ASTRONOMY 1996

EASTERN AUSTRALIAN EDITION

Glenn Dawes Peter Northfield Ken Wallace

A PRACTICAL GUIDE TO THE NIGHT SKY

NEW FOR 1996
EASY TO USE SKY CHARTS

1996

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			

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MARCH

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31						

APRIL

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MAY

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JULY

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21	22	23	24 ◑	25	26	27
28	29	30 ○	31			

AUGUST

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25	26	27	28	29 ○	30	31

SEPTEMBER

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29	30					

OCTOBER

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20 ◑	21	22	23	24	25	26
27 ○	28	29	30	31		

NOVEMBER

SUN	MON	TUE	WED	THUR	FRI	SAT
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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

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A PRACTICAL GUIDE
TO THE NIGHT SKY

GLENN DAWES PETER NORTHFIELD KEN WALLACE

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INTRODUCTION TO THE 1996 EDITION

Welcome to **ASTRONOMY 1996 - Eastern Australian Edition. This book** has been designed for observers **anywhere in Australia**, except W.A. A separate edition has been produced for Perth Observatory to cover Western Australia. These two editions (Eastern and Western) represent a truly national approach in the preparation of these user-friendly yearbooks.

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

In this introduction, last year, mention was made that a planisphere would make an excellent companion to this publication. The authors are pleased to announce that Quasar Publishing is now the Australian distributor for the excellent 'David Chandler planispheres. These can be purchased directly from Quasar. Enquires should be made through the addresses on page 2.

The 'Constellations of the Month' sections in part 1 and the 'Sky Charts are new features this year. The Sky Charts have been **specifically designed for the beginner** just starting to find his/her way around the sky.

As in previous editions of these yearbooks, the authors would like to conclude this introduction with 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 have been necessary, astronomical terms have been explained in the text or covered in the glossary. To a beginner some of this information (especially the tables of numbers) may seem difficult to understand. It is important not to allow yourself to become overwhelmed. Comprehension will come with experience and when there is a need to know.

Wishing you clear skies and many hours of enjoyable observing

Glenn Dawes Peter Northfield Ken Wallace.

ACKNOWLEDGEMENTS

Some of the information for this yearbook was adapted from the following sources:

- Astronomical Almanac for the Year 1996 (US Naval / Royal Greenwich Observatories)
- Astronomical Tables of the Sun, Moon and Planets (Jean Meeus)
- Uranometria 2000.0, Vol I, II & Deep Sky Field Guide
- Hubble Guide Star Catalogue
- International Meteor Organisation Calendar for 1996
- Colours of the Stars (Malin/Murdin)

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

- MICA ver 1.0 (US Naval Observatory)
- Occultation software - International Occultation Timing Association (IOTA)
- Voyager II, the Interactive Desktop Planetarium ver 2.02 (Carina Software)
- Pickles ver 3.82 - University of Texas at Austin/McDonald Observatory
- Occult ver 2.0 (David Herald, IOTA)
- Hartung's Astronomical Objects for Southern Telescopes, Second Edition by Malin/Frew (Cambridge University Press)

Special thanks are extended to Geoff McNamara for contributions to 'Getting Started', Greg Bryant for "Bright Comets: The Show Continues" and general comet information and text, Duncan Steel for his feature article and David Dunham (IOTA) for occultation data.

We would also like to thank the following for assistance in typing and proofreading.

Greg Bryant, Geoff McNamara, Robert McIntyre, Elise Dott ans Sue Nour.

The front cover is the Horse Head Nebula in Orion. Photograph by David Malin, copyright © Anglo-Australian Observatory.

Rear cover shows the field of G Scorpii and globular cluster NGC 6441. Sourced from the Hubble Telescope Digital Sky Survey, original photography copyright © Anglo-Australian Observatory.

SEARCHING FOR CIVILISATION-THREATENING ASTEROIDS AND COMETS

by Duncan Steel

Deep, wide-field photographs such as those taken with the U.K Schmidt Telescope (UKST) often reveal short trails due to asteroids (or comets) that have moved significantly during the long exposures most often utilised. Indeed these asteroids have at times been termed the 'vermin of the skies' since their profusion can cause some problems for astronomers interested in extra-solar system objects: a plate or film taken near the ecliptic may display a hundred or more asteroid trails, predominantly in the main belt between Mars and Jupiter.

However, some asteroids are more wayward, and have orbits that may cross those of the terrestrial planets, making catastrophic impacts possible. Such asteroids make themselves distinguishable through their production of trails which are usually longer than those of main belt bodies, and also often with large declination motions. In the first 17 years of operation of the UKST, five near-Earth asteroids (NEAs) were recognised on plates and later had their orbits determined, but it was clear that most were being missed since staffing constraints meant that it was not possible to diligently scan all plates in detail using binocular microscopes: such scans take perhaps 45 minutes per plate, and on average an NEA is found on only about 1% of the exposed plates.

In 1990 the Anglo-Australian Near-Earth Asteroid Survey began with the aim of identifying as many NEAs as possible on UKST plates and films taken for other purposes, follow-up observations then being made in order to secure their orbits. To date AANEAS has produced about 35 NEA discoveries, this being about 20% of the world-wide discoveries in the same period. As a by-product, Rob McNaught has discovered eight comets and over 50 supernovae on UKST plates. The AANEAS team has included, at various times, McNaught, Gordon Garradd, David Asher, Ken Russell, and the writer.

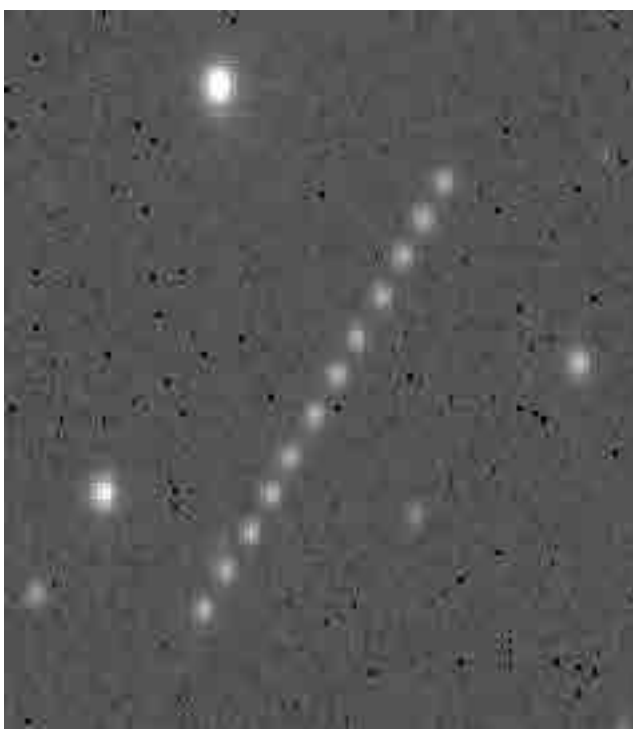
Why the name AANEAS? The reason is simple, and obvious to any student of ancient history and mythology. Aeneas was the only Trojan hero to escape the sacking of Troy, and later went on to produce offspring who founded Rome. Our aim is to make a contribution to humankind's future, and the continuation of civilisation as we know it, by ensuring that a global conflagration due to the impact by a large asteroid or comet does not occur: figuratively-speaking, we do not want Troy to be sacked again. The acronym AANEAS was therefore chosen, closely-echoing the name Aeneas.

Apart from discovering new objects on photographs taken with the UKST, we also put a good deal of effort into tracking asteroids and comets discovered by ourselves, or by others, using the 40-inch reflector (plus CCD) of the Siding Spring Observatory, and occasionally the Anglo-Australian Telescope. For example, we are the only team still tracking Comet Swift-Tuttle as it recedes into the outer planetary region (that comet will miss the Earth by just two weeks in AD 2126, next time around; we think that we should tell our great-great-grandchildren where to look). In 1994 we produced 30% of all precise positions of NEAs obtained world-wide, our contribution being especially important in that we are the only southern hemisphere program in this game.

As often occurs in scientific research which is curiosity-driven, some of our discoveries have been unusual and unexpected. For example, in late 1994 we found an asteroid which has an orbit much smaller than that of the Earth, taking less than seven months to circuit the Sun and only crossing our path near its aphelion, where it was spotted. At the other end of the spectrum, in 1991 McNaught found an asteroid now called (5335) Damocles, which is about 15-20 km in size and in a bizarre 41 year orbit bringing it as close to the Sun as Mars, and then going out beyond Uranus. This is the first asteroid to be found in such an orbit, and it appears likely that this is an extinct or dormant Halley-type comet. Its discovery has important implications for estimates of the impact rate on the Earth, since one might assume that there are many smaller such objects on similar orbits that await discovery. Computations by Steel and Asher have showed that the orbit of Damocles is highly unstable, and it is likely to be diverted into an Earth-crossing orbit through a close approach to one of the giant planets. For that reason it was given its name: the student of mythology will again recognise the source of the name, whilst anyone else should look up the story of the Sword of Damocles.

At least in part on account of these successes, AANEAS members have been asked to serve on various international committees considering the threat to humankind posed by asteroid and comet impacts, such as the NASA committees reporting to the US Congress in 1992/93. The writer is a member of the International Astronomical Union's Working Group on Near-Earth Objects, which is trying to ensure that the planned SPACEGUARD program - aimed at discovering all 2,000-3,000 objects larger than 1 km in size that could cause a global catastrophe in an impact - are discovered and tracked within the next 25 years. SPACEGUARD would require a dedicated NEA search telescope with an aperture of at least 2 metres to be built and operated in Australia.

AANEAS has also been involved in assisting with astrometry of targets for various spacecraft missions. Examples include ESA's extended Giotto mission to Comet Grigg-Skjellerup (our unique



Earth-crossing asteroid 1991 JX as seen with the 40-inch telescope at Siding Spring whilst making a close approach by the Earth in 1995 June. Twelve separate images were co-added, showing the asteroid's motion every minute. The other (single) images are of background stars, which of course do not move.

tracking of the comet enabled the spacecraft to be directed to within 300 km of the cometary nucleus), asteroids Gaspra and Ida (the targets for NASA's Galileo probe en route to Jupiter), and we are currently providing astrometry of asteroids Mathilde and Eros which will be visited by NASA's Near-Earth Asteroid Rendezvous mission later this decade.

Given the success story related above, one might expect that everything is just sailing along. Not so. By the time you read this - I am writing in September 1995 - the AANEAS program may well have terminated. Our funding runs out at the end of 1995, and there is no sign that any more will be forthcoming from the government. Considering how many millions of dollars are spent each year on ensuring that airliners don't crash, it seems silly not to spend a reasonable sum on ensuring that our civilisation does not end prematurely when we just happen to run into one of the many asteroids awaiting discovery. I use that example of the hazard inherent in flying in a plane since, strange though it may seem, there is a greater chance that you will die due to an asteroid or comet hitting the Earth than in a jet crash. It is also notable that, no matter how hard we try - or how much money we spend - we will never be able to stop planes from crashing: but we are able to stop massive asteroids from wreaking havoc on our world.

The history of life on Earth is punctuated by episodes in which mass extinctions have occurred due to catastrophic impacts by extraterrestrial bodies. There was nothing much that the dinosaurs or the ammonites could do about it. But after three billion years of the proliferation - and diebacks - of life on this planet, a species has evolved that can ensure that such terror will never again occur. I think we should do it.

Dr Duncan Steel works at the Anglo-Australian Observatory and the University of Adelaide. His book on the subject of impacts, entitled 'Rogue Asteroids and Doomsday Comets', was published in 1995 by Jacaranda Wiley.

1995 - Great Year For Comets

The latter half of 1995 has seen a breaking of the drought with respect to bright comets. In the space of only 3 months, ie. July through to September, there has been the discovery of 3 comets which were or will be quite bright, and the unexpected brightening of two periodic comets.

On July 23, two American amateur astronomers discovered comet Hale-Bopp. It is ironic that they were not even looking for comets at the time. Its discovery, while it was still beyond the orbit of Jupiter, has excited the professional and amateur astronomical communities. The comet has the potential of being one of the great comets. It is already at least 100 times brighter than Halley was at the same distance in 1987! It is currently predicted to be naked eye brightness in 1996/97.

In August, the Australian amateur Bill Bradfield discovered his 17th comet. Comet Bradfield was found in the evening sky, already at 6th magnitude. Before it was lost in the glare of the Sun, it gave the southern hemisphere a good show with a tail easily visible in small binoculars.

Next up, in September, three Japanese amateurs introduced the world to comet P/1995 S1. However, it was subsequently found that our knowledge of this comet stretches back to the 19th century. This comet is a return of 'de Vico', originally discovered back in 1846. At the time of de Vico's discovery it became visible to the naked eye. It was expected to return in the early 1920's but was not found. This time around, it is possible the comet will again reach naked eye visibility in early October 1995 (unfortunately, better favoured for our northern hemisphere friends).

On top of these extraordinary finds, the known periodic comets of Schwassmann-Wachmann 3 and Tuttle-Giacobini-Kresak have both under gone sudden flare-ups. This is one of the exciting aspects of following comets - you never know what will be found tomorrow or what surprises old friends may have in store.

Let us hope that 1995 has started a trend and that 1996 will present us with further brilliant displays from these most unusual members of the solar system as they call by for a brief visit.

Observations of Comet 1995 Q1 (Bradfield)

Soon after Bradfield's discovery, observations were made at the ESO La Silla Observatory.

Some of the most detailed observations were made by Alain Smette and Manuel Pizarro with the ESO 3.5-metre New Technology Telescope (NTT). They were obtained early in the evening while the sky was still not quite dark and at very low elevation angle, when the comet was only 30 degrees from the Sun.

The photo is a reproduction of a direct 20 second exposure, made on August 19 1995 through a red filter. It shows the elongated coma and the beginning of a very long, narrow ion tail in the SE direction, twisting under the action of the solar wind. Several streamers are also visible near the head in this general direction. The exposure was made while the telescope was tracking the comet.

The image at left is a reproduction of European Southern Observatory Press Photo 23/95 which accompanies ESO Press Release 10/95.

Images are also available on the World-Wide Web (URL: http://www.hq.eso.org/)

GETTING STARTED

If you are just a beginner, this page is for you. If the tables of numbers in the back of this book seem a little daunting, forget them. You don't need them (yet). Nor do you need a telescope to discover the most spectacular show nature has to offer, the night sky. You just need this book to guide you along on your voyage of discovery of the Universe. The remainder of this page will concentrate on part 1 - 'Monthly sections', for this area has the most to offer the novice.

ASTRONOMY 1996 can be used from anywhere in eastern and central Australia. While the charts showing the appearance of the night sky have been drawn for Sydney, the change in the appearance of the sky between cities and towns - even across a country so vast as Australia - is so small you probably won't notice.

Times are given in Australian Eastern Standard Time (in part 1). No adjustment has been made for daylight-saving time since these could be introduced at any time (check your newspapers for details). However, the rise/set graphs will still be useful since they give an approximate local time of rising and setting - no matter where you live!

SO WHAT CAN THIS BOOK HELP ME SEE?

The night sky regularly puts on displays for us called conjunctions. Since the planets including Earth are moving round the Sun, their positions change constantly with respect to the background stars. Seen in the sky, the planets seem to pass by each other and bright stars. When a planet is near another, the Moon or a star, it's called a conjunction. When the Moon joins the scene, it's a wonderful sight.

Conjunctions can be spectacular events. An example of a good conjunction this year is the one between the stars Castor, Pollux, the planets Mars, Venus and the Moon on September 9. The planets and the stars will be in a line with the crescent Moon sitting a few degrees above the brilliant Venus (see the Sky View in the September section). This is simply a chance alignment of the planets, the Moon and the background stars of Castor and Pollux. Incidentally, the true distances between these objects should allay suspicions that they can have any effect on your behaviour (contrary to what astrologers would have you believe). At the time of the conjunction the Moon will be 405,000 kilometres from Earth, Venus will be 128 million kilometres away, Mars 310 million kilometres and the stars Pollux and Castor are 35 and 49 light years away, respectively! If we scaled these distances so that Venus was 1 metre away. Mars would be 2.4 metres away, the Moon 3mm and Pollux and Caster would be respectively at a distant 2,500 and 3,500 KILOMETRES! Distances in astronomy do challenge the imagination!

Conjunctions are fun to watch, free, and entertaining. The equipment needed to see conjunctions? You guessed it...nothing!

When and where to see conjunctions is shown in the Sky View diagrams (see monthly section, part 1). Each Sky View shows you an area of the sky that contains a conjunction or another interesting feature. The horizon is shown at the bottom of the Sky View with any useful notes. At the top of each Sky View is the date you should look. Since the planets move fairly slowly in the sky, many conjunctions occur over a number of days. This means you can often see the event the day before and the day after listed, at the same local time. Be careful of the Moon, it moves quite a bit each day against the background stars. This is why the Moon's position for more than that day is sometimes shown on the same diagram. All the planets visible in a Sky View are labelled, as are the brighter stars.

To use a Sky View, simply go outside under the night sky at the time given, face the direction shown on the Sky View horizon, and hold the book in front of you. What you see in the Sky View will be a temporary map of the sky in front of you. Incidentally, if you don't know the directions around your house, use a street directory to learn them.

But there is more to the night sky than conjunctions. There are meteor showers, comets, minor planets (asteroids), constellations, not to mention the fascinating movements of the planets as they wander against the background stars. These are all described in Part 1 of this publication.

Part 1 is divided into months. At the beginning of each monthly section is a curious looking graph called a rise/set chart. This series of squiggly lines is your guide to knowing when the planets, Sun and Moon rise and set. To use the chart, simply look at the current date on the bottom of the chart and follow that line upwards until it intersects the object you want to look at. The rise or set time of the object can now be read on the left-hand edge of the chart.

Each of these monthly sections also have diagrams showing the relative size and appearance of each planet as seen through a telescope. There is also a description of celestial happenings and highlights; kind of like a celestial movie goer's guide - and in plain English! Want to know what Venus is up to in March? The description will tell you whether and when it's worth looking for. A diary of events is also included that summarises the month's features. To see some of these celestial features you'll need a pair of binoculars or a small telescope.

There is one piece of equipment that every sky watcher should have, a red tinted torch. Any torch will do. Simply tape some red cellophane over the end of the torch so that it gives off a dull red glow. The aim is to preserve your night vision, or 'dark adaptation'. When your eyes become used to the dark, they won't react to a red light and so you can use the charts and illustrations and still enjoy the night sky.

While on the subject of lights, make sure as many lights near your observing site are turned off. The less glare around you the easier it will be to enjoy the night sky. Encourage neighbours to turn off their outside lights, too. A major modern threat to the night sky is light pollution: stray light scatters upwards into the night sky where it drowns out the stars. So, the more lights we all turn off, the less light pollution, the more power we save and the less natural resources we consume. Perhaps it is time the environmentalists had a look at this. After all, it is the only form of pollution where it costs less to fix!

When you start to recognise a few of the constellations, (incidentally, once you try you might be pleasantly surprised how easy it is to see some of the brighter star patterns) check out the 'Sky Charts' starting on page 60 with their explanation on page 69. These pages show ALL the sky visible from mid Australian latitudes. The Sky Views don't show all the sky. By their very nature they concentrate on the ecliptic or zodiac regions of the sky ie. where the planets and Moon wander. On the other hand, the Sky Charts show you the lot (excluding the Sun, Moon and planets).

Part 2 of ASTRONOMY 1996 contains specialised data generally designed for the more experienced enthusiast. The novice however should not miss the appendices. If you wish to pursue the hobby further, the authors strongly recommend that beginners check out the local amateur community. Learn from these experts and look through their equipment, before spending hundreds or thousands of dollars on a telescope that may not suit you or your needs. The public observatories/planetariums and courses can also be great resources. Use them.

SOME ASTRONOMICAL TERMS TO GET YOU STARTED

There are several astronomical terms you'll come across in ASTRONOMY 1996, many of which are defined in the Glossary at the end of the book. Here are a few of the more common ones, just to get you started.

Planet Just like the Earth! A planet is a sphere of either rock or gas that orbits the Sun. There are nine planets in our Solar System, and the Earth is the third planet out from the Sun. There are also a number (actually several thousand) of 'minor planets' that move around the Sun mostly between the orbits of Mars and Jupiter.

Star Just like the Sun! A star is an enormous sphere of glowing gas that gives off tremendous amounts of light and heat. They shine by their own light caused by nuclear reactions going on deep inside them. It's a testament to the distances between the stars when you realise that the Sun is a relatively average star, while some stars visible in the night sky are tens or hundreds of times larger and brighter.

Magnitude The brightness of a star or a planet in the night sky is described as its magnitude (sometimes abbreviated to 'Mag.'). It works backwards. The faintest star you're likely to see with the naked eye is about 6.0 magnitude, while the brightest stars are -1.0 magnitude. Planets can be much brighter. Venus, for example, can be as bright as -4.0 magnitude, the full Moon, -12 magnitude!

Angles in the sky are measured in degrees. You'll see that the 'Sky **Views**' have a line showing what an angle of 10° looks like on the scale of these drawings. On the back cover is a scale that can help you measure angles. It is an interesting exercise to go out on nights when there are conjunctions and doing your own measurements of the objects' separations and compare your results with the predictions in this book.

Twilight does not really end until the Sun is 18 degrees below the horizon, this is called 'astronomical twilight'. This happens about 90 minutes after sunset (or before sunrise) and different to what people would call the end of twilight. This would be Civil twilight, which begins or ends when the Sun is 6° below the horizon (about 30 minutes before sunrise or after sunset). Only when astronomical twilight has ended is the sky truly dark (assuming the Moon isn't above the horizon!). But keep in mind that many celestial features can be seen even during twilight; binoculars can also help. The actual time between sunset and end of twilight (beginning of twilight and sunrise) does vary with latitude. The further south, the longer the time. Compare the times of rise/sets in part 2 between Darwin and Hobart.

INTRODUCTION TO PART I

GENERAL

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

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

Is This Useful for Where I Live? Part 1 is **useful for anywhere in eastern Australia** (some of it is common for the world). The information in part 1 of this handbook, has been calculated for Sydney, NSW, Latitude = 33° 54'S, Longitude = 151° 15'E.

Time. The times used in part 1 are in **Australian Eastern Standard Time (AEST)**. AEST is the mean solar time on the meridian of longitude of 150° E. For Australian Central Standard Time (ACST) subtract 30 minutes from the times given. For other time zones make the appropriate adjustments. **No adjustments have been 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 AEST. You will need to add one hour to any AEST time for the correct local time.

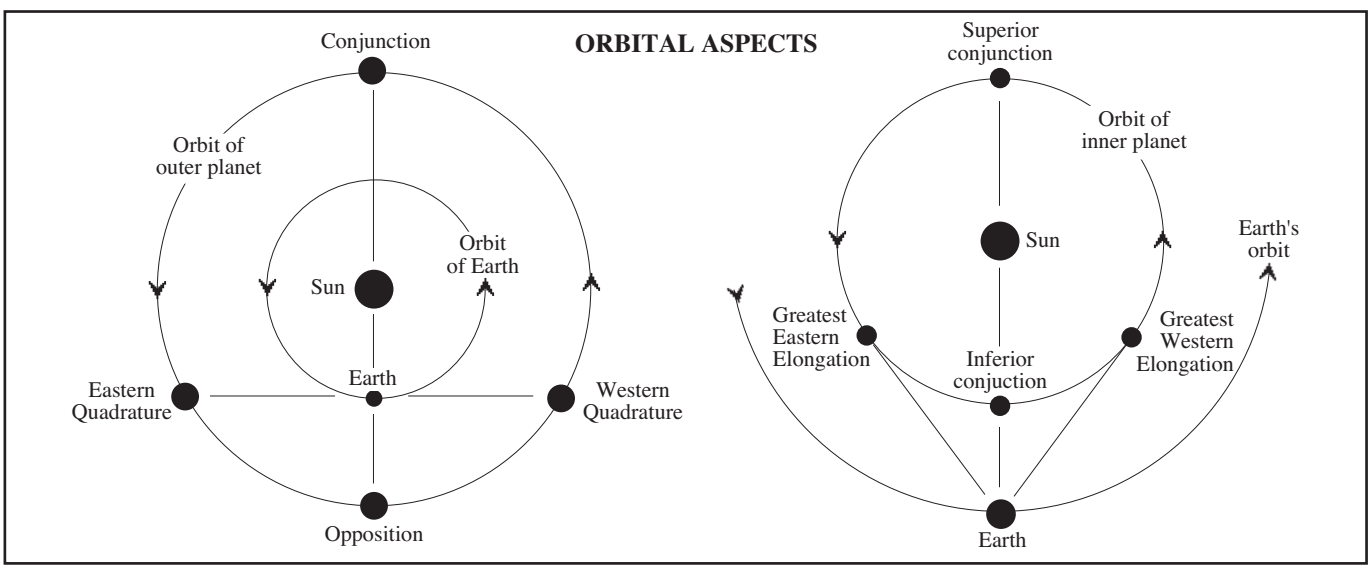
Conjunctions, Oppositions and Elongations.

A **conjunction** of two objects is when they are seen closest to each other as seen from Earth ie. their minimum angular separation. See also discussion on previous page. It is also common to hear this word referring to a planet and the Sun being close together (not exactly the best time to go observing the planet).

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

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

See also the orbital aspects diagrams below.



EXPLANATION OF FEATURES

MOVEMENT OF THE PLANETS (see pages 16 and 17) These diagrams are designed to help observers tell at a glance when the planets first become observable after being in *conjunction* with the Sun, or when they are about to go into conjunction with our star. The drawings are particularly useful as an observing guide for Mercury.

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 the times of morning and evening astronomical twilight. If you are using a telescope you'll soon learn to avoid trying to observe a planet near the horizon (ie. close to rise or set times). Turbulence in the much thicker atmosphere (ie. at lower altitude) gives very poor 'boiling' images. If accurate rise/set times are required, you will need to refer to the specific tables for the object of interest in part 2 of this publication. You can also adjust for country (non city) locations using the appendix on page 126.

APPEARANCE OF THE PLANETS

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

MONTHLY HIGHLIGHTS

This describes a few of the more interesting events during the month..

