137.5	348.3	196.8	246.7	094.2	144.8	6
7	145.5	359.6	102.4	321.0	022.1	239.3	295.3	146.0	354.5	044.4	251.9	302.5	7
8	303.4	157.6	260.4	119.0	180.1	037.2	093.1	303.7	152.2	202.0	049.6	100.2	8
9	101.2	315.5	058.4	277.1	338.1	195.1	250.9	101.4	309.9	359.7	207.2	257.9	9
10	259.0	113.4	216.3	075.1	136.1	353.0	048.7	259.2	107.5	157.4	004.9	055.6	10
11	056.9	271.3	014.3	233.2	294.1	151.0	206.5	056.9	265.2	315.0	162.6	213.3	11
12	214.7	069.3	172.3	031.2	092.1	308.9	004.3	214.6	062.9	112.7	320.3	011.0	12
13	012.6	227.2	330.4	189.2	250.1	106.8	162.1	012.3	220.5	270.3	117.9	168.7	13
14	170.4	025.1	128.4	347.3	048.1	264.7	319.9	170.0	018.2	068.0	275.6	326.5	14
15	328.3	183.1	286.4	145.3	206.1	062.6	117.7	327.7	175.9	225.7	073.3	124.2	15
16	126.1	341.0	084.4	303.4	004.1	220.4	275.5	125.4	333.5	023.3	231.0	281.9	16
17	284.0	138.9	242.4	101.4	162.1	018.3	073.3	283.1	131.2	181.0	028.6	079.6	17
18	081.9	296.9	040.4	259.5	320.1	176.2	231.0	080.8	288.9	338.6	186.3	237.3	18
19	239.7	094.8	198.4	057.5	118.1	334.1	028.8	238.5	086.5	136.3	344.0	035.1	19
20	037.6	252.8	356.4	215.5	276.1	132.0	186.6	036.2	244.2	293.9	141.7	192.8	20
21	195.5	050.7	154.5	013.6	074.1	289.8	344.3	193.9	041.9	091.6	299.4	350.5	21
22	353.3	208.7	312.5	171.6	232.1	087.7	142.1	351.6	199.5	249.3	097.1	148.2	22
23	151.2	006.7	110.5	329.7	030.0	245.6	299.9	149.3	357.2	046.9	254.7	306.0	23
24	309.1	164.6	268.5	127.7	188.0	043.4	097.6	307.0	154.8	204.6	052.4	103.7	24
25	107.0	322.6	066.5	285.7	346.0	201.3	255.4	104.7	312.5	002.2	210.1	261.4	25
26	264.8	120.5	224.6	083.8	144.0	359.1	053.1	262.4	110.2	159.9	007.8	059.2	26
27	062.7	278.5	022.6	241.8	301.9	157.0	210.9	060.1	267.8	317.6	165.5	216.9	27
28	220.6	076.5	180.6	039.8	099.9	314.8	008.6	217.7	065.5	115.2	323.2	014.6	28
29	018.5		338.7	197.9	257.8	112.7	166.4	015.4	223.1	272.9	120.9	172.4	29
30	176.4		136.7	355.9	055.8	270.5	324.1	173.1	020.8	070.6	278.6	330.1	30
31	334.3		294.7		213.7		121.9	330.8		228.2		127.9	31

SYSTEM II (0hr UT)

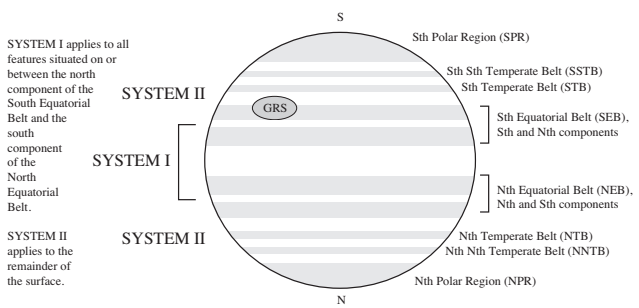
DATE	JAN °	FEB °	MAR °	APR °	MAY °	JUN °	JUL °	AUG °	SEP °	OCT °	NOV °	DEC °	DATE
1	056.2	033.2	281.9	263.6	095.9	077.1	264.9	239.6	212.0	033.1	004.0	185.5	1
2	206.4	183.5	072.2	054.0	246.3	227.4	055.1	029.7	002.0	183.1	154.0	335.5	2
3	356.6	333.8	222.5	204.4	036.7	017.7	205.3	179.8	152.1	333.1	304.1	125.6	3
4	146.8	124.1	012.9	354.8	187.1	168.0	355.5	329.9	302.1	123.2	094.1	275.7	4
5	297.0	274.3	163.3	145.2	337.5	318.3	145.7	120.0	092.2	273.2	244.1	065.8	5
6	087.2	064.6	313.6	295.6	127.8	108.6	295.9	270.1	242.2	063.2	034.2	215.8	6
7	237.4	214.9	104.0	086.1	278.2	258.9	086.0	060.2	032.3	213.2	184.2	005.9	7
8	027.6	005.2	254.3	236.5	068.6	049.2	236.2	210.3	182.3	003.3	334.3	156.0	8
9	177.8	155.5	044.7	026.9	219.0	199.5	026.4	000.4	332.3	153.3	124.3	306.0	9
10	328.0	305.8	195.1	177.3	009.4	349.8	176.6	150.5	122.4	303.3	274.3	096.1	10
11	118.2	096.1	345.4	327.7	159.8	140.1	326.7	300.6	272.4	093.3	064.4	246.2	11
12	268.4	246.4	135.8	118.1	310.1	290.3	116.9	090.7	062.5	243.4	214.4	036.3	12
13	058.6	036.7	286.2	268.5	100.5	080.6	267.1	240.8	212.5	033.4	004.5	186.4	13
14	208.8	187.0	076.5	058.9	250.9	230.9	057.2	030.8	002.5	183.4	154.5	336.5	14
15	359.1	337.3	226.9	209.4	041.3	021.2	207.4	180.9	152.6	333.5	304.6	126.5	15
16	149.3	127.6	017.3	359.8	191.6	171.4	357.6	331.0	302.6	123.5	094.6	276.6	16
17	299.5	277.9	167.7	150.2	342.0	321.7	147.7	121.1	092.6	273.5	244.7	066.7	17
18	089.7	068.2	318.1	300.6	132.4	111.9	297.9	271.1	242.7	063.5	034.7	216.8	18
19	240.0	218.5	108.5	091.0	282.7	262.2	088.0	061.2	032.7	213.6	184.8	006.9	19
20	030.2	008.9	258.8	241.4	073.1	052.4	238.1	211.3	182.7	003.6	334.8	157.0	20
21	180.4	159.2	049.2	031.8	223.4	202.7	028.3	001.3	332.8	153.6	124.9	307.1	21
22	330.7	309.5	199.6	182.2	013.8	352.9	178.4	151.4	122.8	303.7	274.9	097.2	22
23	120.9	099.8	350.0	332.6	164.1	143.1	328.6	301.5	272.8	093.7	065.0	247.3	23
24	271.2	250.2	140.4	123.0	314.5	293.4	118.7	091.5	062.9	243.7	215.0	037.4	24
25	061.4	040.5	290.8	273.5	104.8	083.6	268.8	241.6	212.9	033.8	005.1	187.5	25
26	211.7	190.8	081.2	063.9	255.1	233.8	058.9	031.6	002.9	183.8	155.2	337.6	26
27	001.9	341.2	231.6	214.3	045.5	024.0	209.1	181.7	153.0	333.8	305.2	127.7	27
28	152.2	131.5	022.0	004.7	195.8	174.3	359.2	331.8	303.0	123.9	095.3	277.8	28
29	302.4		172.4	155.1	346.1	324.5	149.3	121.8	093.0	273.9	245.3	067.9	29
30	092.7		322.8	305.5	136.5	114.7	299.4	271.9	243.0	063.9	035.4	218.0	30
31	243.0		113.2		286.8		089.5	061.9		214.0		008.2	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 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. 56

SATURN

RISE AND SET TIMES (E.A.S.T. except Adelaide C.A.S.T.)

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

POSITION

(0hrs UT Epoch 2000.0)

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

SATURN

LONGITUDE OF CENTRAL MERIDIAN (System I)

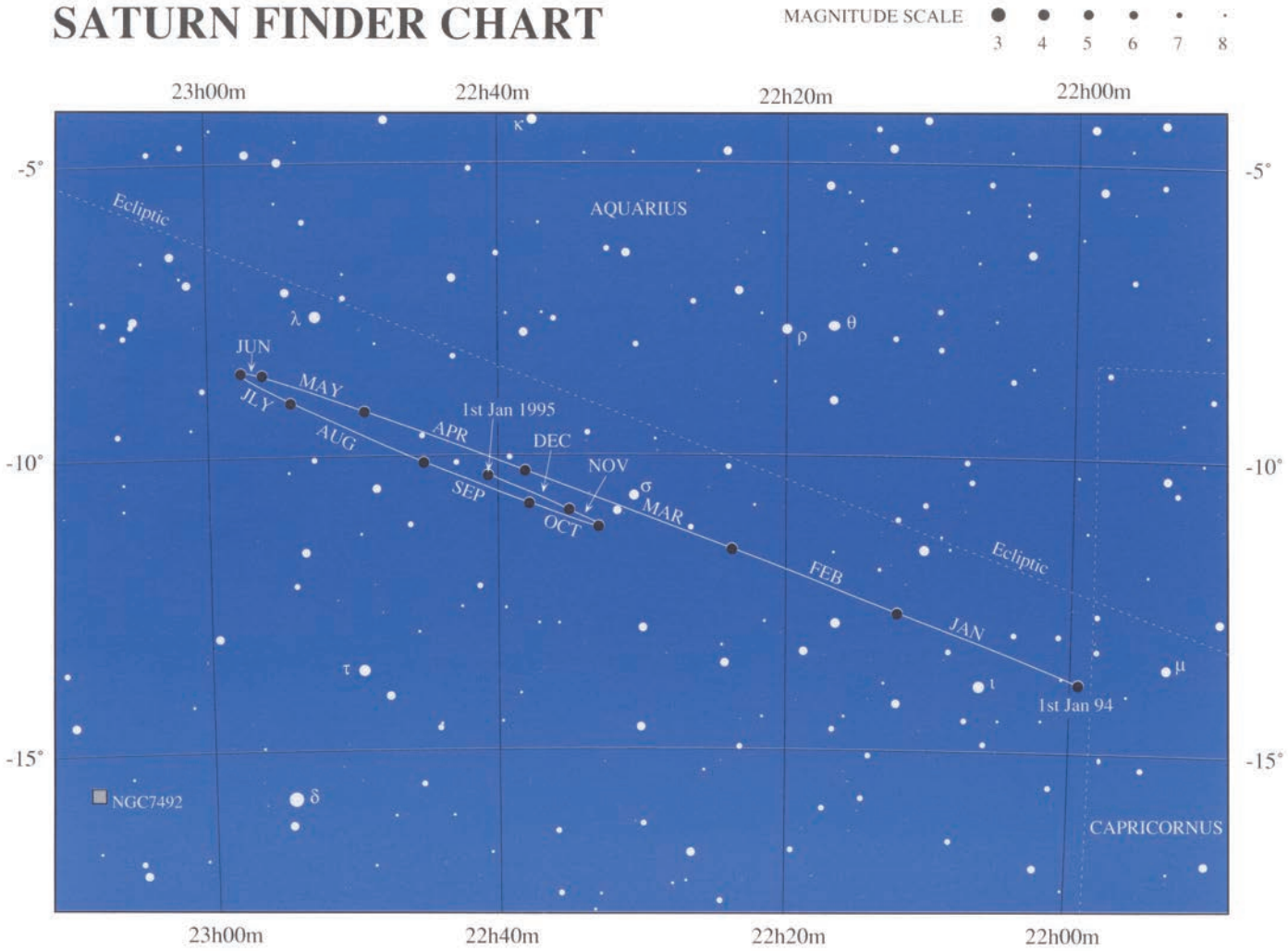
Date	JAN °	FEB °	MAR °	APR °	MAY °	JUN °
1	272.4	161.3	038.4	289.4	057.5	311.6
2	036.6	285.5	162.6	053.6	181.8	075.9
3	160.7	049.7	286.8	177.9	306.1	200.3
4	284.9	173.8	051.0	302.1	070.5	324.6
5	049.0	298.0	175.3	066.4	194.8	089.0
6	173.2	062.2	299.5	190.6	319.1	213.3
7	297.3	186.4	063.7	314.9	083.4	337.7
8	061.5	310.5	187.9	079.1	207.7	102.0
9	185.6	074.7	312.1	203.4	332.0	226.4
10	309.8	198.9	076.3	327.7	096.3	350.8
11	074.0	323.1	200.5	091.9	220.6	115.1
12	198.1	087.2	324.7	216.2	344.9	239.5
13	322.3	211.4	088.9	340.5	109.3	003.8
14	086.4	335.6	213.2	104.7	233.6	128.2
15	210.6	099.8	337.4	229.0	357.9	252.6
16	334.7	224.0	101.6	353.3	122.2	016.9
17	098.9	348.1	225.8	117.5	246.5	141.3
18	223.0	112.3	350.0	241.8	010.9	265.7
19	347.2	236.5	114.3	006.1	135.2	030.1
20	111.4	000.7	238.5	130.4	259.5	154.4
21	235.5	124.9	002.7	254.6	023.8	278.8
22	359.7	249.1	127.0	018.9	148.2	043.2
23	123.8	013.3	251.2	143.2	272.5	167.5
24	248.0	137.5	015.4	267.5	036.8	291.9
25	012.2	261.7	139.7	031.8	161.2	056.3
26	136.3	025.8	263.9	156.1	285.5	180.7
27	260.5	150.0	028.1	280.4	049.9	305.0
28	024.7	274.2	152.4	044.7	174.2	069.4
29	148.8		276.6	169.0	298.5	193.8
30	273.0		040.9	293.3	062.9	318.2
31	037.2		165.1		187.2	

Date	JUL °	AUG °	SEP °	OCT °	NOV °	DEC °
1	082.6	338.7	234.6	004.9	257.5	023.8
2	207.0	103.1	359.0	129.2	021.7	148.0
3	331.3	227.5	123.3	253.5	145.9	272.2
4	095.7	351.9	247.7	017.8	270.2	036.4
5	220.1	116.2	012.0	142.1	034.4	160.6
6	344.5	240.6	136.4	266.4	158.6	284.8
7	108.9	005.0	260.8	030.7	282.9	048.9
8	233.3	129.4	025.1	155.0	047.1	173.1
9	357.7	253.8	149.5	279.3	171.3	297.3
10	122.0	018.2	273.8	043.6	295.6	061.5
11	246.4	142.6	038.2	167.9	059.8	185.6
12	010.8	267.0	162.5	292.2	184.0	309.8
13	135.2	031.4	286.9	056.5	308.2	074.0
14	259.6	155.8	051.2	180.7	072.4	198.2
15	024.0	280.1	175.6	305.0	196.6	322.3
16	148.4	044.5	299.9	069.3	320.9	086.5
17	272.8	168.9	064.3	193.6	085.1	210.7
18	037.2	293.3	188.6	317.8	209.3	334.8
19	161.6	057.7	313.0	082.1	333.5	099.0
20	286.0	182.1	077.3	206.4	097.7	223.2
21	050.3	306.5	201.6	330.7	221.9	347.3
22	174.7	070.8	326.0	094.9	346.1	111.5
23	299.1	195.2	090.3	219.2	110.3	235.7
24	063.5	319.6	214.6	343.4	234.5	359.8
25	187.9	084.0	338.9	107.7	358.7	124.0
26	312.3	208.4	103.3	232.0	122.9	248.1
27	076.7	332.7	227.6	356.2	247.1	012.3
28	201.1	097.1	351.9	120.5	011.3	136.5
29	325.5	221.5	116.2	244.7	135.5	260.6
30	089.9	345.8	240.5	009.0	259.6	024.8
31	214.3	110.2		133.2		148.9

See part 2 Introduction (page 56) for explanation..

hr	deg°	hr	deg°	hr	deg°
1	036.6	13	115.5	5	03.0
2	073.2	14	152.1	10	06.1
3	109.7	15	188.7	15	09.1
4	146.3	16	225.3	20	12.2
5	182.9	17	261.8	25	15.2
6	219.5	18	298.4	30	18.3
7	256.1	19	335.0	35	21.3
8	292.6	20	011.6	40	24.4
9	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

SATURN FINDER CHART



SATURN'S RINGS

SATURN'S RINGS

Date	Major "	Minor "	U °	B °	Date	Major "	Minor "	U °	B °
Jan 04	36.05	7.18	200.966	+11.492	Jul 07	41.24	3.59	214.558	+04.992
Jan 12	35.76	6.90	201.709	+11.124	Jul 15	41.72	3.73	214.367	+05.127
Jan 20	35.52	6.62	202.497	+10.734	Jul 23	42.17	3.90	214.090	+05.304
Jan 28	35.33	6.33	203.321	+10.326	Jul 31	42.56	4.09	213.738	+05.519
Feb 05	35.19	6.05	204.172	+09.904	Aug 08	42.88	4.31	213.318	+05.766
Feb 13	35.10	5.78	205.041	+09.472	Aug 16	43.11	4.53	212.844	+06.036
Feb 21	35.07	5.51	205.918	+09.036	Aug 24	43.27	4.76	212.331	+06.322
Mar 01	35.10	5.25	206.795	+08.599	Sep 01	43.32	4.99	211.797	+06.614
Mar 09	35.17	5.00	207.664	+08.167	Sep 09	43.28	5.20	211.258	+06.902
Mar 17	35.30	4.76	208.516	+07.743	Sep 17	43.15	5.39	210.733	+07.178
Mar 25	35.48	4.53	209.343	+07.333	Sep 25	42.93	5.55	210.240	+07.432
Apr 02	35.71	4.32	210.136	+06.941	Oct 03	42.62	5.68	209.795	+07.655
Apr 10	35.99	4.12	210.888	+06.570	Oct 11	42.24	5.76	209.414	+07.841
Apr 18	36.32	3.94	211.592	+06.227	Oct 19	41.80	5.81	209.109	+07.984
Apr 26	36.69	3.78	212.239	+05.914	Oct 27	41.31	5.81	208.891	+08.079
May 04	37.11	3.64	212.823	+05.635	Nov 04	40.79	5.76	208.766	+08.124
May 12	37.56	3.53	213.338	+05.395	Nov 12	40.25	5.68	208.739	+08.117
May 20	38.04	3.45	213.776	+05.196	Nov 20	39.70	5.57	208.813	+08.058
May 28	38.55	3.39	214.132	+05.041	Nov 28	39.16	5.41	208.986	+07.947
Jun 05	39.09	3.36	214.402	+04.933	Dec 06	38.63	5.23	209.256	+07.787
Jun 13	39.63	3.37	214.581	+04.874	Dec 14	38.12	5.03	209.619	+07.579
Jun 21	40.18	3.41	214.667	+04.864	Dec 22	37.64	4.80	210.068	+07.327
Jun 29	40.71	3.48	214.659	+04.904	Dec 30	37.20	4.56	210.598	+07.035

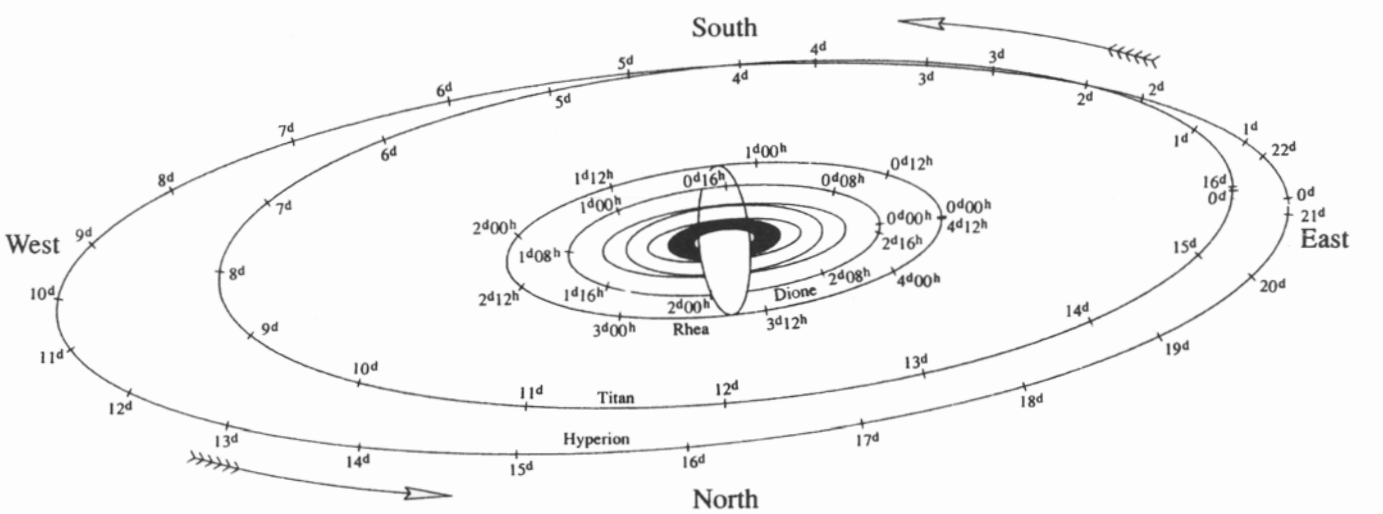
Major and Minor axes (in arc seconds) are for the outer edge of the outer ring. To work out the dimensions of the other rings, multiply by the following factors.

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.

See also the introduction to part 2 (page 56) for explanation.

SATELLITES OF SATURN



APPARENT ORBITS OF SATELLITES I - VII AT DATE OF OPPOSITION, SEPTEMBER 1

	NAME	MEAN SYNODIC PERIOD d	h		NAME	MEAN SYNODIC PERIOD d	h
I	Mimas	0	22.6	VI	Titan	15	23.3
II	Enceladus	1	08.9	VII	Hyperion	21	07.6
III	Tethys	1	21.3	VIII	Iapetus	79	22.1
IV	Dione	2	17.7	IX	Phoebe	523	15.6
V	Rhea	4	12.5				

See introduction to part 2 (page 56) for explanation of use.

TITAN (E.A.S.T.) Mean Synodic Period 15d 23.3h

Greatest Eastern Elongation	Inferior Conjunction	Greatest Western Elongation	Superior Conjunction
			Jan 1 01.2
Jan 4 21.8	Jan 9 01.3	Jan 13 04.9	Jan 17 01.4
Jan 20 22.1	Jan 25 01.8	Jan 29 05.3	Feb 2 01.8
Feb 5 22.6	Feb 10 02.4	Feb 14 05.8	Feb 18 02.2
Feb 21 23.2	Feb 26 03.1	Mar 2 06.4	Mar 6 02.7
Mar 9 23.7	Mar 14 03.7	Mar 18 06.9	Mar 22 03.1
Mar 26 00.2	Mar 30 04.3	Apr 3 07.3	Apr 7 03.3
Apr 11 00.5	Apr 15 04.6	Apr 19 07.5	Apr 23 03.4
Apr 27 00.6	May 1 04.7	May 5 07.4	May 9 03.2
May 13 00.5	May 17 04.5	May 21 07.0	May 25 02.8
May 29 00.0	Jun 2 03.9	Jun 6 06.3	Jun 10 01.9
Jun 13 23.1	Jun 18 03.0	Jun 22 05.2	Jun 26 00.8
Jun 29 21.8	Jul 4 01.6	Jul 8 03.7	Jul 11 23.2
Jul 15 20.1	Jul 19 23.8	Jul 24 01.9	Jul 27 21.3
Jul 31 18.1	Aug 4 21.7	Aug 8 23.8	Aug 12 19.2
Aug 16 15.8	Aug 20 19.3	Aug 24 21.4	Aug 28 16.8
Sep 1 13.4	Sep 5 16.8	Sep 9 19.0	Sep 13 14.4
Sep 17 10.9	Sep 21 14.4	Sep 25 16.6	Sep 29 12.2
Oct 3 08.7	Oct 7 12.1	Oct 11 14.5	Oct 15 10.1
Oct 19 06.7	Oct 23 10.1	Oct 27 12.7	Oct 31 08.4
Nov 4 05.0	Nov 8 08.6	Nov 12 11.3	Nov 16 07.1
Nov 20 03.8	Nov 24 07.4	Nov 28 10.2	Dec 2 06.1
Dec 6 03.0	Dec 10 06.8	Dec 14 09.6	Dec 18 05.6
Dec 22 02.6	Dec 26 06.5	Dec 30 09.4	

IAPETUS (E.A.S.T.) Mean Synodic Period 79d 22.1h

Greatest Eastern Elongation	Inferior Conjunction	Greatest Western Elongation	Superior Conjunction
Jan 15 11.1	Feb 4 20.9	Feb 26 06.8	Mar 18 10.3
Apr 6 17.4	Apr 27 05.1	May 18 08.7	Jun 7 01.5
Jun 25 23.9	Jul 16 00.9	Aug 5 15.0	Aug 24 21.4
Sep 12 11.4	Oct 2 05.7	Oct 22 20.8	Nov 11 10.2
Nov 30 08.6	Dec 20 14.7		

HYPERION (E.A.S.T.) Mean Synodic Period 21d 7.6h

Greatest Eastern Elongation	Inferior Conjunction	Greatest Western Elongation	Superior Conjunction
Jan 2 08.0	Jan 6 22.1	Jan 12 04.5	Jan 18 07.9
Jan 23 15.1	Jan 28 05.1	Feb 2 12.7	Feb 8 16.1
Feb 13 22.0	Feb 18 12.0	Feb 23 20.9	Mar 2 00.0
Mar 7 04.7	Mar 11 18.9	Mar 17 04.8	Mar 23 07.8
Mar 28 11.3	Apr 2 01.5	Apr 7 12.4	Apr 13 15.1
Apr 18 17.4	Apr 23 07.6	Apr 28 19.6	May 4 21.8
May 9 23.1	May 14 13.3	May 20 02.2	May 26 04.1
May 31 04.4	Jun 4 18.7	Jun 10 08.0	Jun 16 09.8
Jun 21 09.4	Jun 25 23.5	Jul 1 13.2	Jul 7 14.8
Jul 12 13.9	Jul 17 03.8	Jul 22 17.9	Jul 28 19.4
Aug 2 18.1	Aug 7 07.8	Aug 12 22.1	Aug 18 23.8
Aug 23 22.4	Aug 28 11.9	Sep 3 02.4	Sep 9 04.5
Sep 14 03.1	Sep 18 16.6	Sep 24 07.2	Sep 30 10.0
Oct 5 08.7	Oct 9 22.1	Oct 15 13.0	Oct 21 16.4
Oct 26 15.2	Oct 31 04.7	Nov 5 20.5	Nov 12 00.4
Nov 16 23.1	Nov 21 12.7	Nov 27 05.5	Dec 3 09.9
Dec 8 08.2	Dec 12 22.3	Dec 18 16.1	Dec 24 20.6
Dec 29 18.5			

TIMES OF GREATEST EASTERN ELONGATION (E.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
4 23.6	1 03.0	4 19.0	5 10.8	2 14.0	3 05.3	4 20.3	5 10.8	1 12.8	3 03.2	3 17.9	5 09.0
9 12.1	5 15.5	9 07.5	9 23.4	7 02.5	7 17.8	9 08.7	9 23.1	6 01.1	7 15.5	8 06.3	9 21.5
14 00.7	10 04.1	13 20.1	14 11.9	11 15.0	12 06.2	13 21.0	14 11.5	10 13.5	12 03.9	12 18.7	14 10.0
18 13.2	14 16.7	18 08.6	19 00.4	16 03.5	16 18.6	18 09.4	18 23.8	15 01.8	16 16.3	17 07.2	18 22.5
23 01.8	19 05.2	22 21.2	23 12.9	20 15.9	21 07.1	22 21.8	23 12.1	19 14.1	21 04.7	21 19.6	23 11.0
27 14.4	23 17.8	27 09.7	28 01.5	25 04.4	25 19.5	27 10.1	28 00.5	24 02.5	25 17.0	26 08.1	27 23.6
	28 06.4	31 22.3		29 16.9	30 07.9	31 22.5		28 14.8	30 05.5	30 20.6	

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
1 13.7	3 10.6	2 20.0	1 23.0	2 02.0	1 04.8	1 07.3	3 03.3	2 05.5	2 07.7	1 10.1	1 12.8
4 07.4	6 04.3	5 13.7	4 16.8	4 19.7	3 22.5	4 01.0	5 21.0	4 23.1	5 01.4	4 03.8	4 06.5
7 01.2	8 22.0	8 07.4	7 10.5	7 13.4	6 16.2	6 18.7	8 14.6	7 16.8	7 19.0	6 21.5	7 00.2
9 18.9	11 15.8	11 01.2	10 04.2	10 07.2	9 09.9	9 12.3	11 08.3	10 10.4	10 12.7	9 15.2	9 17.9
12 12.6	14 09.5	13 18.9	12 22.0	13 00.9	12 03.5	12 06.0	14 01.9	13 04.1	13 06.4	12 08.9	12 11.6
15 06.4	17 03.3	16 12.6	15 15.7	15 18.6	14 21.2	14 23.7	16 19.6	15 21.8	16 00.0	15 02.6	15 05.4
18 00.1	19 21.0	19 06.4	18 09.4	18 12.3	17 14.9	17 17.3	19 13.2	18 15.4	18 17.7	17 20.3	17 23.1
20 17.8	22 14.7	22 00.1	21 03.1	21 06.0	20 08.6	20 11.0	22 06.9	21 09.1	21 11.4	20 14.0	20 16.8
23 11.6	25 08.5	24 17.9	23 20.9	23 23.7	23 02.3	23 04.7	25 00.5	24 02.7	24 05.1	23 07.7	23 10.5
26 05.3	28 02.2	27 11.6	26 14.6	26 17.4	25 20.0	25 22.3	27 18.2	26 20.4	26 22.8	26 01.4	26 04.3
28 23.1		30 05.3	29 08.3	29 11.1	28 13.6	28 16.0	30 11.8	29 14.0	29 16.4	28 19.1	28 22.0
31 16.8						31 09.6					31 15.7

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 18.8	1 00.1	1 08.1	2 10.8	2 15.9	1 21.0	2 01.9	1 06.6	2 08.6	2 13.3	1 18.1	1 23.1
3 16.1	2 21.5	3 05.5	4 08.1	4 13.3	3 18.3	3 23.2	3 03.9	4 05.9	4 10.6	3 15.4	3 20.4
5 13.5	4 18.8	5 02.8	6 05.4	6 10.6	5 15.6	5 20.5	5 01.2	6 03.2	6 07.9	5 12.7	5 17.8
7 10.8	6 16.1	7 00.1	8 02.7	8 07.9	7 12.9	7 17.8	6 22.5	8 00.4	8 05.2	7 10.0	7 15.1
9 08.1	8 13.5	8 21.5	10 00.1	10 05.2	9 10.2	9 15.1	8 19.8	9 21.7	10 02.5	9 07.3	9 12.4
11 05.5	10 10.8	10 18.8	11 21.4	12 02.5	11 07.5	11 12.4	10 17.1	11 19.0	11 23.8	11 04.7	11 09.7
13 02.8	12 08.1	12 16.1	13 18.7	13 23.8	13 04.8	13 09.7	12 14.4	13 16.3	13 21.1	13 02.0	13 07.1
15 00.1	14 05.5	14 13.5	15 16.0	15 21.2	15 02.1	15 07.0	14 11.7	15 13.6	15 18.4	14 23.3	15 04.4
16 21.5	16 02.8	16 10.8	17 13.4	17 18.5	16 23.4	17 04.3	16 08.9	17 10.9	17 15.7	16 20.6	17 01.7
18 18.8	18 00.1	18 08.1	19 10.7	19 15.8	18 20.7	19 01.6	18 06.2	19 08.2	19 13.0	18 17.9	18 23.0
20 16.1	19 21.5	20 05.5	21 08.0	21 13.1	20 18.1	20 22.8	20 03.5	21 05.5	21 10.3	20 15.2	20 20.4
22 13.5	21 18.8	22 02.8	23 05.3	23 10.4	22 15.4	22 20.1	22 00.8	23 02.8	23 07.6	22 12.5	22 17.7
24 10.8	23 16.1	24 00.1	25 02.6	25 07.7	24 12.7	24 17.4	23 22.1	25 00.1	25 04.9	24 09.9	24 15.0
26 08.1	25 13.5	25 21.4	27 00.0	27 05.0	26 10.0	26 14.7	25 19.4	26 21.4	27 02.2	26 07.2	26 12.3
28 05.5	27 10.8	27 18.8	28 21.3	29 02.4	28 07.3	28 12.0	27 16.7	28 18.7	28 23.5	28 04.5	28 09.7
30 02.8		29 16.1	30 18.6	30 23.7	30 04.6	30 09.3	29 14.0	30 16.0	30 20.8	30 01.8	30 07.0
		31 13.4					31 11.3				

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 00.9	1 13.6	2 08.5	1 12.3	1 15.9	2 04.4	2 07.8	1 11.1	1 23.3	2 02.6	1 06.1	1 09.6
2 09.8	2 22.5	3 17.4	2 21.1	3 00.8	3 13.2	3 16.7	2 20.0	3 08.2	3 11.5	2 14.9	2 18.5
3 18.7	4 07.4	5 02.3	4 06.0	4 09.7	4 22.1	5 01.6	4 04.9	4 17.1	4 20.4	3 23.8	4 03.4
5 03.6	5 16.3	6 11.2	5 14.9	5 18.6	6 07.0	6 10.4	5 13.8	6 01.9	6 05.3	5 08.7	5 12.3
6 12.5	7 01.2	7 20.1	6 23.8	7 03.5	7 15.9	7 19.3	6 22.6	7 10.8	7 14.1	6 17.6	6 21.2
7 21.4	8 10.1	9 05.0	8 08.7	8 12.4	9 00.8	9 04.2	8 07.5	8 19.7	8 23.0	8 02.5	8 06.1
9 06.3	9 19.0	10 13.9	9 17.6	9 21.3	10 09.7	10 13.1	9 16.4	10 04.6	10 07.9	9 11.4	9 15.0
10 15.2	11 03.9	11 22.8	11 02.5	11 06.1	11 18.6	11 22.0	11 01.3	11 13.4	11 16.8	10 20.3	10 23.9
12 00.1	12 12.8	13 07.7	12 11.4	12 15.0	13 03.4	13 06.8	12 10.1	12 22.3	13 01.7	12 05.2	12 08.8
13 09.0	13 21.7	14 16.6	13 20.3	13 23.9	14 12.3	14 15.7	13 19.0	14 07.2	14 10.6	13 14.1	13 17.7
14 17.9	15 06.6	16 01.5	15 05.2	15 08.8	15 21.2	16 00.6	15 03.9	15 16.1	15 19.4	14 22.9	15 02.6
16 02.8	16 15.5	17 10.4	16 14.1	16 17.7	17 06.1	17 09.5	16 12.8	17 01.0	17 04.3	16 07.8	16 11.5
17 11.7	18 00.4	18 19.3	17 23.0	18 02.6	18 15.0	18 18.4	17 21.7	18 09.8	18 13.2	17 16.7	17 20.4
18 20.6	19 09.3	20 04.2	19 07.9	19 11.5	19 23.9	20 03.2	19 06.5	19 18.7	19 22.1	19 01.6	19 05.3
20 05.5	20 18.2	21 13.1	20 16.8	20 20.4	21 08.7	21 12.1	20 15.4	21 03.6	21 07.0	20 10.5	20 14.2
21 14.4	22 03.1	22 22.0	22 01.7	22 05.3	22 17.6	22 21.0	22 00.3	22 12.5	22 15.9	21 19.4	21 23.0
22 23.3	23 12.0	24 06.9	23 10.6	23 14.1	24 02.5	24 05.9	23 09.2	23 21.3	24 00.7	23 04.3	23 07.9
24 08.2	24 20.9	25 15.8	24 19.5	24 23.0	25 11.4	25 14.7	24 18.0	25 06.2	25 09.6	24 13.2	24 16.8
25 17.1	26 05.8	27 00.7	26 04.3	26 07.9	26 20.3	26 23.6	26 02.9	26 15.1	26 18.5	25 22.1	26 01.7
27 02.0	27 14.7	28 09.6	27 13.2	27 16.8	28 05.2	28 08.5	27 11.8	28 00.0	28 03.4	27 07.0	27 10.6
28 10.9	28 23.6	29 18.5	28 22.1	29 01.7	29 14.0	29 17.4	28 20.7	29 08.9	29 12.3	28 15.8	28 19.5
29 19.8		31 03.4	30 07.0	30 10.6	30 22.9	31 02.3	30 05.6	30 17.7	30 21.2	30 00.7	30 04.4
31 04.7				31 19.5			31 14.4				31 13.3

URANUS

RISE AND SET TIMES (E.A.S.T. except Adelaide C.A.S.T.)

POSITION

(0hrs UT Epoch 2000.0)

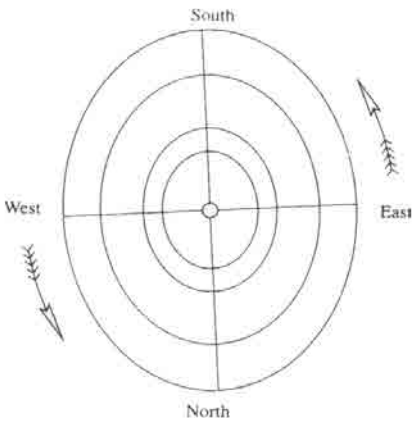
	Adelaide		Brisbane		Cairns		Canberra		Hobart		Melbourne		Sydney		Townsville		RA	DEC
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	h m s	° ' "
Jan 1	05:59	20:15	05:49	19:30	06:38	19:38	05:46	20:04	05:32	20:34	05:56	20:27	05:41	19:52	06:30	19:39	19 33 57	- 22 08 43
8	05:33	19:49	05:23	19:04	06:12	19:12	05:20	19:38	05:06	20:08	05:30	20:01	05:15	19:26	06:04	19:13	19 35 42	- 22 04 48
15	05:08	19:23	04:58	18:38	05:47	18:46	04:55	19:12	04:41	19:42	05:04	19:35	04:50	19:00	05:39	18:47	19 37 28	- 22 00 47
22	04:42	18:57	04:32	18:12	05:21	18:21	04:29	18:46	04:15	19:15	04:39	19:09	04:24	18:34	05:13	18:21	19 39 14	- 21 56 45
29	04:17	18:31	04:06	17:46	04:55	17:55	04:04	18:20	03:50	18:49	04:13	18:43	03:59	18:08	04:47	17:55	19 40 58	- 21 52 43
Feb 5	03:51	18:05	03:41	17:20	04:30	17:29	03:38	17:54	03:24	18:23	03:48	18:17	03:33	17:42	04:22	17:29	19 42 39	- 21 48 44
12	03:25	17:39	03:15	16:54	04:04	17:03	03:13	17:28	02:59	17:57	03:22	17:51	03:07	17:16	03:56	17:03	19 44 17	- 21 44 52
19	03:00	17:13	02:49	16:28	03:38	16:37	02:47	17:01	02:33	17:31	02:56	17:25	02:42	16:50	03:30	16:37	19 45 50	- 21 41 08
26	02:34	16:46	02:23	16:02	03:12	16:11	02:21	16:35	02:07	17:04	02:31	16:58	02:16	16:23	03:04	16:11	19 47 17	- 21 37 37
Mar 5	02:08	16:20	01:57	15:36	02:46	15:44	01:55	16:09	01:41	16:38	02:05	16:32	01:50	15:57	02:38	15:45	19 48 38	- 21 34 20
12	01:42	15:53	01:31	15:09	02:20	15:18	01:29	15:42	01:15	16:11	01:39	16:06	01:24	15:31	02:12	15:18	19 49 51	- 21 31 20
19	01:15	15:27	01:05	14:43	01:53	14:51	01:02	15:16	00:49	15:45	01:12	15:39	00:57	15:04	01:45	14:52	19 50 57	- 21 28 41
26	00:49	15:00	00:38	14:16	01:27	14:25	00:36	14:49	00:22	15:18	00:46	15:12	00:31	14:37	01:19	14:25	19 51 53	- 21 26 24
Apr 2	00:22	14:33	00:11	13:49	01:00	13:58	00:09	14:22	23:52	14:51	00:19	14:45	00:04	14:10	00:52	13:58	19 52 40	- 21 24 32
9	23:52	14:06	23:41	13:22	00:33	13:31	23:39	13:55	23:25	14:24	23:49	14:18	23:34	13:43	00:25	13:31	19 53 18	- 21 23 05
16	23:25	13:39	23:14	12:55	00:06	13:04	23:12	13:28	22:58	13:57	23:22	13:51	23:07	13:16	23:54	13:04	19 53 45	- 21 22 05
23	22:57	13:12	22:47	12:28	23:35	12:37	22:45	13:01	22:31	13:30	22:54	13:24	22:39	12:49	23:27	12:37	19 54 02	- 21 21 34
30	22:30	12:45	22:19	12:00	23:08	12:09	22:17	12:33	22:04	13:02	22:27	12:57	22:12	12:22	23:00	12:09	19 54 09	- 21 21 30
May 7	22:02	12:17	21:51	11:33	22:40	11:42	21:50	12:06	21:36	12:35	21:59	12:29	21:44	11:54	22:32	11:42	19 54 05	- 21 21 54
14	21:35	11:49	21:24	11:05	22:12	11:14	21:22	11:38	21:08	12:07	21:32	12:01	21:17	11:26	22:04	11:14	19 53 51	- 21 22 46
21	21:07	11:21	20:56	10:37	21:44	10:46	20:54	11:10	20:40	11:39	21:03	11:33	20:49	10:59	21:36	10:46	19 53 27	- 21 24 03
28	20:38	10:53	20:28	10:09	21:16	10:18	20:26	10:42	20:12	11:11	20:35	11:05	20:20	10:31	21:08	10:18	19 52 54	- 21 25 44
Jun 4	20:10	10:25	19:59	09:41	20:48	09:50	19:57	10:14	19:44	10:43	20:07	10:37	19:52	10:02	20:40	09:50	19 52 12	- 21 27 47
11	19:42	09:57	19:31	09:13	20:20	09:22	19:29	09:46	19:15	10:15	19:38	10:09	19:24	09:34	20:11	09:22	19 51 23	- 21 30 08
18	19:13	09:29	19:02	08:45	19:51	08:53	19:00	09:18	18:46	09:47	19:10	09:41	18:55	09:06	19:43	08:53	19 50 26	- 21 32 46
25	18:44	09:00	18:34	08:16	19:22	08:25	18:31	08:49	18:18	09:18	18:41	09:13	18:26	08:38	19:14	08:25	19 49 24	- 21 35 35
Jul 2	18:15	08:32	18:05	07:48	18:54	07:56	18:03	08:21	17:49	08:50	18:12	08:44	17:57	08:09	18:46	07:56	19 48 18	- 21 38 33
9	17:47	08:03	17:36	07:19	18:25	07:28	17:34	07:52	17:20	08:22	17:43	08:16	17:29	07:41	18:17	07:28	19 47 09	- 21 41 36
16	17:18	07:35	17:07	06:51	17:56	06:59	17:05	07:24	16:51	07:53	17:15	07:47	17:00	07:12	17:48	06:59	19 45 58	- 21 44 40
23	16:49	07:06	16:38	06:22	17:27	06:30	16:36	06:55	16:22	07:25	16:46	07:19	16:31	06:43	17:19	06:31	19 44 46	- 21 47 40
30	16:20	06:38	16:10	05:53	16:59	06:02	16:07	06:27	15:53	06:56	16:17	06:50	16:02	06:15	16:50	06:02	19 43 36	- 21 50 35
Aug 6	15:51	06:09	15:41	05:25	16:30	05:33	15:38	05:58	15:24	06:28	15:48	06:22	15:33	05:46	16:22	05:33	19 42 28	- 21 53 20
13	15:23	05:41	15:12	04:56	16:01	05:05	15:10	05:30	14:55	05:59	15:19	05:53	15:05	05:18	15:53	05:05	19 41 24	- 21 55 53
20	14:54	05:13	14:44	04:28	15:33	04:36	14:41	05:01	14:27	05:31	14:51	05:25	14:36	04:50	15:25	04:37	19 40 26	- 21 58 09
27	14:25	04:44	14:15	04:00	15:04	04:08	14:12	04:33	13:58	05:03	14:22	04:57	14:07	04:21	14:56	04:08	19 39 34	- 22 00 09
Sep 3	13:57	04:16	13:47	03:31	14:36	03:40	13:44	04:05	13:30	04:35	13:54	04:28	13:39	03:53	14:28	03:40	19 38 49	- 22 01 48
10	13:29	03:48	13:19	03:03	14:08	03:11	13:16	03:37	13:02	04:07	13:26	04:00	13:11	03:25	14:00	03:12	19 38 13	- 22 03 06
17	13:01	03:20	12:51	02:35	13:40	02:44	12:48	03:09	12:34	03:39	12:57	03:32	12:43	02:57	13:32	02:44	19 37 46	- 22 04 02
24	12:33	02:52	12:23	02:08	13:12	02:16	12:20	02:41	12:06	03:11	12:30	03:05	12:15	02:29	13:04	02:16	19 37 29	- 22 04 34
Oct 1	12:05	02:25	11:55	01:40	12:44	01:48	11:52	02:14	11:38	02:43	12:02	02:37	11:47	02:02	12:36	01:48	19 37 22	- 22 04 41
8	11:38	01:57	11:28	01:13	12:17	01:21	11:25	01:46	11:11	02:16	11:35	02:10	11:20	01:34	12:09	01:21	19 37 26	- 22 04 24
15	11:11	01:30	11:00	00:45	11:50	00:53	10:58	01:19	10:43	01:49	11:07	01:42	10:53	01:07	11:42	00:54	19 37 41	- 22 03 42
22	10:44	01:03	10:33	00:18	11:23	00:26	10:31	00:52	10:16	01:21	10:40	01:15	10:26	00:40	11:14	00:27	19 38 06	- 22 02 36
29	10:17	00:36	10:06	23:47	10:56	23:55	10:04	00:25	09:50	00:54	10:13	00:48	09:59	00:13	10:48	23:56	19 38 41	- 22 01 05
Nov 5	09:50	00:09	09:40	23:20	10:29	23:29	09:37	23:54	09:23	00:27	09:47	00:21	09:32	23:42	10:21	23:29	19 39 27	- 21 59 10
12	09:24	23:38	09:13	22:54	10:02	23:02	09:11	23:27	08:56	23:57	09:20	23:51	09:06	23:15	09:54	23:02	19 40 22	- 21 56 52
19	08:57	23:12	08:47	22:27	09:36	22:35	08:44	23:01	08:30	23:30	08:54	23:24	08:39	22:49	09:28	22:36	19 41 26	- 21 54 12
26	08:31	22:45	08:21	22:01	09:10	22:09	08:18	22:34	08:04	23:03	08:28	22:57	08:13	22:22	09:02	22:09	19 42 38	- 21 51 12
Dec 3	08:05	22:19	07:55	21:34	08:44	21:43	07:52	22:08	07:38	22:37	08:02	22:31	07:47	21:56	08:36	21:43	19 43 58	- 21 47 51
10	07:39	21:53	07:29	21:08	08:18	21:17	07:26	21:41	07:12	22:11	07:36	22:05	07:21	21:30	08:10	21:17	19 45 24	- 21 44 13
17	07:13	21:26	07:03	20:42	07:52	20:50	07:01	21:15	06:47	21:44	07:10	21:38	06:55	21:03	07:44	20:51	19 46 56	- 21 40 18
24	06:48	21:00	06:37	20:16	07:26	20:24	06:35	20:49	06:21	21:18	06:45	21:12	06:30	20:37	07:18	20:25	19 48 33	- 21 36 10
31	06:22	20:34	06:11	19:50	07:00	19:58	06:09	20:23	05:56	20:52	06:19	20:46	06:04	20:11	06:52	19:59	19 50 13	- 21 31 49