THE MOON

This provides information on any events relating to the Moon. The data includes the Moon's phases, apogee, perigee, occultations of planets/bright stars and lunar and solar eclipses. The event does not have to be visible from Australia to be included.

THE PLANETS

Presented are 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.

Minor Planets (or asteroids). This section deals with the 20 brightest asteroids that reach opposition this year (see also pages 122 and 123). An entry is included if the asteroid reaches opposition, ie. the time it is brightest during the month. It lists the magnitude, date and constellation the asteroid is in at the time of opposition.

COMETS

This brief section deals with the comets known to be visible during 1996. It points out the comets that are bright during the month and include interesting conjunctions. The latter half of 1995 has had some spectacular comets. Let's hope this trend continues into 1996. Comet Hale-Bopp is showing great promise and has received close attention in this section (as well as in the Sky Views, see below).

METEOR SHOWERS

On any clear night we can see up to five shooting stars per hour, these are known as random or sporadic meteors. There are also annual 'showers' which return at the same time each year. Each shower seems to radiate from a focal point in the sky and is named after the constellation or a bright star the radiant lies near. The monthly section lists the major showers for 1996 that are suitable for observation. Full details for all showers are given in part 2 (page 117). The selected showers are those largely unaffected by moonlight. It can take great patience to watch for meteors but the occasional fireball can make it all worthwhile. It is best to do your searching on moonless nights and dark skies ie. away from light polluted cities.

DIARY OF EVENTS

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

- Lunar phases and key events in the planets' orbits.
- Selected conjunctions between the Sun, Moon, comets, asteroids (minor planets), brighter stars and deep sky objects (see also page 125 for descriptions of deep sky objects).

Conjunctions. Differences will be often found between the separation distances (and times quoted) and those found in the remainder of part 1. The information in the daily events was designed to cater for everyone and is *geocentric* ie. as it would look from a position corresponding to the centre of the Earth. The exact time of closest approach may be in daylight or the objects of interest may not be above the horizon for Australia. The planetary text and sky views have been tailor made to suit Australia. Sometimes a lunar conjunction is followed by a 'Occn.'. This indicates that somewhere in the world the object will be occulted (covered) by the Moon. The distance given is measured from the centre of the Moon and the Moon has a diameter of 0.5°. *Occultations* involving the planets or the brightest stars are mentioned in the 'Moon' text. There are no bright star occultations visible from Australia during 1996.

Abbreviations. These include:

- 'G' which is for a galaxy
- 'OC' represents a open cluster
- 'GC' is a globular cluster
- 'm.p.' equals a minor planet
- 'Occn.' is an occultation

There are also some astronomical catalogues

- NGC stands for New General Catalogue
- IC stands for Index Catalogue
- 'M' for the number in the Messier catalogue.

CONSTELLATION OF THE MONTH

This section concentrates on a particular constellation. Information includes:

- History of the constellation including any associated legends.
- How some of the brighter stars were named.
- Some well known or unusual stars (including "doubles") or deep sky objects.
- What is needed to observe these celestial bodies.
- A star map plotting the objects mentioned in the text.

SKY VIEWS

These diagrams are designed to help you find the planets. The date/time of each diagram has been carefully chosen to show the most interesting patterns of the planets and Moon. Sometimes the times chosen correspond to about one hour (or even down to 30 minutes) before sunrise or after sunset. Although, astronomically speaking, this would still be considered twilight, this is sometimes necessary to catch a glimpse of the planets when they are close to the Sun. This is especially needed for Mercury that never wanders more than 28° from the Sun. Sky Views which show a twilight view after sunset are called 'Evening Twilight' and morning twilights are 'Dawn Sky'. Those before midnight are 'Evening Sky' and after midnight, 'Morning Sky'.

The 'Sky Views' include:

- The Moon (showing approximate phase) and the planets visible with the naked eye.
- All stars down to 4th magnitude.
- Names of the brightest stars and clusters / nebulae (*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 object is in the New General Catalogue (NGC), an 'I' is the Index Catalogue (IC) and 'M' is a number in the Messier catalogue. All these deep sky objects are also listed on page 125, ie. the appendix - 'Non Stellar Objects'.
- Constellations are labelled (capital letters) and each represented by black lines joining key stars (according to convention in astronomy atlases and books).

See also the legend in this introduction.

Although only stars down to 4th magnitude are shown, the positions of some fainter stars are sometimes indicated in the constellation lines. Wherever there is a bend, or end the of a line, there is a star. When using these 'windows to the sky' it is important to keep in mind that the horizon shown is theoretical (eg. looking out over the ocean). You will soon learn to make mental adjustments for local hills, buildings and trees etc. The scale has been kept constant and the view is 37° in azimuth (along the horizon) by 49° in altitude (a 10° reference scale is also marked). Sometimes the altitude of an object of interest is such that the field of view is not large enough to include the horizon.

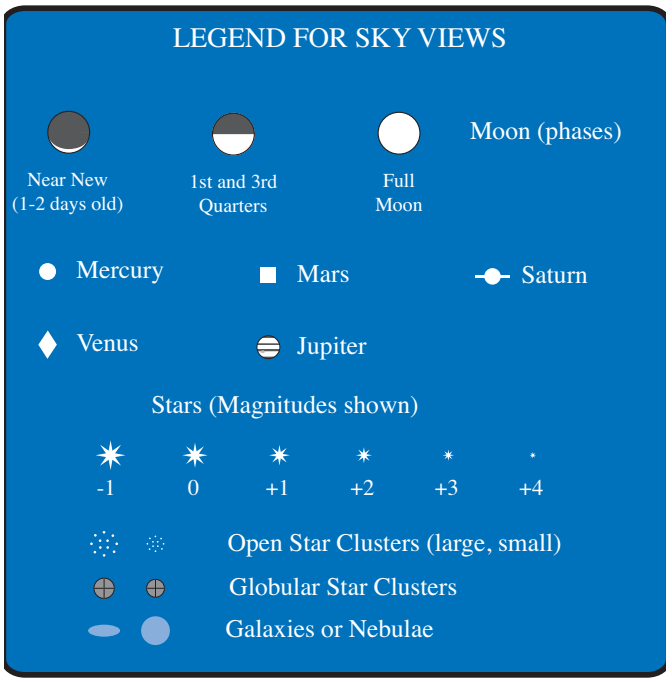
Uranus and Neptune have been excluded from the 'Sky Views' since they are not generally visible to the naked eye. Uranus would certainly need 'dark sky' conditions to be visible to the unaided eye. Neptune will always need at least binoculars. In either case, because of the many faint stars of similar brightness close by, the finder charts, on page 114, would be needed to identify these outer worlds. Pluto needs at least a 20cm telescope to glimpse this faint distant member of our Solar System and so is not marked. Finder charts can be found on pages 114 and 115.

As a special addition to the sky views for 1996, the **comet Hale-Bopp has been included**. Normally only objects bright enough to be seen with the unaided eye are plotted on sky views. The authors have made an exception here due to the potential of this comet. It is unlikely Hale-Bopp will be visible without a telescope/binoculars for the first half of the year (but who knows?). In most cases the comet is shown on a sky view with the Moon. These are NOT exactly favourable conditions to view any comet. However, in this case, our closest neighbour is being used as a guide for those less experienced observers to find the comet. Even though it may be necessary to wait a few days for the Moon to no longer interfere. On the other hand, the date/time of the November 1 sky view has been chosen to show the comet at its 1996 optimum for southern hemisphere observers.

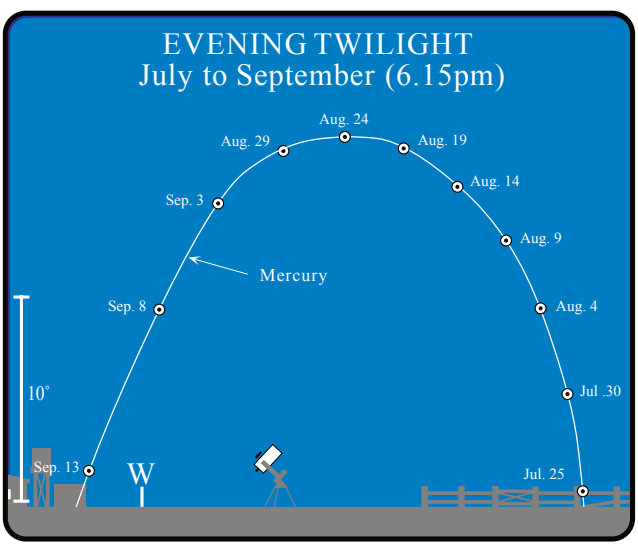
The Sky View diagrams were designed for the unaided eye, but binoculars can be very useful. Binoculars can help you find:

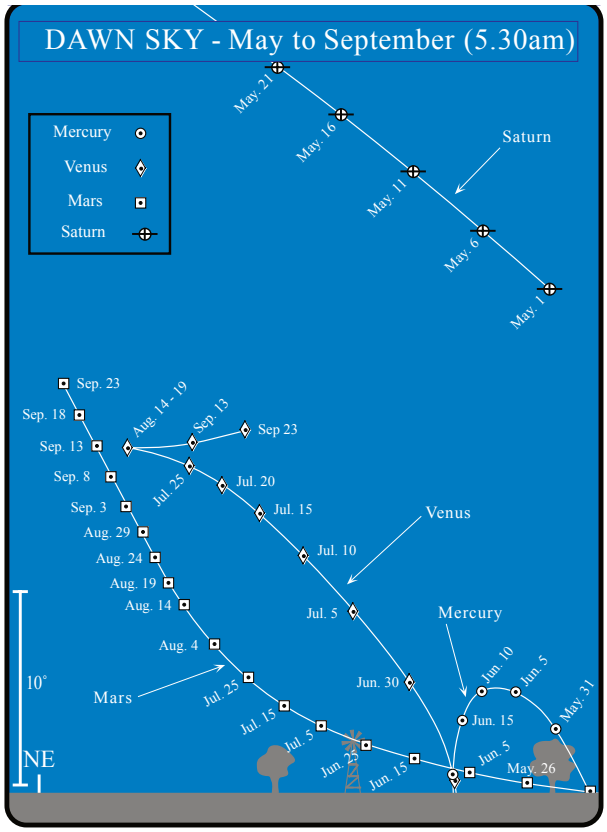
- stars and planets during twilight
- fainter stars
- stars dimmed by the nearby Moon
- stars close to the horizon.

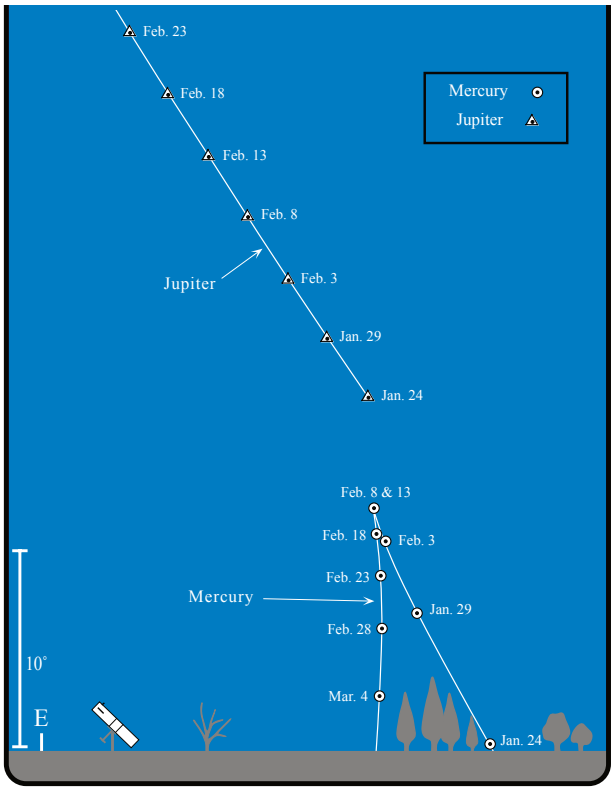
The 'Sky Views' are useful for more than just the date and time on the drawings. The pattern of stars relative to the horizon is the same one month from now, but 2 hours earlier. Of course the planets and the Moon will have moved. Compare the Sky Views for January 9 (11pm) with that for February 5 (9pm). The 'Hours of Right Ascension / Constellations on the Meridian' diagram (see page 128) 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 January 9 at 11pm (23hr) is about 6 hours. Following this diagonal (parallel to the RA lines) shows the equivalent time for other dates.

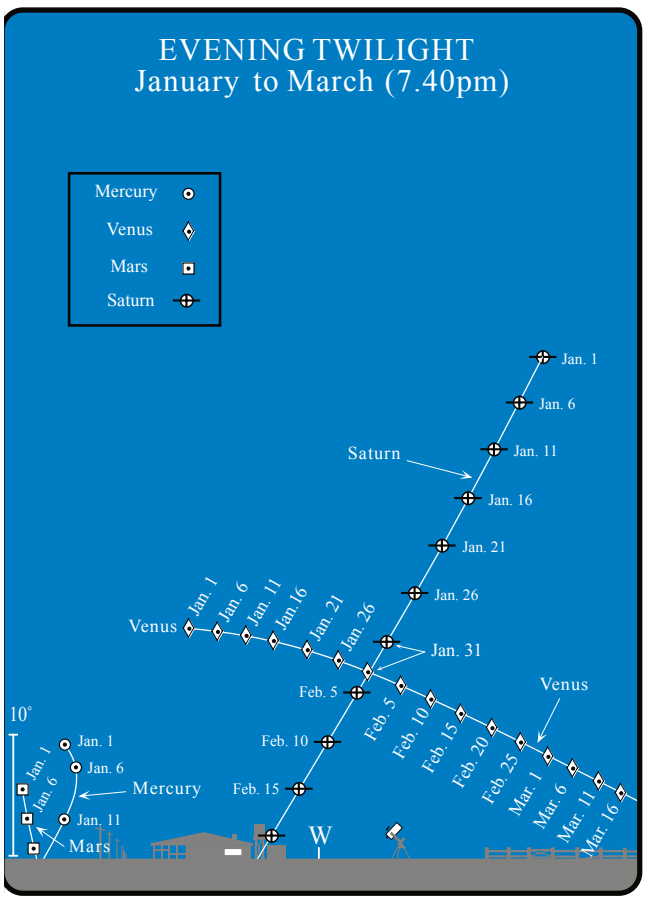


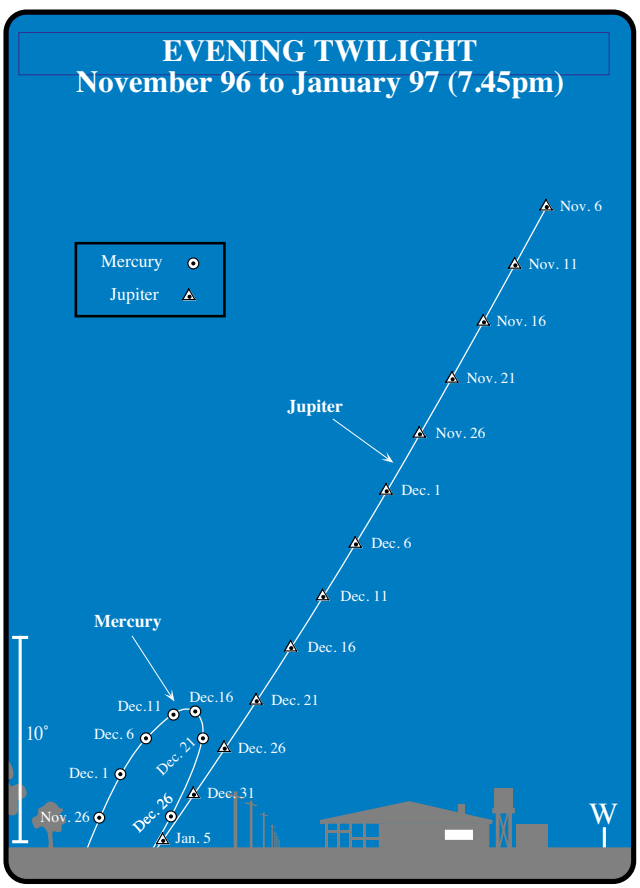
MOVEMENT OF THE PLANETS




DAWN SKY - May to September (5.30am)
Mercury
Venus
Mars
Saturn
May. 21
May. 16
May. 11
May. 6
May. 1
Saturn
Sep. 23
Sep. 18
Sep. 13
Sep. 8
Sep. 3
Aug. 29
Aug. 24
Aug. 19
Aug. 14
Aug. 4
Aug. 14 - 19
Sep. 13
Sep 23
Jul. 25
Jul. 20
Jul. 15
Jul. 10
Jul. 5
Venus
Mercury
Mars
Jul. 25
Jul. 15
Jul. 5
Jun. 30
Jun. 25
Jun. 15
Jun. 10
Jun. 5
Jun. 15
Jun. 5
May. 31
May. 26
10˚
NE

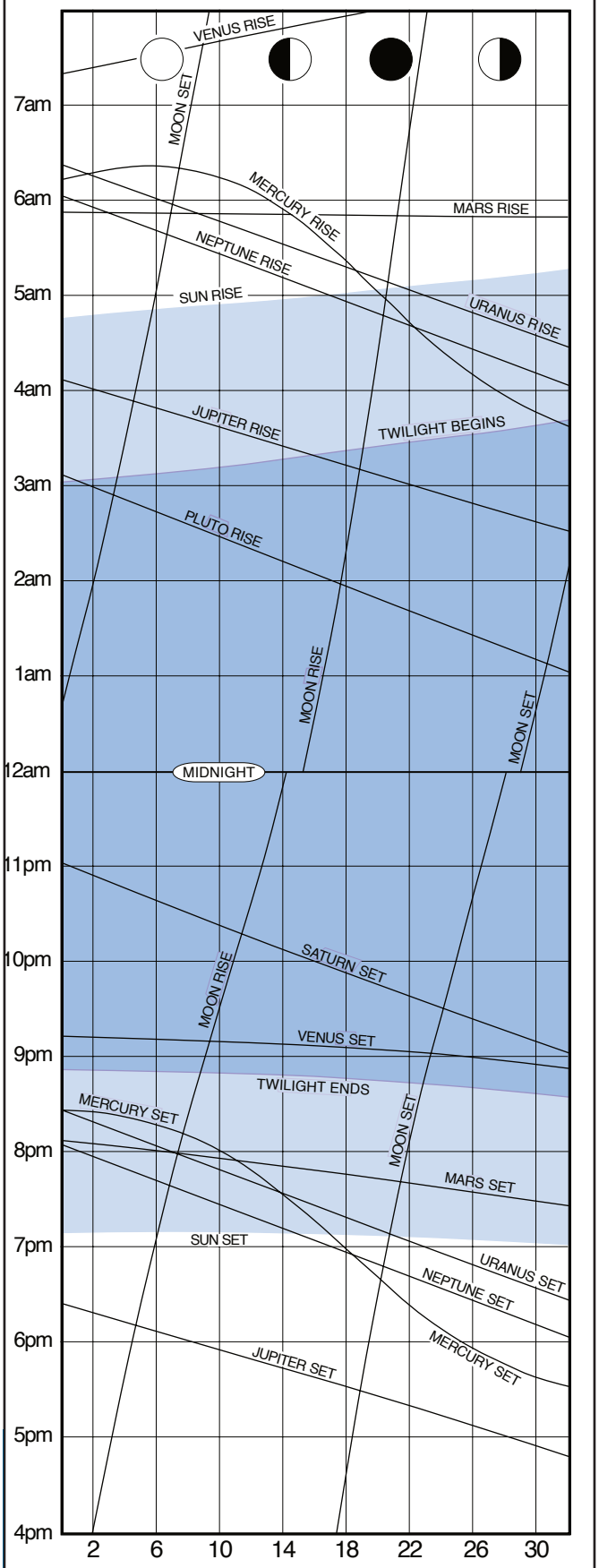

Feb. 23
Feb. 18
Feb. 13
Feb. 8
Feb. 3
Jan. 29
Jan. 24
Jupiter
Mercury
Jupiter
Feb. 8 & 13
Feb. 18
Feb. 3
Feb. 23
Jan. 29
Feb. 28
Mar. 4
Jan. 24
Mercury
10˚
E


EVENING TWILIGHT
January to March (7.40pm)
Mercury
Venus
Mars
Saturn
Jan. 1
Jan. 6
Jan. 11
Jan. 16
Jan. 21
Jan. 26
Jan. 31
Saturn
Venus
Jan. 1
Jan. 6
Jan. 11
Jan.16
Jan. 21
Jan. 26
Feb. 5
Feb. 5
Feb. 10
Feb. 15
Feb. 20
Feb. 25
Mar. 1
Mar. 6
Mar. 11
Mar. 16
Venus
10˚
Jan. 1
Jan. 6
Jan. 1
Jan. 6
Mercury
Jan. 11
Mars
Feb. 10
Feb. 15
W


EVENING TWILIGHT
November 96 to January 97 (7.45pm)
Mercury
Jupiter
Nov. 6
Nov. 11
Nov. 16
Nov. 21
Nov. 26
Dec. 1
Dec. 6
Dec. 11
Dec. 16
Dec. 21
Dec. 26
Dec.31
Jan. 5
Jupiter
Mercury
Dec.16
Dec.11
Dec. 6
Dec. 1
Nov. 26
Dec. 21
Dec. 26
Dec. 31
Jan. 5
10˚
W

JANUARY

RISE/SET CHART



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

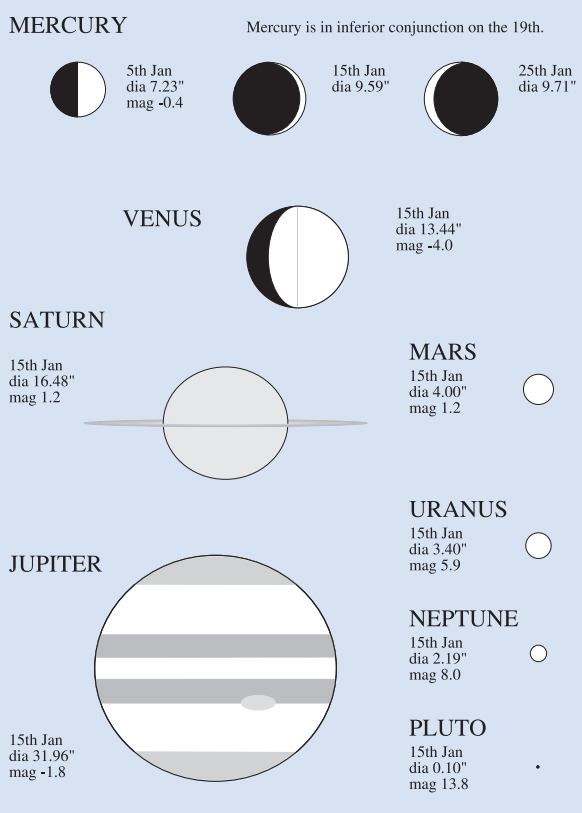
JANUARY HIGHLIGHTS

- Early in January, Mercury is visible briefly in the western twilight evening sky (August will be the best time to observe Mercury in the evening sky).
- Venus low in early evening sky. Will remain there until end of May.
- Late in January, Jupiter reappears in the morning sky after being in conjunction with the Sun.
- Best month to observe comets Honda-Mrkos-Pajdusakova (late in Jan.) and Churyumov-Gerasimenko.

THE MOON

5th	Moon at apogee, 10pm (furthest from Earth - 406,525 km, size 29.4'). Distance given is between the centres of the Earth and Moon.
6th	Full Moon, 6:52am.
14th	Last Quarter, 6:45am.
20th	Moon at perigee, 9am (closest to Earth - 357,251 km, size 33.4'). Distance given is between the centres of the Earth and Moon.
20th	New Moon, 10:50pm.
27th	First Quarter, 9:14pm.

APPEARANCE OF THE PLANETS



THE PLANETS

MERCURY begins the month in the early western evening sky in Capricornus, moving into Sagittarius mid-month. Observers wishing to capture a glimpse of Mercury should do so early in the month as its greatest elongation east of the Sun (19.5º) occurs on the 3rd. The planet then rapidly moves toward inferior conjunction (when Mercury is between the Earth and Sun) on the 19th. Mercury reappears toward the end of January in the morning sky, where it remains until March. On the 1st, Mercury will be less than 1° from Uranus and within 5° of Mars and Neptune (the four planets forming a parallelogram). Venus is located further around towards the north. This follows the interesting configurations and conjunctions with other planets and the Moon in November/ December 1995. It should be noted that Uranus and Neptune will not be visible to the unaided eye.

VENUS at magnitude -4.0 is very prominent in the western evening sky. The planet moves from Capricornus into Aquarius on the 14th, and into Pisces in early February. If viewing Venus at the same time each night, it will be seen that the planet remains at about the same altitude throughout the month. The setting Saturn however, moves toward the horizon and Venus. By the end of the month the planets are within 3° of each other. Venus and Saturn move even closer in early February when they will appear about 1° apart (see sky view for Feb. 2).

MARS begins the month low in the early western evening sky in Sagittarius, and moves into Capricornus on the 8th. During the month Mars will be 1.5° from Neptune on the 1st, 0.8° from Uranus on the 7th, and 0.6° from Uranus on the 8th. The interactions with these outer planets will not be visible to the unaided eye. Uranus needs a dark sky (away from city lights) to be visible and Neptune requires a small telescope (or at least binoculars and a good finder chart). Mars is not visible outside of twilight during January.

JUPITER spends the entire year in the constellation of Sagittarius (The Archer - see constellation of the month for July). Most of the time is spent in the rich Milky Way region known as the Great Sagittarius Star Cloud, consequently the planet passes nearby some interesting deep sky objects. In January, Jupiter rises just before the Sun and unfortunately the low altitude and dawn do not permit easy observation. However, here are some close approaches with deep sky objects, as some telescope owners may want to take up the challenge. The first of these deep sky objects is the Trifid Nebula (NGC6514 or M20) on the 6th, an open star cluster known as NGC6546 on the 11th, and a planetary nebula named NGC6629 on the 30th; Jupiter passes extremely close to the latter two objects. On the 19th the 27 day old Moon can be seen 5° north of the giant planet (see sky view).