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

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
					ARIEL						
2 03.7	1 09.4	1 02.7	2 20.9	3 02.8	2 08.5	2 14.5	1 20.4	1 02.4	1 08.3	3 02.7	3 08.6
4 16.2	3 21.9	3 15.2	5 09.4	5 15.2	4 21.0	5 03.0	4 08.9	3 14.9	3 20.8	5 15.2	5 21.0
7 04.7	6 10.4	6 03.7	7 21.9	8 03.7	7 09.5	7 15.5	6 21.4	6 03.4	6 09.3	8 03.7	8 09.6
9 17.2	8 22.9	8 16.1	10 10.4	10 16.2	9 22.0	10 04.0	9 09.9	8 15.9	8 21.8	10 16.2	10 22.0
12 05.7	11 11.4	11 04.7	12 22.8	13 04.7	12 10.5	12 16.4	11 22.4	11 04.4	11 10.3	13 04.7	13 10.6
14 18.1	13 23.8	13 17.1	15 11.3	15 17.2	14 23.0	15 04.9	14 10.9	13 16.9	13 22.8	15 17.2	15 23.0
17 06.6	16 12.3	16 05.6	17 23.8	18 05.6	17 11.5	17 17.4	16 23.4	16 05.3	16 11.3	18 05.6	18 11.5
19 19.1	19 00.8	18 18.1	20 12.3	20 18.1	20 00.0	20 05.9	19 11.9	18 17.9	18 23.8	20 18.1	21 00.0
22 07.5	21 13.2	21 06.6	23 00.8	23 06.6	22 12.5	22 18.4	22 00.4	21 06.3	21 12.3	23 06.6	23 12.5
24 20.0	24 01.7	23 19.0	25 13.3	25 19.1	25 01.0	25 06.9	24 12.9	23 18.8	24 00.8	25 19.1	26 01.0
27 08.5	26 14.2	26 07.5	28 01.8	28 07.5	27 13.5	27 19.4	27 01.4	26 07.3	26 13.3	28 07.6	28 13.5
29 21.0		28 20.0	30 14.3	30 20.0	30 02.0	30 07.9	29 13.9	28 19.8	29 01.8	30 20.1	31 01.9
		31 08.4							31 14.3		
					UMBRIEL						
3 06.0	1 05.9	2 06.0	4 09.6	3 09.7	1 09.8	4 13.5	2 13.9	4 17.9	3 18.2	1 18.3	4 22.0
7 09.4	5 09.4	6 09.4	8 12.9	7 13.2	5 13.4	8 17.0	6 17.4	8 21.4	7 21.6	5 21.7	9 01.5
11 12.9	9 12.9	10 12.8	12 16.4	11 16.7	9 16.8	12 20.4	10 21.0	13 00.9	12 01.0	10 01.2	13 04.9
15 16.3	13 16.3	14 16.2	16 19.9	15 20.1	13 20.2	17 00.0	15 00.5	17 04.3	16 04.5	14 04.7	17 08.4
19 19.7	17 19.7	18 19.7	20 23.4	19 23.6	17 23.7	21 03.5	19 04.0	21 07.7	20 07.9	18 08.2	21 11.8
23 23.1	21 23.1	22 23.2	25 02.8	24 03.0	22 03.1	25 07.0	23 07.4	25 11.2	24 11.4	22 11.7	25 15.2
28 02.5	26 02.5	27 02.7	29 06.3	28 06.4	26 06.6	29 10.5	27 10.9	29 14.8	28 14.9	26 15.0	29 18.7
		31 06.2			30 10.1		31 14.4			30 18.5	
					TITANIA						
3 15.4	7 10.8	5 13.3	9 08.8	5 11.4	9 07.3	5 10.3	9 06.3	4 09.4	9 05.4	4 08.1	9 03.6
12 08.3	16 03.6	14 06.2	18 01.7	14 04.4	18 00.3	14 03.3	17 23.4	13 02.5	17 22.4	13 01.0	17 20.4
21 01.1	24 20.5	22 23.1	26 18.6	22 21.4	26 17.3	22 20.3	26 16.4	21 19.5	26 15.3	21 17.9	26 13.2
29 17.9		31 15.9		31 14.3		31 13.3		30 12.4		30 10.7	
					OBERON						
2 19.5	12 04.2	11 01.8	6 23.8	3 22.0	13 07.4	10 06.2	6 04.6	2 03.2	12 12.5	8 10.7	5 08.8
16 06.4	25 15.0		20 10.9	17 08.9	26 18.8	23 17.5	19 15.9	15 14.3	25 23.6	21 21.8	18 19.8
29 17.3				30 20.1				29 01.6			

SATELLITES OF URANUS

Apparent orbit of Satellites I-IV at date of opposition, July 17

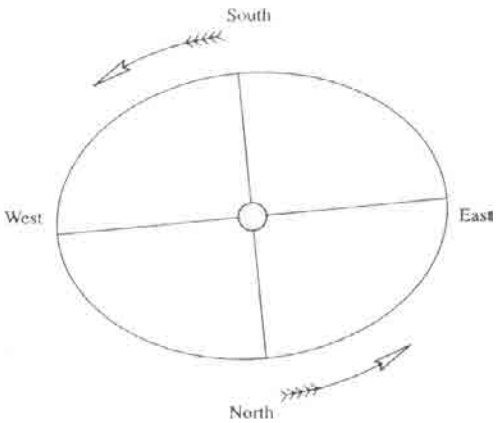


Name		Sidereal Period d	h
V	Miranda	1.4	
I	Ariel	2	12.489
II	Umbriel	4	03.460
III	Titania	8	16.941
IV	Oberon	13	11.118

See introduction to Part 2 (page 56) for explanation.

SATELLITE OF NEPTUNE

Apparent orbit of Triton at date of opposition, July 14



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

See introduction to Part 2 (page 56) for explanation.

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

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
					TRITON						
3 02.8	1 11.4	2 20.1	1 04.9	6 11.0	4 20.4	4 06.0	2 15.6	1 01.3	6 07.8	4 16.9	4 01.8
8 23.7	7 08.3	8 17.0	7 01.9	12 08.0	10 17.5	10 03.1	8 12.8	6 22.4	12 04.8	10 13.9	9 22.7
14 20.6	13 05.3	14 14.0	12 22.9	18 05.1	16 14.6	16 00.2	14 09.9	12 19.5	18 01.9	16 10.9	15 19.7
20 17.6	19 02.2	20 10.9	18 19.9	24 02.2	22 11.7	21 21.4	20 07.0	18 16.6	23 22.9	22 07.9	21 16.6
26 14.5	24 23.1	26 07.9	24 16.9	29 23.3	28 08.8	27 18.5	26 04.1	24 13.6	29 19.9	28 04.8	27 13.6
			30 13.9					30 10.7			

NEPTUNE

RISE AND SET TIMES (E.A.S.T. except Adelaide C.A.S.T.)

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

POSITION

(0hrs UT Epoch 2000.0)

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

PLUTO

RISE AND SET TIMES (E.A.S.T. except Adelaide C.A.S.T.)

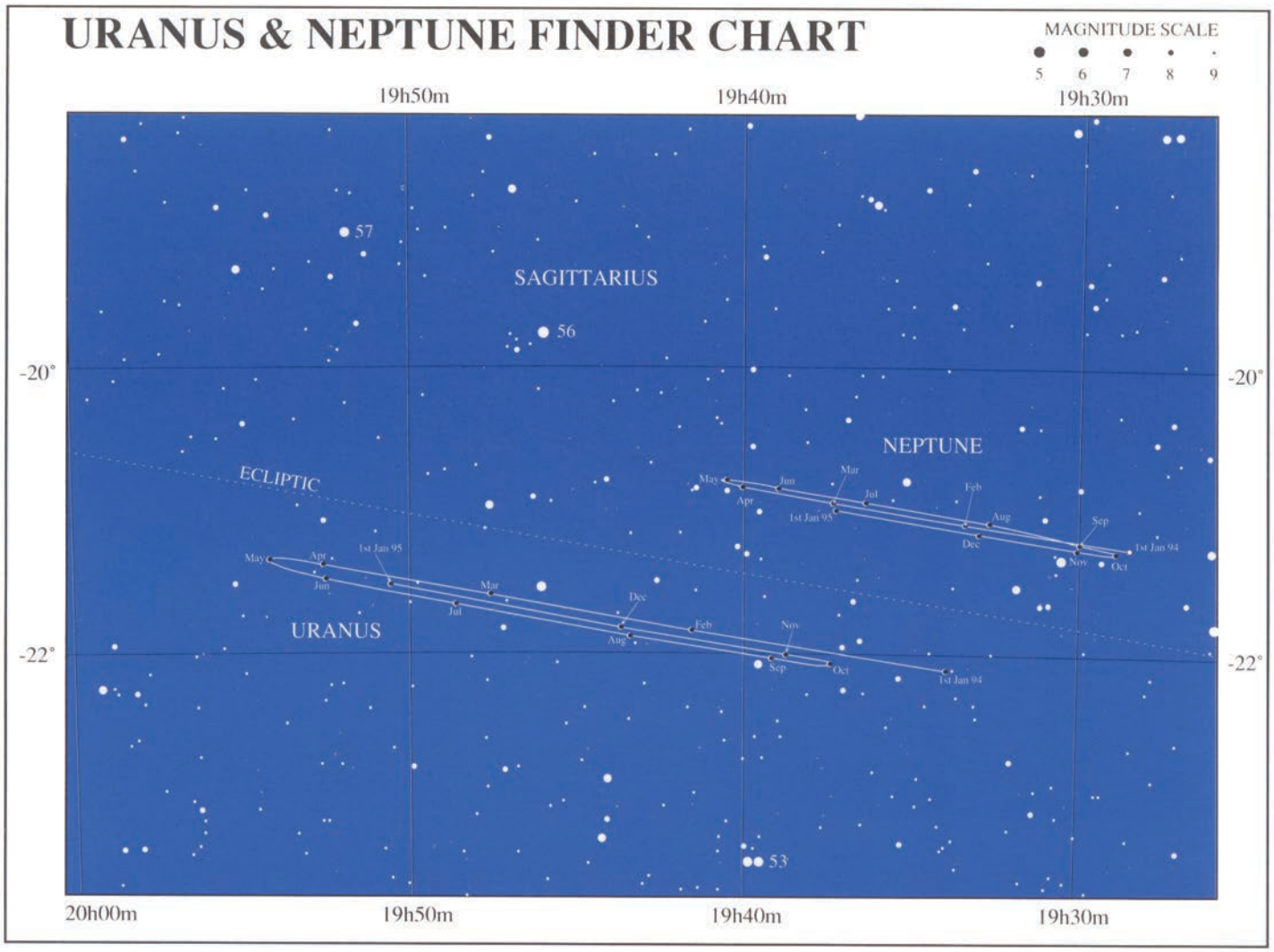
	Adelaide		Brisbane		Cairns		Canberra		Hobart		Melbourne		Sydney		Townsville	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
Jan 1	03:07	15:45	02:44	15:12	03:18	15:36	02:55	15:33	02:57	15:46	03:09	15:51	02:47	15:23	03:13	15:33
8	02:40	15:18	02:17	14:46	02:51	15:09	02:28	15:06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

POSITION

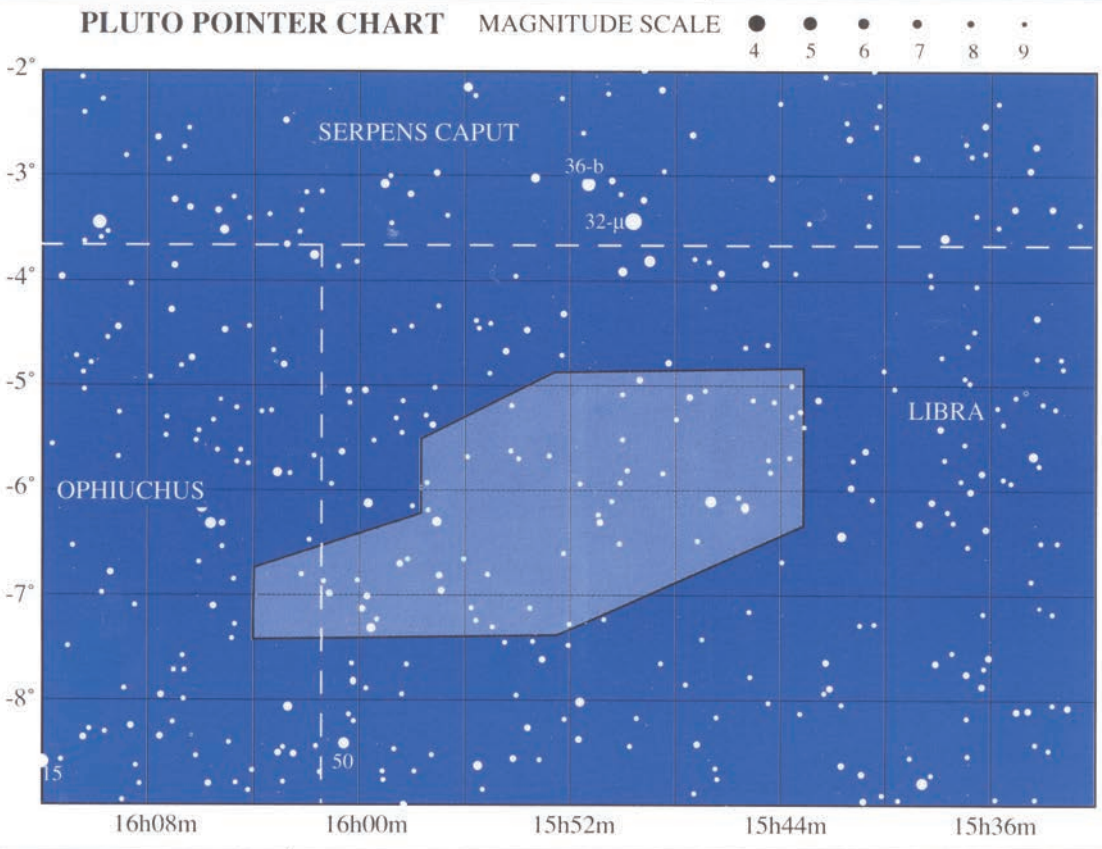
(0hrs UT Epoch 2000.0)

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

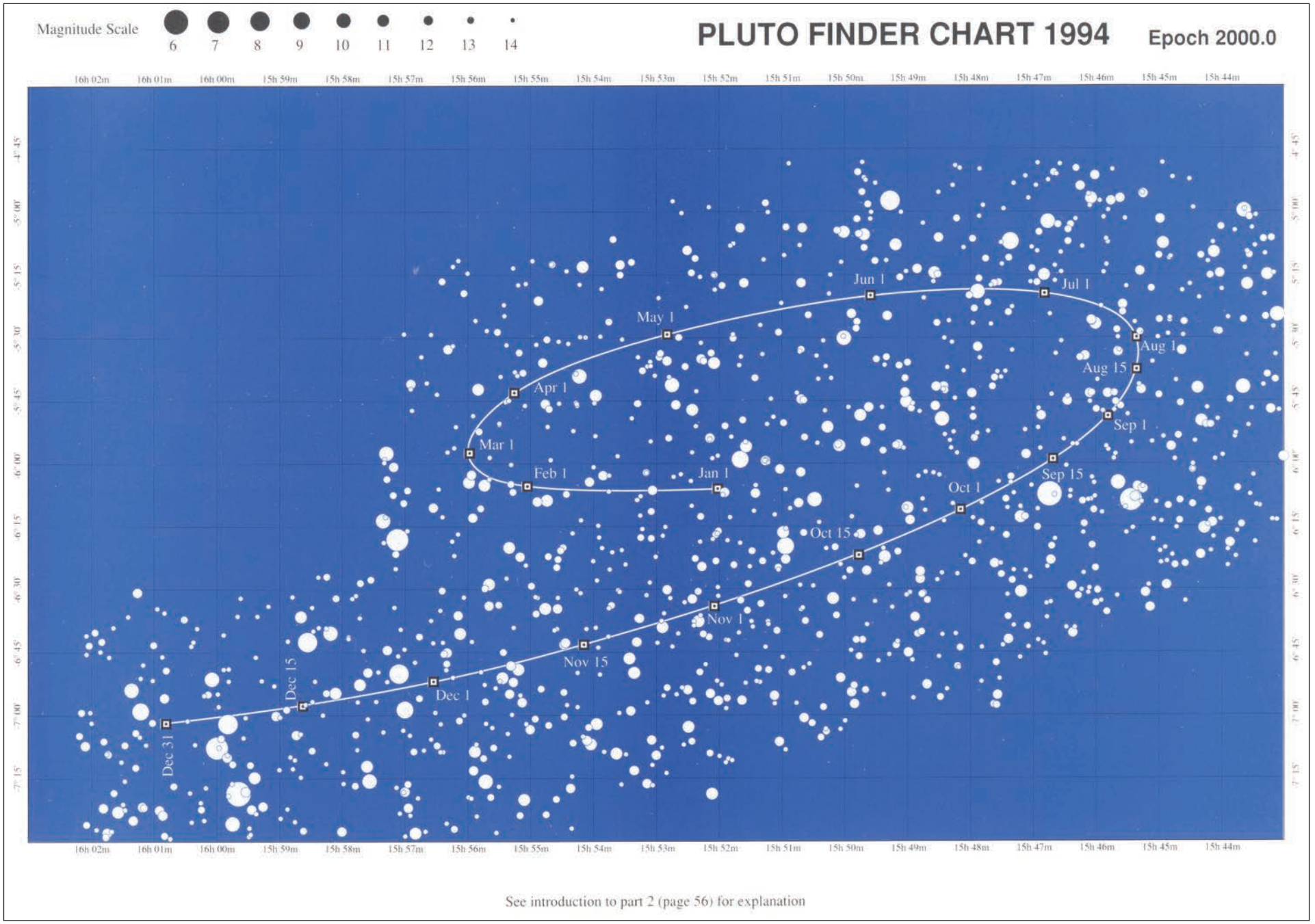
URANUS & NEPTUNE FINDER CHART



PLUTO POINTER CHART



See introduction to part 2 (page 56) for explanation



See introduction to part 2 (page 56) for explanation

TABLE 1 - METEOR SHOWERS

SHOWER	*	MOON	ACTIVITY	MAX	RADIANT		DIA	DRIFT		VEL	ZHR
		PHASE	DURATION	ACT	R.A.	Dec.		R.A.	Dec.	km/s	
Quadrantids		LQ	Jan 01-Jan 05	Jan 03	230˚	+49˚	5˚	+0.8˚	-0.2˚	41	110
Pi Puppids II	3	NM	Jan 06-Jan 14	Jan 10	113˚	-43˚	5˚	+0.4˚	-0.2˚	35	
Delta Cancrids		FQ	Jan 05-Jan 24	Jan 17	130˚	+20˚	10˚-5˚	+0.9˚	-0.1˚	28	5
Alpha Crucids		FQ	Jan 06-Jan 28	Jan 19	192˚	-63˚	10˚-5˚	+1.1˚	-0.2˚	50	5
Lambda Velids II	3	FQ	Jan 18-Jan 26	Jan 21	133˚	-46˚	5˚	+0.7˚	-0.2˚	35	
Alpha Carinids		FM	Jan 24-Feb 09	Jan 31	095˚	-54˚	5˚			25	
Virginids			Feb 01-May 30	Several	195˚	-4˚	15˚-10˚	See table 2		30	5
Theta Centaurids		LQ	Jan 23-Mar 12	Feb 01	210˚	-40˚	6˚	+1.1˚	-0.2˚	60	
Alpha Centaurids	1	NM	Jan 28-Feb 21	Feb 07	210˚	-59˚	4˚	+1.2˚	-0.3˚	56	25
Omicron Centaurids		NM	Jan 31-Feb 19	Feb 11	177˚	-56˚	6˚	+1.0˚	-0.3˚	51	
Delta Leonids		NM	Feb 05-Mar 19	Feb 15	159˚	+19˚	8˚	+0.9˚	-0.3˚	23	3
Gamma Normids		NM	Feb 25-Mar 22	Mar 14	249˚	-51˚	5˚	+1.1˚	+0.1˚	56	8
Beta Pavonids		LQ	Mar 11-Apr 16	Apr 07	308˚	-63˚	10˚-15˚	+1.2˚	+0.1˚	59	13
Scorpid/Sagittarids			Apr 15-Jul 25	Several	260˚	-30˚	15˚-10˚	See table 3		30	10
Lyrids	1	FQ	Apr 16-Apr 25	Apr 22	271˚	+34˚	5˚	+1.1˚	+0.0˚	49	90
Pi Puppids	1	FM	Apr 15-Apr 28	Apr 23	110˚	-45˚	5˚	+0.6˚	-0.2˚	18	40
Alpha Bootids		FM	Apr 14-May 12	Apr 27	218˚	+19˚	8˚	+0.9˚	-0.1˚	20	3
Eta Aquarids		LQ	Apr 19-May 28	May 03	336˚	-02˚	4˚	+0.9˚	+0.4˚	66	50
Alpha Scorpids	2	LQ	Mar 26-May 12	May 03	240˚	-27˚	5˚	+0.9˚	-0.1˚	35	10
Ophiuchids N	2	NM	Apr 25-May 31	May 10	249˚	-14˚	5˚	+0.9˚	-0.1˚	30	
Beta Corona Australids	2	FQ	Apr 23-May 30	May 15	284˚	-40˚	5˚	+0.9˚	-0.1˚	45	
Kappa Scorpids	2	FQ	May 04-May 27	May 19	267˚	-39˚	5˚	+0.9˚	+0.0˚	45	
Ophiuchids S	2	FQ	May 13-May 26	May 20	258˚	-24˚	5˚	+0.9˚	-0.1˚	30	
Omega Scorpids	2	LQ	May 23-Jun 15	Jun 04	243˚	-22˚	5˚	+0.9˚	-0.1˚	23	
Chi Scorpids	2	NM	May 24-Jun 20	Jun 05	248˚	-14˚	6˚	+0.9˚	-0.1˚	21	
Gamma Sagittarids	2	NM	May 22-Jun 13	Jun 06	272˚	-28˚	6˚	+0.9˚	+0.0˚	29	
Theta Ophiuchids	2	FQ	Jun 04-Jul 15	Jun 13	267˚	-20˚	5˚	+0.9˚	+0.0˚	27	
Lyrids (Jun)		FQ	Jun 11-Jun 21	Jun 16	278˚	+35˚	5˚	+0.8˚	+0.0˚	31	5
Bootids (Jun)		LQ	Jun 26-Jun 30	Jun 28	219˚	+49˚	8˚			14	2
Lambda Sagittarids	2	LQ	Jun 05-Jul 25	Jul 01	276˚	-25˚	6˚	+0.9˚	+0.0˚	23	
Pegasids		NM	Jul 07-Jul 11	Jul 10	340˚	+15˚	5˚	+0.8˚	+0.2˚	70	8
Phoenicids (Jul)		FQ	Jun 24-Jul 18	Jul 15	021˚	-43˚	7˚	+1.0˚	+0.2˚	47	
Piscis Austrinids		LQ	Jul 09-Aug 17	Jul 29	341˚	-30˚	5˚	+1.0˚	+0.2˚	35	8
Delta Aquarids S		LQ	Jul 08-Aug 19	Jul 29	339˚	-16˚	5˚	See table 4		41	20
Alpha Capricornids		LQ	Jul 03-Aug 25	Jul 30	307˚	-10˚	8˚	See table 4		23	8
Iota Aquarids S		NM	Jul 15-Aug 25	Aug 04	333˚	-15˚	5˚	See table 4		34	3
Delta Aquarids N		FQ	Jul 15-Aug 25	Aug 12	337˚	-05˚	5˚	See table 4		42	5
Perseids		FQ	Jul 17-Aug 24	Aug 12	046˚	+58˚	5˚	See table 4		59	95
Kappa Cygnids		FM	Aug 03-Aug 31	Aug 19	286˚	+59˚	6˚			25	5
Iota Aquarids N		FM	Aug 11-Sep 20	Aug 20	327˚	-06˚	5˚	See table 4		31	3
Pi Eridanids		LQ	Aug 20-Sep 05	Aug 29	052˚	-15˚	6˚	+0.8˚	+0.2˚	59	
Alpha Aurigids		LQ	Aug 24-Sep 05	Sep 01	084˚	+42˚	5˚	+1.1˚	+0.0˚	66	15
Delta Aurigids		FQ	Sep 05-Oct 10	Sep 09	060˚	+47˚	5˚	+1.0˚	+0.1˚	64	7
Piscids S		FM	Aug 15-Oct 14	Sep 20	008˚	+00˚	8˚	+0.9˚	+0.2˚	26	3
Kappa Aquarids		FM	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)		NM	Sep 20-Oct 14	Oct 03	303˚	-10˚	5˚	+0.8˚	+0.2˚	15	3
Sigma Orionids		NM	Sep 10-Oct 26	Oct 05	086˚	-03˚	5˚	+1.2˚	+0.0˚	65	3
Draconids	1	FQ	Oct 06-Oct 10	Oct 10	262˚	+54˚	5˚			20	storm
Epsilon Geminids		FM	Oct 14-Oct 27	Oct 20	104˚	+27˚	5˚	+1.0˚	+0.0˚	71	5
Orionids		FM	Oct 02-Nov 07	Oct 22	095˚	+16˚	10˚	+1.2˚	+0.1˚	66	25
Taurids S		NM	Sep 15-Nov 25	Nov 03	050˚	+14˚	10˚-5˚	See table 6		27	10
Taurids N		FQ	Sep 13-Nov 25	Nov 13	060˚	+23˚	10˚-5˚	See table 6		29	8
Leonids	1	FM	Nov 14-Nov 21	Nov 18	152˚	+22˚	5˚	+0.7˚	-0.4˚	71	storm
Alpha Monocerotids		FM	Nov 15-Nov 25	Nov 21	117˚	-06˚	5˚	+1.1˚	-0.1˚	60	5
Chi Orionids		NM	Nov 26-Dec 15	Dec 02	082˚	+23˚	8˚	+1.2˚	+0.0˚	28	3
Phoenicids (Dec)	1	NM	Nov 28-Dec 09	Dec 06	018˚	-53˚	5˚	+0.8˚	+0.1˚	18	100
Sigma Puppids II	3	NM	Nov 27-Dec 12	Dec 06	102˚	-45˚	5˚	+0.3˚	+0.1˚	38	
Monocerotids (Dec)		FQ	Nov 27-Dec 17	Dec 10	100˚	+14˚	5˚	+1.2˚	+0.0˚	42	5
Sigma Hydrids		FQ	Dec 03-Dec 15	Dec 11	127˚	+02˚	5˚	+0.7˚	-0.2˚	58	5
Geminids		FM	Dec 07-Dec 17	Dec 14	112˚	+33˚	4˚	+1.0˚	-0.1˚	35	110
Coma Berenicids		FM	Dec 12-Jan 23	Dec 19	175˚	+25˚	5˚	+0.8˚	-0.2˚	65	5
Ursids	1	FM	Dec 17-Dec 26	Dec 23	217˚	+75˚	5˚			33	50
Tau Puppids	3	LQ	Dec 19-Dec 30	Dec 23	104˚	-50˚	5˚	+0.2˚	-0.1˚	33	

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.

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.
Sep 30	104˚	-44˚	Oct 10	107˚	-44˚	Nov 10	116˚	-44˚	Dec 10	132˚	-44˚
			20	110˚	-44˚	20	120˚	-44˚	20	137˚	-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˚			

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.

NOTES ON TABLE 1. (page 102)

SHOWER: Name given to shower, associated with the constellation and or bright star that the radiant appears near.

*: (1) Periodic shower producing listed rates only in certain years, at other times the rate may be limited to only a few meteors per hour.

(2) Major components of the Scorpid/Sagittarid complex.

(3) Major components of the Puppid/Velid complex.

(4) No recent activity, stream is thought to have moved away from Earth'sorbit.

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).

MINOR PLANET POSITIONS (0hr UT, Epoch 2000.0)

	1 CERES			2 PALLAS			3 JUNO			4 VESTA			5 ASTRAEA		
	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 1	01 38.7	+ 02 15	8.5	22 19.0	- 07 23	10.3	13 44.7	- 06 40	10.9	23 22.2	- 11 10	8.1	23 00.4	- 09 36	12.6
8	01 41.6	+ 03 05	8.6	22 27.2	- 07 14	10.3	13 51.0	- 06 51	10.9	23 31.9	- 09 57	8.1	23 08.3	- 08 47	12.6
15	01 45.5	+ 03 59	8.7	22 35.7	- 07 02	10.3	13 56.7	- 06 57	10.9	23 41.9	- 08 41	8.2	23 16.7	- 07 55	12.6
22	01 50.3	+ 04 56	8.8	22 44.5	- 06 46	10.2	14 01.6	- 06 57	10.8	23 52.2	- 07 25	8.2	23 25.5	- 07 00	12.6
29	01 55.8	+ 05 56	8.8	22 53.5	- 06 27	10.2	14 05.8	- 06 50	10.7	00 02.6	- 06 07	8.3	23 34.5	- 06 03	12.6
Feb 5	02 02.1	+ 06 56	8.9	23 02.7	- 06 05	10.2	14 09.0	- 06 37	10.7	00 13.3	- 04 49	8.3	23 43.8	- 05 04	12.6
12	02 09.1	+ 07 58	8.9	23 12.1	- 05 40	10.1	14 11.3	- 06 17	10.6	00 24.1	- 03 30	8.3	23 53.3	- 04 03	12.6
19	02 16.7	+ 09 01	9.0	23 21.6	- 05 13	10.0	14 12.5	- 05 50	10.5	00 35.1	- 02 11	8.3	00 03.1	- 03 01	12.5
26	02 24.8	+ 10 04	9.0	23 31.3	- 04 45	10.0	14 12.7	- 05 17	10.4	00 46.2	- 00 53	8.3	00 13.0	- 01 58	12.5
Mar 5	02 33.4	+ 11 07	9.0	23 41.1	- 04 15	9.9	14 11.7	- 04 37	10.3	00 57.5	+ 00 25	8.3	00 23.2	- 00 54	12.5
12	02 42.5	+ 12 09	9.0	23 51.0	- 03 44	9.8	14 09.7	- 03 51	10.2	01 08.8	+ 01 42	8.3	00 33.5	+ 00 11	12.4
19	02 52.1	+ 13 10	9.0	00 01.0	- 03 13	9.7	14 06.7	- 03 01	10.1	01 20.3	+ 02 58	8.3	00 43.9	+ 01 15	12.3
26	03 02.0	+ 14 10	9.0	00 11.1	- 02 43	9.7	14 02.7	- 02 08	10.0	01 31.8	+ 04 13	8.3	00 54.5	+ 02 20	12.2
Apr 2	03 12.2	+ 15 09	9.0	00 21.2	- 02 12	9.8	13 58.0	- 01 14	9.9	01 43.5	+ 05 26	8.3	01 05.2	+ 03 24	12.1
9	03 22.9	+ 16 06	9.0	00 31.4	- 01 42	9.9	13 52.8	- 00 19	9.8	01 55.2	+ 06 37	8.2	01 16.0	+ 04 28	12.1
16	03 33.8	+ 17 00	9.0	00 41.7	- 01 14	9.9	13 47.3	+ 00 32	9.8	02 07.0	+ 07 46	8.2	01 27.0	+ 05 31	12.1
23	03 45.0	+ 17 53	8.9	00 52.0	- 00 47	9.9	13 41.7	+ 01 19	9.9	02 18.9	+ 08 53	8.1	01 38.0	+ 06 32	12.2
30	03 56.5	+ 18 42	8.9	01 02.3	- 00 22	10.0	13 36.5	+ 02 01	10.0	02 30.8	+ 09 57	8.1	01 49.2	+ 07 32	12.2
May 7	04 08.2	+ 19 29	8.8	01 12.6	- 00 01	10.0	13 31.7	+ 02 34	10.1	02 42.8	+ 10 58	8.2	02 00.4	+ 08 30	12.3
14	04 20.1	+ 20 12	8.8	01 22.9	+ 00 21	10.0	13 27.5	+ 03 00	10.3	02 54.8	+ 11 56	8.2	02 11.8	+ 09 27	12.3
21	04 32.3	+ 20 53	8.7	01 33.3	+ 00 37	10.0	13 24.2	+ 03 17	10.4	03 06.9	+ 12 51	8.3	02 23.2	+ 10 21	12.3
28	04 44.6	+ 21 30	8.6	01 43.6	+ 00 49	10.0	13 21.7	+ 03 26	10.5	03 19.0	+ 13 42	8.3	02 34.6	+ 11 13	12.3
Jun 4	04 57.1	+ 22 03	8.5	01 53.9	+ 00 57	9.9	13 20.2	+ 03 27	10.6	03 31.1	+ 14 30	8.4	02 46.2	+ 12 02	12.3
11	05 09.7	+ 22 33	8.4	02 04.1	+ 01 01	9.9	13 19.7	+ 03 20	10.7	03 43.2	+ 15 15	8.4	02 57.8	+ 12 48	12.3
18	05 22.4	+ 22 59	8.6	02 14.2	+ 00 59	9.9	13 20.1	+ 03 07	10.8	03 55.2	+ 15 55	8.4	03 09.4	+ 13 31	12.3
25	05 35.3	+ 23 21	8.6	02 24.3	+ 00 51	9.8	13 21.3	+ 02 48	10.9	04 07.2	+ 16 32	8.4	03 20.9	+ 14 11	12.3
Jul 2	05 48.1	+ 23 40	8.7	02 34.2	+ 00 36	9.8	13 23.4	+ 02 24	1.0	04 19.1	+ 17 06	8.5	03 32.5	+ 14 48	12.3
9	06 01.0	+ 23 54	8.8	02 43.9	+ 00 15	9.7	13 26.3	+ 01 56	1.1	04 30.9	+ 17 35	8.5	03 44.1	+ 15 21	12.3
16	06 13.9	+ 24 05	8.8	02 53.4	- 00 15	9.7	13 29.9	+ 01 24	1.2	04 42.6	+ 18 00	8.5	03 55.5	+ 15 50	12.2
23	06 26.8	+ 24 13	8.8	03 02.6	- 00 52	9.6	13 34.1	+ 00 48	1.3	04 54.1	+ 18 22	8.5	04 06.9	+ 16 15	12.2
30	06 39.6	+ 24 17	8.9	03 11.5	- 01 38	9.5	13 38.9	+ 00 10	1.3	05 05.3	+ 18 40	8.4	04 18.1	+ 16 36	12.1
Aug 6	06 52.4	+ 24 17	8.9	03 20.0	- 02 34	9.4	13 44.3	- 00 30	1.4	05 16.4	+ 18 55	8.4	04 29.1	+ 16 53	12.1
13	07 05.0	+ 24 15	8.9	03 28.0	- 03 40	9.3	13 50.1	- 01 11	1.4	05 27.1	+ 19 07	8.4	04 39.8	+ 17 06	12.0
20	07 17.5	+ 24 10	8.9	03 35.4	- 04 56	9.2	13 56.5	- 01 54	1.5	05 37.4	+ 19 15	8.4	04 50.2	+ 17 16	11.9
27	07 29.8	+ 24 02	8.9	03 42.2	- 06 23	9.1	14 03.2	- 02 38	1.5	05 47.4	+ 19 21	8.3	05 00.3	+ 17 21	11.9
Sep 3	07 41.8	+ 23 52	8.9	03 48.2	- 08 01	9.0	14 10.2	- 03 22	1.5	05 56.8	+ 19 24	8.3	05 09.9	+ 17 23	11.8
10	07 53.7	+ 23 40	8.9	03 53.4	- 09 48	8.9	14 17.7	- 04 06	1.5	06 05.7	+ 19 25	8.2	05 18.9	+ 17 21	11.7
17	08 05.2	+ 23 27	8.8	03 57.5	- 11 46	8.7	14 25.4	- 04 49	1.5	06 14.0	+ 19 24	8.1	05 27.3	+ 17 16	11.6
24	08 16.4	+ 23 13	8.8	04 00.6	- 13 51	8.6	14 33.4	- 05 32	1.5	06 21.6	+ 19 22	8.1	05 34.9	+ 17 08	11.5
Oct 1	08 27.3	+ 22 59	8.8	04 02.4	- 16 03	8.5	14 41.7	- 06 15	1.5	06 28.4	+ 19 20	8.0	05 41.7	+ 16 57	11.3
8	08 37.7	+ 22 46	8.7	04 02.9	- 18 18	8.4	14 50.1	- 06 56	1.5	06 34.2	+ 19 18	7.9	05 47.5	+ 16 44	11.2
15	08 47.7	+ 22 34	8.7	04 02.1	- 20 33	8.3	14 58.8	- 07 35	1.5	06 39.0	+ 19 16	7.8	05 52.1	+ 16 30	11.0
22	08 57.1	+ 22 23	8.6	03 59.9	- 22 44	8.2	15 07.7	- 08 13	1.5	06 42.7	+ 19 15	7.7	05 55.5	+ 16 15	10.9
29	09 06.0	+ 22 15	8.5	03 56.4	- 24 46	8.1	15 16.8	- 08 49	1.5	06 45.2	+ 19 17	7.6	05 57.5	+ 16 00	10.7
Nov 5	09 14.2	+ 22 11	8.5	03 51.8	- 26 34	8.1	15 25.9	- 09 23	1.4	06 46.2	+ 19 21	7.4	05 58.0	+ 15 45	10.5
12	09 21.6	+ 22 11	8.4	03 46.4	- 28 04	8.1	15 35.2	- 09 55	1.4	06 45.8	+ 19 28	7.3	05 56.9	+ 15 32	10.3
19	09 28.2	+ 22 16	8.3	03 40.4	- 29 13	8.1	15 44.6	- 10 24	1.4	06 43.9	+ 19 38	7.2	05 54.3	+ 15 20	10.1
26	09 33.9	+ 22 28	8.2	03 34.4	- 30 00	8.1	15 54.1	- 10 50	1.4	06 40.5	+ 19 51	7.0	05 50.1	+ 15 12	9.9
Dec 3	09 38.6	+ 22 46	8.0	03 28.7	- 30 22	8.2	16 03.5	- 11 13	1.4	06 35.6	+ 20 08	6.9	05 44.6	+ 15 07	9.7
10	09 42.1	+ 23 12	7.9	03 23.7	- 30 22	8.2	16 13.0	- 11 33	1.5	06 29.4	+ 20 27	6.7	05 38.1	+ 15 06	9.5
17	09 44.3	+ 23 46	7.8	03 19.7	- 30 00	8.3	16 22.4	- 11 49	1.5	06 22.2	+ 20 48	6.5	05 31.0	+ 15 09	9.4
24	09 45.1	+ 24 27	7.6	03 17.0	- 29 19	8.4	16 31.8	- 12 03	1.5	06 14.5	+ 21 09	6.4	05 24.0	+ 15 17	9.5
31	09 44.6	+ 25 15	7.5	03 15.7	- 28 22	8.4	16 41.1	- 12 13	1.5	06 06.6	+ 21 31	6.5	05 17.4	+ 15 30	9.7