SATURN, unquestionably the most beautiful of the planets viewed through a telescope, has denied observers a good show of its rings over the last year. The Earth crossed Saturn's ring plane in May and August last year, rendering the rings edge-on and invisible in most telescopes. In fact the rings would have been difficult for several months around May and August in most small instruments. In early 1996, the rings will also be a test for small telescopes, with the Earth again crossing the ring plane on the 11th February. Visible in the early western evening sky in Aquarius, the 1st magnitude dusky planet sets around 10pm mid-month. On the 24th, Saturn will be 7° south of the 4 day old Moon (see sky view for 23rd). Drawing together each evening as the month progresses, Saturn and Venus come within 3° of each other on the 31st. The near edge-on

CONSTELLATION OF THE MONTH — TAURUS (Tau)

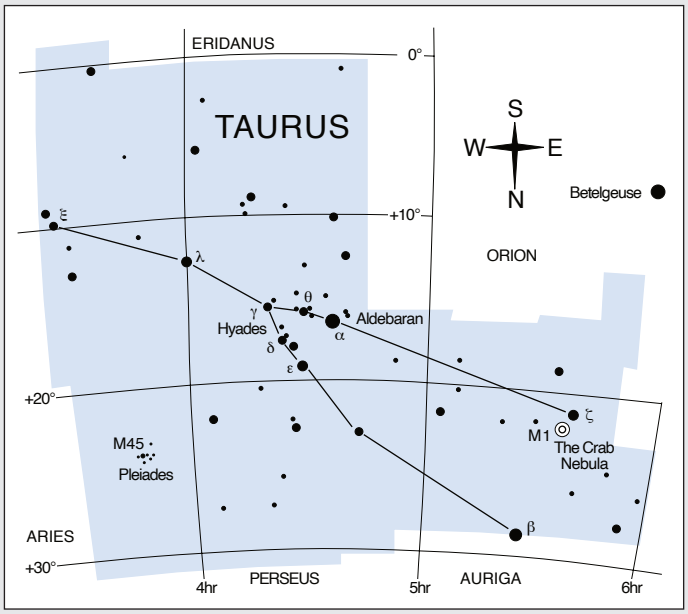
Taurus, The Bull, the 2nd constellation of the zodiac, is generally considered to be one of the oldest constellations. Marking the vernal equinox (the First Point of Aries) from about 4000 to 1700 BC probably explains its prominence in ancient man's impressions of the sky. The actual form of the bull possibly came much later from the Babylonians.

Culminating mid-January around 9pm, Taurus can be seen in the north sky below and west of Orion. The most visually striking feature of the constellation is the 'V' shaped cluster of stars known as the 'Hyades'. This group forms the face of the bull. Its brightest star, the 1st magnitude red giant Aldebaran, is its flaming eye. The horns of the bull extend out to Beta (El Nath, the 'butting one') and Zeta Tauri.

Two of the most conspicuous and magnificent open star clusters in the sky reside in Taurus: the afore mentioned Hyades and the Pleiades. The Hyades with its large "V' shape of bright stars is easily recognisable. The Pleiades, west of the Hyades, are fainter and smaller. Both clusters are excellent in binoculars. The Pleiades are further away from us than the Hyades, their distances being 400 and 130 light years respectively.

The Hyades is a cluster of about 130 stars that share the same proper motion in space and hence move together around the Milky Way galaxy as a family group. Aldebaran (Alpha Tauri), the brightest star, appears to be a member of the 'family', but is not attached and is only a line of sight foreground star.

The Pleiades, or the Seven Sisters, are named after the seven nymphs who were the daughters of Atlas and Pleione (the group is named after the mother). The brightest stars bear the names of these daughters: Alcyone, Celeone, Electra, Maia, Merope, Asterope and Taygeta. Two other stars are named after Atlas and Pleione. The Pleiades are immersed in nebulosity, which is visible in photographs or larger telescopes, and is particularly bright in the region illuminated by Merope.



Another famous object in the constellation is Ml. This first object in Messier's catalogue was actually discovered in 1731 by John Bevis but then forgotten. Messier rediscovered it in 1758. Ml is commonly known as the Crab Nebula, and is the remnant of a star that became a supernova that was observed in the year AD 1054 by Chinese astronomers.

Aldebaran is one of only a few 1st magnitude stars that can be occulted by the Moon (the others are Regulus, Spica and Antares). The occultations occur in 'series'. The first of the next Aldebaran series starts this year in August and continues monthly until February 2000. There is then a break of fifteen years with the next Aldebaran series starting 29th January 2015. No occultations of Aldebaran (or any of the other bright stars) are visible from Australia during 1996.

appearance of the rings provides a good opportunity to view some of the planet's eighteen satellites (see under 'Saturn' in November).

URANUS, NEPTUNE & PLUTO

Readers will note we have grouped the outermost planets together under one heading this year (Uranus & Neptune were grouped in ASTRONOMY 1993 & 1994 because of their nearness to each other). In this text we will not include any close approaches by the Moon to these bodies (see the diary of events for these). Important events such as oppositions, conjunctions with other planets etc will be kept. Since Uranus needs a dark sky (away from city lights) to be visible and Neptune requires a small telescope, we feel the Moon would only hinder those observations.

Uranus is close to Mars on the 8th (see Mars description above). Neptune and Uranus are both in conjunction with the Sun during January (on the 16th and 21st respectively). Hence both planets are too close to Sun for observation. Uranus, early in the month, crosses from Sagittarius into Capricornus; the constellation it remains in for the rest of the year. Neptune spends the entire year in Sagittarius. Pluto reappears from the morning twilight sky, rising around lam by month's end.

MINOR PLANETS at opposition this month include 14 Irene on 21 st in Cancer at mag. 9.2 and 354 Eleonora on 30th in Cancer at mag. 9.5. 354 Eleonora has a close conjunction with open cluster M67, in Cancer, on the 30th.

COMETS

Churyumov-Gerasimenko. This is the best month to observe this comet. It reaches perihelion on the 17th at mag. 10.8 in Pisces. At this time it is in the evening sky setting at 11pm.

Hale-Bopp. Not visible during January as it is too close to the Sun.

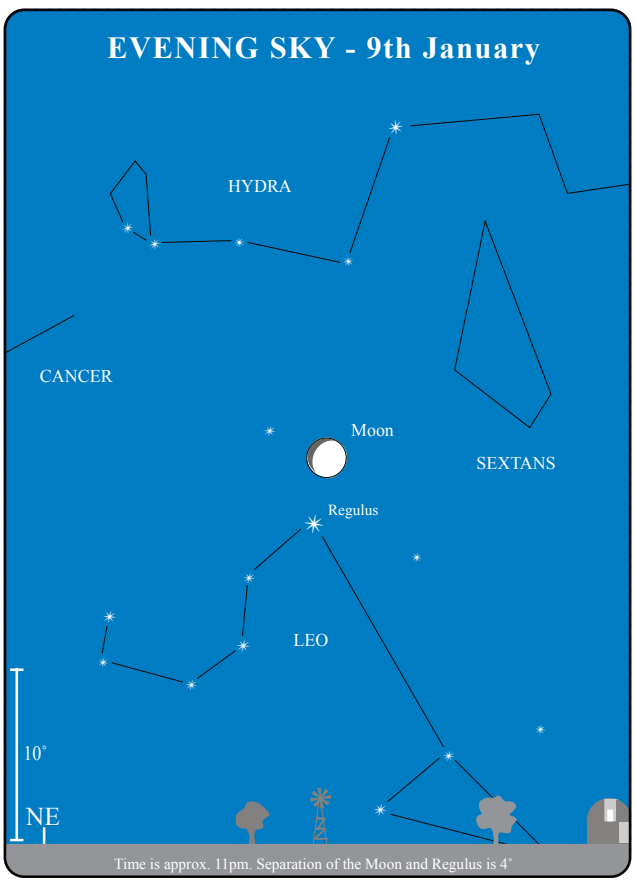
Honda-Mrkos-Pajdusakova. After perihelion on December 25 (at about mag. 7), this comet moves out of conjunction with the Sun into the morning sky. It rises around 4am on 22nd in Scutum. On the 31st it rises around 2am in Ophiuchus at mag. 9.

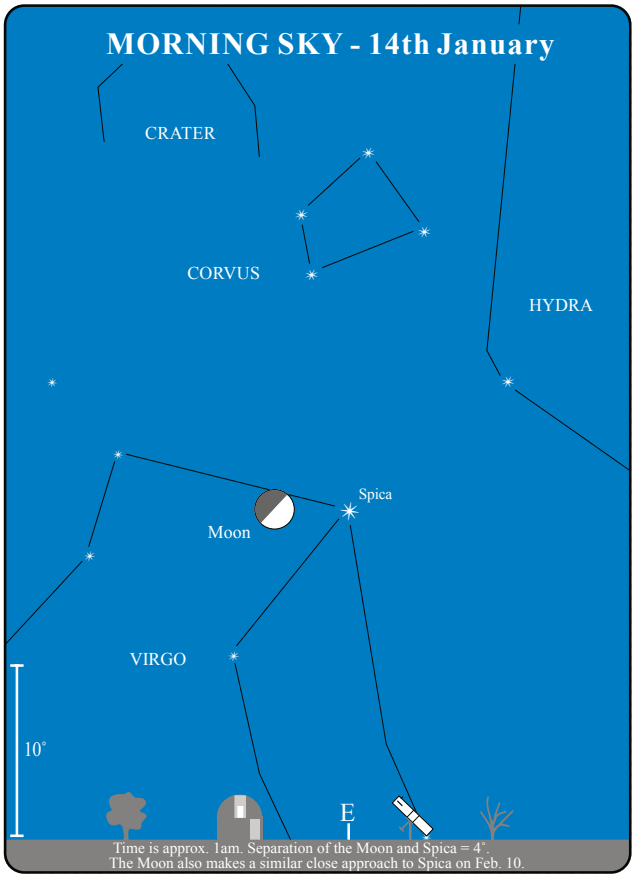
METEOR SHOWERS

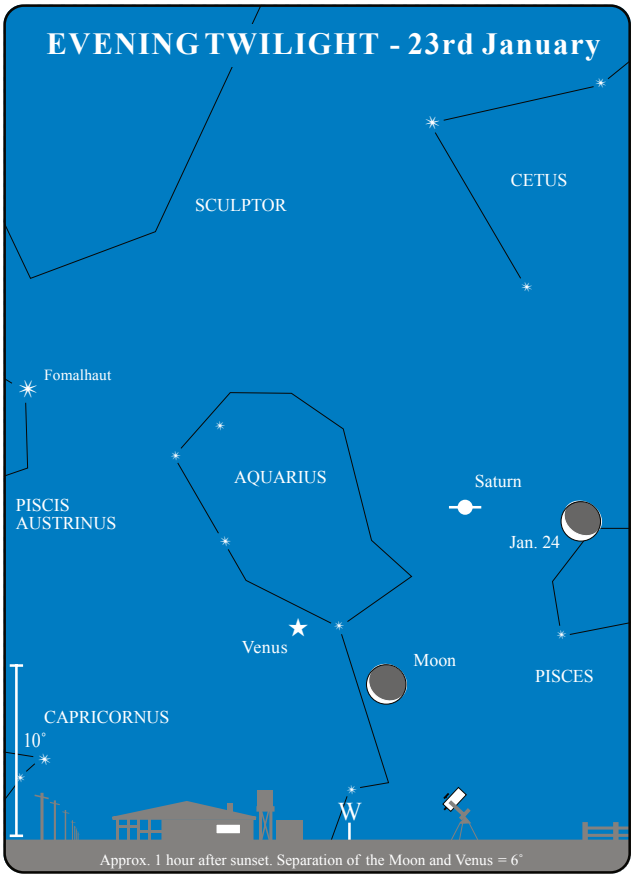
The **delta-Cancrids** are a minor meteor stream with the radiant above the horizon for most of the night. Typically faint, the zenith hourly rate is unlikely to rise above 3 to 5. The shower's duration is from the 1st to 24th January with maximum on the 16th. Unfortunately the Moon could interfere with early morning observations until after maximum activity.

DIARY OF EVENTS

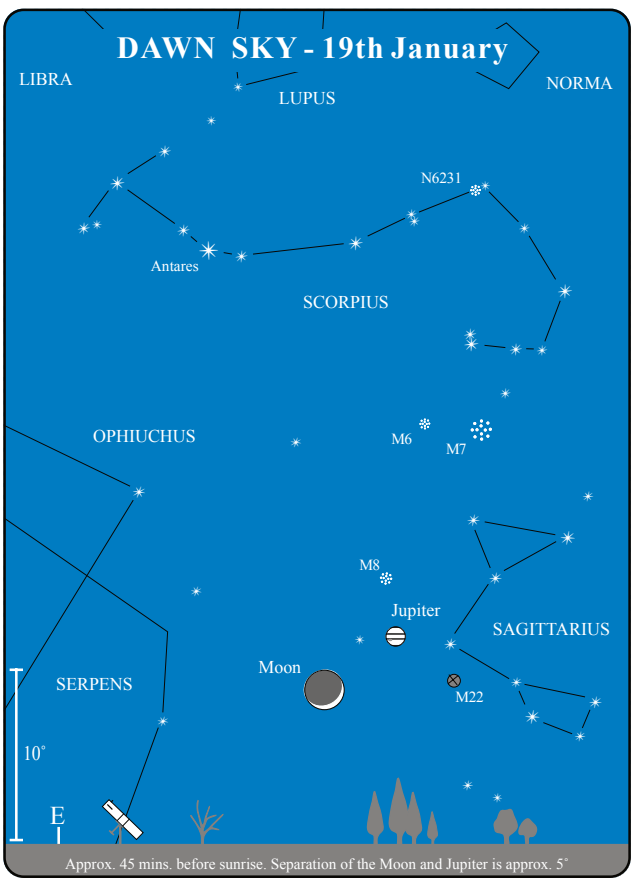
1st		m.p. 354 Eleonora 0.5° North of NGC 2775 (G) in Cancer.
1st		Mercury 0.3° North of M75 (GC) in Sagittarius.
1st		Uranus 0.8° NW of Mercury.
1st		Uranus 1° North of M75 (GC) in Sagittarius.
1st	11 AM	Mercury 0.9° South of Uranus.
1st	5 PM	Mars 1.6° South of Neptune.
3rd	2 AM	Mercury greatest elong. East (19°).
4th	5 PM	Earth at perihelion.
5th	10 PM	Moon at apogee.
6th	6:51	AM Full Moon.
7th		Mercury at ascending node.
7th		Mars 0.5° North of M75 (GC) in Sagittarius.
8th	10 AM	Mars 0.6° South of Uranus.
8th		Jupiter 0.6° South of M21 (OC) in Sagittarius.
9th	10 PM	Mercury stationary.
12th		Mercury at perihelion.
12th		m.p. 9 Metis 0.2° NE of NGC 6235 (GC) in Ophiuchus.
13th	10 AM	Mercury 3° North of Mars.
13th		m.p. 4 Vesta 1.3° South of NGC 5634 (GC) in Virgo.
14th	6:45 AM	Last Quarter Moon.
16th		m.p. 21 Lutetia 0.9° North of NGC 6401 (GC) in Ophiuchus.
16th	1 PM	Neptune in conjunction with Sun.
18th		m.p. 12 Victoria 0.5° NE of M80 (GC) in Scorpius.
19th	6 AM	Jupiter 5° South of Moon.
19th	8 AM	Mercury in inferior conjunction.
19th		m.p. 9 Metis 0.3° NE of NGC 6287 (GC) in Ophiuchus.
20th	9 AM	Moon at perigee.
20th	10:50 PM	New Moon.
21st	5 PM	Uranus in conjunction with Sun.
22nd		Mercury at greatest latitude North (Heliocentric).
22nd		m.p. 21 Lutetia 0.8° South of NGC 6469 (OC) in Ophiuchus.
23rd	6 PM	Venus 5° South of Moon.
24th	2 PM	Saturn 5° South of Moon.
26th	4 AM	comet (45P) Honda-Mrkos-Pajdusakova 2° SE of NGC 6517 (GC) in Ophiuchus.
26th	3 PM	m.p. 3 Juno in conjunction with Sun.
27th		m.p. 21 Lutetia 0.2° South of the Trifid Nebula (M20) in Sagittarius.
27th	9:14 PM	First Quarter Moon.
28th		comet (22P) Kopff 0.1° North of m.p. 11 Parthenope.
30th		m.p. 354 Eleonora 0.4° NE of M67 (OC) in Cancer.
30th		m.p. 532 Herculina 0.8° East of NGC 3344 (G) in Leo Minor.
30th	4 PM	Mercury stationary.

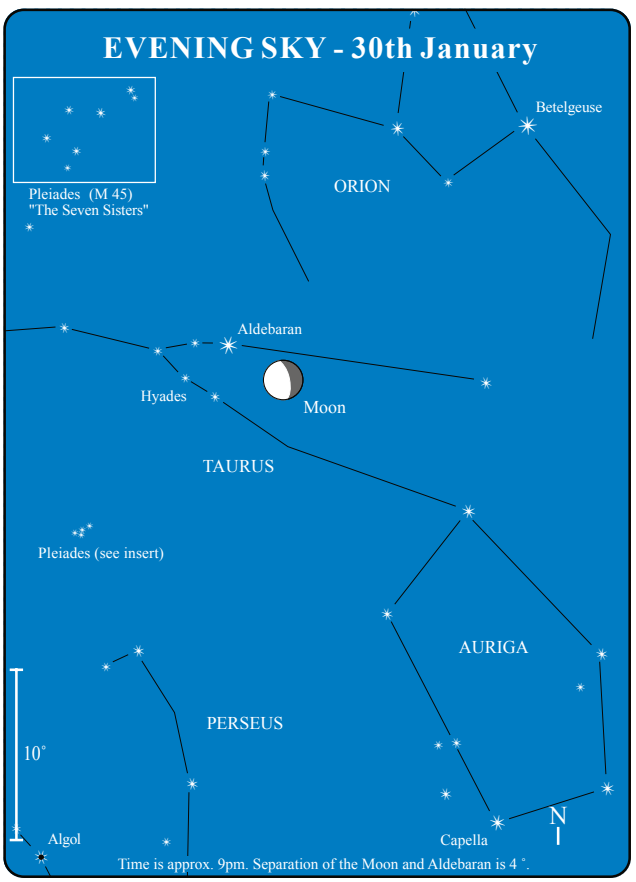






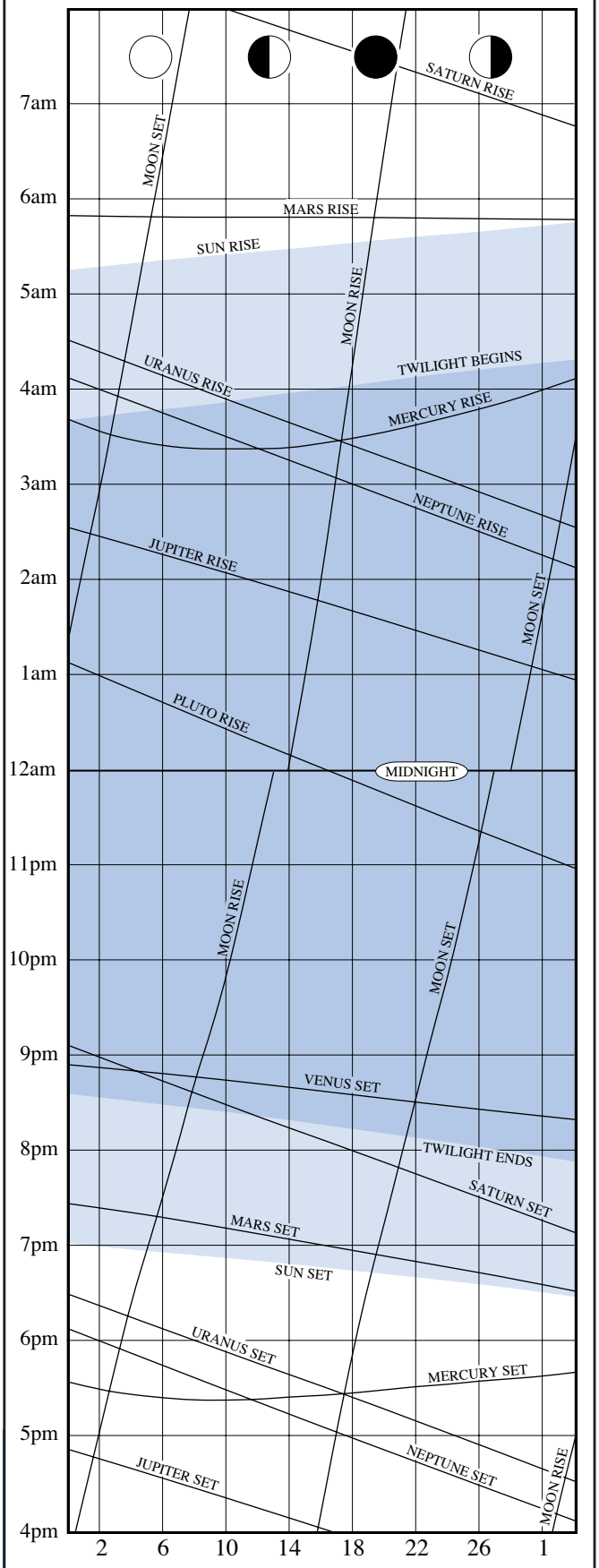
All times are AEST. For daylight saving add 1 hour.





FEBRUARY

RISE/SET CHART



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

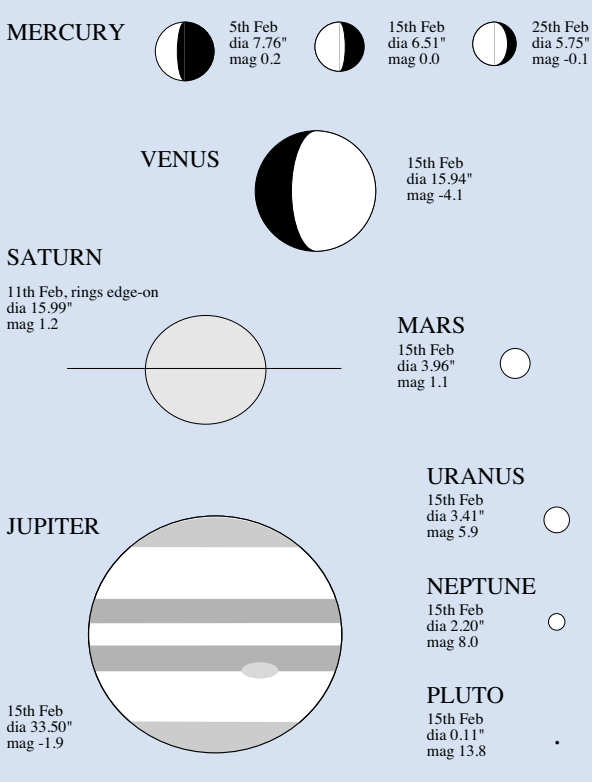
FEBRUARY HIGHLIGHTS

- Best view of Mercury in the morning sky for 1996.
- Occultation of Venus by the Moon on 22nd. Daytime event, visible from far north Australia.
- On the 2nd, Venus and Saturn only 1° apart !
- Early in the month, last chance to see Saturn in the evening sky until July.
- Comet Hale-Bopp reappears in the morning sky after conjunction with the Sun.
- Saturn's rings are edge-on as seen from Earth on 12th.

THE MOON

2nd	Moon at apogee, 2am (furthest from Earth - 406,163 km, size 29.4').
5th	Full Moon, 1:59am.
12th	Last Quarter, 6:38pm.
17th	Moon at perigee, 7pm (closest to Earth - 360,884 km, size 33.1).
19th	New Moon, 9:31am.
22nd	Occultation of Venus by the Moon on 22nd at approx. 3pm. Visible from far north Australia (see occultation data).
26th	First Quarter, 1:53pm.
29th	Moon at apogee, 5pm (furthest from Earth - 405,274 km, size 29.5').

APPEARANCE OF THE PLANETS



THE PLANETS

MERCURY offers the first of its two best periods for morning viewing this month (the other occurs in June). Rising in the eastern sky just before the beginning of astronomical twilight, Mercury reaches its greatest elongation west of the Sun (26°) on the 12th. Reversing January's movement among the constellations, Mercury begins the month in Sagittarius and moves back into Capricornus mid-month. This innermost planet has close approaches with two of the most distant planets this month, Uranus and Neptune. The Mercury/Neptune conjunction occurs on the 12th and is best observed around 4am, provided a good eastern horizon is available. The separation between the planets will be less than 0.2° (closest approach of less than 0.1° happens about 4 hours earlier, but both planets are below the horizon for Australian observers). On the 17th (again best seen around 4am) Mercury and Uranus approach to within 0.3° with the 27 day old thin crescent Moon 5° to the north. (NB. Uranus and Neptune will not be visible to the unaided eye).

VENUS For the first 3 days of the month is within 2° of Saturn. The pair are at their closest (approx. 1º) on the 2nd (see sky view). The planet moves from Aquarius into Pisces on the 4th where it remains for the rest of the month. On the 22nd, Venus is occulted by the 4 day old crescent Moon. The brightness of Venus (-4.0), the presence of the Moon and the large angular separation from the Sun (42°), would help keen eyed observers locate the planet in broad daylight without a telescope or binoculars.

A WORD OF WARNING: IRREPARABLE EYE DAMAGE AND BLINDNESS CAN RESULT IF USING ANY FORM OF OPTICAL AID NEAR THE SUN.

Do not attempt to use optical aids unless you are conversant with procedures for daytime astronomy. If in doubt consult your local astronomical society. The occultation happens at about 3pm (times are given for Sydney - check the occultation tables starting on page 85 for other cities) when Venus makes contact with the dark lunar limb. Remember that the dark side of a 4 day old Moon in broad daylight will be invisible. It reappears at 4.30pm from the bright limb. Although visible to the unaided eye, a small telescope or binoculars should show the gibbous phase of Venus. It would be wise to begin searching for Venus about half an hour before the event. Once Venus is located near the Moon it may surprise you how obvious it is, but without the Moon as a reference point it becomes a challenge. The event is relatively rare and exciting, and readers may recall the previous occurrence that happened under similar circumstances on the 25th February 1993. For those that miss the daytime show, Venus and the crescent Moon will make an attractive sight in the early evening sky after the occultation, separated by about 2° (see sky view, 21st).

MARS, setting shortly after the Sun in the western sky, is not visible this month. The planet moves from Capricornus into Aquarius on the 12th as it nears conjunction with the Sun early next month.

JUPITER, now rising around 2am, has close encounters with several objects in the Great Sagittarius Star Cloud. A telescope is required to see these deep sky objects but the whole region is extremely rewarding in binoculars under a dark sky away from city lights. Jupiter begins the month less than 0.5° from a planetary nebula named NGC6629. It is about 0.5° from a 9th magnitude globular cluster known as NGC6642 on the 5th and 6th and within 1° of the magnificent globular star cluster M22 (NGC6656) between the 9th and 14th (Jupiter will come even closer to M22 in August and September). On the 16th, the 26 day old Moon will be 6º north of Jupiter (see sky view for 15th).

SATURN. On the 12th Saturn's rings will be edge-on with the Earth again passing through the ring plane. Since 1979/80 when the rings were last edge-on, observers have been viewing the northern face of the rings (except for a few months in 1995). This passage of the Earth reveals the southern side. This will remain the visible side as the rings open and close once again appearing edge-on in September 2009. Saturn and Venus appear within 2° of each other early in the month, with closest approach on the 2nd of 1°(see sky view). On the 20th, Saturn will be 7º directly above the 2 day old Moon. The planet is low in the western evening sky at the end of the month, as it moves toward conjunction with the Sun on the 18th March.

URANUS, NEPTUNE. Mercury has close approaches to Neptune on the 12th, and Uranus on the 17th (see Mercury).

MINOR PLANETS. At opposition this month is 532 Herculina on 25th in Leo Minor at mag. 8.8.

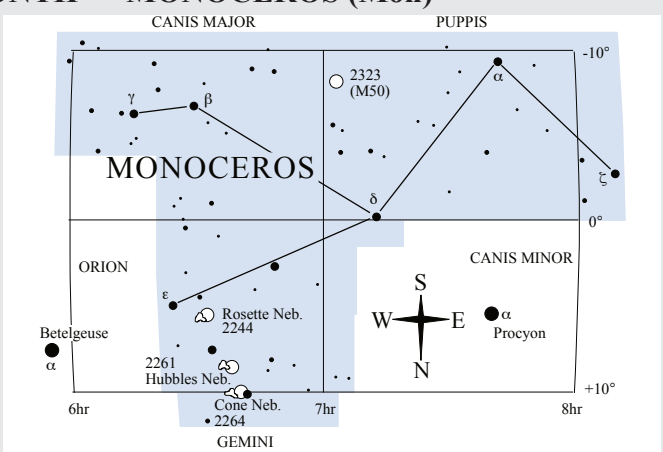
CONSTELLATION OF THE MONTH — MONOCEROS (Mon)

Monoceros, the Unicorn, is a fairly modern constellation, and was introduced on star charts by German astronomer Jakob Bartschius in 1624 as 'Unicornu'. However, Bartschius was probably not the originator of the constellation. It more than likely goes back even further, as some earlier works of the sixteenth century make reference to the constellation.

Crossing the meridian mid-February (around 9pm), this large but fairly inconspicuous constellation can be easily identified by bright stars from three other constellations. Monoceros lies within a triangle formed by the stars Betelgeuse (in Orion), Sirius (in Canis Major), and Procyon (in Canis Minor).

For a rather visually uninteresting constellation (its brightest member Alpha Monocerotis is a poor magnitude 3.6) Monoceros has some remarkable objects within its boundaries. Two binary systems form an extreme contrast. Ross 614 contains two of the smallest star masses ever discovered (0.14 and 0.08 the mass of our Sun) and Plaskett's Star has one of the most massive pairs (75 and 65 times the mass of our Sun). Although both stars are visible in amateur instruments, they are not seen as being double.

With the constellation lying in the Milky Way, there are many open star clusters and nebulae of interest to telescope users. NGC2323 (M50) is a fine cluster in a star spangled field, and visible in binoculars. The Rosette Nebula, NGC2237, surrounds the bright star cluster NGC2244. The nebula may be difficult in small telescope, but the cluster is easy. NGC2264 is a cluster of about 20 bright stars in nebulosity and features the famous Cone Nebula.



Large telescopes or photographs are needed to see the nebulosity at its best.

The first object to be photographed with the newly commissioned 200 inch telescope at Mt Palomar in January 1949 was NGC2261, Hubble's Variable Nebula. At about 10th magnitude, with a high surface brightness, the wedge shaped nebula is not difficult in amateur telescopes.

FEBRUARY

COMETS

Churyumov-Gerasimenko. This comet is moving slowly northward and setting earlier. By mid-month it is setting around 10pm in Aries. By month's end it has faded to mag. 11.5.

Hale-Bopp. Reappears (after conjunction with the Sun) in the morning sky. It rises early in the month around 3am in Sagittarius. At month's end it will be rising around 2am in Sagittarius at approx. 9th mag. It is worthwhile noting that all magnitude estimates for Hale-Bopp, in this publication, are very approximate (best guesses?). This is because the comet was only discovered in 1995 and hence we have no historical data on its brightness behaviour from previous returns.

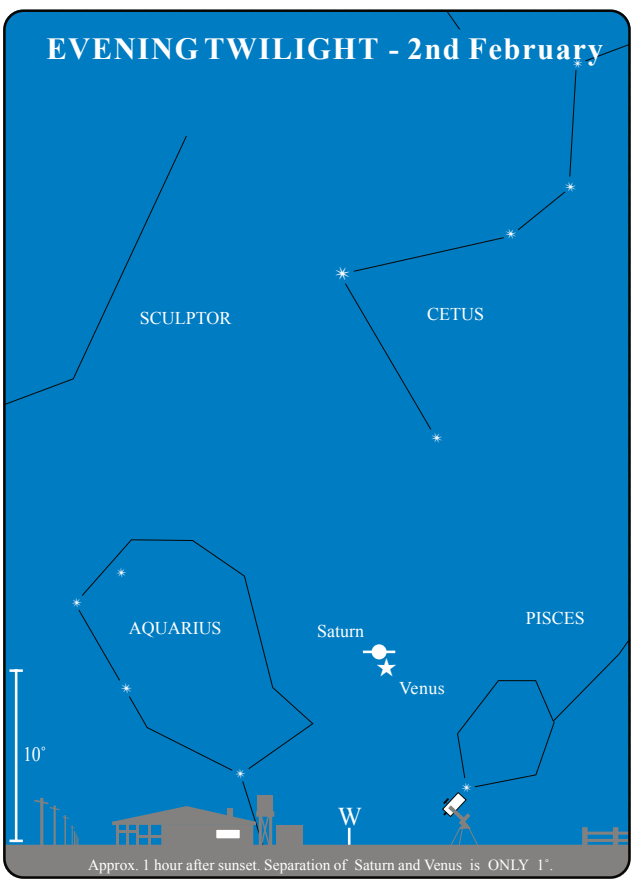
Honda-Mrkos-Pajdusakova. The comet continues to move further into the morning sky with it rising around midnight on the 8th in Serpens. Around 20th (rising 9pm) it passes through the Coma Berenices/Virgo cluster of galaxies. At the end of the month it has faded to mag. 13.

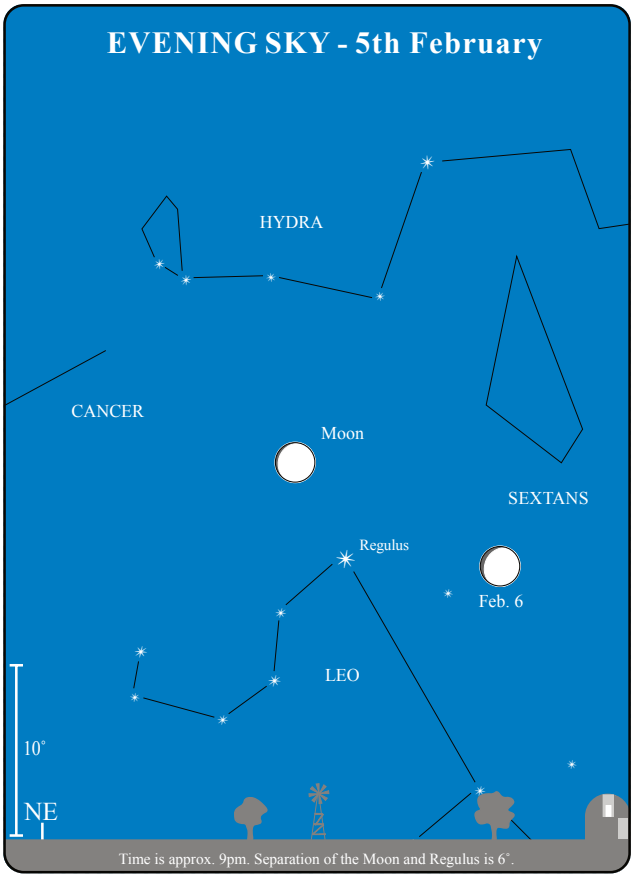
METEOR SHOWERS

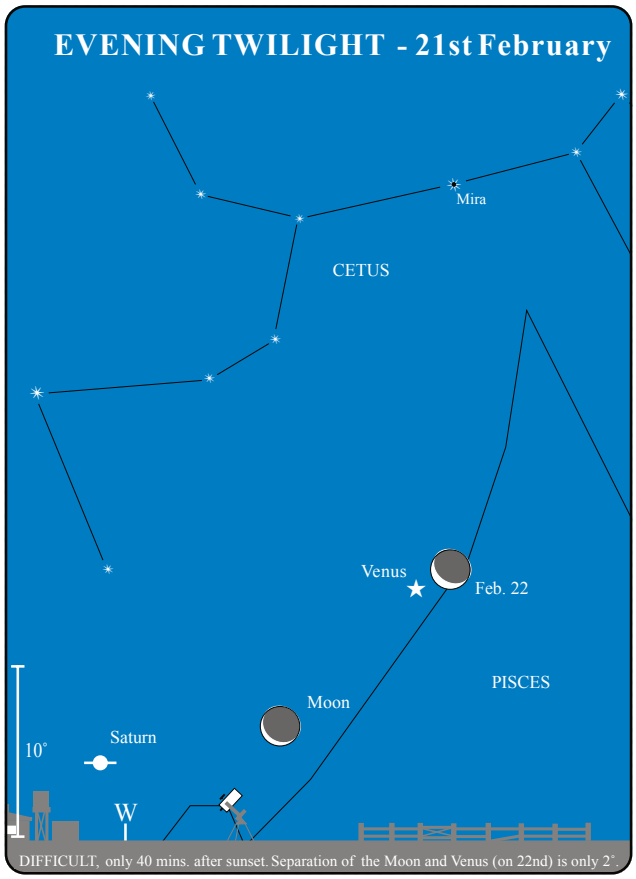
The **delta-Leonids** are not well placed for southern observers, but with the radiant near the 'sickle' or 'head' of Leo, it will be above the northern horizon for a few hours late evening and early morning. With predominantly faint meteors this shower is considered a minor one, active from 15th February to 10th March, with maximum on the 25th. A low zenith hourly rate of around 2 can be expected.

DIARY

1st	3 AM	comet (45P) Honda-Mrkos-Pajdusakova 2° SE of M10 (GC) in Ophiuchus.
2nd	2 AM	Moon at apogee.
2nd		comet (67P) Churyumov- Gerasimenko 0.5° North of NGC 660 (G) in Pisces.
3rd		m.p. 12 Victoria 1° South of NGC 6235 (GC) in Ophiuchus.
3rd	Noon	Venus 1.3° North of Saturn.
5th	1:58 AM	Full Moon.
6th		Jupiter 0.5° North of NGC6642 (GC) in Sagittarius.
7th	3 AM	comet (45P) Honda-Mrkos-Pajdusakova 1.5° South of NGC 5921 (G) in Serpens.
7th		m.p. 21 Lutetia 0.05° South of NGC 6629 (Plan. Neb.) in Sagittarius.
9th		m.p. 12 Victoria 0.5° South of NGC 6287 (GC) in Ophiuchus.
9th		m.p. 9 Metis 0.7° North of NGC 6401 (GC) in Ophiuchus.
10th		m.p. 21 Lutetia 0.3° North of NGC 6642 (GC) in Sagittarius.
11th		Jupiter 0.6° North of M22 (GC) in Sagittarius.
11th		m.p. 2 Pallas 0.5° West of NGC 5746 (G) in Virgo.
11th	Midnight	Mercury 0.07° North of Neptune.
12th	3 AM	Jupiter 0.2° North of m.p. 21 Lutetia.
12th	7 AM	Mercury greatest elong. West (26°).
12th		m.p. 21 Lutetia 0.8° North of M22 (GC) in Sagittarius.
12th	Noon	Passage of the Earth through the ring-plane of Saturn from North to South.
12th	6:37 PM	Last Quarter Moon.
14th		Mercury at descending node.
15th		m.p. 12 Victoria 0.5° North of NGC 6325 (GC) in Ophiuchus.
16th	1 AM	Jupiter 5º South of Moon.
17th	6 AM	Neptune 5° South of Moon.
17th	8 AM	Mercury 0.2° North of Uranus.
17th		Venus at ascending node.
17th	3 PM	Uranus 6º South of Moon.
17th	4 PM	Mercury 5º South of Moon.
17th	7 PM	Moon at perigee.
19th	9:30 AM	New Moon.
20th	1 AM	comet (45P) Honda-Mrkos-Pajdusakova 0.5°North of NGC 4866 (G) in Virgo.
20th		Mars at perihelion.
20th		comet (65P) Gunn 0.3° South of comet (22P) Kopff.
21st	3 AM	comet (45P) Honda-Mrkos-Pajdusakova 0.3° East of NGC 4710 (G) in Virgo.
21st	5 AM	Saturn 4° South of Moon.
22nd	3 PM	Venus 0.06° North of Moon Occn.
24th		m.p. 12 Victoria 0.8° North of NGC 6401 (GC) in Ophiuchus.
25th		Mercury at aphelion.
25th		m.p. 9 Metis 0.6° South of the Trifid Nebula (M20) in Sagittarius.
26th	3:52 PM	First Quarter Moon.
27th		m.p. 9 Metis 0.7° North of the Lagoon Nebula in Sagittarius.
29th		Venus 0.3° North of NGC 524 (G) in Pisces.
29th	5 PM	Moon at apogee.







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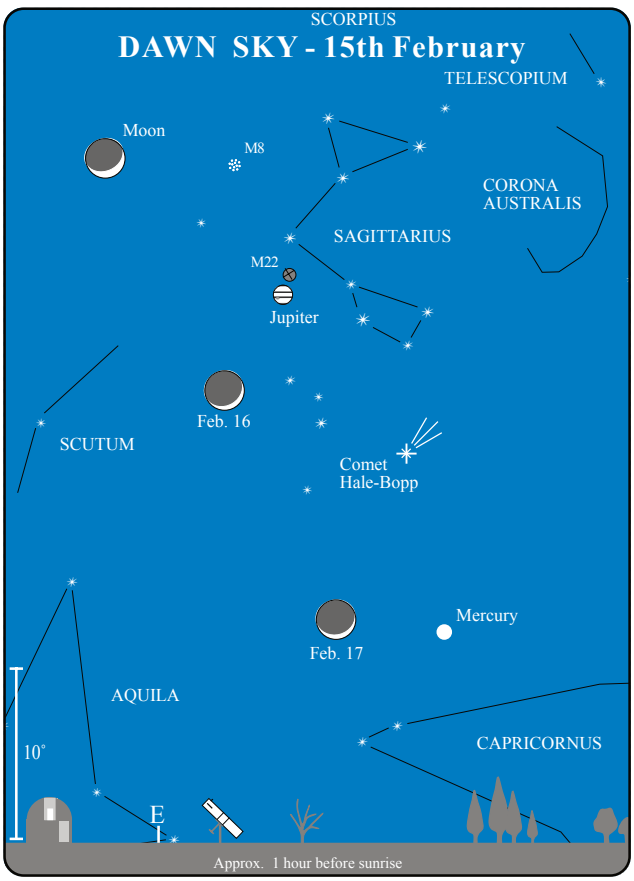
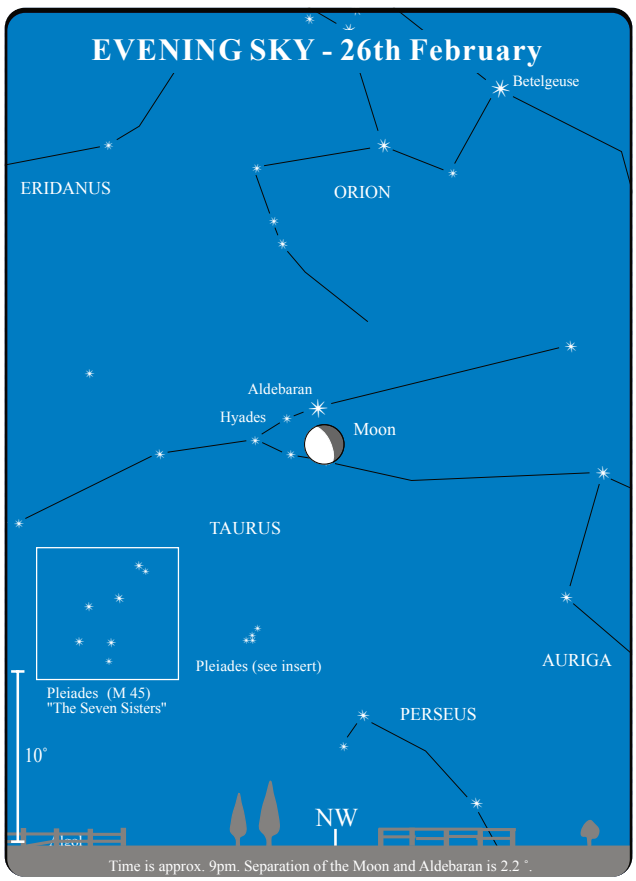
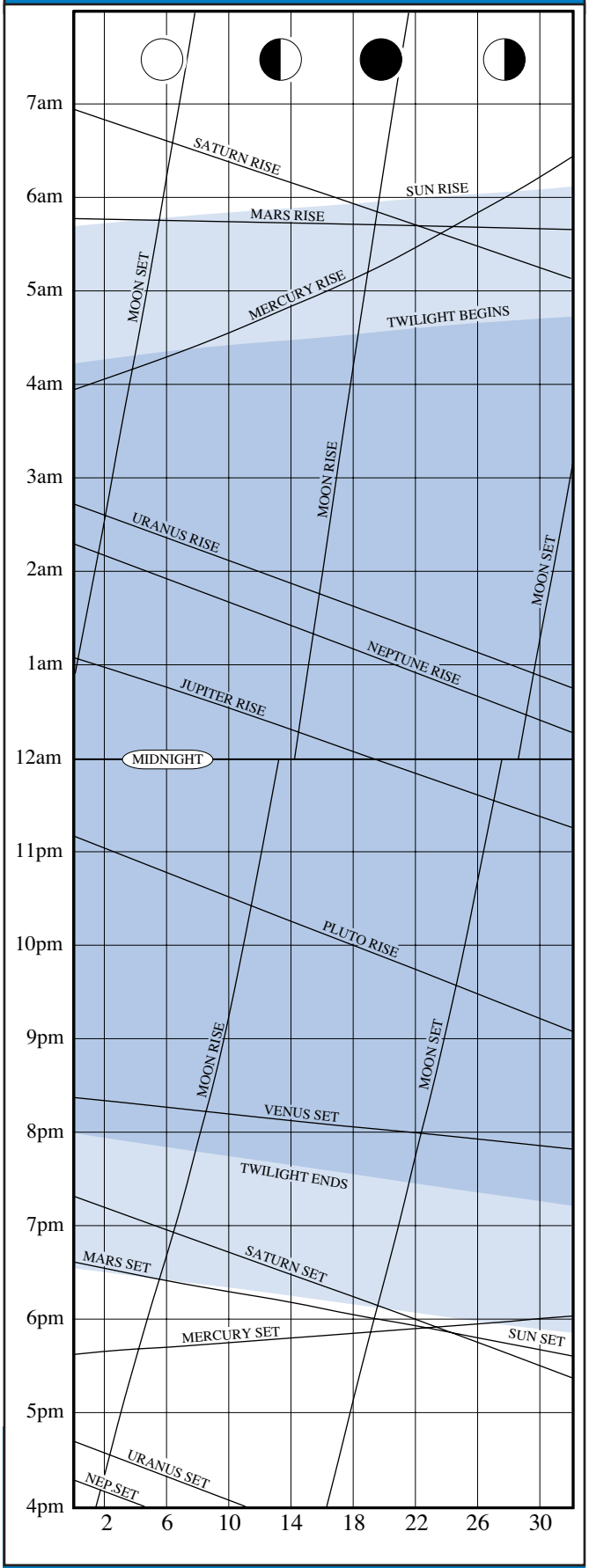




MARCH

RISE/SET CHART



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

MARCH HIGHLIGHTS

- Moon has 2 close encounters with Regulus during the month (see Sky Views on 4th and 21st).
- Minor planet Nysa has two close encounters with the Leo galaxy pair M95/M96.
- Jupiter has a temporary extra moon as it visits 5th mag. star 35 Sagittarii (around the 7th)
- Comet Kopff, as it starts to brighten, has a close encounter (on 8th) with minor planet Ceres.

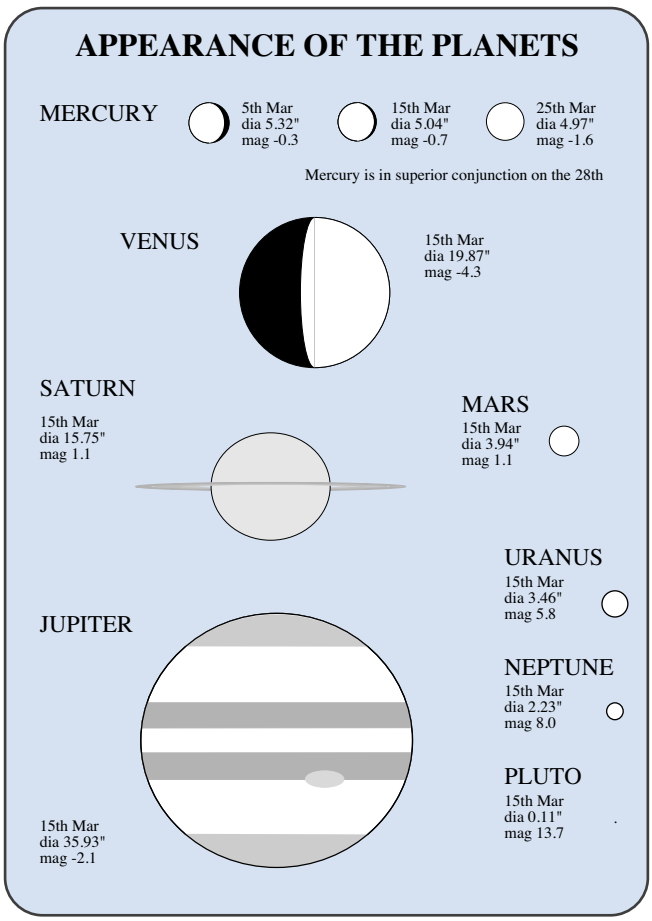
THE MOON

5th	Full Moon, 7:24pm.
12th	Last Quarter, 3:16am.
16th	Moon at perigee, 4pm (closest to Earth - 366,290 km, size 32.6').
19th	New Moon, 8.46pm.
27th	First Quarter, 11:32am.
28th	Moon at apogee, 1pm (furthest from Earth - 404,463 km, size 29.5').

THE PLANETS

MERCURY moves from Capricornus into Aquarius on the 5th, then into Pisces on the 22nd. After a a brief sojourn in Cetus on the 28th it moves back into Pisces until the first week in April. Mercury is bright and maintains negative magnitudes during the month, but is best observed in the first week before it is lost in the morning twilight. The planet is in superior conjunction (on the opposite side of the Sun to the Earth) on the 28th and returns to the evening western sky in April. Unfortunately close approaches by Mercury to

APPEARANCE OF THE PLANETS



Saturn and Mars, a few days before superior conjunction, will be lost in the morning twilight.

VENUS moves from Pisces into Aries on the 5th and into Taurus at the end of the month. The planet has two close approaches by the thin crescent Moon on consecutive evenings. On the 22nd the 3 day old Moon will be 10° south and on the 23rd the 4 day old Moon appears 5° directly above (see sky view). With Venus at -4.3 magnitude these close approaches by the Moon in the early western evening sky are truly spectacular.

MARS begins the month in Aquarius and moves into Pisces on the 17th. The planet is in conjunction with the Sun (on the opposite side of the Sun to the Earth) on the 5th, and remains invisible to observers. After conjunction, Mars moves to the west of the Sun to become a morning object.

JUPITER rises around midnight and at magnitude -2.0 is very prominent below the 'Teapot' in Sagittarius. Jupiter's path takes it very close to the 5th magnitude star Nu 2 Sagittarii (35 Sgr) and on the 7th the star will be in the Jovian satellite plane. Being of similar magnitude as the four major moons, the interloper will be virtually indistinguishable from them and closest to the planet when first visible above the eastern horizon. The line-up shows lo isolated to the east of Jupiter with (in order from the planet) Nu 2 Sagittarii, Europa, Ganymede and Callisto to the west. On the 14th the 23 day old Moon will be 9º north of Jupiter (see sky view), and on the following morning 9° below.

SATURN is lost in the evening twilight as it moves toward conjunction with the Sun on the 17th. After conjunction Saturn moves west of the Sun to become a morning object. The planet passes from Aquarius into Pisces during the month in which it remains until June. Lamentably, due to the morning twilight, a close approach by Saturn to Mars of 1.3° (23rd) and Mercury of 0.3° (also 23rd) will not be visible.