	6 HEBE			7 IRIS			8 FLORA			10 HYGIEA			15 EUNOMIA		
	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 1	14 59.6	- 04 29	11.4	15 57.1	- 22 44	11.4	19 52.1	- 21 48	11.1	12 53.9	- 09 51	11.0	21 29.7	- 07 50	10.2
8	15 08.4	- 04 42	11.4	16 07.5	- 23 10	11.4	20 07.6	- 21 13	11.0	12 59.6	- 10 37	10.9	21 42.3	- 06 40	10.2
15	15 16.9	- 04 50	11.3	16 17.7	- 23 33	11.4	20 23.2	- 20 32	10.9	13 04.5	- 11 18	10.9	21 55.1	- 05 26	10.2
22	15 25.0	- 04 52	11.3	16 27.6	- 23 53	11.4	20 38.8	- 19 46	10.8	13 08.7	- 11 55	10.8	22 08.0	- 04 08	10.1
29	15 32.6	- 04 49	11.2	16 37.2	- 24 11	11.3	20 54.4	- 18 54	10.7	13 12.0	- 12 27	10.6	22 21.0	- 02 47	10.1
Feb 5	15 39.7	- 04 40	11.2	16 46.4	- 24 25	11.3	21 10.0	- 17 57	10.7	13 14.3	- 12 54	10.5	22 34.1	- 01 23	10.1
12	15 46.1	- 04 26	11.1	16 55.2	- 24 37	11.3	21 25.5	- 16 56	10.8	13 15.6	- 13 15	10.4	22 47.4	+ 00 04	10.0
19	15 51.8	- 04 06	11.0	17 03.5	- 24 46	11.2	21 40.9	- 15 51	10.8	13 15.8	- 13 29	10.3	23 00.7	+ 01 33	10.0
26	15 56.7	- 03 40	10.9	17 11.2	- 24 53	11.2	21 56.3	- 14 41	10.8	13 14.9	- 13 36	10.1	23 14.1	+ 03 04	9.9
Mar 5	16 00.6	- 03 09	10.8	17 18.3	- 24 58	11.1	22 11.6	- 13 28	10.9	13 12.9	- 13 36	10.0	23 27.7	+ 04 37	9.9
12	16 03.6	- 02 33	10.7	17 24.6	- 25 00	11.0	22 26.8	- 12 12	10.9	13 09.8	- 13 28	9.8	23 41.3	+ 06 11	9.8
19	16 05.5	- 01 52	10.6	17 30.0	- 25 01	10.9	22 42.0	- 10 53	10.9	13 05.7	- 13 13	9.7	23 55.0	+ 07 47	9.8
26	16 06.2	- 01 08	10.5	17 34.5	- 25 00	10.8	22 57.0	- 09 32	10.9	13 01.0	- 12 50	9.5	00 08.9	+ 09 22	9.8
Apr 2	16 05.7	- 00 20	10.3	17 37.9	- 24 58	10.7	23 12.1	- 08 09	10.9	12 55.8	- 12 22	9.3	00 22.8	+ 10 58	9.8
9	16 04.0	+ 00 29	10.2	17 40.2	- 24 55	10.6	23 27.1	- 06 45	10.9	12 50.5	- 11 50	9.3	00 36.9	+ 12 33	9.8
16	16 01.0	+ 01 18	10.1	17 41.3	- 24 50	10.5	23 42.0	- 05 20	10.9	12 45.3	- 11 15	9.4	00 51.1	+ 14 07	9.8
23	15 56.9	+ 02 06	10.0	17 41.1	- 24 43	10.3	23 56.9	- 03 54	10.9	12 40.5	- 10 40	9.5	01 05.5	+ 15 40	9.9
30	15 51.9	+ 02 49	9.9	17 39.4	- 24 36	10.2	00 11.8	- 02 28	10.9	12 36.5	- 10 07	9.7	01 20.0	+ 17 11	9.9
May 7	15 46.0	+ 03 26	9.8	17 36.5	- 24 26	10.0	00 26.6	- 01 03	10.9	12 33.3	- 09 37	9.8	01 34.6	+ 18 39	9.9
14	15 39.7	+ 03 56	9.8	17 32.2	- 24 15	9.9	00 41.5	+ 00 21	10.8	12 31.2	- 09 12	10.0	01 49.4	+ 20 05	10.0
21	15 33.1	+ 04 16	9.8	17 26.7	- 24 01	9.7	00 56.4	+ 01 43	10.8	12 30.2	- 08 53	10.1	02 04.3	+ 21 28	10.0
28	15 26.8	+ 04 25	9.8	17 20.3	- 23 45	9.5	01 11.2	+ 03 04	10.8	12 30.4	- 08 40	10.2	02 19.4	+ 22 47	10.0
Jun 4	15 20.9	+ 04 23	9.9	17 13.2	- 23 26	9.3	01 26.0	+ 04 22	10.7	12 31.6	- 08 34	10.3	02 34.6	+ 24 03	10.0
11	15 15.7	+ 04 10	10.0	17 05.7	- 23 05	9.1	01 40.9	+ 05 37	10.7	12 33.9	- 08 35	10.4	02 49.9	+ 25 13	10.0
18	15 11.4	+ 03 47	10.1	16 58.4	- 22 43	9.4	01 55.7	+ 06 48	10.7	12 37.2	- 08 43	10.5	03 05.3	+ 26 20	10.0
25	15 08.2	+ 03 14	10.2	16 51.4	- 22 20	9.5	02 10.5	+ 07 56	10.6	12 41.4	- 08 57	10.6	03 20.8	+ 27 21	10.0
Jul 2	15 06.2	+ 02 34	10.3	16 45.3	- 21 58	9.7	02 25.2	+ 09 00	10.6	12 46.5	- 09 16	10.7	03 36.4	+ 28 16	10.0
9	15 05.4	+ 01 48	10.4	16 40.2	- 21 37	9.8	02 39.9	+ 09 58	10.5	12 52.3	- 09 41	10.8	03 51.9	+ 29 07	10.0
16	15 05.8	+ 00 55	10.5	16 36.3	- 21 19	9.9	02 54.4	+ 10 52	10.5	12 58.8	- 10 10	10.8	04 07.4	+ 29 51	10.0
23	15 07.3	+ 00 01	10.6	16 33.7	- 21 04	10.0	03 08.7	+ 11 41	10.4	13 06.0	- 10 44	10.9	04 22.7	+ 30 30	10.0
30	15 09.9	- 01 00	10.6	16 32.5	- 20 53	10.2	03 22.8	+ 12 24	10.3	13 13.7	- 11 21	10.9	04 38.0	+ 31 03	10.0
Aug 6	15 13.5	- 02 02	10.7	16 32.7	- 20 45	10.3	03 36.6	+ 13 01	10.3	13 22.0	- 12 00	11.0	04 52.9	+ 31 31	10.0
13	15 18.1	- 03 05	10.8	16 34.2	- 20 41	10.4	03 50.1	+ 13 33	10.2	13 30.8	- 12 43	11.0	05 07.6	+ 31 53	9.9
20	15 23.6	- 04 09	10.8	16 37.0	- 20 40	10.5	04 03.0	+ 13 59	10.1	13 40.0	- 13 27	11.1	05 21.9	+ 32 09	9.9
27	15 29.9	- 05 13	10.9	16 40.9	- 20 41	10.5	04 15.4	+ 14 19	10.0	13 49.6	- 14 13	11.1	05 35.7	+ 32 21	9.9
Sep 3	15 36.9	- 06 17	10.9	16 45.9	- 20 45	10.6	04 27.1	+ 14 34	9.9	13 59.6	- 15 00	11.1	05 48.9	+ 32 28	9.8
10	15 44.7	- 07 19	10.9	16 51.9	- 20 50	10.7	04 38.0	+ 14 44	9.8	14 10.0	- 15 47	11.1	06 01.5	+ 32 31	9.8
17	15 53.2	- 08 21	11.0	16 58.8	- 20 56	10.7	04 47.9	+ 14 49	9.7	14 20.7	- 16 35	11.1	06 13.3	+ 32 31	9.7
24	16 02.2	- 09 20	11.0	17 06.6	- 21 02	10.8	04 56.6	+ 14 51	9.6	14 31.7	- 17 22	11.1	06 24.2	+ 32 27	9.7
Oct 1	16 11.8	- 10 17	11.0	17 15.1	- 21 08	10.8	05 04.1	+ 14 49	9.4	14 43.1	- 18 09	11.1	06 34.1	+ 32 21	9.6
8	16 22.0	- 11 12	11.0	17 24.3	- 21 13	10.8	05 10.0	+ 14 44	9.3	14 54.7	- 18 54	11.1	06 42.9	+ 32 14	9.5
15	16 32.7	- 12 03	11.0	17 34.1	- 21 16	10.8	05 14.2	+ 14 38	9.1	15 06.6	- 19 38	11.1	06 50.4	+ 32 05	9.4
22	16 43.8	- 12 51	11.0	17 44.5	- 21 18	10.9	05 16.6	+ 14 32	9.0	15 18.7	- 20 20	11.0	06 56.5	+ 31 55	9.3
29	16 55.4	- 13 36	10.9	17 55.4	- 21 17	10.9	05 17.0	+ 14 27	8.8	15 31.0	- 21 00	11.0	07 01.1	+ 31 45	9.2
Nov 5	17 07.4	- 14 17	10.9	18 06.9	- 21 13	10.8	05 15.3	+ 14 23	8.7	15 43.6	- 21 37	10.9	07 03.9	+ 31 35	9.1
12	17 19.8	- 14 53	10.9	18 18.7	- 21 05	10.8	05 11.6	+ 14 23	8.5	15 56.3	- 22 11	10.9	07 05.0	+ 31 25	9.0
19	17 32.5	- 15 25	10.8	18 30.9	- 20 54	10.8	05 06.1	+ 14 26	8.3	16 09.2	- 22 43	10.8	07 04.1	+ 31 14	8.8
26	17 45.6	- 15 52	10.8	18 43.4	- 20 40	10.8	04 59.3	+ 14 33	8.2	16 22.2	- 23 10	10.7	07 01.3	+ 31 02	8.7
Dec 3	17 58.9	- 16 15	10.7	18 56.2	- 20 20	10.7	04 51.6	+ 14 46	8.0	16 35.3	- 23 35	10.6	06 56.8	+ 30 47	8.6
10	18 12.5	- 16 32	10.7	19 09.3	- 19 57	10.7	04 43.8	+ 15 03	8.1	16 48.5	- 23 55	10.7	06 50.6	+ 30 28	8.4
17	18 26.4	- 16 44	10.6	19 22.6	- 19 28	10.6	04 36.5	+ 15 25	8.3	17 01.7	- 24 11	10.8	06 43.2	+ 30 04	8.3
24	18 40.4	- 16 51	10.5	19 36.1	- 18 55	10.6	04 30.4	+ 15 52	8.5	17 14.9	- 24 24	10.9	06 35.1	+ 29 35	8.1
31	18 54.6	- 16 53	10.5	19 49.7	- 18 17	10.5	04 25.9	+ 16 23	8.7	17 28.1	- 24 32	10.9	06 26.9	+ 29 00	8.1

MINOR PLANET POSITIONS (0hr UT, Epoch 2000.0)

	16 PSYCHE			20 MASSALIA			23 THALIA			29 AMPHITRITE			40 HARMONIA		
	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 1	18 03.3	- 21 21	11.6	19 41.3	- 20 52	11.9	09 41.7	+ 28 54	09.8	18 06.1	- 27 56	11.2	20 38.8	- 20 39	11.8
8	18 15.0	- 21 19	11.7	19 53.5	- 20 21	11.8	09 40.9	+ 30 03	09.6	18 19.6	- 27 53	11.2	20 53.8	- 19 45	11.8
15	18 26.6	- 21 14	11.7	20 05.7	- 19 46	11.7	09 38.3	+ 31 15	09.4	18 33.0	- 27 46	11.3	21 08.6	- 18 47	11.7
22	18 38.1	- 21 06	11.7	20 17.9	- 19 08	11.6	09 33.9	+ 32 24	09.3	18 46.3	- 27 36	11.3	21 23.4	- 17 44	11.7
29	18 49.6	- 20 54	11.7	20 29.9	- 18 27	11.7	09 28.3	+ 33 27	09.2	18 59.5	- 27 22	11.3	21 38.1	- 16 37	11.6
Feb 5	19 00.9	- 20 39	11.8	20 41.9	- 17 43	11.8	09 21.9	+ 34 18	09.2	19 12.5	- 27 04	11.4	21 52.7	- 15 26	11.6
12	19 12.0	- 20 22	11.8	20 53.8	- 16 56	11.8	09 15.4	+ 34 55	09.3	19 25.3	- 26 44	11.4	22 07.1	- 14 13	11.5
19	19 22.9	- 20 01	11.8	21 05.5	- 16 07	11.9	09 09.3	+ 35 14	09.5	19 37.8	- 26 20	11.4	22 21.5	- 12 56	11.4
26	19 33.6	- 19 39	11.7	21 17.1	- 15 15	11.9	09 04.4	+ 35 16	09.6	19 50.1	- 25 54	11.4	22 35.7	- 11 38	11.4
Mar 5	19 44.0	- 19 14	11.7	21 28.5	- 14 22	11.9	09 01.0	+ 35 02	09.8	20 02.1	- 25 26	11.4	22 49.8	- 10 17	11.4
12	19 54.1	- 18 47	11.7	21 39.7	- 13 27	12.0	08 59.4	+ 34 34	10.0	20 13.7	- 24 56	11.4	23 03.8	- 08 55	11.5
19	20 03.8	- 18 19	11.7	21 50.7	- 12 30	12.0	08 59.5	+ 33 55	10.2	20 24.9	- 24 25	11.3	23 17.7	- 07 31	11.6
26	20 13.2	- 17 49	11.6	22 01.5	- 11 32	12.0	09 01.5	+ 33 07	10.3	20 35.7	- 23 53	11.3	23 31.4	- 06 07	11.6
Apr 2	20 22.1	- 17 20	11.6	22 12.1	- 10 34	12.0	09 05.1	+ 32 10	10.5	20 46.1	- 23 21	11.3	23 45.1	- 04 42	11.7
9	20 30.5	- 16 49	11.5	22 22.5	- 09 35	12.0	09 10.2	+ 31 08	10.6	20 55.9	- 22 48	11.2	23 58.7	- 03 18	11.7
16	20 38.4	- 16 20	11.5	22 32.6	- 08 35	11.9	09 16.5	+ 30 00	10.8	21 05.3	- 22 16	11.2	00 12.2	- 01 54	11.8
23	20 45.8	- 15 51	11.4	22 42.4	- 07 36	11.9	09 23.9	+ 28 48	10.9	21 14.1	- 21 45	11.1	00 25.5	- 00 31	11.8
30	20 52.5	- 15 23	11.3	22 51.9	- 06 38	11.9	09 32.2	+ 27 32	11.0	21 22.2	- 21 16	11.0	00 38.9	+ 00 51	11.8
May 7	20 58.5	- 14 58	11.2	23 01.2	- 05 41	11.8	09 41.2	+ 26 12	11.1	21 29.6	- 20 50	10.9	00 52.1	+ 02 12	11.8
14	21 03.7	- 14 35	11.1	23 10.0	- 04 45	11.8	09 50.8	+ 24 50	11.2	21 36.3	- 20 26	10.9	01 05.2	+ 03 30	11.9
21	21 08.1	- 14 15	11.0	23 18.5	- 03 50	11.7	10 00.9	+ 23 25	11.3	21 42.2	- 20 06	10.8	01 18.3	+ 04 46	11.9
28	21 11.6	- 13 59	10.9	23 26.6	- 02 58	11.7	10 11.3	+ 21 58	11.4	21 47.2	- 19 49	10.7	01 31.3	+ 06 00	11.9
Jun 4	21 14.1	- 13 48	10.8	23 34.2	- 02 09	11.6	10 22.1	+ 20 28	11.5	21 51.1	- 19 38	10.5	01 44.2	+ 07 10	11.9
11	21 15.6	- 13 41	10.6	23 41.3	- 01 22	11.5	10 33.1	+ 18 57	11.6	21 54.0	- 19 32	10.4	01 56.9	+ 08 18	11.8
18	21 16.0	- 13 41	10.5	23 47.8	- 00 39	11.4	10 44.3	+ 17 24	11.7	21 55.7	- 19 31	10.3	02 09.6	+ 09 22	11.8
25	21 15.2	- 13 46	10.4	23 53.6	- 00 01	11.3	10 55.6	+ 15 50	11.7	21 56.1	- 19 35	10.2	02 22.1	+ 10 22	11.8
Jul 2	21 13.2	- 13 57	10.2	23 58.8	+ 00 33	11.2	11 07.0	+ 14 15	11.8	21 55.2	- 19 45	10.0	02 34.4	+ 11 18	11.8
9	21 10.2	- 14 14	10.0	00 03.1	+ 01 02	11.1	11 18.5	+ 12 40	11.9	21 53.0	- 20 00	09.9	02 46.4	+ 12 10	11.7
16	21 06.1	- 14 37	09.9	00 06.4	+ 01 24	11.0	11 30.1	+ 11 03	11.9	21 49.4	- 20 19	09.7	02 58.2	+ 12 58	11.7
23	21 01.3	- 15 03	09.7	00 08.8	+ 01 40	10.8	11 41.7	+ 09 27	12.0	21 44.7	- 20 41	09.5	03 09.7	+ 13 41	11.6
30	20 55.9	- 15 33	09.5	00 10.0	+ 01 49	10.7	11 53.3	+ 07 51	12.0	21 38.9	- 21 04	09.4	03 20.8	+ 14 20	11.6
Aug 6	20 50.1	- 16 04	09.4	00 10.1	+ 01 50	10.5	12 05.0	+ 06 15	12.0	21 32.3	- 21 25	09.2	03 31.4	+ 14 55	11.5
13	20 44.5	- 16 35	09.6	00 08.8	+ 01 42	10.4	12 16.8	+ 04 40	12.1	21 25.4	- 21 44	09.2	03 41.5	+ 15 24	11.5
20	20 39.2	- 17 04	09.7	00 06.4	+ 01 26	10.2	12 28.6	+ 03 05	12.1	21 18.5	- 21 58	09.3	03 51.0	+ 15 50	11.4
27	20 34.6	- 17 31	09.9	00 02.7	+ 01 01	10.0	12 40.4	+ 01 32	12.1	21 12.1	- 22 07	09.4	03 59.7	+ 16 11	11.3
Sep 3	20 31.0	- 17 53	10.0	23 57.9	+ 00 30	09.8	12 52.2	+ 00 00	12.1	21 06.4	- 22 08	09.6	04 07.5	+ 16 27	11.2
10	20 28.5	- 18 12	10.1	23 52.2	- 00 08	09.6	13 04.1	- 01 31	12.1	21 01.8	- 22 04	09.7	04 14.4	+ 16 40	11.1
17	20 27.2	- 18 25	10.3	23 46.0	- 00 50	09.4	13 16.0	- 03 00	12.1	20 58.5	- 21 53	09.9	04 20.0	+ 16 49	11.0
24	20 27.3	- 18 34	10.4	23 39.6	- 01 34	09.5	13 28.0	- 04 26	12.1	20 56.7	- 21 36	10.0	04 24.4	+ 16 54	10.8
Oct 1	20 28.6	- 18 38	10.5	23 33.4	- 02 16	09.7	13 40.0	- 05 51	12.1	20 56.2	- 21 14	10.1	04 27.3	+ 16 56	10.7
8	20 31.2	- 18 36	10.6	23 27.8	- 02 55	09.8	13 52.0	- 07 13	12.0	20 57.2	- 20 47	10.3	04 28.6	+ 16 56	10.5
15	20 35.0	- 18 30	10.7	23 23.2	- 03 28	10.0	14 04.1	- 08 32	12.0	20 59.5	- 20 16	10.4	04 28.2	+ 16 52	10.4
22	20 39.9	- 18 19	10.8	23 19.7	- 03 53	10.1	14 16.2	- 09 49	12.0	21 03.0	- 19 40	10.5	04 26.1	+ 16 47	10.2
29	20 45.7	- 18 03	10.9	23 17.6	- 04 10	10.2	14 28.3	- 11 02	11.9	21 07.7	- 19 01	10.6	04 22.2	+ 16 40	10.0
Nov 5	20 52.5	- 17 42	10.9	23 16.9	- 04 17	10.4	14 40.5	- 12 12	11.9	21 13.3	- 18 18	10.7	04 16.8	+ 16 31	09.9
12	21 00.0	- 17 17	11.0	23 17.5	- 04 16	10.5	14 52.6	- 13 19	12.0	21 19.9	- 17 32	10.7	04 10.1	+ 16 22	09.7
19	21 08.2	- 16 47	11.1	23 19.6	- 04 05	10.6	15 04.8	- 14 23	12.1	21 27.2	- 16 42	10.8	04 02.6	+ 16 12	09.5
26	21 17.0	- 16 12	11.1	23 22.9	- 03 47	10.7	15 16.9	- 15 22	12.2	21 35.2	- 15 48	10.9	03 54.7	+ 16 04	09.4
Dec 3	21 26.4	- 15 34	11.2	23 27.4	- 03 20	10.8	15 29.0	- 16 19	12.3	21 43.8	- 14 51	10.9	03 47.1	+ 15 58	09.6
10	21 36.2	- 14 51	11.2	23 33.0	- 02 47	10.9	15 41.0	- 17 11	12.3	21 52.9	- 13 51	11.0	03 40.3	+ 15 55	09.9
17	21 46.4	- 14 03	11.2	23 39.5	- 02 06	11.0	15 52.9	- 17 59	12.4	22 02.5	- 12 48	11.0	03 34.7	+ 15 57	10.1
24	21 56.9	- 13 13	11.2	23 46.9	- 01 21	11.0	16 04.7	- 18 44	12.4	22 12.4	- 11 41	11.0	03 30.6	+ 16 04	10.3
31	22 07.7	- 12 18	11.2	23 55.1	- 00 29	11.1	16 16.3	- 19 25	12.5	22 22.6	- 10 32	11.0	03 28.2	+ 16 16	10.4