PLUTO is stationary on the 8th, and thereafter is in retrograde motion, with opposition in May.

MINOR PLANETS at opposition this month include 15 Eunomia on 25th in Corvus at mag. 9.9, 20 Massalia on 8th in Leo at mag. 8.8 and 44 Nysa on 1st in Leo at mag. 9.1. Nysa has close conjunctions with M95/M96 as it passes between this famous pair of Leo galaxies on 6/8th (and then again on 16/18th!).

CONSTELLATION OF THE MONTH — CARINA (Car)

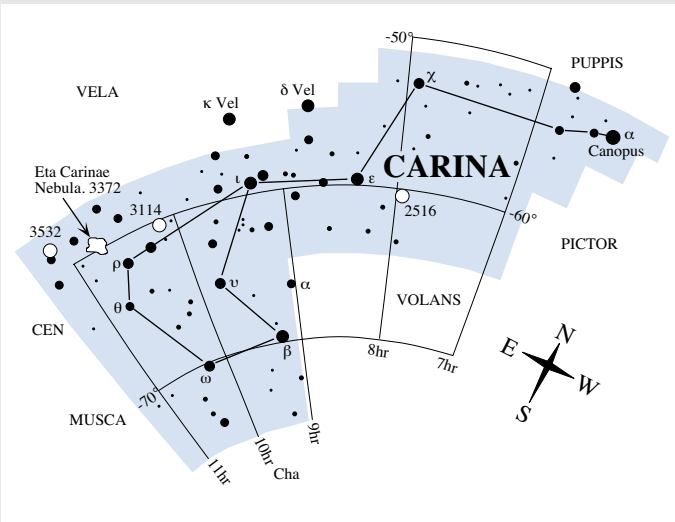
Carina was originally part of a larger constellation named Argo Navis, the Argonaut's ship from Greek mythology. For convenience Argo Navis was subdivided into smaller constellations: Carina the Keel, Puppis the Stern, Vela the Sail, and Pyxis the Compass by the French astronomer Lacaille in the 1750s. When the division took place the stars retained their original designations, hence Vela does not contain an Alpha or Beta, both of these are now in Carina.

Culminating at 9pm mid-March in the south, Carina offers some of the best southern objects for binoculars and small telescopes. Open star clusters NGC3114 and NGC3532 are real gems in small apertures, as is the nebulosity known as the Keyhole Nebula (NGC3372) surrounding the remarkable star Eta Carinae. This is only a small sampling of the many objects in this region, a host of other clusters and superb double stars await the observer.

The Eta Carinae Nebula is gigantic, measuring some 300 light years across. This is about twenty times the size of the Great Nebula in Orion. The true immensity of the Eta Carinae Nebula becomes apparent when we learn that it lies about 9000 light years from us yet still manages to span 2° of the sky (the Great Nebula in Orion, at 1500 light years, covers about 1º). The nebula is situated in a superb rich region of the southern Milky Way, and is visible to the unaided eye from dark skies ie. away from city lights.

Binoculars reveal three wedge shaped areas of nebulosity, separated by opaque dust lanes. Telescopes at low magnification 'sweeping' the region will uncover double stars, clusters, dark and light nebulae, all combining to make this an area of beauty and complexity with few equals. Sir John Herschel commented in the 1830s: "Nor is it easy for language to convey a full impression of the beauty and sublimity of the spectacle it offers when viewed in a sweep, ushered in as it is by so glorious and innumerable a procession of stars, to which it forms a sort of climax, justifying expressions which, though I find them written in my journal in the excitement of the moment would be thought extravagant if transferred to these pages." A description well fitting of this southern showpiece.

Within the brightest portion of the nebula is the remarkable orange star Eta Carinae. In 1677 Eta was recorded as 4th magnitude, since then the star has undergone some spectacular variations in brightness. In 1843 it was the second brightest star in the sky at -0.8 magnitude and today, after many fluctuations over the years, is around 7th magnitude. Eta is embedded in a tiny nebula known as the Homunculus and so never looks quite focused in the telescope.



Many people incorrectly call the Eta Carinae Nebula the 'Keyhole Nebula', however this name refers to a small dark region near the star Eta. Herschel's drawings in the 1830s indeed show a definite old fashioned keyhole shape, but since fading Eta no longer illuminates the near side of the keyhole and the original shape is now lost.

Carina's brightest star, Canopus (Alpha Carinae), at -0.7 magnitude is the second brightest star in the heavens. It is outshone only by Sirius in Canis Major. Aptly named after the pilot of the fleet of the Greek king Menelaus, Canopus is often used for spacecraft navigation. Midway between Canopus and the Southern Cross (Crux) is a group of four stars which is sometimes confused with the real cross. Known as the False Cross it is larger and not as prominent as the real Crux. Two of the stars that form the False Cross are actually in the constellation of Vela.

MARCH

COMETS

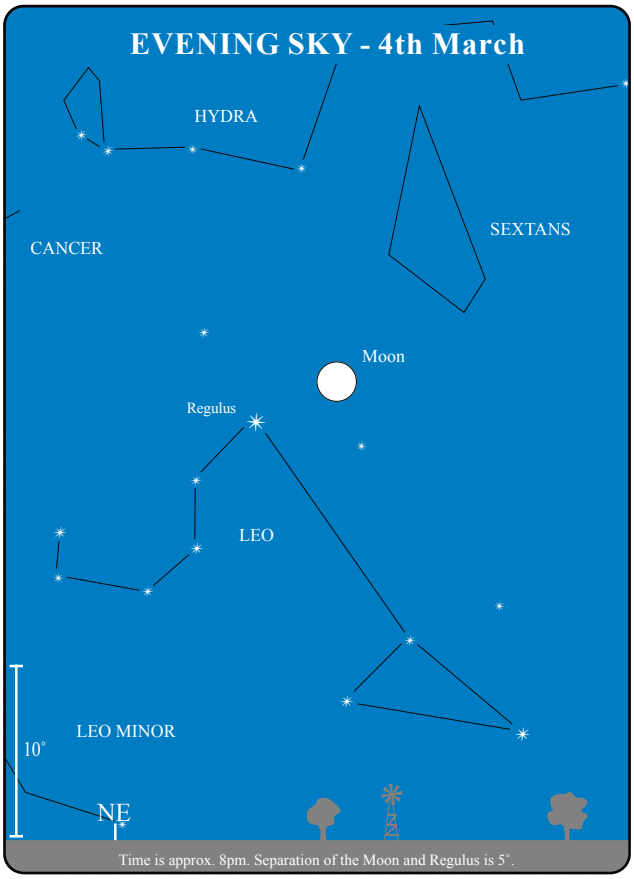
Hale-Bopp. This month the comet remains in the morning sky, in Sagittarius. At month's end it is rising around midnight at approx. mag. 8.

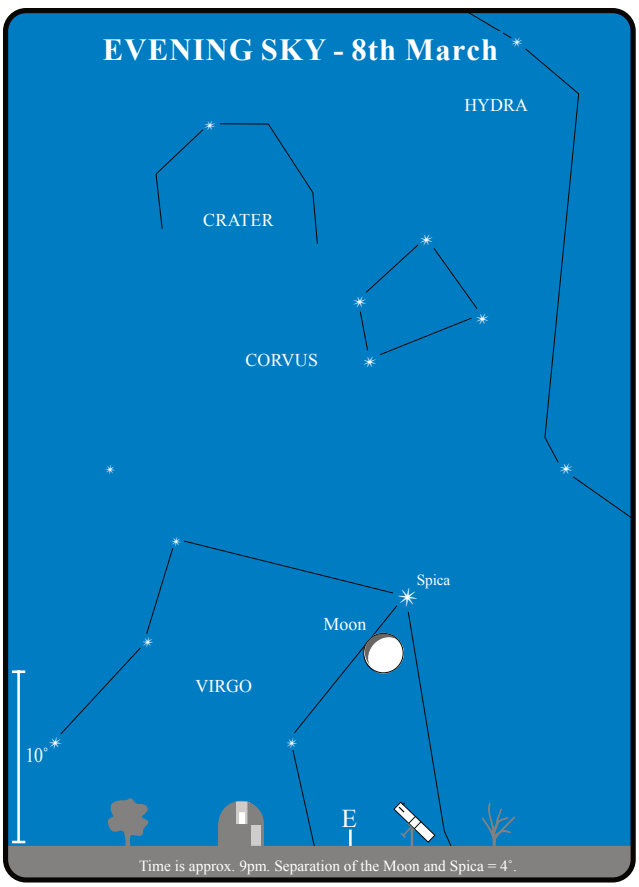
Churyumov-Gerasimenko. In early March the comet passes close to the Pleiades. By month's end it has moved into Auriga, setting around 9pm. It has faded to mag. 12.5.

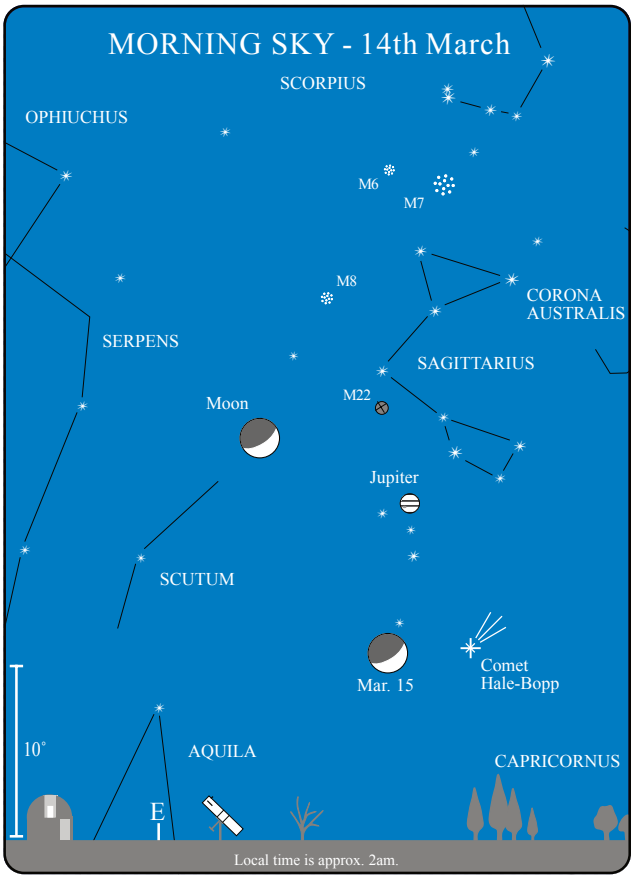
Kopff. The comet stays in Ophiuchus all month. At the beginning of March it rises around 11pm at mag. 12. By month's end it has brightened to mag. 10 and rising around 10pm.

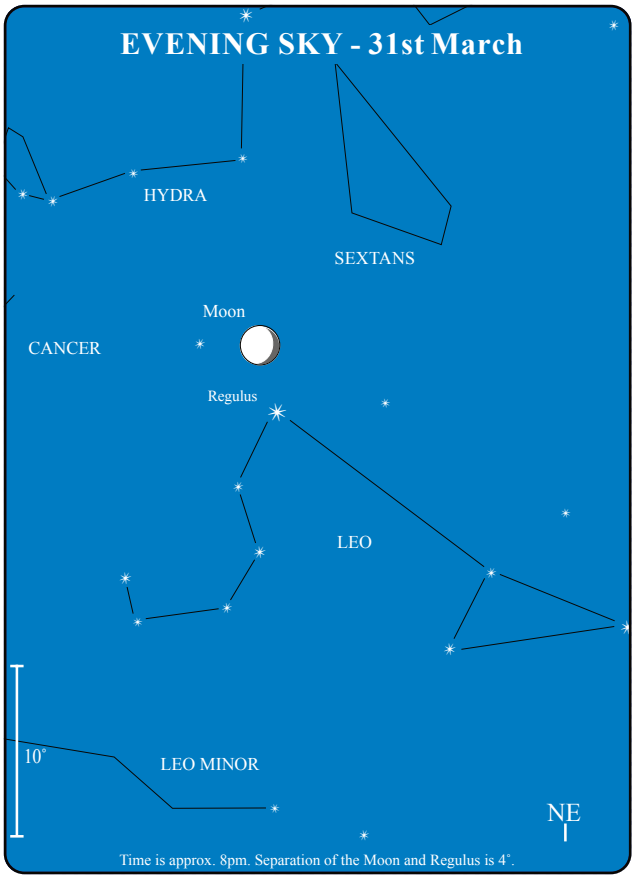
DIARY

2nd		m.p. 12 Victoria 0.4° South of NGC 6469 (OC) in Sagittarius.
2nd	11 PM	m.p. 20 Massalia 0.1° North of NGC 3640 (G) in Leo.
4th	Midnight	Mars in conjunction with Sun.
5th	7:23 PM	Full Moon.
6th		comet (67P) Churyumov- Gerasimenko 2° NW of the Pleiades (M45, OC) in Taurus.
6th		m.p. 44 Nysa 0.3° SW of M96 (G) in Leo.
7th	2 AM	Jupiter 0.03° North of NGC 6717 (GC) in Sagittarius.
7th	2 AM	Jupiter 0.02° East of 35 Sagittarii (mag. 5).
8th	1 AM	comet (22P) Kopff 0.2° SW of m.p. 1 Ceres.
8th	6 AM	Pluto stationary.
8th		m.p. 12 Victoria 0.1° NE of M21 (OC) in Sagittarius.
8th		m.p. 44 Nysa 0.1° North of M95 (G) in Leo.
12th		m.p. 21 Lutetia 1° SE of Comet Hale Bopp.
13th	3:15 AM	Last Quarter Moon.
13th	10 AM	m.p. 2 Pallas stationary.
14th	4 PM	Jupiter 5º South of Moon.
15th	3 PM	Neptune 5° South of Moon.
16th	2 AM	Uranus 6º South of Moon.
16th		Mercury at greatest latitude South (Heliocentric).
16th	4 PM	Moon at perigee.
18th	5 AM	Saturn in conjunction with Sun.
19th	8:45 PM	New Moon.
20th	6 PM	Equinox.
22nd		Venus at perihelion.
22nd		Neptune 1° North of m.p. 21 Lutetia.
23rd	6 AM	Mars 1.3° North of Saturn.
23rd	10 AM	Venus 5° North of Moon.
23rd		m.p. 9 Metis 0.1°, SE of M22 (GC) in Sagittarius.
23rd	9 PM	Mercury 0.3° North of Saturn.
24th	6 AM	Mercury 0.9° South of Mars.
26th	1 AM	comet (22P) Kopff 1° North of NGC 6356 (GC) in Ophiuchus.
26th		comet (1995 01) Hale-Bopp 4° West of Neptune.
26th		m.p. 21 Lutetia 1° North of M75 (GC) in Sagittarius.
27th	11:31 AM	First Quarter Moon.
28th	1 PM	Moon at apogee.
28th	6 PM	Mercury in superior conjunction.
29th	6 PM	m.p. 4 Vesta stationary.
30th		m.p. 39 Laetitia 1.5° North of M72 (GC) in Aquarius.

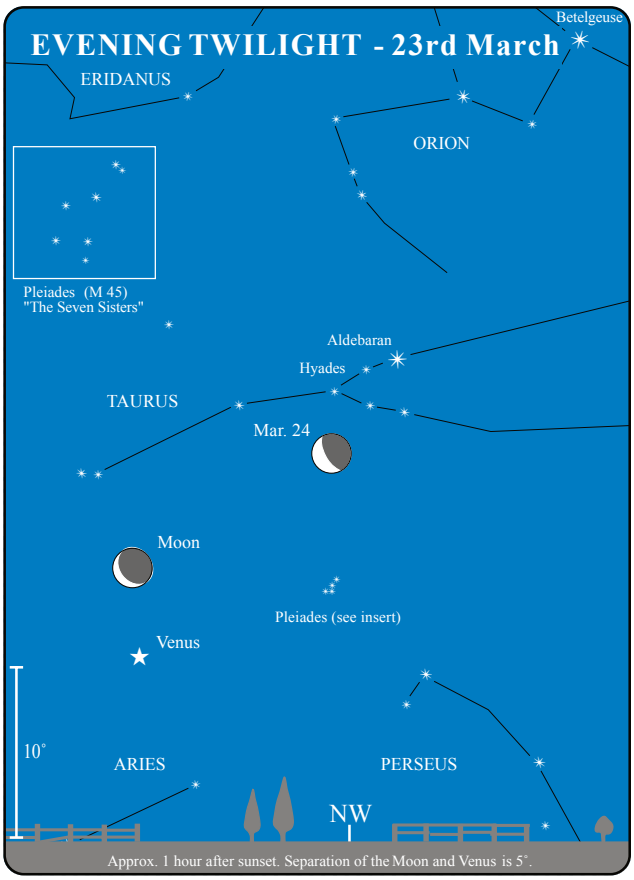


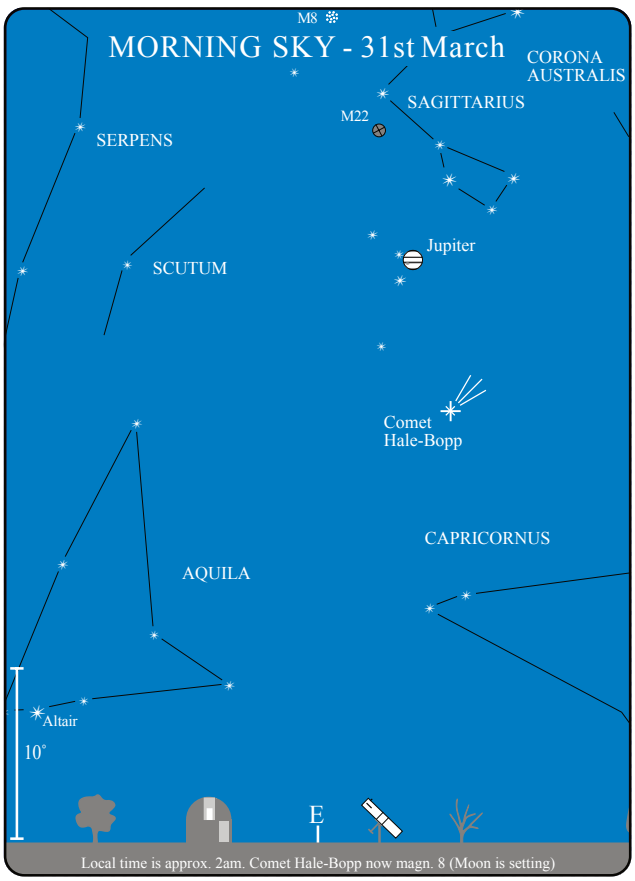






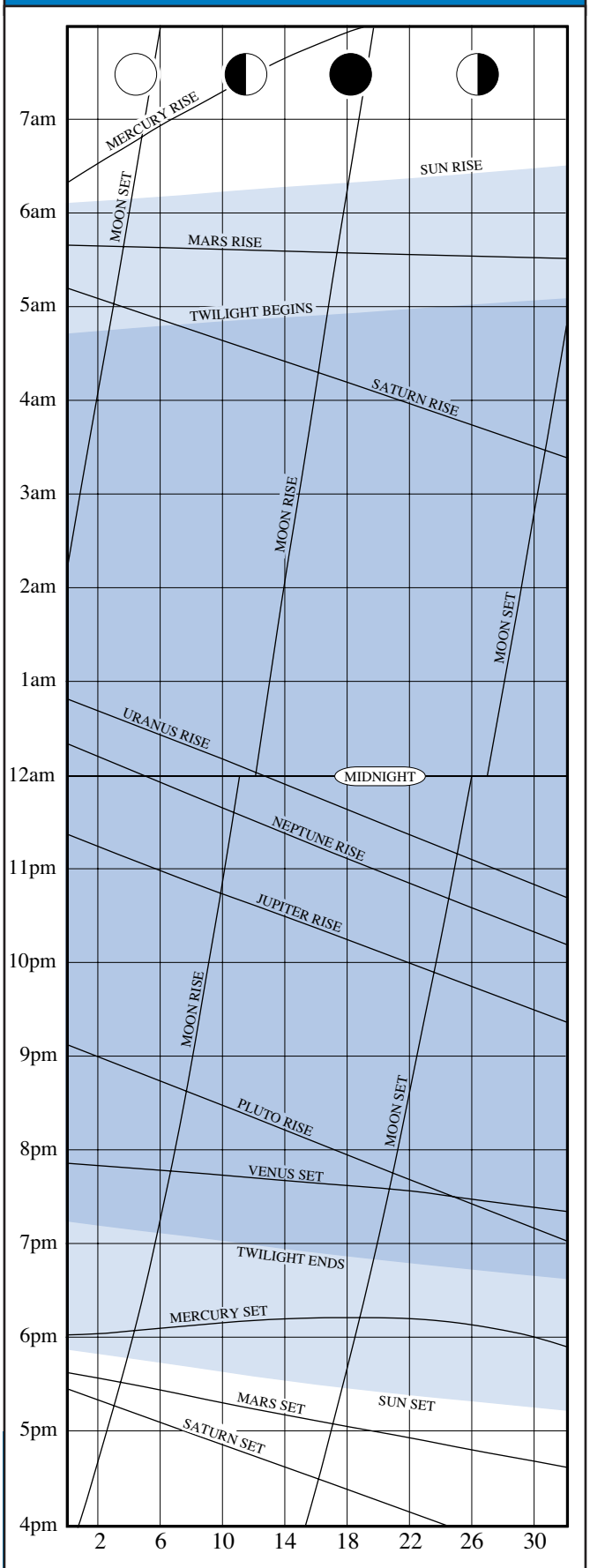
All times are AEST. For summer time (daylight saving) add 1 hour.





APRIL

RISE/SET CHART



All times are AEST.

APRIL HIGHLIGHTS

- April/May are the best months to see Venus in the evening sky.
- Jupiter moves into the evening sky.
- In late April, Uranus/Neptune move into the evening sky.
- Saturn reappears in the eastern morning sky (after being in conjunction with the Sun).
- Look for the Lyrid Meteors.

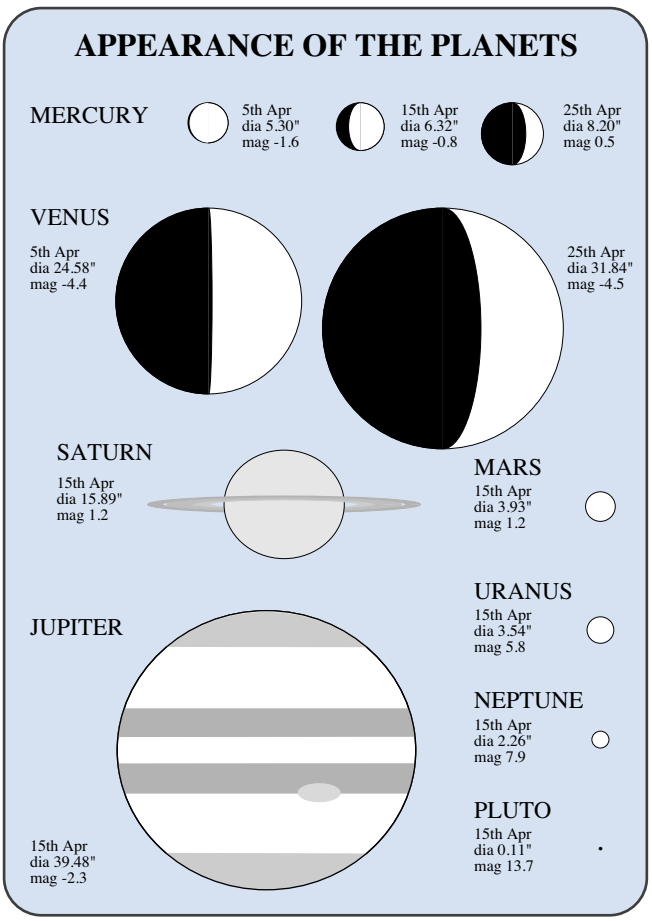
THE MOON

4th	Full Moon, 10:08am.
4th	Total Eclipse of the Moon, not visible from Australia.
11th	Moon at perigee, 1pm (closest to Earth - 369,910 km, size 32.3').
11th	Last Quarter, 9:37am.
18th	New Moon, 8.50am.
18th	Partial Eclipse of the Sun, not visible from Australia.
25th	Moon at apogee, 8am (furthest from Earth - 404,374 km, size 29.6').
26th	First Quarter, 6:41am.

THE PLANETS

MERCURY spends the first week of April in Pisces, moves into Aries, and finally Taurus is graced by the planet's presence during the last week. The planet reaches its greatest elongation east of the

APPEARANCE OF THE PLANETS



Sun on the 23rd (20°). Low in the western evening sky, Mercury sets less than an hour after sunset and is generally difficult to locate under these conditions. With the 1 day old thin crescent Moon 5° south of Mercury on the 19th, the task should be a little easier (see sky view). Try finding the thin lunar crescent about half hour after sunset and then look to the north (right) and a little lower than the Moon. Mercury, at mag. -1.0, should stand out against the twilight sky. Using binoculars to 'sweep' the sky often helps when searching for planets during twilight.

VENUS, since crossing the border from Aries into Taurus late last month, has been approaching the Pleiades star cluster (or the Seven Sisters, also known as M45 - the 45th object in the catalogue of Messier). From the 1st to the 6th the planet is less than 2° from the Pleiades, and on the 3rd passes through some of the fainter cluster members being only 0.7° from the brightest star in the group, 3rd magnitude Alcyone (Eta Tauri) (see sky view). With the unaided eye (away from lights) most people can see 6 or 7 main stars of the Pleiades. Through a small telescope, under a dark sky away from the city glare, over 100 members are visible. The low power telescopic or binocular view should be striking as the bright Venus (magnitude -4.4) passes by, washing out the fainter stars. On the 21st (see sky view), the 3 day old thin crescent Moon can be seen 9° to the south of Venus, with Aldebaran 2° south of the Moon. Aldebaran (Alpha Tauri) is the brightest member of the 'V' shaped Hyades open star cluster. Venus' greatest elongation east of the Sun (46°) occurs on the 1st.