	1620 GEOGRAPHOS			42 ISIS			44 NYSA			97 KLOTHO			115 THYRA		
	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 1	08 06.3	+ 48 18	16.5	18 51.5	- 24 40	11.5	19 47.4	- 20 35	12.4	07 21.6	+ 04 03	10.1	09 20.4	+ 18 23	10.7
8	07 44.3	+ 48 57	16.3	19 09.9	- 24 29	11.5	19 59.4	- 20 07	12.3	07 15.4	+ 04 47	10.0	09 14.6	+ 18 08	10.5
15	07 19.2	+ 48 51	16.2	19 28.3	- 24 10	11.6	20 11.4	- 19 35	12.3	07 09.4	+ 05 43	10.1	09 07.3	+ 17 56	10.4
22	06 54.2	+ 47 54	16.3	19 46.7	- 23 43	11.7	20 23.3	- 19 00	12.2	07 03.9	+ 06 48	10.2	08 59.1	+ 17 45	10.2
29	06 32.0	+ 46 09	16.4	20 05.1	- 23 09	11.7	20 35.2	- 18 22	12.2	06 59.5	+ 07 58	10.4	08 50.5	+ 17 34	09.9
Feb 5	06 14.7	+ 43 51	16.5	20 23.4	- 22 27	11.8	20 46.9	- 17 42	12.3	06 56.5	+ 09 10	10.6	08 42.0	+ 17 22	10.2
12	06 02.9	+ 41 14	16.6	20 41.5	- 21 39	11.8	20 58.6	- 16 59	12.3	06 54.9	+ 10 21	10.8	08 34.1	+ 17 09	10.4
19	05 56.3	+ 38 33	16.8	20 59.5	- 20 44	11.8	21 10.1	- 16 13	12.4	06 55.0	+ 11 29	11.0	08 27.4	+ 16 54	10.7
26	05 54.4	+ 35 56	16.9	21 17.3	- 19 44	11.9	21 21.5	- 15 26	12.4	06 56.6	+ 12 32	11.2	08 22.2	+ 16 37	10.9
Mar 5	05 56.1	+ 33 25	17.0	21 34.8	- 18 38	11.9	21 32.7	- 14 37	12.4	06 59.8	+ 13 30	11.4	08 18.6	+ 16 19	11.1
12	06 00.9	+ 31 02	17.1	21 52.1	- 17 28	11.9	21 43.7	- 13 46	12.4	07 04.3	+ 14 21	11.5	08 16.7	+ 15 59	11.3
19	06 08.2	+ 28 46	17.2	22 09.2	- 16 14	11.9	21 54.5	- 12 55	12.4	07 10.1	+ 15 05	11.7	08 16.4	+ 15 37	11.5
26	06 17.3	+ 26 34	17.3	22 26.0	- 14 57	11.9	22 05.1	- 12 02	12.4	07 17.1	+ 15 42	11.8	08 17.7	+ 15 14	11.7
Apr 2	06 28.0	+ 24 24	17.3	22 42.5	- 13 37	11.9	22 15.5	- 11 10	12.4	07 24.9	+ 16 12	12.0	08 20.3	+ 14 48	11.8
9	06 39.9	+ 22 13	17.3	22 58.8	- 12 16	11.9	22 25.7	- 10 17	12.4	07 33.6	+ 16 35	12.1	08 24.2	+ 14 21	12.0
16	06 52.7	+ 20 00	17.4	23 14.8	- 10 53	11.9	22 35.6	- 09 24	12.4	07 42.9	+ 16 51	12.2	08 29.2	+ 13 51	12.1
23	07 06.2	+ 17 41	17.3	23 30.5	- 09 30	12.0	22 45.2	- 08 32	12.3	07 52.9	+ 17 01	12.3	08 35.0	+ 13 19	12.3
30	07 20.2	+ 15 15	17.3	23 46.0	- 08 07	12.0	22 54.6	- 07 42	12.3	08 03.3	+ 17 04	12.4	08 41.7	+ 12 44	12.4
May 7	07 34.4	+ 12 41	17.3	00 01.2	- 06 45	11.9	23 03.6	- 06 52	12.3	08 14.0	+ 17 00	12.5	08 49.1	+ 12 07	12.5
14	07 48.7	+ 09 57	17.3	00 16.1	- 05 25	11.9	23 12.3	- 06 05	12.2	08 25.1	+ 16 51	12.6	08 57.0	+ 11 27	12.6
21	08 02.9	+ 07 03	17.2	00 30.8	- 04 07	11.9	23 20.5	- 05 20	12.1	08 36.5	+ 16 37	12.7	09 05.4	+ 10 44	12.7
28	08 16.7	+ 03 59	17.2	00 45.1	- 02 51	11.9	23 28.4	- 04 37	12.1	08 48.0	+ 16 17	12.8	09 14.2	+ 09 58	12.7
Jun 4	08 29.9	+ 00 45	17.2	00 59.1	- 01 39	11.9	23 35.8	- 03 58	12.0	08 59.6	+ 15 52	12.8	09 23.3	+ 09 09	12.8
11	08 42.2	- 02 38	17.1	01 12.8	- 00 30	11.9	23 42.6	- 03 23	11.9	09 11.3	+ 15 22	12.9	09 32.7	+ 08 18	12.8
18	08 53.5	- 06 07	17.1	01 26.1	+ 00 34	11.9	23 48.9	- 02 52	11.8	09 23.1	+ 14 48	12.9	09 42.4	+ 07 23	12.9
25	09 03.4	- 09 40	17.1	01 39.0	+ 01 34	11.8	23 54.5	- 02 26	11.7	09 34.8	+ 14 11	13.0	09 52.2	+ 06 27	12.9
Jul 2	09 11.7	- 13 15	17.2	01 51.4	+ 02 29	11.8	23 59.3	- 02 06	11.6	09 46.6	+ 13 30	13.0	10 02.2	+ 05 28	13.0
9	09 18.4	- 16 49	17.2	02 03.4	+ 03 18	11.7	00 03.4	- 01 51	11.5	09 58.4	+ 12 46	13.0	10 12.3	+ 04 26	13.0
16	09 23.4	- 20 23	17.2	02 14.7	+ 04 02	11.7	00 06.5	- 01 44	11.4	10 10.1	+ 11 58	13.1	10 22.5	+ 03 23	13.0
23	09 26.7	- 24 01	17.1	02 25.4	+ 04 40	11.6	00 08.6	- 01 44	11.3	10 21.7	+ 11 09	13.1	10 32.8	+ 02 17	13.0
30	09 28.5	- 27 58	16.8	02 35.4	+ 05 12	11.6	00 09.6	- 01 52	11.1	10 33.3	+ 10 17	13.1	10 43.2	+ 01 09	13.0
Aug 6	09 29.5	- 32 55	16.3	02 44.5	+ 05 37	11.5	00 09.4	- 02 07	11.0	10 44.8	+ 09 24	13.1	10 53.6	+ 00 00	13.0
13	09 30.4	- 41 03	15.2	02 52.6	+ 05 57	11.4	00 08.0	- 02 32	10.9	10 56.2	+ 08 29	13.1	11 04.0	- 01 10	13.0
20	09 33.7	- 61 48	12.9	02 59.6	+ 06 10	11.3	00 05.4	- 03 04	10.7	11 07.6	+ 07 33	13.0	11 14.5	- 02 22	13.0
27	21 23.2	- 50 52	10.0	03 05.4	+ 06 17	11.3	00 01.7	- 03 43	10.6	11 18.8	+ 06 36	13.0	11 25.0	- 03 36	13.0
Sep 3	21 27.6	- 08 03	10.9	03 09.8	+ 06 18	11.1	23 56.9	- 04 28	10.4	11 30.0	+ 05 38	13.0	11 35.6	- 04 50	12.9
10	21 30.0	+ 03 41	12.3	03 12.7	+ 06 14	11.0	23 51.3	- 05 16	10.3	11 41.1	+ 04 41	12.9	11 46.1	- 06 05	12.9
17	21 33.3	+ 08 18	13.3	03 13.9	+ 06 05	10.9	23 45.2	- 06 05	10.2	11 52.1	+ 03 43	12.9	11 56.7	- 07 20	12.9
24	21 37.7	+ 10 31	14.1	03 13.5	+ 05 52	10.8	23 38.9	- 06 53	10.2	12 03.0	+ 02 46	12.9	12 07.3	- 08 36	12.8
Oct 1	21 43.1	+ 11 41	14.7	03 11.3	+ 05 36	10.7	23 32.9	- 07 37	10.3	12 13.8	+ 01 49	13.0	12 17.9	- 09 52	12.8
8	21 49.6	+ 12 20	15.2	03 07.4	+ 05 18	10.5	23 27.5	- 08 14	10.5	12 24.5	+ 00 54	13.1	12 28.5	- 11 08	12.8
15	21 57.2	+ 12 43	15.7	03 02.1	+ 05 00	10.4	23 23.0	- 08 42	10.6	12 35.1	+ 00 00	13.2	12 39.0	- 12 23	12.9
22	22 05.7	+ 12 59	16.1	02 55.5	+ 04 44	10.3	23 19.6	- 09 02	10.7	12 45.6	- 00 52	13.2	12 49.6	- 13 38	13.0
29	22 15.1	+ 13 14	16.5	02 48.3	+ 04 32	10.2	23 17.4	- 09 12	10.8	12 55.9	- 01 43	13.3	13 00.2	- 14 53	13.0
Nov 5	22 25.2	+ 13 29	16.8	02 40.8	+ 04 25	10.2	23 16.6	- 09 12	10.9	13 06.1	- 02 31	13.4	13 10.7	- 16 07	13.1
12	22 36.0	+ 13 47	17.1	02 33.5	+ 04 26	10.3	23 17.2	- 09 02	11.0	13 16.1	- 03 16	13.4	13 21.1	- 17 20	13.1
19	22 47.3	+ 14 10	17.4	02 27.0	+ 04 34	10.5	23 19.0	- 08 44	11.1	13 26.0	- 03 59	13.4	13 31.5	- 18 32	13.2
26	22 59.2	+ 14 36	17.7	02 21.6	+ 04 50	10.8	23 22.1	- 08 19	11.2	13 35.6	- 04 38	13.5	13 41.8	- 19 42	13.2
Dec 3	23 11.4	+ 15 07	17.9	02 17.5	+ 05 14	11.0	23 26.3	- 07 46	11.3	13 44.9	- 05 14	13.5	13 52.0	- 20 51	13.2
10	23 24.1	+ 15 43	18.1	02 14.9	+ 05 45	11.2	23 31.5	- 07 06	11.4	13 54.0	- 05 47	13.5	14 02.1	- 21 59	13.2
17	23 37.2	+ 16 23	18.3	02 13.8	+ 06 23	11.4	23 37.6	- 06 20	11.5	14 02.8	- 06 15	13.5	14 11.9	- 23 05	13.2
24	23 50.6	+ 17 07	18.5	02 14.1	+ 07 06	11.5	23 44.6	- 05 29	11.5	14 11.2	- 06 39	13.5	14 21.6	- 24 09	13.2
31	00 04.2	+ 17 54	18.6	02 15.9	+ 07 54	11.7	23 52.3	- 04 34	11.6	14 19.1	- 06 58	13.5	14 31.0	- 25 11	13.2

COMETS FOR 1994

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 from each other. 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 1994 (or late 1993 in the case of West-Kohoutek-Ikemura). 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 these brighter comets. In some cases the positions/ magnitudes are only approximates, for the comet may have not been found yet on this return. Hence the orbital elements and magnitude parameters, used to generate ephemerides, are often based on previous returns. There are also non gravitational effects, associated with comets, which can render ephemerides inaccurate.

Many of the comets expected in 1994 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 1994

P/ WEST-KOHOUTEK-IKEMURA The comet is at opposition during its perihelion period (peri. is Dec. 25, 1993). Although the comet will be observable most of the night in late 93, it is questionable whether a tail will be visible. If one exists it would tend to point away from the Earth. The comet moves into Orion in late October 93. It will be approx. 3° east of Rigel on Nov. 8. West-Kohoutek-Ikemura passes into Taurus at the end of November, being 1° from Aldebaran on Dec. 18, 1993. The comet remains in the evening sky in early 94. It heads west and gets lower in the sky until finally being lost in the evening twilight in early March. It will then be in the constellation of Auriga (near Capella).

MUELLER (1993a) During the comet'sbrightest period from Nov. 93 to Mar. 94 it will be too far north, for Australia, and close to the Sun. The comet moves into the eastern morning sky in early April in the constellation of Aquarius. It continues to move south, getting higher in the morning sky. On May 11 the comet will be 4° below Saturn (around 4:00am). At the end of June, Mueller will be near the star, Formalhaut. By August, visible all night.

P/ SCHWASSMANN-WACHMANN 2 From late 93 to at least April 94 the comet is resident in the constellation of Cancer. In Nov. 93 the comet is in the NE morning sky, moving into the evening sky in December.

P/ ENCKE Although Halley'scomet is the most famous, "Encke" has the distinction of being the comet with the shortest well established period (ie. just over 3 years). It has been seen to return by Man more times than any other comet (since at least its return in 1786AD). The appearance of Encke'stail has been known to change; sometimes having a "fan-like" display.

In Nov. 93, "Encke" is in the NW evening sky in Pegasus. Dec. 93 sees it moving south into Aquarius, getting lower in the western evening sky. It is finally lost in twilight in early Jan. The comet reaches perihelion on Feb 9. Encke again becomes visible low in the eastern morning sky in late Feb. in Capricornus. The best time to observe the comet (post-perihelion) may be around March 10 (after the Moon has left the morning sky).

MUELLER (1993p) This comet was only discovered in late August 1993. Hence, at the time of printing, only a preliminary orbit has been established. However, this may be the comet for 1994 (famous last words?). During its observable period this comet will be located in the western evening sky, moving south. In Nov. 93 it will be in Pegasus; setting around midnight. For Dec. 93 and Jan. 94 Mueller will be in Aquarius. Feb. sees the comet in Cetus; setting at 9:00pm. It continues to set around this time through to the end of April. May sees Mueller setting later as it moves south. On May 13 it will pass 10° north of Canopus; later in that month moving through a number of open star clusters in Puppis. By the end of August it will have moved into Virgo, setting at 8:00pm. It is finally lost, in the evening twilight, in early September.

P/ TEMPEL 1 In Feb. the comet rises around 10:00pm in Virgo. By the end of March the comet will be visible the whole night. It moves slowly into the NW evening sky. In May, the comet has some interesting conjunctions with members of the Virgo cluster of galaxies. At its brightest, in June, it will be well placed in the evening sky, still in Virgo (not setting before 2:00am). As the comet fades, it passes through Scorpio and Sagittarius in Sep. and Oct. It makes many interesting conjunctions with deep sky objects in these constellations (good targets for astrophotographers?).

P/ BORRELLY In the second half of 1994 this comet is well placed in the eastern morning sky. From Jun. through to Oct it rises around midnight; in Nov., around 11:00pm. In June, "Borrelly" is in Cetus and in late July moves into Eridanus. Sep. sees the comet in Orion (it has a close approach to the Orion Nebula on Sep. 9) and by mid Oct. it moves into Gemini. At its brightest (mid Nov.), "Borrelly" will lie between M44 in Cancer and the star Pollux. The comet moves NW finally disappearing over the northern horizon in late Dec. for observers from Australian latitudes.

P/ SHOEMAKER-LEVY 9 (1993e) No ephemeris is given for this faint (14th mag.) object but it is so unusual it is worthy of a mention. This comet, when it was discovered in March 1993, looked like a bar with a wispy tail. On closer examination, astronomers have now discovered that this bar consists of at least 17 fragments! The stress of the gravitational pull of Jupiter may have caused this split. In July, 1994, this comet may even collide with Jupiter!

EXPLANATION OF COMET ELEMENTS TABLE

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

Perihelion Date Date of closest approach to the Sun.

q The perihelion distance, in AU (Astronomical units)

e The eccentricity of the comet's orbit. Values less than one indicate a known periodic comet with an elliptical orbit. A value equal to one 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 (thousands 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 i.e., 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 10am E.A.S.T. (9:30am C.A.S.T.) of date.

R.A., DEC Right Ascension and Declination are for equinox 2000.0

Δ (delta) Geocentric distance (distance from the Earth) in AU.

R Heliocentric distance (distance from the Sun) in AU .

P/Encke

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1993 Oct 30	23 31.8	+ 14 34	0.960	1.835	14.7
1993 Nov 6	23 15.8	+ 12 46	0.946	1.752	14.0
1993 Nov 13	23 02.0	+ 10 59	0.943	1.666	13.4
1993 Nov 20	22 50.9	+ 09 19	0.946	1.577	12.9
1993 Nov 27	22 42.3	+ 07 51	0.951	1.484	12.3
1993 Dec 4	22 36.3	+ 06 36	0.956	1.388	11.7
1993 Dec 11	22 32.4	+ 05 34	0.956	1.287	11.1
1993 Dec 18	22 30.4	+ 04 44	0.949	1.181	10.6
1993 Dec 25	22 29.6	+ 04 02	0.933	1.071	10.0
1994 Jan 1	22 29.5	+ 03 23	0.904	0.955	9.4
1994 Jan 8	22 29.0	+ 02 38	0.861	0.834	8.8
1994 Jan 15	22 26.5	+ 01 31	0.803	0.707	8.2
1994 Jan 22	22 18.7	- 00 36	0.731	0.577	7.5
1994 Jan 29	21 59.1	- 04 56	0.660	0.450	7.0
1994 Feb 5	21 21.0	- 12 42	0.637	0.353	6.7
1994 Feb 12	20 43.8	- 20 24	0.737	0.338	7.0
1994 Feb 19	20 37.2	- 23 33	0.915	0.418	7.6
1994 Feb 26	20 48.4	- 23 58	1.084	0.540	8.3
1994 Mar 5	21 04.1	- 23 24	1.224	0.671	9.0
1994 Mar 12	21 19.7	- 22 29	1.339	0.799	9.6
1994 Mar 19	21 34.2	- 21 29	1.431	0.922	10.2
1994 Mar 26	21 47.3	- 20 28	1.505	1.039	10.9
1994 Apr 2	21 59.0	- 19 30	1.562	1.151	11.5
1994 Apr 9	22 09.3	- 18 37	1.605	1.258	12.1
1994 Apr 16	22 18.4	- 17 49	1.634	1.360	12.7
1994 Apr 23	22 26.2	- 17 08	1.652	1.458	13.3
1994 Apr 30	22 32.8	- 16 34	1.658	1.551	13.9
1994 May 7	22 38.0	- 16 08	1.656	1.641	14.5

P/Borrelly

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1994 Jul 2	02 32.2	- 16 07	1.951	1.915	13.0
1994 Jul 9	02 48.8	- 15 07	1.859	1.867	12.6
1994 Jul 16	03 05.7	- 14 06	1.770	1.819	12.2
1994 Jul 23	03 22.7	- 13 05	1.684	1.773	11.8
1994 Jul 30	03 40.0	- 12 02	1.600	1.727	11.5
1994 Aug 6	03 57.3	- 10 58	1.519	1.683	11.1
1994 Aug 13	04 14.8	- 09 52	1.441	1.640	10.7
1994 Aug 20	04 32.4	- 08 42	1.365	1.600	10.3
1994 Aug 27	04 50.1	- 07 27	1.292	1.561	9.9
1994 Sep 3	05 07.8	- 06 07	1.220	1.525	9.5
1994 Sep 10	05 25.7	- 04 38	1.151	1.492	9.2
1994 Sep 17	05 43.5	- 03 00	1.085	1.462	8.8
1994 Sep 24	06 01.4	- 01 09	1.021	1.436	8.5
1994 Oct 1	06 19.4	+ 00 57	0.959	1.413	8.2
1994 Oct 8	06 37.5	+ 03 21	0.900	1.394	7.9
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

COMETS FOR 1994 — 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/West-Kohoutek-Ikemura	93 Dec 25.30696	1.5767930	0.5432690	6.41	359.97388	84.16843	30.54136	9.0	20.0
Mueller (1993a)	94 Jan 12.89554	1.9373218	1.0018991		130.66948	144.72261	124.87801	4.5	10.0
P/Schwassmann-Wachmann 2	94 Jan 23.90914	2.0702659	0.3987452	6.39	358.21774	126.24703	3.75301	7.6	10.0
Shoemaker-Levy (1993h)	94 Jan 27.82711	4.8800641	1		231.57562	30.40782	68.00040	6.0	10.0
P/Encke	94 Feb 09.47328	0.3309118	0.8502121	3.28	186.27004	334.72946	11.94051	9.8	*
P/Kojima (1992z)	94 Feb 17.99495	2.3990696	0.3926452	7.85	348.53617	154.80326	0.87800	11.0	15.0
P/Tempel 2	94 Mar 16.81620	1.4835360	0.5224470	5.48	194.88342	118.24870	11.97477	5.0	25.0
P/Maury	94 Mar 19.14563	2.0271127	0.5222947	8.74	119.81230	176.83223	11.69354	11.5	15.0
Mueller (1993p)	94 Apr 05.04	0.9835	1		261.27	193.95	105.58	6.5	9.0
P/Shoemaker-Levy 9 (1993e)	94 Apr 17.78882	5.3824657	0.1737029	16.60	356.29593	221.25371	5.05620	3.0	10.0
P/Hartley 3 (1993m)	94 May 20.86842	2.4616815	0.3169111	6.84	168.45831	287.87911	11.69541	9.5	15.0
P/Tuttle (1992r)	94 Jun 25.29070	0.9977321	0.8240894	13.50	206.70304	270.54845	54.69231	8.0	20.0
P/Bus (1993b)	94 Jun 28.14437	2.1831123	0.3746433	6.52	24.40399	182.22140	2.57299	10.0	15.0
P/Reinmuth 2 (1993g)	94 Jun 29.67589	1.8930653	0.4641112	6.64	45.87653	296.17000	6.98193	9.0	15.0
P/Kohoutek	94 Jun 29.90113	1.7846553	0.4963085	6.67	175.80149	269.68646	5.90726	10.5	10.0
P/Tempel 1 (1993c)	94 Jul 03.30846	1.4941517	0.5202546	5.50	178.90206	68.98533	10.55187	5.0	25.0
P/Wild 3	94 Jul 21.21135	2.2994737	0.3660743	6.91	179.27200	72.62598	15.45313	11.0	15.0
P/Harrington	94 Aug 23.24588	1.5719020	0.5613367	6.78	233.45328	119.26258	8.65586	11.0	20.0
P/Brooks 2	94 Sep 01.08820	1.8433400	0.4907310	6.89	197.98800	176.94664	5.54158	9.0	15.0
P/Russell 2	94 Oct 27.37598	2.2764923	0.3996651	7.38	249.18655	42.53294	12.04121	10.0	15.0
P/Borrelly	94 Nov 01.49226	1.3651154	0.6228036	6.88	353.35863	75.42389	30.27061	4.5	25.0
P/Whipple (1993n)	94 Dec 22.42725	3.0938778	0.2587135	8.53	201.87539	182.49524	9.92714	8.5	15.0

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 the behaviour of its brightness during previous return(s).

The estimate of total magnitude is normally calculated using the formula: MAG. = H1 + 5. log (Δ) + 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.

Comet Encke is an example of a comet with an unusual light curve and the equation used to calculate its MAG in this book is as follows:

$$* \text{MAG.} = 9.8 + \log(\Delta) + 2.5\,(R^{18} - 1)$$

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

P/Schwassmann Wachmann 2

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1993 Oct 30	08 02.1	+ 17 52	1.798	2.168	12.2
1993 Nov 6	08 11.3	+ 17 28	1.709	2.153	12.1
1993 Nov 13	08 19.6	+ 17 05	1.622	2.139	12.0
1993 Nov 20	08 26.8	+ 1646	1.539	2.127	11.8
1993 Nov 27	08 32.8	+ 16 31	1.460	2.116	11.7
1993 Dec 4	08 37.5	+ 16 22	1.386	2.105	11.5
1993 Dec 11	08 40.9	+ 16 19	1.317	2.097	11.4
1993 Dec 18	08 42.7	+ 16 24	1.255	2.089	11.3
1993 Dec 25	08 43.0	+ 16 37	1.202	2.083	11.2
1994 Jan 1	08 41.7	+ 16 58	1.157	2.078	11.1
1994 Jan 8	08 39.1	+ 17 26	1.123	2.074	11.0
1994 Jan 15	08 35.4	+ 17 59	1.099	2.071	11.0
1994 Jan 22	08 30.9	+ 18 36	1.087	2.070	10.9
1994 Jan 29	08 26.2	+ 19 14	1.087	2.071	10.9
1994 Feb 5	08 21.7	+ 19 50	1.100	2.072	11.0
1994 Feb 12	08 18.0	+ 20 22	1.124	2.075	11.0
1994 Feb 19	08 15.4	+ 20 49	1.158	2.080	11.1
1994 Feb 26	08 14.2	+ 21 09	1.203	2.085	11.2
1994 Mar 5	08 14.6	+ 21 22	1.256	2.092	11.3
1994 Mar 12	08 16.6	+ 21 29	1.317	2.100	11.4
1994 Mar 19	08 20.1	+ 21 28	1.385	2.110	11.5
1994 Mar 26	08 25.1	+ 21 21	1.458	2.121	11.7
1994 Apr 2	08 31.3	+ 21 07	1.536	2.132	11.8
1994 Apr 9	08 38.7	+ 20 47	1.617	2.145	12.0
1994 Apr 16	08 47.0	+ 20 21	1.703	2.159	12.1

P/West Kohoutek Ikemura

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1993 Nov 6	05 22.9	- 08 03	0.801	1.652	12.9
1993 Nov 13	05 20.4	- 05 48	0.743	1.633	12.6
1993 Nov 20	05 15.5	- 02 50	0.692	1.616	12.4
1993 Nov 27	05 08.4	+ 00 56	0.651	1.602	12.2
1993 Dec 4	04 59.7	+ 05 29	0.623	1.591	12.0
1993 Dec 11	04 49.8	+ 10 39	0.609	1.583	11.9
1993 Dec 18	04 39.7	+ 16 07	0.610	1.579	11.9
1993 Dec 25	04 30.5	+ 21 34	0.627	1.577	11.9
1994 Jan 1	04 23.1	+ 26 39	0.657	1.578	12.1
1994 Jan 8	04 18.2	+ 31 13	0.700	1.583	12.2
1994 Jan 15	04 16.3	+ 35 10	0.753	1.591	12.4
1994 Jan 22	04 17.6	+ 38 32	0.814	1.601	12.6
1994 Jan 29	04 22.0	+ 41 23	0.881	1.615	12.9
1994 Feb 5	04 29.4	+ 43 47	0.953	1.631	13.1
1994 Feb 12	04 39.5	+ 45 47	1.029	1.651	13.4
1994 Feb 19	04 52.2	+ 47 26	1.108	1.672	13.7
1994 Feb 26	05 07.2	+ 48 46	1.190	1.696	14.0
1994 Mar 5	05 24.1	+ 49 48	1.273	1.723	14.2
1994 Mar 12	05 42.5	+ 50 32	1.358	1.751	14.5
1994 Mar 19	06 02.3	+ 51 00	1.444	1.781	14.8
1994 Mar 26	06 22.9	+ 5111	1.531	1.813	15.1