MARS remains in Pisces this month, aside from a very brief sojourn into Cetus and back from the 2nd to the 4th. Now rising in the eastern morning twilight sky, Mars has not been visible this yea, in a 'twilight free' sky. The planet will not move into dark skies until June. It will then linger as a morning object until the end of the year.

JUPITER slows in its apparent eastern path as it nears its stationary point early next month. After that it will be in retrograde motion and heading for opposition in early July (see discussion on retrograde motion in part two). Now rising around 10.30pm, the equatorial diameter of the gas giant reaches 40 seconds of arc and magnitude -2.3 mid-month. On the 11th the last quarter Moon can be seen 5.5° north of Jupiter, (see sky view).

SATURN is visible in the early morning sky before the beginning of twilight. The planet's rings, difficult to see so far this year, begin to open up. The rings are at their widest this year over the three month period from June to August, but observers will have to wait until 2002 to see them wide open. On the 16th, Saturn will be 4° south of the 27 day old Moon (see sky view).

NEPTUNE is stationary on the 29th, and thereafter is in retrograde motion, with opposition in July.

MINOR PLANETS at opposition this month include 2 Pallas on 29th in Bootes at mag. 8.3, 8 Flora on 28th in Virgo at mag. 9.8 and 40 Harmonia on 11th in Virgo at mag. 9.9.

COMETS

Hale-Bopp. Remains in Sagittarius for the month. On the 1st it rises around midnight; by the 30th, 10pm. Brightness is around mag. 8.

Kopff. The comet moves into Sagittarius early in the month. By the end of the month it has brightened to 9th mag., rising at 9pm. On the 30th it has a close approach to the Omega Nebula.

METEOR SHOWERS

The **Lyrids** are a northern shower, but can be observed south of the equator. They are best seen from 2am to dawn from the 16th to 25th April, with maximum on the 21st. Maximum rates may only last an hour or so, and typically the zenith hourly rate is around 15. The Lyrids have on occasion produced higher rates and because of their erratic nature they are a shower to be watched. In 1982 American observers observed a short peak of 90 per hour.

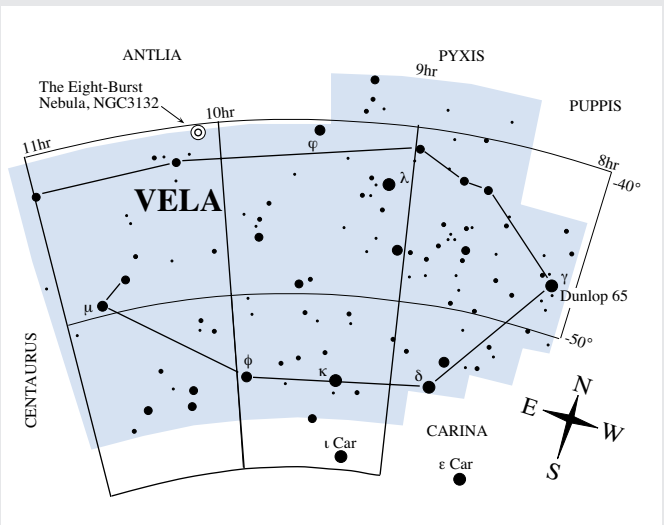
DIARY

1st	11 AM	Venus greatest elong. East (46°).
3rd		comet (67P) Churyumov- Gerasimenko 1° North of Beta Tauri.
3rd		Venus 0.5° South of the Pleiades (M45) in Taurus.
4th		Mercury at ascending node.
4th	10:07 AM	Full Moon Eclipse.

CONSTELLATION OF THE MONTH - VELA (Vel)

Vela, like Carina last month, was originally part of a larger constellation named Argo Navis, the Argonaut's ship from Greek mythology. Vela became the Sail, Carina the Keel, Puppis the Stern, and Pyxis the Compass. When Argo was arranged into more manageable areas of sky in 1750 by the French astronomer Lacaille, the stars retained their original letters and numbers. Consequently Vela was left with no stars designated as Alpha or Beta, both of these ended up in Carina. Vela's brightest star Gamma Velorum shines at magnitude 1.8. Under normal convention a star labelled Gamma would be the third brightest in a constellation.

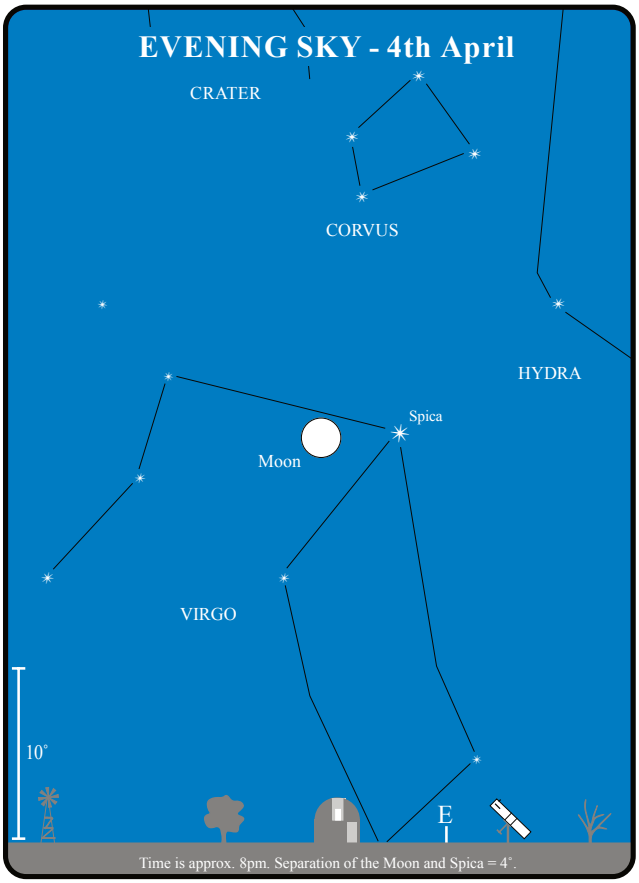
Vela culminates high in the southern sky, above Carina, early in the month. The Milky Way passes through a large part of the constellation and as a result there are many fine doubles and open star clusters. As far as double or multiple star systems go, Gamma Velorum (Dunlop 65) is hard to beat. It is a beautiful double star set in a splendid field and is easily resolved in good binoculars and small telescopes. Another fainter pair of stars, almost at right angles to Gamma, is in the same field. Another popular object is the strange and complex planetary nebula NGC3132, or the Eight-Burst nebula, which lies on the Vela/Antlia border. It is easily visible in small instruments as a circle of nebulosity with a 10th magnitude central star. It is remarkable on long exposure photographs, showing several rings of nebulous material

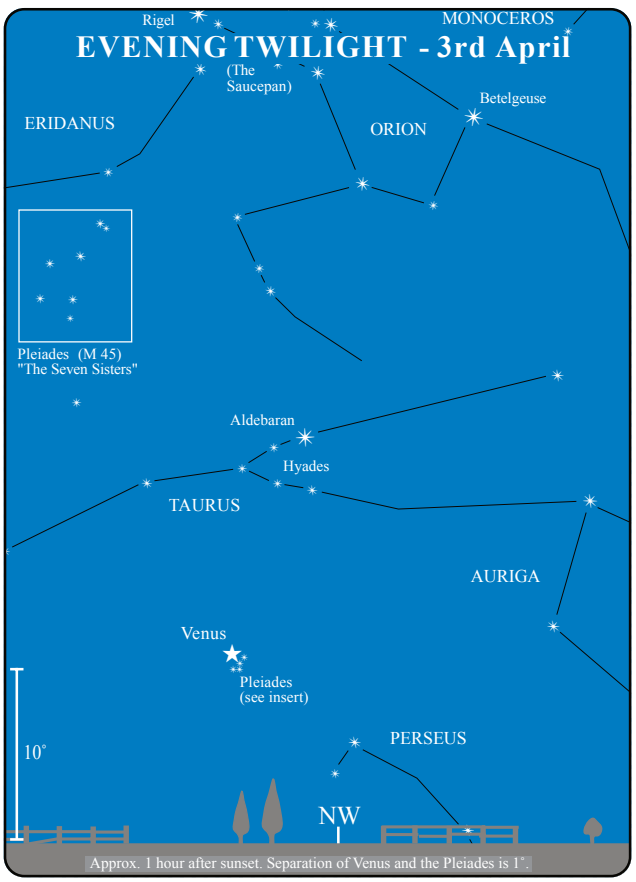


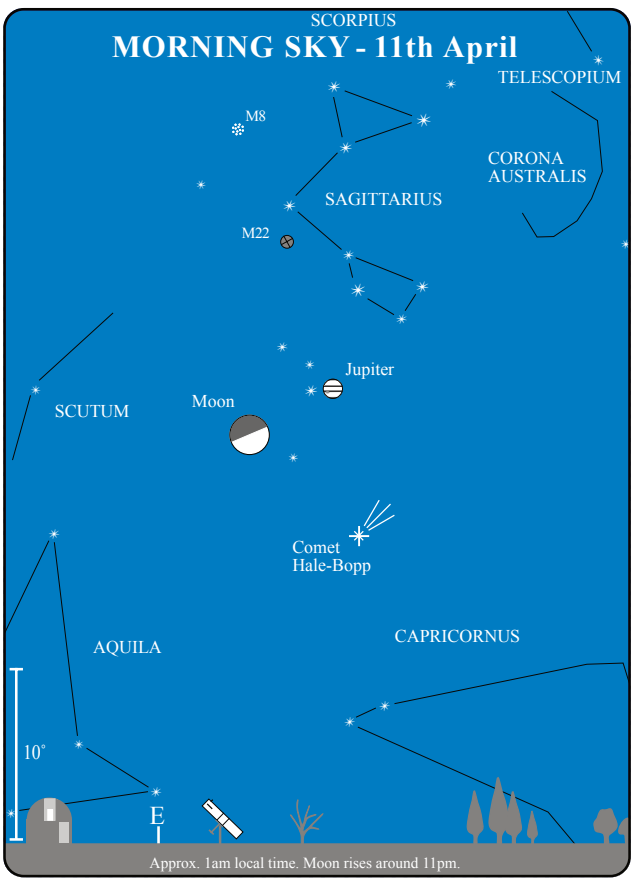
superimposed on each other. The European Southern Observatory, shortly after they started up their 4 metre telescope, made a remarkable discovery about this nebula. The energy needed to make the nebula glow does not come from the central 10th mag. star. It is instead 'fuelled' by a faint companion (mag. 16) of this Star.

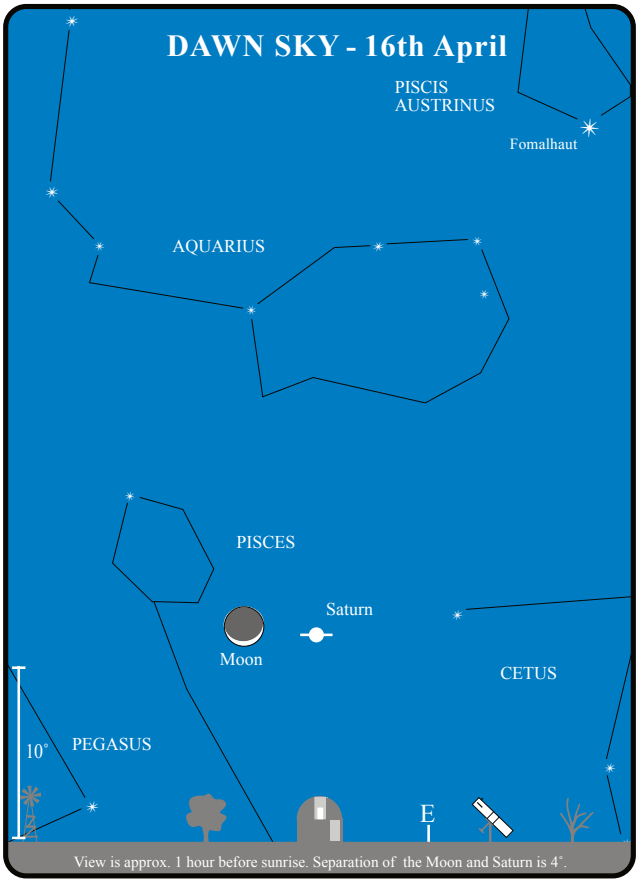
APRIL

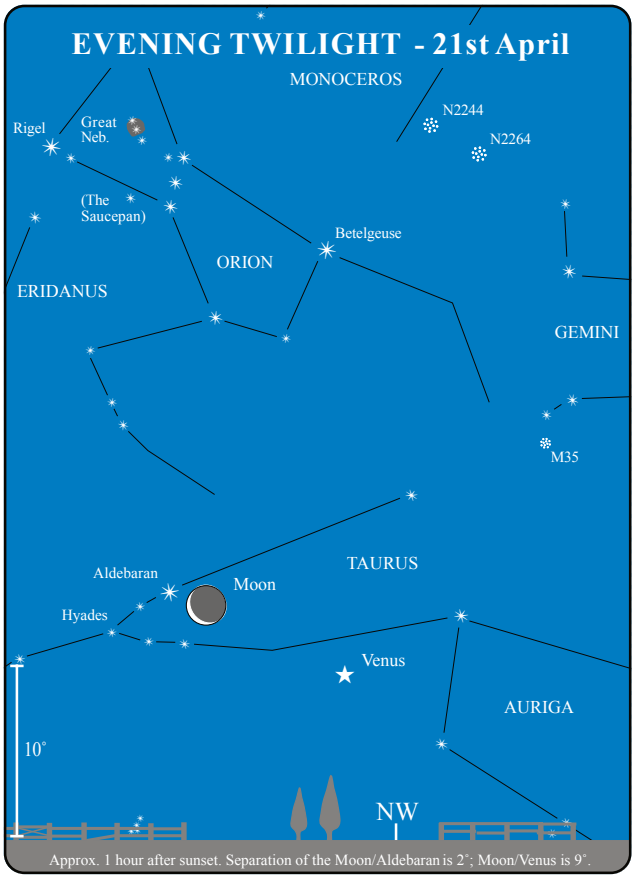
6th		Uranus 0.3° North of m.p. 21 Lutetia.
8th		m.p. 39 Laetitia 1° North of the Saturn Neb. (NGC 7009) in Aquarius.
8th	10 PM	m.p. 1 Ceres 1.0° North of Moon Occn.
9th		Mercury at perihelion.
10th	5 AM	m.p. 1 Ceres Stationary.
11th	3 AM	Jupiter 5° South of Moon.
11th	9:36 AM	Last Quarter Moon.
11th	1 PM	Moon at perigee.
11th	10 PM	Neptune 5° South of Moon.
12th	10 AM	Uranus 6º South of Moon.
13th		Venus at greatest latitude North (Heliocentric)
13th		m.p. 15 Eunomia 0.3° NE of NGC 4038 (G) in Corvus.
16th	8 AM	Venus 10° North of Aldebaran.
16th	11 AM	Saturn 4° South of Moon.
18th	8:49 AM	New Moon Eclipse.
19th	7 AM	m.p. 2 Pallas at opposition.
19th		Mercury at greatest latitude North (Heliocentric).
19th	8 PM	Mercury 5° North of Moon.
21st		m.p. 20 Massalia 1° North of NGC 3423 (G) in Sextans.
21st		m.p. 8 Flora 1.2° NE of NGC 5634 (GC) in Virgo.
21st	Midnight	Venus 9º North of Moon.
23rd	6 PM	Mercury greatest elong. East (20°).
25th	8 AM	Moon at apogee.
26th	6:40 AM	First Quarter Moon.
26th	11 PM	comet (22P) Kopff 0.1° South of the Omega Nebula (M17) in Sagittarius.
29th	7 PM	Neptune stationary.
30th		Mercury 2.5° SW of the Pleiades in Taurus.

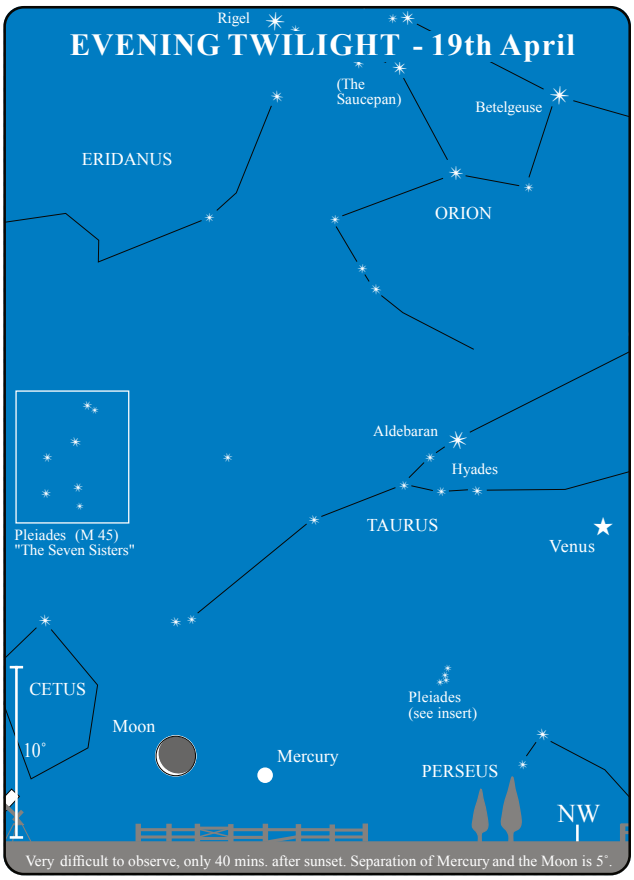


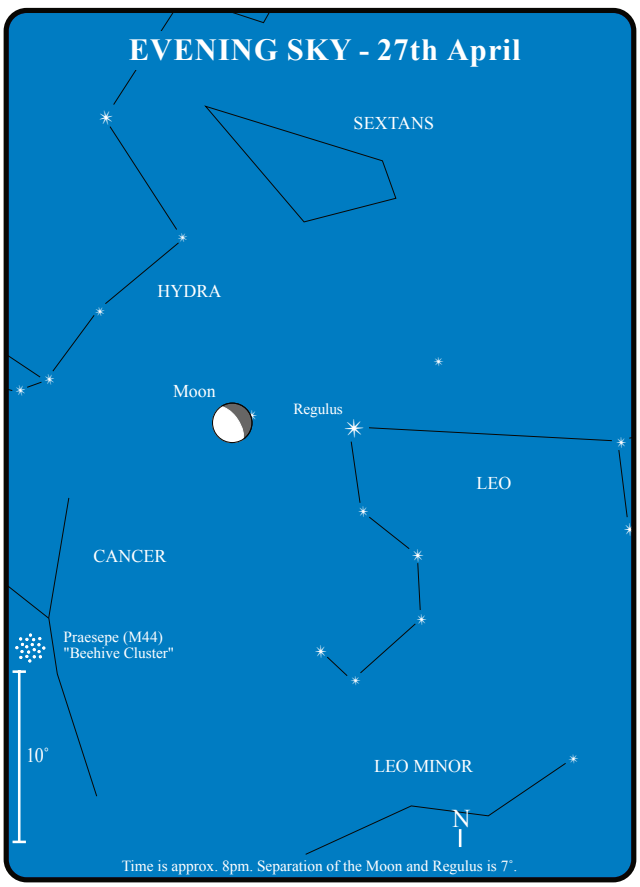





DAWN SKY - 16th April
PISCIS AUSTRINUS
Fomalhaut
AQUARIUS
PISCES
Saturn
Moon
CETUS
10˚
PEGASUS
E
View is approx. 1 hour before sunrise. Separation of the Moon and Saturn is 4˚.

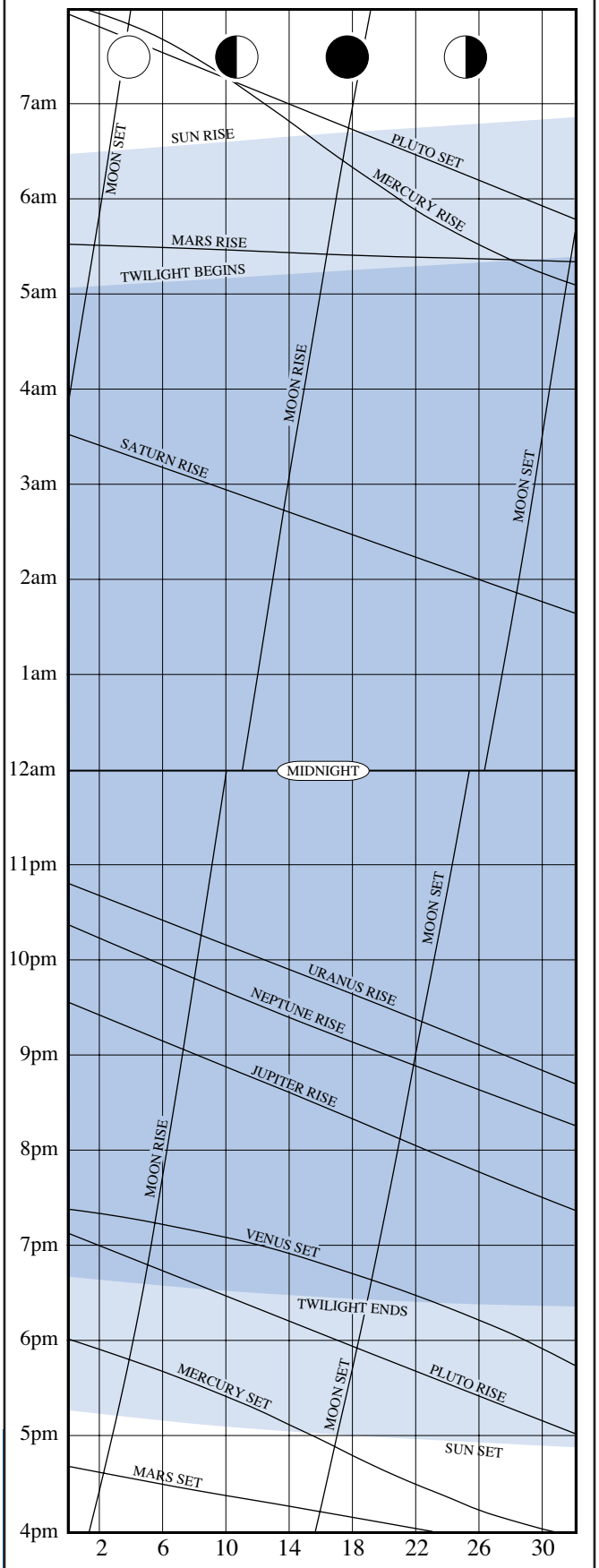

EVENING TWILIGHT - 21st April
MONOCEROS
Rigel
Great Neb.
N2244
N2264
(The Saucepan)
Betelgeuse
ORION
ERIDANUS
GEMINI
M35
Aldebaran
Moon
TAURUS
Hyades
Venus
AURIGA
10˚
NW
Approx. 1 hour after sunset. Separation of the Moon/Aldebaran is 2˚; Moon/Venus is 9˚.


Rigel
EVENING TWILIGHT - 19th April
(The Saucepan)
Betelgeuse
ERIDANUS
ORION
Aldebaran
Hyades
Pleiades (M 45)
"The Seven Sisters"
TAURUS
Venus
CETUS
10˚
Moon
Mercury
Pleiades
(see insert)
PERSEUS
NW
Very difficult to observe, only 40 mins. after sunset. Separation of Mercury and the Moon is 5˚.


EVENING SKY - 27th April
SEXTANS
HYDRA
Moon
Regulus
LEO
CANCER
Praesepe (M44)
"Beehive Cluster"
10˚
LEO MINOR
N
Time is approx. 8pm. Separation of the Moon and Regulus is 7˚.

MAY

RISE/SET CHART



All times are AEST.

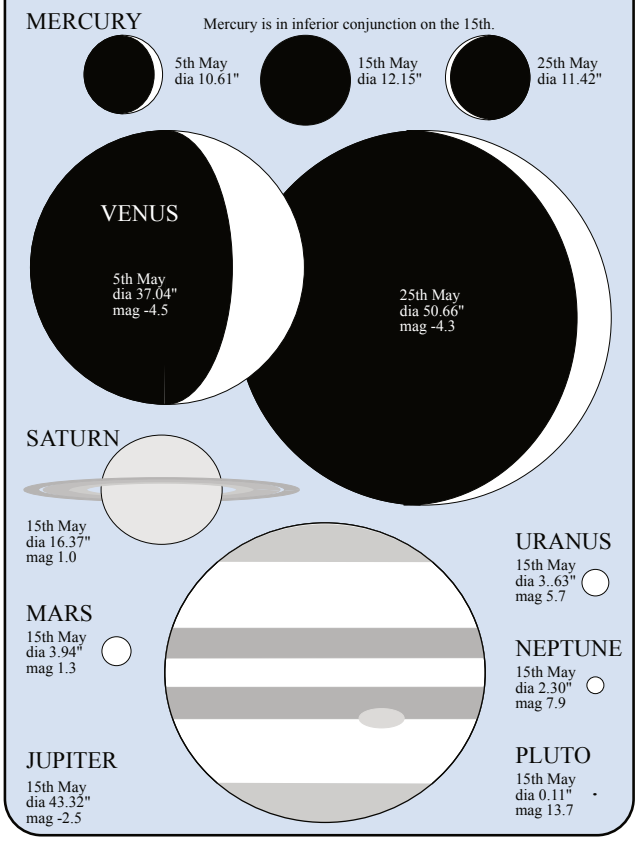
MAY HIGHLIGHTS

- Towards the end of the month, Mercury reappears in the eastern twilight morning sky.
- Occultation of m.p. 1 Ceres by the Moon on 15th (around midnight).
- Last chance to see Venus in the western evening sky for 1996. Greatest brightness is on 4th.
- Venus has a close approach to Beta Tauri. On 1st they are only 1° apart.
- Mars reappears in the eastern twilight morning sky.

THE MOON

3rd	Full Moon, 9:49pm.
5th	Occultation of m.p. 1 Ceres (around midnight).
7th	Moon at perigee, 8am (closest to Earth - 366,531 km, size 32.6').
10th	Last Quarter, 3:05pm.
17th	New Moon, 9:47pm.
23rd	Moon at apogee, 2am (furthest from Earth - 405,072 km, size 29.5').
26th	First Quarter, 12:14am.

APPEARANCE OF THE PLANETS



THE PLANETS

MERCURY, low in the western evening sky, moves toward the Sun and inferior conjunction on the 15th. It then returns to the morning twilight sky. Moving through Taurus then into Aries just after inferior conjunction, Mercury is lost in twilight until the end of the month. On the 24th Mercury and Mars come within 5° of each other and remain close companions until the end of the month. Closest approach, (3.3°), occurs on the 29th (see dawn sky view). The pair can be observed during this period in reasonably dark skies. Mercury is located south of Mars and both planets are around magnitude 1.5. Mars is easily recognised by its orange colour.

VENUS, in Taurus, begins the month within 1º of 2nd magnitude Alnath (Beta Tauri) (see sky view for 1st). The planet is at its greatest brilliancy in the evening sky on the 4th at -4.5 magnitude. It can be seen slowly moving toward the horizon as it heads towards inferior conjunction (when Venus is between the Earth and the Sun) next month. The 3 day old Moon passes 8° above Venus on the 20th (see sky view for 19th).

MARS at magnitude 1.3 now begins to stand out against the eastern morning twilight sky. The planet crosses over from Pisces on the 1st to reside in Aries for the rest of the month. On the 16th, the 27 day old thin crescent Moon can be observed just over 3° above Mars (see sky view for 14th). Mars and Mercury form a close partnership toward the end of the month, with the closest distance of just over 3° on the 29th (see Mercury for detail).

JUPITER, reaching opposition in early July, now shines brilliantly at magnitude -2.5 in the late eastern evening sky. The planet appears stationary on the 5th, and then begins its western motion which continues until September, before returning to its west-to-east track (see discussion on retrograde motion and Jupiter finder chart in part two). On the 8th, the 19 day old Moon will be 7° north of the planet (see sky view for the 7th).

SATURN, at 1st magnitude, can be seen high in the late eastern morning sky near the border of Pisces and Cetus. During the month the Moon appears nearby Saturn on two occasions. On the 13th, the 25 day old Moon will be 9° above the planet, and on the 14th 7° below (see sky view for 14th).

URANUS, PLUTO. Uranus is stationary on the 9th, and thereafter is in retrograde motion, with opposition in July. Pluto is at opposition on the 23rd.

MINOR PLANETS at opposition this month include 1 Ceres on 30th on the border of Scorpius/Ophiuchus at mag. 7.0, 4 Vesta on 11th in Libra at mag. 5.6 and 11 Parthenope on 22nd in Libra at mag. 9.5.

COMETS

Hale-Bopp. Stays in Sagittarius rising about 8pm by the 31st (mag at this time being 7.0). See sky view on 7th.

Kopff. The comet stays in Sagittarius for the month. By month's end it rises around 8pm at mag. 7.5.

Gunn. This comet is visible most of the night and spends the month in Ophiuchus at mag. 12.

DIARY

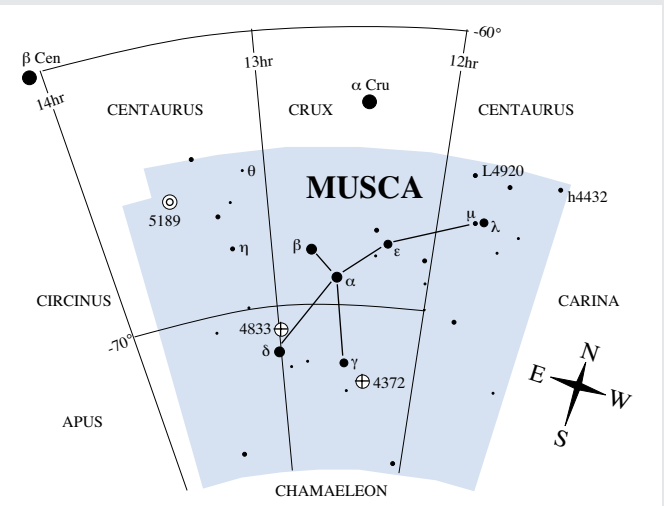
1st		comet (1995 01) Hale-Bopp 2° SE of m.p. 12 Victoria.
2nd		m.p. 349 Dembowska 0.5° North of M30 (GC) in Capricornus.
3rd		comet (67P) Churyumov- Gerasimenko 1.3° North of NGC 2331 (OC) in Gemini.
3rd	9:48 PM	Full Moon.
4th		m.p. 15 Eunomia 1° NE of NGC 3887 (G) in Crater.
4th	8 PM	Mercury stationary.
4th	Midnight	Venus greatest brilliancy.
5th	3 AM	Jupiter stationary.
6th	1 AM	m.p. 1 Ceres 0.3° North of Moon Occn.
7th	8 AM	Moon at perigee.
7th		m.p. 12 Victoria 0.2° East of NGC 6822 (G) in Sagittarius.
8th	10 AM	Jupiter 5° South of Moon.
9th	3 AM	Neptune 5° South of Moon.
9th	7 AM	m.p. 4 Vesta at opposition.

CONSTELLATION OF THE MONTH - MUSCA (MUS)

Musca, Latin for The Fly, is a small constellation directly south of Crux, the Southern Cross, and culminates in the middle of the month at the same time as the Cross. The German astronomer Johann Bayer named this constellation Apis, the Bee, early in the 1600s. It is not known with certainty who renamed the group, but Lacaille's maps of 1763 display it as a fly. Musca was also known as Musca Australis (the Southern Fly), or Musca Indica (the Indian Fly), to differentiate it from a now abandoned northern constellation, Musca Borealis (the Northern Fly). The Southern Fly was once part of Centaurus and its past northern relative was a part of Aries.

Musca, although a small grouping of stars, has an area twice that of the smallest constellation, its northern neighbour Crux. There are about 20 double and multiple stars in the Fly, the four best are h4432, L4920, Beta, and Theta. Some of these will certainly test the seeing conditions and the resolving power of smaller telescopes.

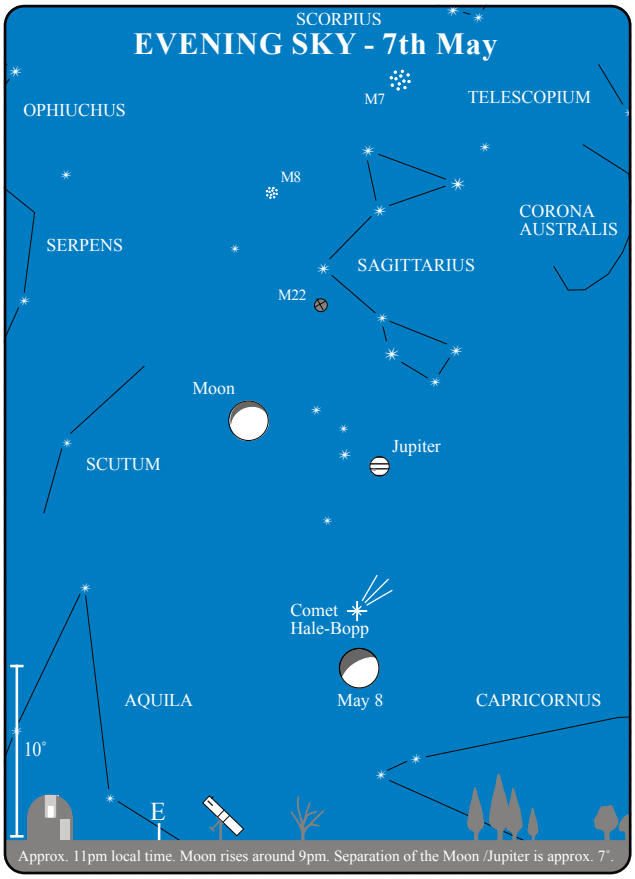
There are a number of other objects worthy of observation, including two good globular star clusters, NGC4372 and NGC4833. These would be even brighter if not for some obscuration by dark absorbing matter/nebula in the area. The planetary nebula NGC5189 is one of the most remarkable of the planetaries, being rather strange and complex in structure. There has been much confusion with observers as to its nature. John

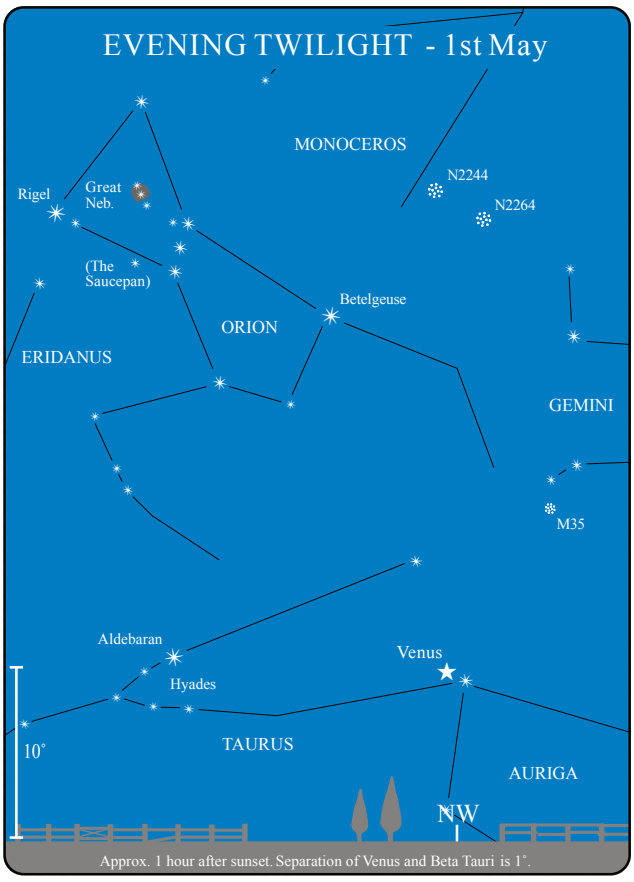


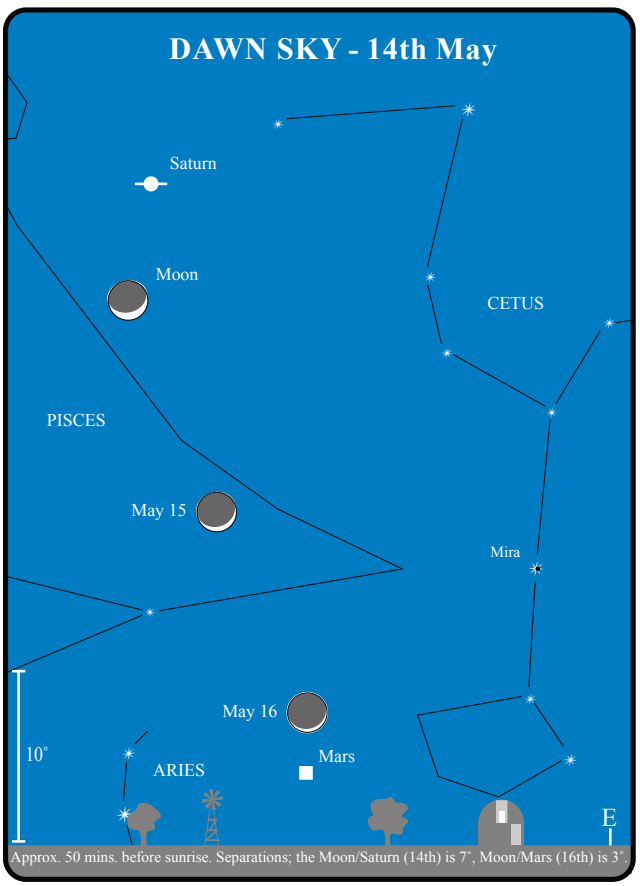
Herschel, in 1835, labelled NGC5189 as a 'very strange object'. Others have described it as being three nebulae, or a barred spiral galaxy. It is set in a fine starry field and is excellent in small instruments.

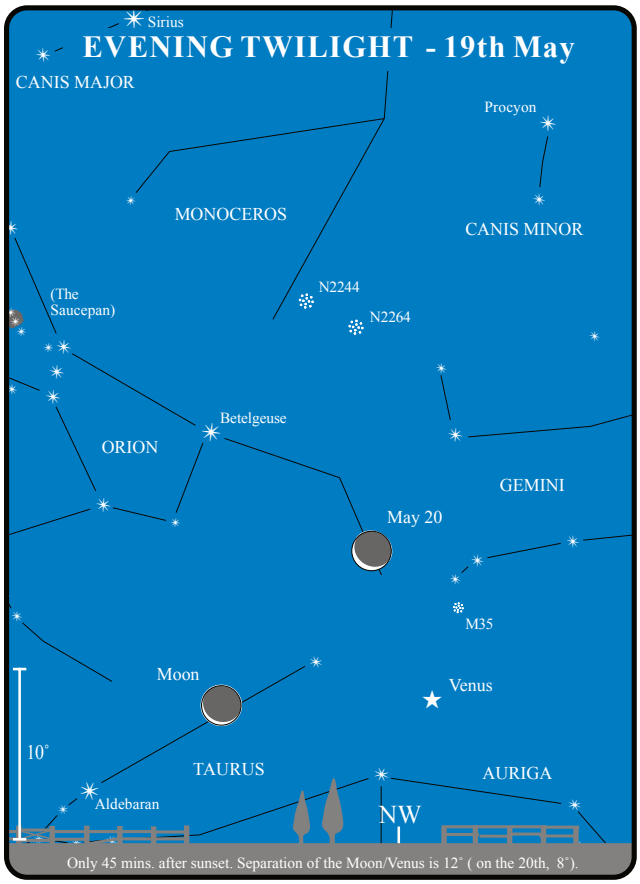
MAY

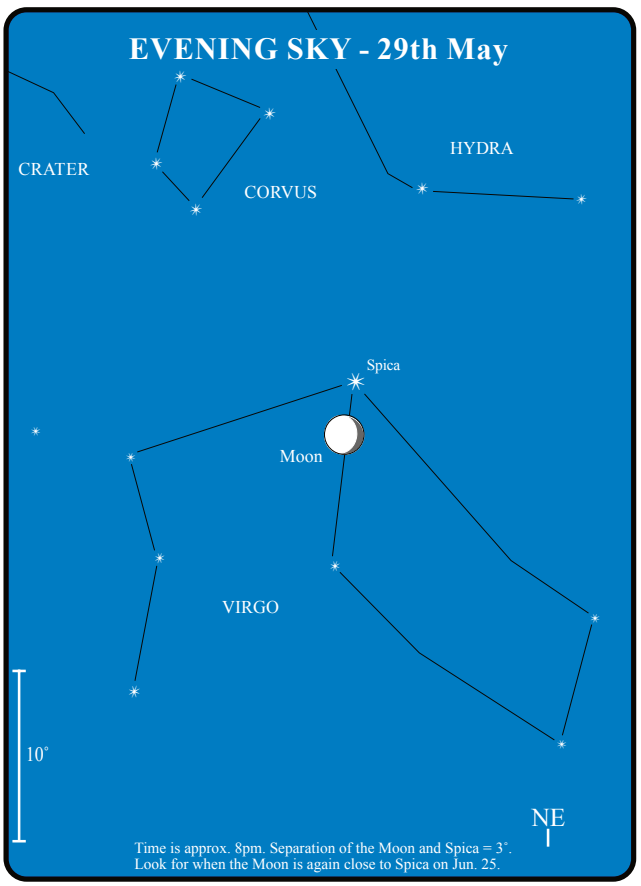
9th	10 AM	Uranus stationary.
9th	4 PM	Uranus 6° South of Moon.
10th	3:04 PM	Last Quarter Moon.
11th		m.p. 532 Herculina 0.4° North of NGC 3245 (G) in Leo Minor.
12th		Mercury at descending node.
13th	11 PM	Saturn 3° South of Moon.
15th	11 AM	Mercury in inferior conjunction.
16th		comet (1995 01) Hale-Bopp 2° SW of NGC 6822 (G) in Sagittarius.
16th		comet (67P) Churyumov- Gerasimenko 0.7° South of Pollux.
16th		m.p. 44 Nysa 0.3° NE of M95 (G) in Leo.
16th	1 PM	Mars 1.7° North of Moon.
17th	9:46 PM	New Moon.
18th		m.p. 44 Nysa 0.1° South of M96 (G) in Leo.
20th	11 AM	Venus 8° North of Moon.
20th	5 PM	Venus stationary.
22nd	Midnight	Pluto at opposition.
23rd	2 AM	Moon at apogee.
23rd		Mercury at aphelion.
26th	12:13 AM	First Quarter Moon.
27th	5 PM	Mercury stationary.
28th		m.p. 354 Eleonora 0.2° South of NGC 2903 (G) in Leo.
28th		m.p. 532 Herculina 1.2° North of NGC 3344 (G) in Leo Minor.
30th	10 AM	m.p. 1 Ceres at opposition.
31st	4 PM	Mercury 4° South of Mars.

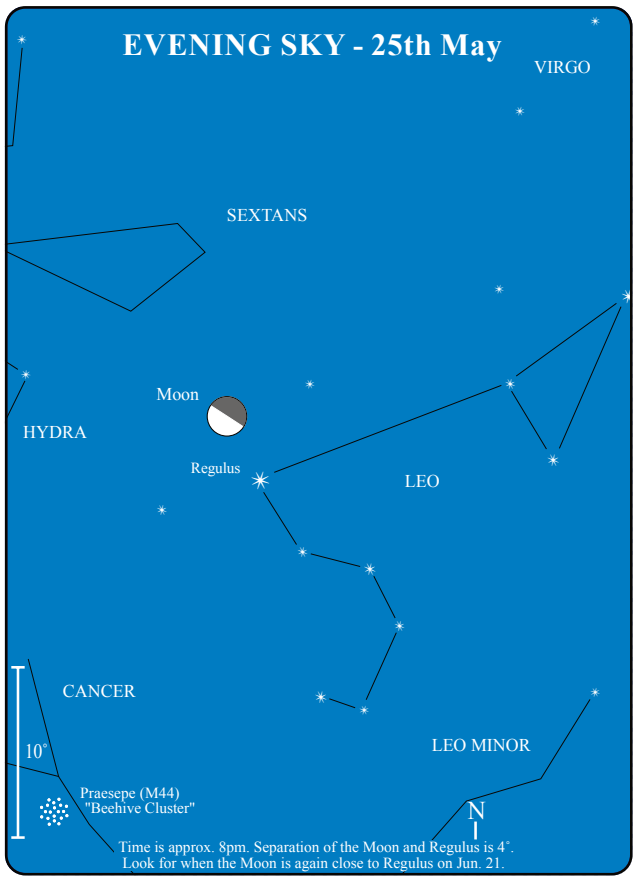


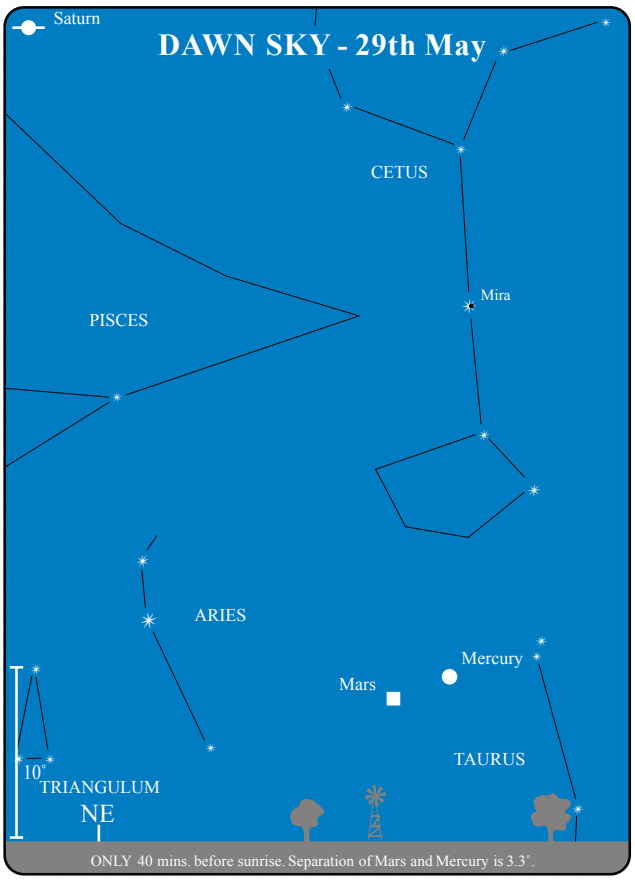





EVENING TWILIGHT - 19th May
Sirius
CANIS MAJOR
Procyon
MONOCEROS
CANIS MINOR
(The Saucepan)
N2244
N2264
Betelgeuse
ORION
GEMINI
May 20
M35
Moon
Venus
10˚
TAURUS
AURIGA
Aldebaran
NW
Only 45 mins. after sunset. Separation of the Moon/Venus is 12˚ (on the 20th, 8˚).

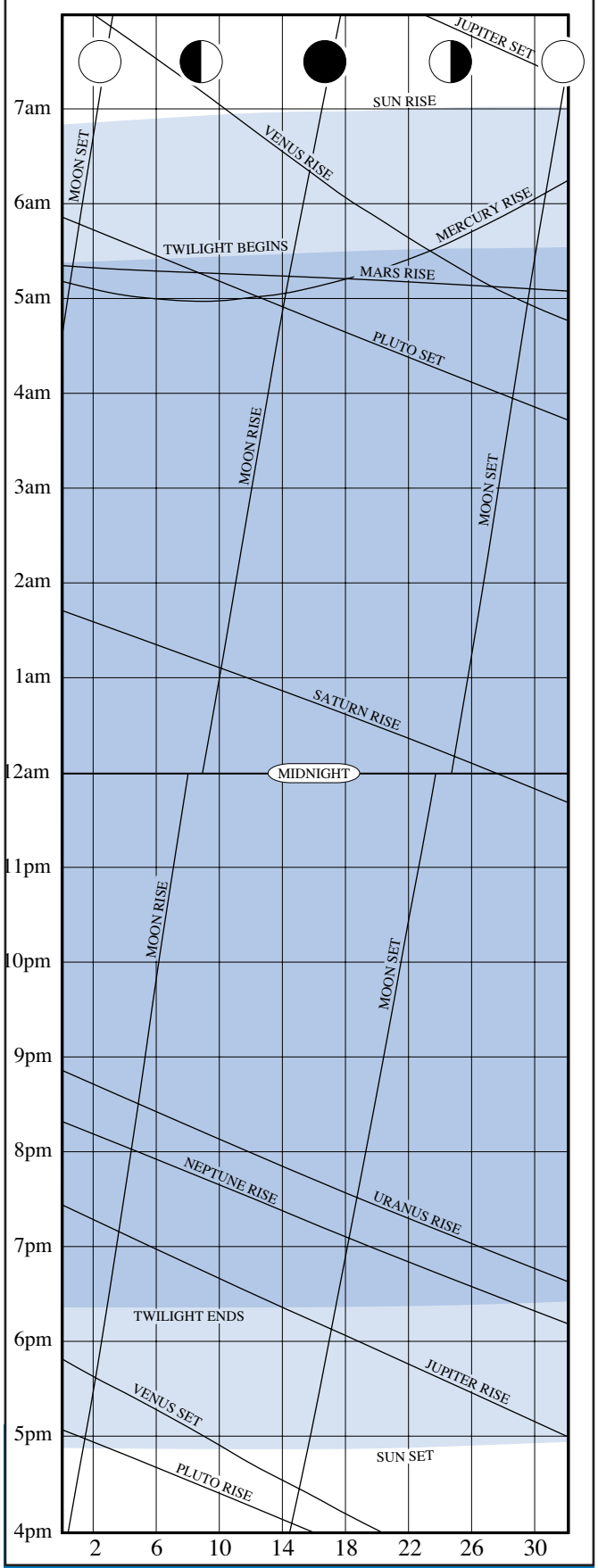

EVENING SKY - 29th May
CRATER
CORVUS
HYDRA
Spica
Moon
VIRGO
10˚
NE
Time is approx. 8pm. Separation of the Moon and Spica = 3˚.
Look for when the Moon is again close to Spica on Jun. 25.


EVENING SKY - 25th May
VIRGO
SEXTANS
Moon
HYDRA
Regulus
LEO
CANCER
10˚
LEO MINOR
Praesepe (M44)
"Beehive Cluster"
N
Time is approx. 8pm. Separation of the Moon and Regulus is 4˚.
Look for when the Moon is again close to Regulus on Jun. 21.


Saturn
DAWN SKY - 29th May
CETUS
Mira
PISCES
ARIES
Mercury
Mars
TAURUS
10˚
TRIANGULUM
NE
ONLY 40 mins. before sunrise. Separation of Mars and Mercury is 3.3˚.

JUNE

RISE/SET CHART



All times are AEST.

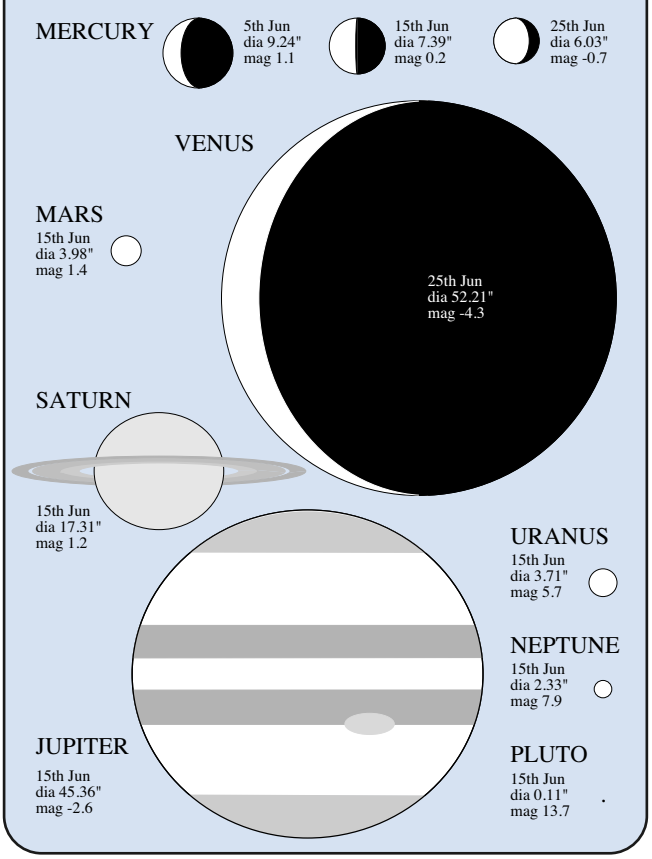
JUNE HIGHLIGHTS

- Mars, Mercury. Venus and the Moon are involved in number of close approaches (conjunctions) in the morning/dawn sky. For example see sky views for 14th, 23rd and 30th.
- Mercury well placed in the morning sky for the first 3 weeks.
- Daytime occultation of Mercury by the Moon on 14th. In the dawn sky on 14th, Moon/Mercury only 1° apart!
- First view of Mars, in dark sky, for 1996. The planet is low in the eastern pre-twilight morning sky. It remains a morning object for the rest of the year.