Mueller (1993a)

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1994 Apr 2	22 50.8	+ 00 02	2.988	2.166	10.2
1994 Apr 9	22 55.3	- 01 13	2.953	2.205	10.3
1994 Apr 16	22 59.4	- 02 28	2.906	2.246	10.3
1994 Apr 23	23 03.0	- 03 49	2.848	2.289	10.4
1994 Apr 30	23 06.0	- 05 18	2.780	2.334	10.4
1994 May 7	23 08.4	- 06 56	2.703	2.381	10.4
1994 May 14	23 10.0	- 08 47	2.620	2.430	10.4
1994 May 21	23 10.7	- 10 52	2.532	2.480	10.5
1994 May 28	23 10.3	- 13 14	2.443	2.531	10.5
1994 Jun 4	23 08.7	- 15 54	2.354	2.583	10.5
1994 Jun 11	23 05.6	- 18 53	2.270	2.637	10.5
1994 Jun 18	23 00.8	- 22 14	2.193	2.691	10.5
1994 Jun 25	22 54.0	- 25 53	2.129	2.747	10.5
1994 Jul 2	22 44.8	- 29 47	2.081	2.803	10.6
1994 Jul 9	22 33.1	- 33 49	2.052	2.860	10.6
1994 Jul 16	22 18.7	- 37 50	2.046	2.910	10.7
1994 Jul 23	22 01.6	- 41 38	2.066	2.976	10.8
1994 Jul 30	21 42.2	- 45 02	2.111	3.034	10.9
1994 Aug 6	21 21.1	- 47 53	2.181	3.093	11.1
1994 Aug 13	20 59.3	- 50 06	2.275	3.153	11.3
1994 Aug 20	20 38.1	- 51 43	2.390	3.213	11.5
1994 Aug 27	20 18.5	- 52 46	2.523	3.273	11.7

Mueller (1993p)

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1993 Oct 30	23 35.0	+ 33 22	1.748	2.575	11.4
1993 Nov 6	23 23.1	+ 28 50	1.717	2.492	11.2
1993 Nov 13	23 13.5	+ 24 07	1.709	2.408	11.1
1993 Nov 20	23 06.1	+ 19 24	1.719	2.323	11.0
1993 Nov 27	23 01.0	+ 14 53	1.747	2.238	10.9
1993 Dec 4	22 57.8	+ 10 39	1.786	2.152	10.8
1993 Dec 11	22 56.5	+ 06 47	1.834	2.067	10.7
1993 Dec 18	22 56.7	+ 03 16	1.886	1.981	10.5
1993 Dec 25	22 58.3	+ 00 06	1.939	1.895	10.4
1994 Jan 1	23 01.1	- 02 44	1.990	1.809	10.3
1994 Jan 8	23 05.0	- 05 19	2.035	1.724	10.2
1994 Jan 15	23 09.8	- 07 41	2.073	1.640	10.0
1994 Jan 22	23 15.5	- 09 53	2.101	1.556	9.8
1994 Jan 29	23 21.9	- 11 58	2.117	1.474	9.6
1994 Feb 5	23 29.0	- 13 58	2.119	1.395	9.4
1994 Feb 12	23 36.9	- 15 57	2.107	1.318	9.2
1994 Feb 19	23 45.6	- 17 57	2.079	1.245	8.9
1994 Feb 26	23 55.2	- 20 01	2.034	1.178	8.7
1994 Mar 5	00 05.7	- 22 11	1.972	1.118	8.4
1994 Mar 12	00 17.7	- 24 30	1.893	1.067	8.1
1994 Mar 19	00 31.4	- 27 00	1.796	1.027	7.9
1994 Mar 26	00 47.6	- 29 44	1.684	0.999	7.6
1994 Apr 2	01 07.3	- 32 43	1.559	0.985	7.4
1994 Apr 9	01 32.3	- 35 57	1.426	0.986	7.2
1994 Apr 16	02 05.2	- 39 22	1.292	1.002	7.1
1994 Apr 23	02 49.7	- 42 41	1.165	1.031	7.0
1994 Apr 30	03 49.6	- 45 09	1.058	1.073	6.9
1994 May 7	05 04.7	- 45 29	0.984	1.126	6.9
1994 May 14	06 24.9	- 42 30	0.959	1.187	7.1
1994 May 21	07 35.5	- 36 39	0.988	1.255	7.4
1994 May 28	08 30.2	- 29 42	1.069	1.328	7.8
1994 Jun 4	09 10.9	- 23 11	1.192	1.405	8.2
1994 Jun 11	09 41.7	- 17 45	1.344	1.485	8.7
1994 Jun 18	10 05.9	- 13 27	1.514	1.567	9.2
1994 Jun 25	10 25.6	- 10 06	1.695	1.650	9.6
1994 Jul 2	10 42.2	- 07 29	1.882	1.735	10.0
1994 Jul 9	10 56.7	- 05 28	2.071	1.820	10.4
1994 Jul 16	11 09.5	- 03 54	2.258	1.906	10.8
1994 Jul 23	11 21.2	- 02 40	2.442	1.992	11.1
1994 Jul 30	11 32.0	- 01 41	2.621	2.078	11.5
1994 Aug 6	11 42.1	+ 00 56	2.793	2.163	11.7
1994 Aug 13	11 51.7	+ 00 19	2.957	2.249	12.0

P/Tempel 1

Date	R.A. h m	Dec ° '	Δ AU	R AU	Mag
1994 Feb 19	13 27.6	+ 09 21	1.177	1.974	12.7
1994 Feb 26	13 31.2	+ 09 48	1.091	1.934	12.4
1994 Mar 5	13 33.4	+ 10 21	1.011	1.896	12.0
1994 Mar 12	13 34.0	+ 10 58	0.939	1.858	11.6
1994 Mar 19	13 33.0	+ 11 35	0.876	1.821	11.2
1994 Mar 26	13 30.3	+ 12 09	0.822	1.785	10.9
1994 Apr 2	13 26.2	+ 12 34	0.777	1.750	10.5
1994 Apr 9	13 21.0	+ 12 46	0.742	1.717	10.2
1994 Apr 16	13 15.1	+ 12 39	0.715	1.685	9.9
1994 Apr 23	13 09.2	+ 12 10	0.698	1.655	9.7
1994 Apr 30	13 04.0	+ 11 16	0.688	1.627	9.5
1994 May 7	12 59.9	+ 09 58	0.686	1.601	9.3
1994 May 14	12 57.6	+ 08 18	0.690	1.578	9.1
1994 May 21	12 57.3	+ 06 17	0.700	1.557	9.0
1994 May 28	12 59.1	+ 04 00	0.715	1.539	8.9
1994 Jun 4	13 03.1	+ 01 31	0.734	1.523	8.9
1994 Jun 11	13 09.1	- 01 08	0.757	1.511	8.9
1994 Jun 18	13 17.1	- 03 54	0.783	1.502	8.9
1994 Jun 25	13 26.9	- 06 43	0.813	1.497	8.9
1994 Jul 2	13 38.4	- 09 33	0.846	1.494	9.0
1994 Jul 9	13 51.4	- 12 20	0.883	1.495	9.1
1994 Jul 16	14 05.9	- 15 04	0.924	1.500	9.2
1994 Jul 23	14 21.7	- 17 41	0.967	1.507	9.4
1994 Jul 30	14 38.6	- 20 08	1.015	1.518	9.6
1994 Aug 6	14.56.6	- 22 26	1.067	1.533	9.8
1994 Aug 13	15 15.6	- 24 31	1.123	1.550	10.0
1994 Aug 20	15 35.3	- 26 23	1.183	1.569	10.3
1994 Aug 27	15 55.8	- 28 00	1.246	1.592	10.5
1994 Sep 3	16 16.8	- 29 23	1.315	1.617	10.8
1994 Sep 10	16 38.1	- 30 30	1.387	1.644	11.1
1994 Sep 17	16 59.7	- 31 21	1.463	1.673	11.4
1994 Sep 24	17 21.3	- 31 58	1.543	1.704	11.7
1994 Oct 1	17 42.8	- 32 20	1.627	1.737	12.1
1994 Oct 8	18 04.1	- 32 28	1.715	1.771	12.4
1994 Oct 15	18 25.1	- 32 23	1.805	1.807	12.7
1994 Oct 22	18 45.6	- 32 07	1.898	1.844	13.0
1994 Oct 29	19 05.6	- 31 41	1.994	1.881	13.4

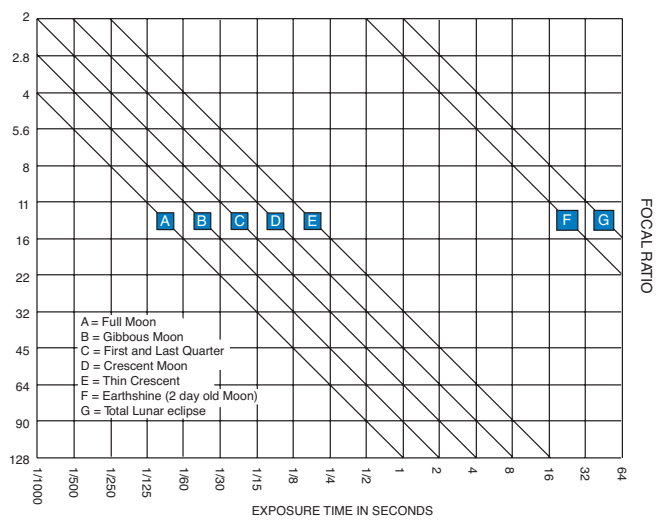
APPENDIX A: THE BRIGHTEST STARS

See introduction to part 3 (page 57) for explanation.

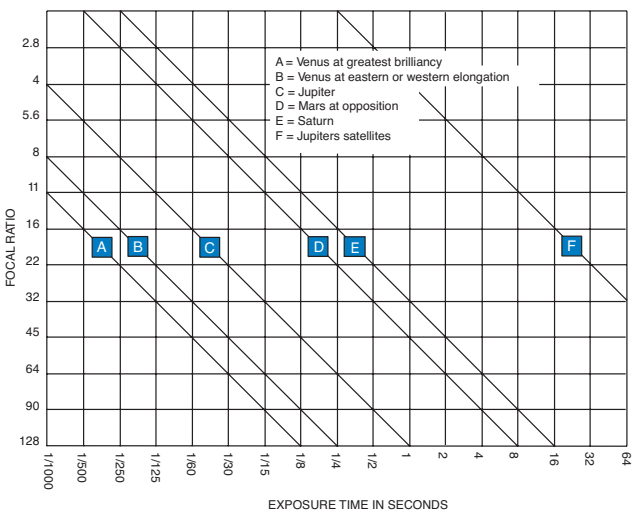
	Designation		Name	Constellation	R.A. (2000.0)	Dec (2000.0)	Magnitude App.	Magnitude Abs.	Spectral Type	Parallax	Distance ly	Distance pc
1			Sun				-26.70	4.8	G2 V			
2	α	CMa	Sirius	Canis Major	06 45.2	-16 43	-1.46	1.4	A1 V	0.375	8.7	2.67
3	α	Car	Canopus	Carina	06 23.9	-52 42	-0.72	-8.5	F0 Ia	0.018	180	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: 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 (right) 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 ratio 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). This will help smooth out variables and should provide at least one image at the required density.

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

Film Speed	Multiply By	Film Speed	Divide By
32 ISO	4	200 ISO	2
64 ISO	2	400 ISO	4

APPENDIX C: NON STELLAR OBJECTS (Epoch 2000.0)

CAT	NUM	R.A.	DEC	SIZE	CON	TYPE	MAG	DESCRIPTION
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'
	SMC	00 52.7	-72° 30'	5°x4°	Tuc	Galaxy	2.3	Small Magellanic Cloud. Visible to unaided eye from dark sky
	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
	LMC	05 23.6	-69° 45'	9°x10°	Dor	Galaxy	0.1	Large Magellanic Cloud. Visible to unaided eye from dark sky
NGC	1976	05 35.4	-05° 27'	65'x60'	Ori	Gaseous nebula	4.0	M42, 'Orion Nebula', emission and reflection nebula
NGC	2070	05 38.6	-69° 05'	30'x20'	Dor	Emission nebula	8.3	30 Doradus, 'Tarantula Nebula', bright complex looped structure
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 to 16, no central concentration
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	2362	07 18.8	-24° 57'	8'	CMa	Open cluster	4.1	60 stars, large brightness range (4th mag. down), concentrated centre
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 in 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	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, central concentration
NGC	2632	08 40.1	+19° 59'	95'	Cnc	Open cluster	3.1	M44, 'Praesepe' or 'Beehive Cluster', very large cluster, 50 stars
IC	2391	08 40.2	-53° 04'	50'	Vel	Open cluster	2.5	Moderately rich in bright (about 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	2808	09 12.0	-64° 52'	13.8'	Car	Globular cluster	6.1	Large and rich, compressed centre, stars 13 to 15th magnitude
NGC	3114	10 02.7	-60° 07'	35'	Car	Open cluster	4.2	Rich cluster, stars 9 to 14th magnitude, slight central concentration
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 to 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	4755	12 53.6	-60° 20'	10'	Cru	Open cluster	4.2	The 'Jewel Box', rich in stars, large brightness range
NGC	5139	13 26.8	-47° 29'	36'	Cen	Globular cluster	3.5	Omega Centauri, perhaps the finest example of a globular cluster
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	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	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	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	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	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 and reflection nebulosity cut by dark lanes
NGC	6523	18 03.8	-24° 23'	45'x30'	Sgr	Emission nebula	5.0	M8, 'Lagoon', densest section known as the 'Hourglass', dark lane
NGC	6611	18 18.8	-13° 47'	21'	Ser	Open cluster	6.0	M16, 100 bright and faint stars, involved in the 'Eagle Nebula'
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 Centauri and 47 Tucanae are brighter.
NGC	6705	18 51.1	-06° 16'	13'	Sct	Open cluster	5.8	M11, the 'Wild Duck Cluster', rich and compact open cluster

APPENDIX D: 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!

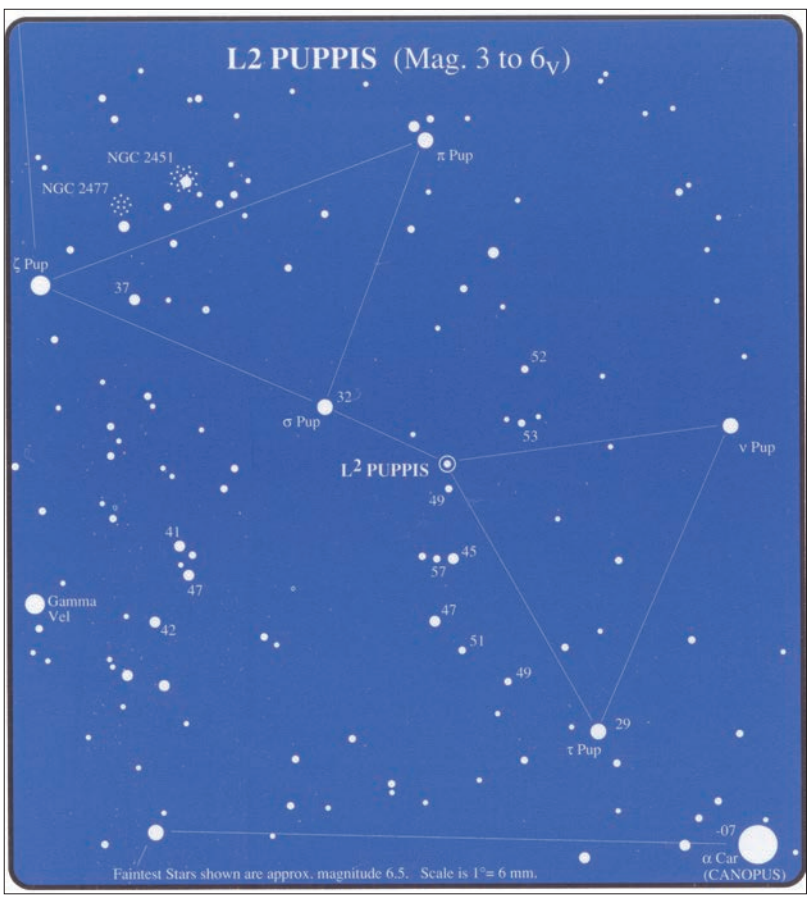
Variable stars are split into a number of classes. These are often named after the first star of the type to be discovered eg. RR Lyrae stars. Variables fit into two broad categories ie. those whose brightness changes are caused by a physical change in the star, or by an external factor. The most common 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, and one of these stars is dimmer, we periodically see the brighter star eclipsed by the fainter. The star'sbrightness, as seen from Earth, can drop dramatically. 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.

L² PUPPIS

This is an ideal star for the novice to try making estimates of brightness. L2 Puppis is similar to the long period type variables but it is considered to be semiregular; ie. its light curve is not as smooth and predictable as the Miras. It has a magnitude range of approximately 3 down to 6 (visual) and a period of about 140 days. At this brightness it is ideally suited for binoculars or naked eye observations. The star chart has reference stars with their magnitudes (the decimal point has been omitted ie. mag. 5.1 is shown as 51). 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 best to make estimates when L2 is reasonably high in the sky. The star is well placed to observe in the evening sky from January through to April. Weekly observations should be adequate to establish a good light curve. The star is expected to return to maximum in mid November 93, late March and early August 94. To help find L2 Puppis, the star has been labelled on the wide field skyview diagram for February 28 (11:00pm) on page 16.



APPENDIX E
RISE/SET TIME CORRECTIONS FOR OTHER LOCATIONS

As mentioned previously in this book, the rise/set tables for the Sun, Moon and planets, in part 2, are calculated for Adelaide, Brisbane, Canberra, Darwin, Hobart, Melbourne, Sydney and Townsville.

This page is designed to help people, who live outside of these cities, to make corrections to determine the rise/set 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 SYDNEY, 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 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 you 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:-

   cosA = -tanB*tanC

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

You need to calculate the value of A for Sydney (C=-33.9) and subtract the value of A for your location/ object's declination. Express the answer in degrees (some computers/calculators give output in radians); then multiply by 4 to convert to minutes.

It is IMPORTANT that Rise/Set times for SYDNEY are used, IRRESPECTIVE of which town in Australia the calculations are for; if you are using table 2.

In all these calculations it is easier to first convert all latitudes and longitudes to decimal degrees.

Example of rise/set time corrections.

Calculate the rise/set times for the Sun on Jan 22 for Albury (36° 05'S, 146° 55'E)

	Rise	Set
From p. 63 the rise/set values for Sydney are:-	5:06	19:07
Adjust for longitude (151.25-146.92)*4 (table 1)	+ :17	+ :17
(value is positive due to Albury being west of Syd.)		
Adjust for latitude & Declination of Sun from table 2 (Dec. = -19°45' p. 64)	- :05	+ :05
Rise/Set times for Albury are :-	5:18	19:29

NB. If your local time is Australian Central Standard time, **subtract** 30 minutes.

If daylight saving is in force, **add** 60 minutes.

TABLE 1

LONGITUDE ADJUSTS FOR SOME TOWNS/CITIES

Location	Latitude (° ' S)	Longitude ° ' E)	Change in Longitude (decimal °)	correction (mins.)
NSW				
Albury	36 05	146 55	4.3	17
Bathurst	33 25	149 34	1.7	7
Broken Hill	32 0	141 27	9.8	39
Coffs Harbour	30 13	153 08	-1.9	-8
Dubbo	32 15	148 37	2.6	11
Eden	37 01	149 56	1.3	5
Gosford	33 26	151 21	-0.1	0
Goulburn	34 45	149 43	1.5	6
Katoomba	33 42	150 18	0.9	4
Newcastle	32 55	151 45	-0.5	-2
Parkes	33 05	148 10	3.1	12
Tamworth	31 03	151 02	0.2	1
Wagga Wagga	35 05	147 20	3.9	16
Wollongong	34 25	150 52	0.4	2
NORTHERN TERRITORY				
Alice Springs	23 42	133 56	17.3	69
Ayers Rock	25 11	130 58	20.3	8
Tennant Creek	19 34	134 08	17.1	68
QUEENSLAND				
Bundaberg	24 52	152 21	-1.1	-4
Longreach	23 22	144 09	7.1	28
Mount Isa	20 38	139 28	11.8	47
Rockhampton	23 21	150 28	0.8	3
Surfers Paradise	28 00	153 26	-2.2	-9
Toowoomba	27 33	151 58	-0.7	-3
TASMANIA				
Launceston	41 20	147 08	4.1	16
Stanley	40 40	145 08	6.1	24
VICTORIA				
Ballarat	37 25	143 55	7.3	29
Benalla	36 30	146 01	5.2	21
Bendigo	36 46	144 17	7.1	28
Geelong	38 09	144 10	7.1	28
Morwell	38 12	146 21	4.9	20
Shepparton	36 13	145 25	5.8	23
Swan Hill	35 13	143 30	7.8	31
Wangaratta	36 17	146 13	5.0	20
Warnambool	38 27	142 30	8.8	35
SOUTH AUSTRALIA				
Port Augusta	32 30	137 52	13.4	54
Port Lincoln	34 42	135 59	15.3	61
Mount Gambier	37 41	140 49	10.4	42

TABLE 2 - RISE/SET CORRECTIONS FOR LATITUDE/DECLINATION (from Sydney)

Declination

South Latitude (negative)	30°	25°	20°	15°	10°	5°	0°	-5°	-10°	-15°	-20°	-25°	-30°
-12°	-63	-50	-39	-28	-19	-9	0	9	19	28	39	50	63
-14°	-58	-46	-36	-26	-17	-8	0	8	17	26	36	46	58
-16°	-53	-42	-33	-24	-16	-8	0	8	16	24	33	42	53
-18°	-48	-38	-29	-22	-14	-7	0	7	14	22	29	38	48
-20°	-43	-34	-26	-19	-13	-6	0	6	13	19	26	34	43
-22°	-37	-30	-23	-17	-11	-5	0	5	11	17	23	30	37
-24°	-32	-25	-19	-14	-9	-5	0	5	9	14	19	25	32
-26°	-26	-20	-16	-11	-7	-4	0	4	7	11	16	20	26
-28°	-20	-16	-12	-9	-6	-3	0	3	6	9	12	16	20
-30°	-13	-11	-8	-6	-4	-2	0	2	4	6	8	11	13
-32°	-7	-5	-4	-3	-2	-1	0	1	2	3	4	5	7
-34°	0	0	0	0	0	0	0	0	0	0	0	0	0
-36°	8	6	5	3	2	1	0	-1	-2	-3	-5	-6	-8
-38°	16	12	9	7	4	2	0	-2	-4	-7	-9	-12	-16
-40°	25	19	15	10	7	3	0	-3	-7	-10	-15	-19	-25
-42°	34	26	20	14	9	5	0	-5	-9	-14	-20	-26	-34
-44°	44	34	26	18	12	6	0	-6	-12	-18	-26	-34	-44

APPENDIX F

JULIAN DATE — 1994

To calculate Julian Date (JD), first convert local time to Universal Time (UT); subtract 10 hrs from E.A.S.T., 9.5 hrs from C.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 23:00 EAST on July 17th. Subtract 10 hours to get UT.

23 - 10 = 13:00 hrs UT

From the table the JD for July is 2449533.5 Add the day of month, 17 gives us 2449550.5

Now add the hours as a fraction of a day from the 2nd table. 13hr is 0.542. Thus JD at 23:00hr 17 Jul 94 EAST is 2449551.042

JULIAN DATE at 0hrs UT		
Month		Julian Date
Jan	0	244 9352.5
Feb	0	244 9383.5
Mar	0	244 9411.5
Apr	0	244 9442.5
May	0	244 9472.5
Jun	0	244 9503.5
Jul	0	244 9533.5
Aug	0	244 9564.5
Sep	0	244 9595.5
Oct	0	244 9625.5
Nov	0	244 9656.5
Dec	0	244 9686.5

Hours as decimal of a 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 G

SIDEREAL TIME — 1994

Greenwich mean sidereal time at 0hrs UT

Jan	0	06.6289	Jul	0	18.5223
Feb	0	08.6659	Aug	0	20.5593
Mar	0	10.5057	Sep	0	22.5963
Apr	0	12.5427	Oct	0	00.5676
May	0	14.5140	Nov	0	02.6046
Jun	0	16.5510	Dec	0	04.5758

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 23:00 hours Sydney time on 17th July 1994.

23:00 local time = 13:00 UT. GMST for July 0 is 18.5223 hrs.

GMST = 18.5223 + (0.06571 × 17) + (1.00274 × 13) = 32.6750

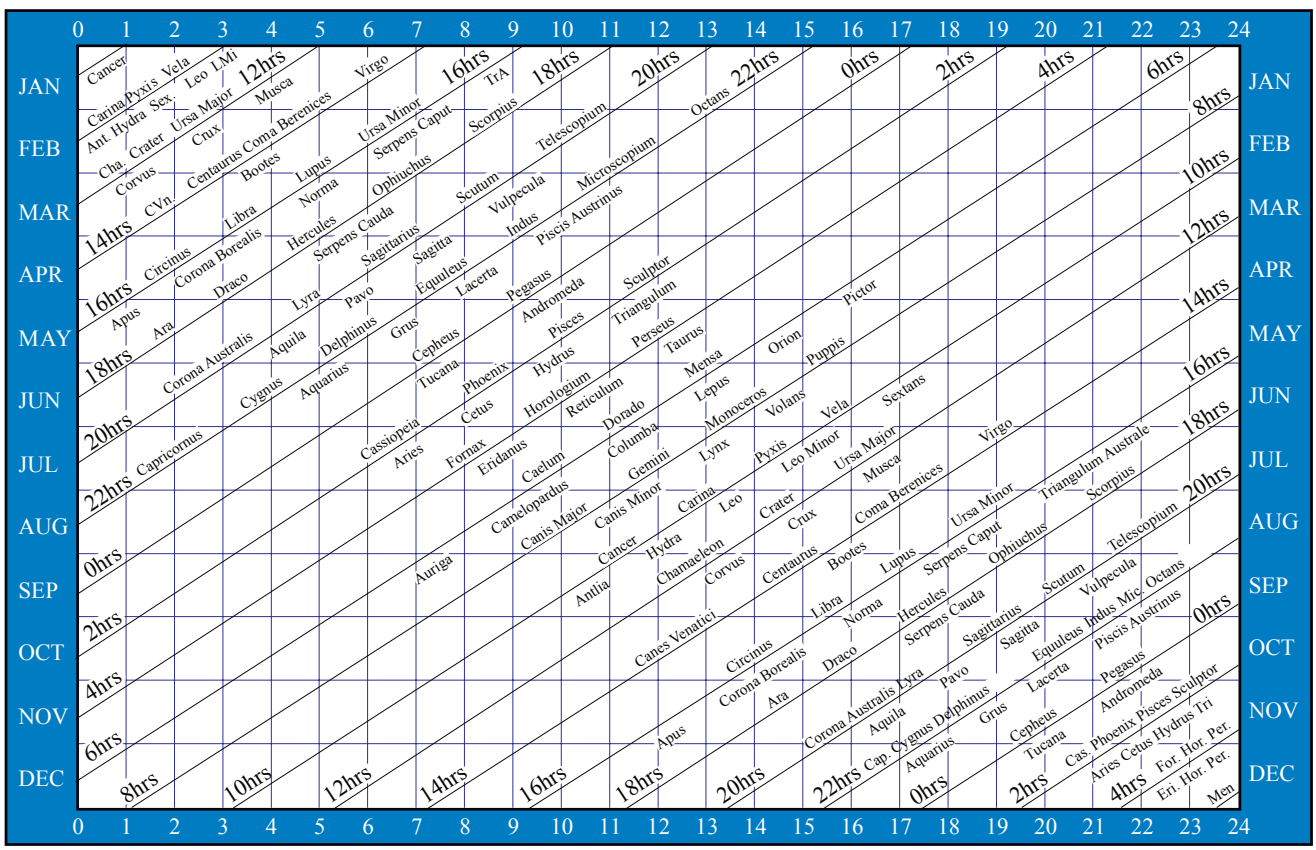
Sydney's longitude is 151.25° which is 10.0833 hrs so

LMST = 32.6750 + 10.0833 = 42.7583

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

42.7583 - 24 = 18.7583 hrs or 18h 45m 30s

APPENDIX H — HOURS of RIGHT ASCENSION / CONSTELLATIONS on the MERIDIAN



APPENDIX I
PLACES OF ASTRONOMICAL INTEREST

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

NEW SOUTH WALES

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 setup 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'shistoric 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: J. Kitchener (02) 241-2478.

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 can function 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'scentre is free. A modest charge is made for the Audio/Visual presentation: $3:00 Adults, $2:50 Students, $2:00 Pensioners and up to $10 for families.

Contact: (068) 62-3677

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 newer 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'sknowledge of the Universe. The Visitor'sCentre 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/Pensioners and $12:00 Family.

Contact - (068) 42-6211.

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

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'sPaul 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'strack, 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).

Cost: There is no charge to visit the centre. There is a cost of $40 to $60 (depending on the number of people) for bus tours; refreshments also available if booked in advance. There is no charge for school groups.

Contact: (067) 90-4070.

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'sdeep space tracking network. It has played a large role in nearly all of NASA'slunar 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'smanned and unmanned probes. The centre incorporates audio and visual displays as well as a multi-slide production. In December 1990, an additional visitors 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 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'scentre.

Contact: (06) 281-2190 (visitor'scentre)

JOHN TEBBUTT OBSERVATORIES

Today, John Tebbutt is best known as the man on the $100 note. As well as being a gentleman farmer, he was also a remarkably successful amateur astronomer. He built his observatory at Windsor, NSW, in the mid 19th century. For some 60 years he conducted an incredible career which continually outstripped all the professional astronomers in Australia at that time. His crowning achievement was his discovery of the great comet of 1861. This was by far the brightest comet of the 19th century with it being clearly visible in bright daylight! In recorded history, perhaps, only "Halley" in 1910 had a tail that came as close to Earth and as spectacular as "1861".

In recent years the observatory has been expertly restored and has had reinstalled (and overhauled) Tebbutt'soriginal 9 inch refractor. The observatory has on display some excellent and rare memorabilia on Tebbutt'slife and his work.

Tours are organised as required. Cost approx. $10 per adult.

Contact: George Smith (018) 61-1232

KOOLANG ASTRONOMY AND SCIENCE CENTRE.

This centre, located near Gosford, on the Central Coast, is due to open soon. The observatory will open with an operating 0.5 metre telescope housed in a two-story building. The ground floor will feature a number of displays. In the longer term, the centre will consist of a number of large buildings which will house various astronomy and space science displays.

Contact: Russell Neuman (043) 41-5853

PORT MACQUARIE OBSERVATORY

Regular public observing nights are held. Contact the Port Macquarie Astronomical Society for more information.

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: $7:00 Adults, $3:50 Children (under 15 years) and concessions for Students / Pensioners.

Bookings and Enquiries - (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

Contact: (003) 31-6777

VICTORIA

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 1994, 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.

Contact Richard Allen (03) 669-9942 or (03) 669-9973 (at Museum of Victoria) for bookings and cost.

H.V.MCKAY MELBOURNE PLANETARIUM

Current session times (Nov/Dec 1993) are: Sat. and Sun. 12, 1, 2, and 3pm; Wed. to Thurs.3:00pm; Fri. 3 and 8:00pm and public and school holidays 11am, 12 1,2 and 3pm. All shows last 45 minutes.

Contact: as for Melbourne Observatory (see above), for costs and programme/ timetable details for 1994.

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, $7 Adults and $4 Concessions. Night Tours, $4 Adults and $2 Concessions.

Contact: (09) 293-8255. There is also a recorded Information Line (09) 293-8109..

APPENDIX J
ASTRONOMICAL COURSES, SOURCES OF INFORMATION IN 1994

The following lists astronomy courses, events, magazines and radio programmes, known to the authors, for 1994. 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. Enquiries from the general public are most welcome.

A number of the amateur astronomical societies also provide an invaluable service to public education by their public lectures and public observing 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 marketplace 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 night sky, the environment 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

NATIONAL AUSTRALIAN CONVENTION OF AMATEUR ASTRONOMERS The NACAA is a bi-annual gathering of amateur astronomers from across Australia. The next convention is to be held over Easter 1994,in Canberra, and is being hosted by the Canberra Astronomical Society. Contact the CAS for further details.

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 1994. Contact WEA (02) 264-2781 or Sydney Observatory (02) 241-2478 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'sproperty at Ilford, NSW. To be held from May 5.

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'sequipment. 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).

SOUTH AUSTRALIA

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.

TASMANIA

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

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).

APPENDIX M
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 (Oct 1993).

NEW SOUTH WALES

ASTRONOMICAL SOCIETY OF NSW

The society holds meetings twice per month at the "Catholic College of Education", 179 Albert St, Strathfield. At ordinary meetings, professional astronomers are invited to talk on various astronomical topics. The Technical meetings are less formal, where members of the Society often present discussions on their amateur projects. Guests are most welcome. The Society also runs two observing sites. One at Bowen Mountain, (near Richmond -west of Sydney), where the society has an observatory and the other is their "dark sky" property "Wiruna" near Ilford. A monthly magazine "Universe" is published for members. The Society also runs an information service called "Astrocards". This service alerts subscribers quickly to any new discoveries such as Novae and Comets.

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.

SUTHERLAND ASTRONOMICAL SOCIETY

The society operates from Green Point Observatory near Sutherland. This houses a 40cm reflecting telescope and has a well equipped library and meeting hall. Other telescopes include a high quality 150mm refractor. The SAS meets every Thursday at 8:00pm (visitors welcome). The Society also publishes a regular newsletter. Star nights are available for interested groups. There is also a public open night held annually during August.

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

BRITISH ASTRONOMICAL ASSOCIATION - NSW BRANCH

The BAA meets at Sydney Observatory. The Association meets on the third Wednesday of each month (except for January), commencing at 7:45pm. At these meetings, professional astronomers are often invited as guest speakers. Regular practical workshops are also held on weekends. The BAA also publish a regular newsletter called "The Bulletin".

Fees: $30 Full, $15 Junior (no joining fee) and there are family concessions available. There is a $12:50 Joining Fee.
Contact: Michael Chapman (02) 949-1058

WESTERN SYDNEY AMATEUR ASTRONOMICAL SOCIETY

The society meets 3rd Wednesday of the month at the Uni. of Western Sydney, Nepean. Also regular observing nights and a monthly newsletter.

Fees: $15
Address: PO Box 400, Kingswood NSW 2747
Contact: John Jarman (047) 30-1588

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. There are monthly observing nights held at a "deep sky" site west of Wollongong.

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

HAWKESBURY ASTRONOMICAL ASSOCIATION

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

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

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. It is currently restoring the college'shistoric observatory.

Fees: $30 adult
Contact: Gordon Stott (02) 871-7838

PORT MACQUARIE ASTRONOMICAL ASSOCIATION

Meets at the Port Macquarie Observatory, open to public Wed. & Sun

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

TAREE ASTRONOMICAL SOCIETY

The society meets at the Community Centre, Mabiac on the second Thursday of each month at 7:30pm. There is also a bi-monthly newsletter and regular Friday night observing sessions.

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

THE ASTRONOMICAL SOCIETY OF THE HUNTER

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

Fees: $20 adult
Address: PO Box 193, Wallsend NSW 2289
Contact: George Livanos (049) 69-2313

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 255, Nowra NSW 2541
Contact: David Hawksworth (044) 41-5866

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

ASTRONOMICAL ASSOCIATION OF THE CENTRAL COAST

The Association holds monthly meetings at Gosford Hospital. They also have a monthly newsletter and an observing site at Mt. White.

Fees: $15 adult, $20 family and $10 student.
Address: PO Box 229, Toukley NSW
Contact: Andrew Murrell (043) 41-4598

ASTRONOMICAL SOCIETY OF COONABARABRAN

Meets on the third Thursday of each month at the Tourist Information Centre. They also publish an occasional newsletter.

Address: C/- AAO Private Bag, Coonabarabran NSW 2357
Contact: Paul Cass (068) 42-1639

(ACT) CANBERRA ASTRONOMICAL SOCIETY

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

Fees: $25 adult, $15 student/ pensioner and $20 country.
Address: PO Box 1338, Woden ACT 2606
Contact: Ross Gould (06) 241-3187

QUEENSLAND

ASTRONOMICAL ASSOCIATION OF QUEENSLAND (AAQ)

Meetings are held on the Saturday nearest to full moon at 7:30pm. The venue is Brisbane State High, South Brisbane. 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

SOUTHERN ASTRONOMICAL SOCIETY

Meetings are held at their observing site/ clubhouse at Pimpama on the second Saturday of each month at 7:30pm. The society holds regular public field nights and produces a monthly newsletter.

Fees: $28 adult and $21 student.
Address: PO Box 685, Springwood QLD 4127
Contact: Ray Suckling (075) 78-3795

BRISBANE ASTRONOMICAL SOCIETY

Meet on the second Friday of each month at 7:30pm. Venue is Kelvin Grove State High. There is a bi-monthly newsletter.

Fees: $20 adult, $25 family and $10 student and pensioner.
Address: PO Box 204, Morningside QLD 4170
Contact: Darryl Mitchell (07) 349-8393

SOUTH EAST QUEENSLAND ASTRONOMICAL SOCIETY

The society meets at the Teachers Training College, Kedron High on the third Monday of each month. They publish a quarterly newsletter.

Address: 17 Enchelmaier St., Dayboro QLD 4521
Contact: John Stewart (07) 425-1640

TOWNSVILLE ASTRONOMY GROUP

Meet on the last Wednesday of each month at 7pm at Kirwan State High. Meetings are followed by observing sessions. There is a monthly newsletter.
Fees: $15
Address: 21 Gladys St., Kelso QLD 4815.
Contact: Richard Free (077) 89-2214

BUNDABERG ASTRONOMICAL SOCIETY

Meetings are held at Alloway Observatory on the first Friday of each month at 7:30pm. The society publishes a bi-monthly newsletter and ephemeris.
Fees: $30 adult and $15 junior. (also joining fee except country mem.)
Address: PO Box 586, Bundaberg QLD 4670
Contact: Greg Fielding (071) 59-7232

SUN COAST ASTRONOMICAL SOCIETY

Meetings are held at Caloundra State High on the third Saturday of each month (except Dec/Jan.) at 7:30pm. There is a bi-monthly newsletter.
Address: PO Box 166, Kenilworth QLD 4574
Contact: Col Blumson (047) 46-7449

CAIRNS ASTRONOMY GROUP

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

SOUTH AUSTRALIA

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. The society maintains two observatories. The Heights Observatory at Heights School, Modbury, houses a 300mm telescope. The society'scountry site is Stockport Observatory, 80km north of Adelaide, which has a 0.5m telescope. Public education is important to the ASSA with various lectures and observing nights. The society publishes a monthly newsletter and yearly ephemeris. Public field nights are held at Ellanora (Calicsz, Norlunga Downs) 1st/3rd Sat.
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

BOWMAN PARK ASTRONOMICAL SOCIETY

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

TASMANIA

ASTRONOMICAL SOCIETY OF TASMANIA (AST)

Meetings are held at the Hutchins School, Sandy Bay, on the last Tuesday of each month.
Address: c/o Norwood Ave. PO, Launceston TAS 7250
Contact: Karen Barnes (003) 44-7100

VICTORIA

ASTRONOMICAL SOCIETY OF VICTORIA (ASV)

Meetings are held on the 2nd Wednesday of each month (except Jan.) at the Herbarium, botanic Gardens in Melbourne. The ASV is probably the largest society in Australia with numerous specialist sections catering to a wide range of astronomical taste. They offer: monthly members' nights on the telescopes at the Old Melbourne Observatory, an extensive library, a bi-monthly newsletter, a yearly ephemeris, the society observatory and club rooms at Burwood and a dark sky site near Heathcote (1 hour drive Nth of Melbourne).
Fees: $35 ordinary members, $35 family, $24 junior (under 18) and various other rates, also $20 joining fee).
Address: GPO Box 1059J, Melbourne VIC 3001
Contact: David Walker (Pub. Rel.) (03) 877-3181

ASTRONOMICAL SOCIETY OF FRANKSTON

Meets at the Peninsula Church of England School, Mt Eliza, on the 3rd Wednesday of each month at 8pm. They have a bi-monthly newsletter.
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 Hall. The society publishes a quarterly newsletter and holds regular viewing nights for schools and community groups.
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.

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

BALLARAT ASTRONOMICAL SOCIETY

The society meets at the Ballarat Municipal Observatory on the second Friday of each month at 8pm. They publish a quarterly journal and yearbook and hold regular public viewing nights.
Fees: $18 adult and $12 junior.
Address: PO Box 284, Ballarat VIC 3353
Contact: Ian Thompson (053) 39-6698

LATROBE VALLEY ASTRONOMICAL SOCIETY

Meets at Monash Uni. College, Churchill, on the 2nd Tuesday of each month at 7:30pm. They publish a bi-monthly newsletter and are active in public education, conducting demonstrations for schools, church and youth groups.
Fees: $25 adult and $13 associate
Address: PO Box 329, Glengarry VIC 3854
Contact: Geoff Thomas (051) 92-4347

THE BENDIGO DISTRICT ASTRONOMICAL SOCIETY

Address PO Box 123, Golden Square, Bendigo VIC 3551
Contact: (054) 74-8220

WESTERN AUSTRALIA

ASTRONOMICAL SOCIETY OF WA

The Society meets at 8 pm on the second Monday of every month at the gymnasium of WESLEY COLLEGE, South Perth. The Society Conducts regular "astrocamps" at remote locations with good accommodation and very dark skies. It also promotes public awareness of astronomy by holding regular viewing nights for the public, and by providing speakers to schools, clubs and community groups. The Society owns a wealth of astronomical apparatus for use by Members. The society also publishes a bi-monthly journal "The Sidereal Times"
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.

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.
Fees. Murdoch Students $ 6, Non Students $12 (No Joining Fee)
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

Conducts monthly meetings. The main aim of the ASSW is to increase public awareness in astronomy.
Address: P.O. Box 1100 Bunbury WA 6230
Contact: (09) 95-8516

GOLDFIELDS ASTRONOMICAL SOCIETY

Kalgoorlie Contact: (090) 21-5805

NEWMAN ASTRONOMICAL SOCIETY

Newman Contact: (091) 75-2660

PILBARA ASTRONOMICAL SOCIETY

Sth Hedland Contact: (091) 40-1512

NORTHERN TERRITORY

ASTRONOMICAL SOCIETY OF ALICE SPRINGS

Alice Springs Contact: (089) 52-6426

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 the opposite to ***perihelion***.

Apogee The point at which a body in orbit around the Earth reaches its farthest distance from the Earth. It is the opposite to ***perigee***

Asteroid See ***Minor Planet***.

Astronomical unit The average distance from Earth to the Sun, approximately 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.

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 observer's 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 body that orbits the Sun and produces 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 co-ordinate 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. This book 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 (northern hemisphere seasons).

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 km).

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 cloud of interstellar gas and dust. See also ***emission, reflection*** and ***planetary nebula.***

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.

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.

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.

Reflection nebula. A gas cloud illuminated by a nearby star.

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 co-ordinate 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***.

Spectrum The light of an object spread out like a rainbow. As well as this continuous spectrum, a star normally shows a distinctive set of dark and light lines which are characteristic of its composition.

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.

Zenith The point directly overhead (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

INDEX

Entries which refer to diagrams or tables are in **bold** type.

This book is your "window" to the Universe. It is the first guide for those fascinated by the beauty of the night sky. If you have wondered; what is that bright star ? Why do some of them move from night to night? Which planet is that ? This book is for you. **No previous knowledge of Astronomy** is needed.

No telescope is required to use this publication. Five of the planets are easily visible to the unaided eye. This book is all that is needed to find these celestial neighbours.

This user-friendly publication has been designed to cater for both the needs of the novice and the more experienced amateur astronomer.

FEATURES INCLUDE:

- Realistic views of the sky, easily identifying the planets from the surrounding stars. These "sky views" also highlight any interesting patterns made by the planets/Moon and stars.
- The "Sky Views" also include the brightest star clusters/nebulae (all visible in at least binoculars if not the naked eye). An introduction to whet the appetite of any budding deep-sky observer.
- Guide to the best times to observe the planets including detailed finder charts.
- Easy to read monthly rise/set charts. A quick reference to when (or if) a planet or the Moon will be visible tonight.
- Appearance diagrams, showing the relative size and phase of the planets for each month.
- Guide to Shooting Stars (Meteor showers) including the best times to observe them.
- Minor planets and comets for 1994.
- Introduction to Variable Stars.
- A guide to places of astronomical interest and the amateur astronomical societies in Australia.
- and much more ...

The rise and set times for the Sun, Moon and planets is presented for **Sydney, Melbourne, Hobart, Canberra, Brisbane, Adelaide, Cairns and Townsville.**

Lunar occultation predictions are presented for the Eastern Capital cities. Information is provided to adjust data for other locations.

ASTRONOMY 1994 has built on the successful format used in ASTRONOMY 1993, 1992 and 1991.

The authors have had many years of experience in observational astronomy, production of astronomical publications and computer programming. They have also had extensive involvement in public education in astronomy and the amateur astronomical community.

QUASAR PUBLISHING **ISBN 0 646 15034 0**