THE MOON

2nd	Full Moon, 6:48am.
4th	Moon at perigee, 2am (closest to Earth - 361,491 km, size 33.0').
8th	Last Quarter, 9:07pm.
14th	Daytime occultation of Mercury at approx. 10am. Visible from Western Australia, South Australia and parts of northern Australia - see occultation section.
16th	New Moon, 11:37am.
19th	Moon at apogee, 4pm (furthest from Earth - 406,033 km, size 29.4').
24th	First Quarter, 3:24pm.

APPEARANCE OF THE PLANETS



THE PLANETS

MERCURY is visible most of the month low in the eastern sky before the beginning of astronomical twilight. This apparition will be the last time that the planet can easily be observed in the morning sky this year. Mercury reaches its greatest elongation west of the Sun (24°) on the 10th, and travels from Aries into Taurus on the 6th where it remains until early next month. For the early riser there are plenty of interesting conjunctions and configurations during the month, especially as Mercury approaches the Hyades star cluster in Taurus towards the end of June. Mercury and Mars remain close companions, separated by 4 early in the month and closer at slightly less than 3° around the 18th (see sky view on 14th). On the 14th the 27 day old thin crescent Moon will be just over 1° north of Mercury (see sky view). On the 20th, Mars, Mercury and 1st magnitude Aldebaran form a straight line, with separations of 3.6° and 3.8° respectively (6° below Aldebaran is Venus). Mars, Mercury and Venus form a straight line on the 22nd, with separations of 4.8° and 3.2° respectively (3.7° directly above Venus is Aldebaran). Mercury and Venus come within 1.7° on the 23rd (see sky view). On the 25th, Aldebaran, Venus and Mercury form a straight line at right angles to the horizon, with separations of 3.9° and 3.7° respectively (with Mars to the north).

On the 14th Mercury is occulted by the Moon. This is a daylight event, occurring around 10am, with the Sun ONLY 24 degrees away! With the Sun so close to the Moon, viewing of this event using any optical aid such as binoculars or a telescope should ONLY be attempted by experienced observers (otherwise blindness can result; see also warning for Venus occultation in February section).

VENUS is lost from sight as it moves between the Earth and Sun (inferior conjunction) on the 11th, effectively ending the planets status as the 'Evening Star' for the rest of the year. After conjunction, Venus moves to the west of the Sun and quickly gains altitude to become the brilliant Morning Star. Between the 22nd and the end of the month the planet interacts with Mercury, Mars and Aldebaran (see Mercury above for detail) forming interesting alignments and configurations. Venus ends the month 4° from Mars and less than 4º from Aldebaran (see sky view for 30th).

MARS has not been visible this year in a truly dark sky, always setting before the end of/or rising during astronomical twilight. This month the planet is visible in dark sky rising around two hours before sunrise. It will remain a morning object until the end of the year. Mars rises within 4° of Mercury early in the month (see sky view for 29th May) and is of similar brightness, but Mars can be picked by its orange colour. Mars forms some very interesting alignments and patterns with Mercury, Venus and Aldebaran as detailed under 'Mercury'.

JUPITER rises at the end of astronomical twilight (mid-month). It is visible the entire night and is at opposition on the 4th July. The planet has already reached its maximum brightness of -2.7. On the 4th, the Moon, two days past full, will be 7º north of Jupiter (see sky view for 3rd). The planet is an ideal target for even small telescopes, its main cloud belts and its four Galilean satellites being easily visible. The Galilean satellites provide a fascinating subject on their own. See Jupiter Satellite Events in part two for a daily diary and explanation of phenomena like transits, occultations and eclipses.

SATURN rising just before midnight, moves from Pisces into Cetus early in the month. It remains in this constellation until late August. The rings are at their widest (for the year) over the coming three months and will be easily visible in small telescopes. While the rings are narrow the planet's oblateness (how oval shaped it is) is more obvious, with the equatorial diameter exceeding the polar diameter by

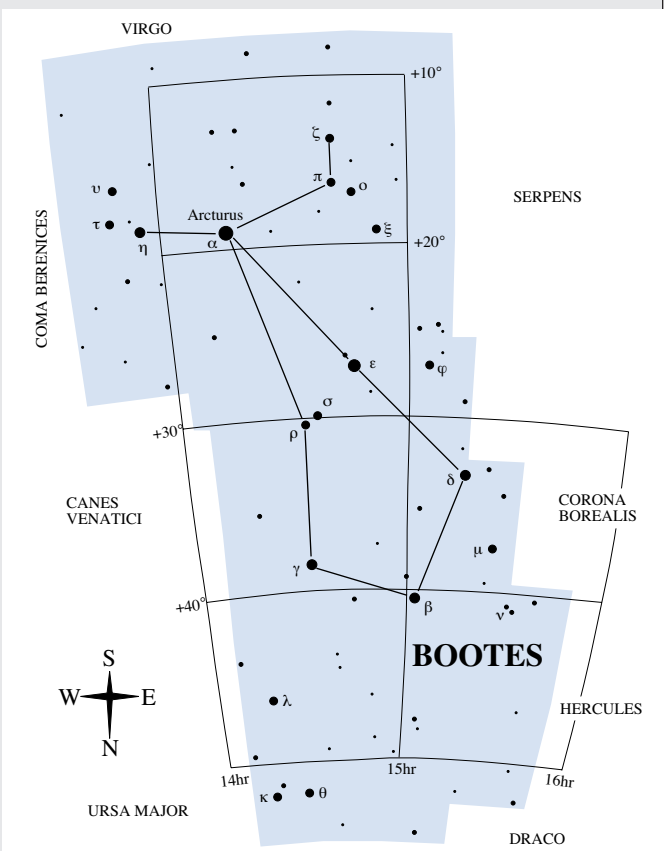
CONSTELLATION OF THE MONTH - BOOTES (Boo)

Bootes, the Herdsman, is a large constellation culminating in the northern sky at 9pm in mid-June. It is west of the Northern Crown, Corona Borealis. Homer mentions Bootes in the Odyssey as the Bear Driver, pursuing the Great Bear (Ursa Major) and the Small Bear (Ursa Minor) across the sky. Southern hemisphere observers can only see a small portion of Ursa Major, and Ursa Minor is never seen. Old constellation drawings show Bootes with two hunting dogs (Canes Venatici), apparently ready to be unleashed after the Great Bear.

An easy way to recognise Bootes is to picture the outline of an upside down kite formed by the stars Beta, Gamma, Delta and Epsilon. Arcturus, the constellation's brightest star, is midway along the kite's tail which curves westward.

Bootes contains no open star clusters, planetary or diffuse nebulae and only one dim globular cluster. There are many galaxies, most of which are faint and disappointing even in fairly large amateur telescopes. This seemingly uninteresting constellation has one saving grace for the telescope user, scores of double stars! Two good doubles are Kappa and Iota Bootis and for colour, Pi Bootis is a neat yellow pair. For colour contrast, Epsilon Bootis is considered one of the finest in the sky. Its primary star is a yellowish orange and the companion, bluish or green. Xi Bootis also has excellent contrast with a yellow primary and a reddish orange secondary.

Arcturus (Alpha Bootis), at magnitude -0.04 is the brightest star north of the celestial equator and the fourth brightest star in the sky. Sirius, Canopus and Alpha Centauri are Arcturus' seniors and all have negative declinations. Arcturus has a large annual proper motion of 2.28 arc seconds, and 3000 years ago was situated about two degrees north east of its present position. Its course takes it towards the constellation of Virgo. Of the first magnitude stars only Alpha Centauri (Rigil Kent), with a 3.68 are second annual proper motion, exceeds that of Arcturus.



JUNE

11%. This is greater than Jupiter's polar flattening. On the 10th, Saturn will be 3° south of the 23 day old Moon (see sky view).

MINOR PLANETS. At opposition this month is 9 Metis on 29th in Sagittarius at mag. 9.7.

COMETS

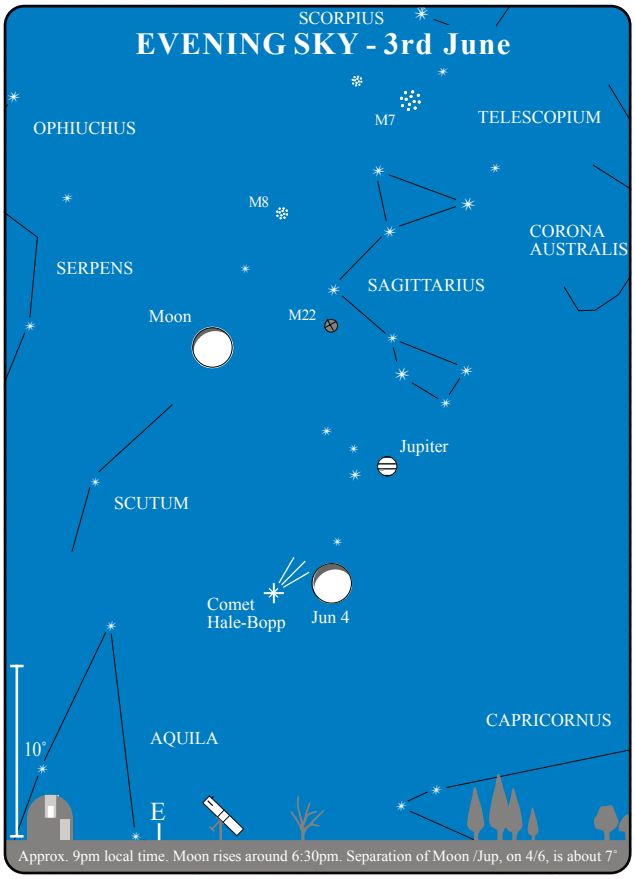
Hale-Bopp. Still in Sagittarius, Hale-Bopp moves into Scutum at the end of June. At this time it will be visible the whole night at 6th magn (see sky view on 3rd).

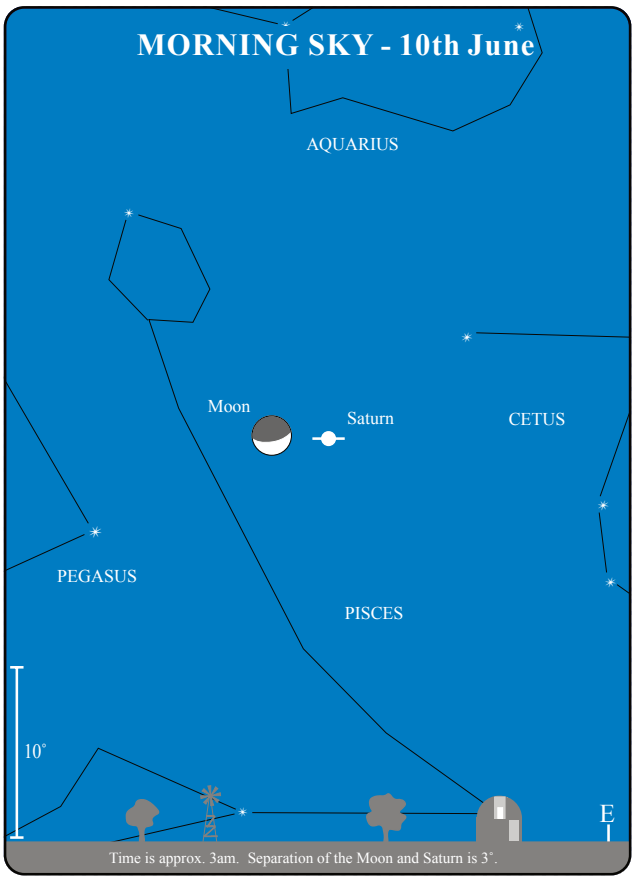
Kopff. The comet stays in Sagittarius for the month. By month's end it rises around 6pm (at mag. 7) and visible all night.

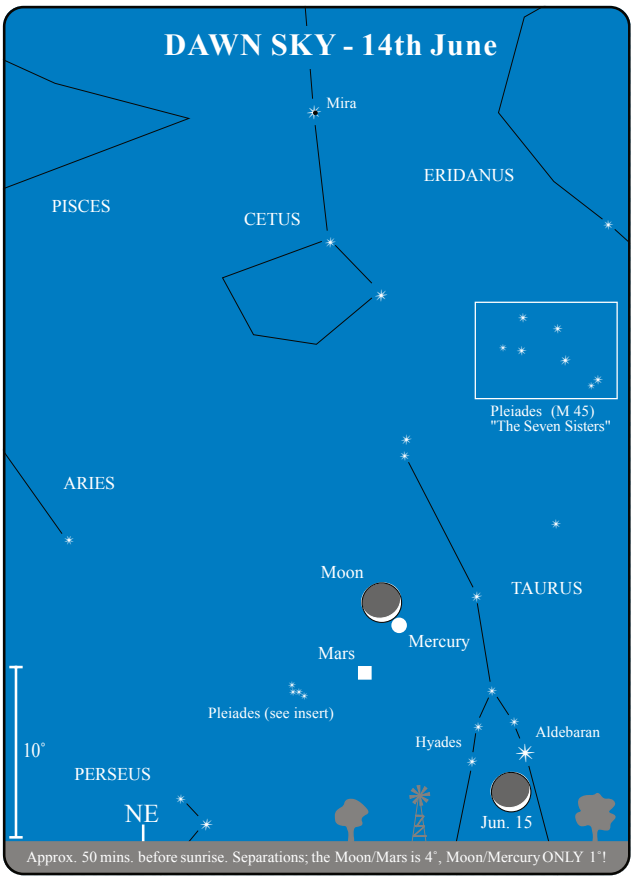
Gunn. In early June the comet moves into Scorpius, making a close approach to M80 mid-month. This mag. 12 object remains visible most of the night, setting around Sam by the end of the month.

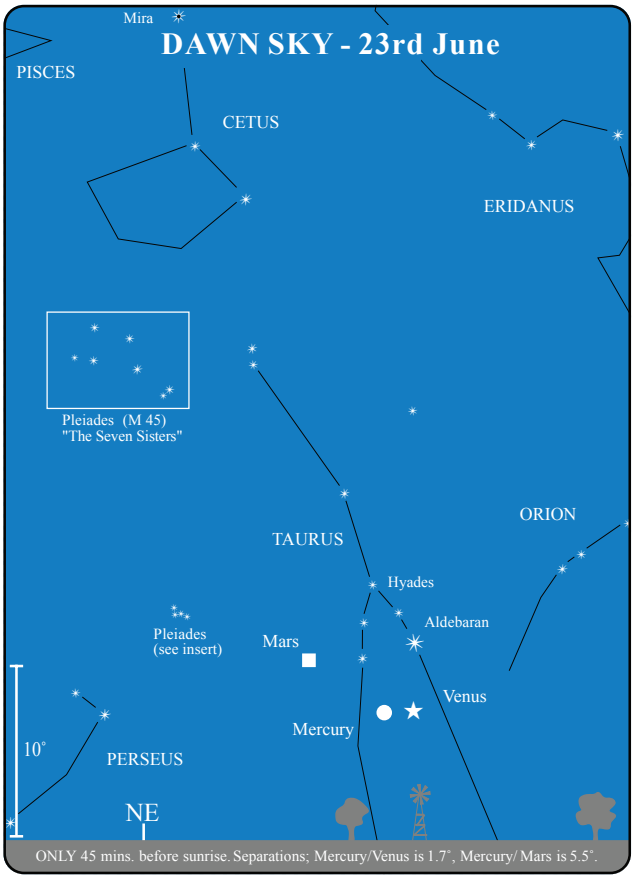
DIARY

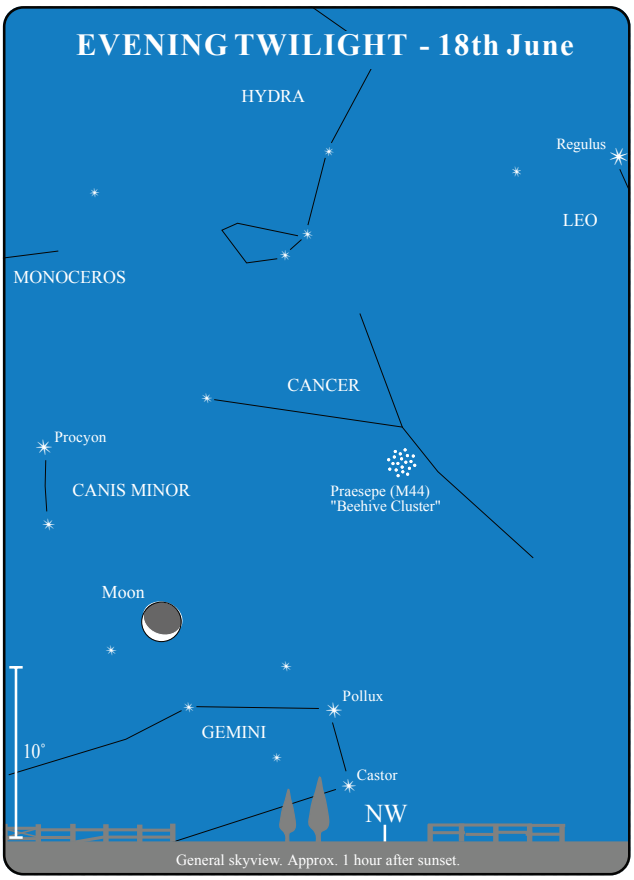
2nd	1 AM	m.p. 1 Ceres 0.8° South of Moon Occn.
2nd	6:47 AM	Full Moon.
4th	2 AM	Moon at perigee.
4th	4 PM	Jupiter 5° South of Moon.
5th	10 AM	Neptune 5° South of Moon.
5th	10 PM	Uranus 6° South of Moon.
6th		Jupiter at descending node.
6th		m.p. 40 Harmonia 1° NE of NGC 4753 (G) in Virgo.
6th		m.p. 9 Metis 0.1° South of Sigma Sagittarii.
7th		m.p. 14 Irene 1.3° North of NGC 2903 (G) in Leo.
8th		Venus at descending node.
8th		comet (1995 01) Hale-Bopp 3° NE of comet (22P) Kopff.
8th	9:05 PM	Last Quarter Moon.
9th		m.p. 20 Massalia 0.8° North of NGC 3640 (G) in Leo.
10th	8 AM	Saturn 3° South of Moon.
10th	7 PM	Mercury greatest elong. West (24°).
11th	2 AM	Venus in inferior conjunction.
12th		Mercury at greatest latitude South (Heliocentric).
13th		m.p. 15 Eunomia 0.05° South of NGC 3962 (G) in Crater.
14th	10 AM	Mercury 0.4° North of Moon Occn.
14th	11 AM	Mars 4º North of Moon.
14th	11 PM	Mercury 3° South of Mars.
15th	7 PM	m.p. 2 Pallas stationary.
16th		comet (65P) Gunn 0.1° South of M80 (GC) in Scorpius.
16th	11:36 AM	New Moon.
19th	4 PM	Moon at apogee.
20th		Mars at ascending node.
20th		m.p. 192 Nausikaa 1° North of M30 (GC) in Capricornus.
21st		Noon Solstice.
21st	9 PM	Mercury 4° North of Aldebaran.
23rd	10 PM	Mercury 1.6° North of Venus.
24th		m.p. 532 Herculina 0.5° North of NGC 3646 (G) in Leo.
24th	3:23 PM	First Quarter Moon.
25th	2 AM	m.p. 4 Vesta stationary.
26th		Venus 0.3° South of NGC1647 (OC) in Taurus.
27th	10 PM	Mars 6º North of Aldebaran.
30th	2 PM	Venus 4° South of Mars.

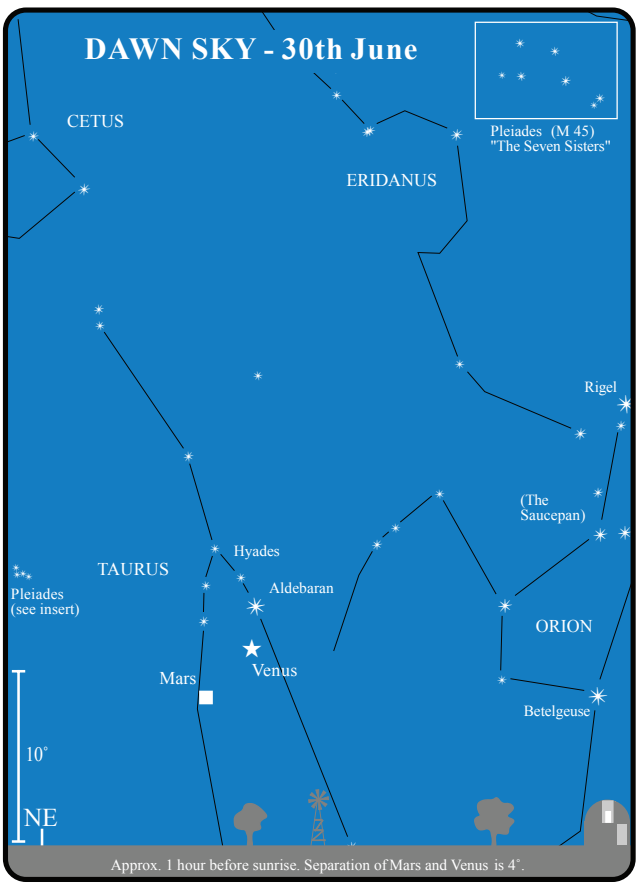





DAWN SKY - 14th June
Mira
ERIDANUS
PISCES
CETUS
Pleiades (M 45)
"The Seven Sisters"
ARIES
Moon
TAURUS
Mercury
Mars
Pleiades (see insert)
Hyades
Aldebaran
10˚
PERSEUS
NE
Jun. 15
Approx. 50 mins. before sunrise. Separations; the Moon/Mars is 4˚, Moon/Mercury ONLY 1˚!

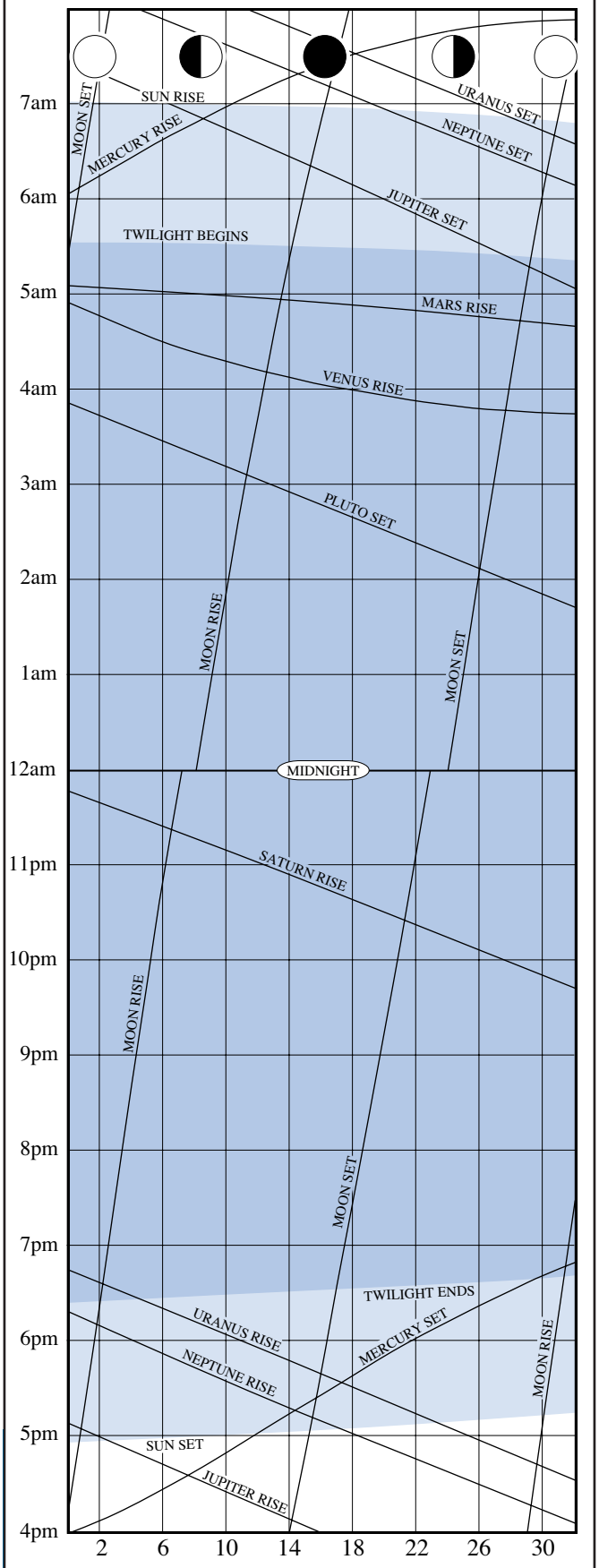

Mira
DAWN SKY - 23rd June
PISCES
CETUS
ERIDANUS
Pleiades (M 45)
"The Seven Sisters"
ORION
TAURUS
Hyades
Aldebaran
Pleiades
(see insert)
Mars
Venus
Mercury
10˚
PERSEUS
NE
ONLY 45 mins. before sunrise. Separations; Mercury/Venus is 1.7˚, Mercury/ Mars is 5.5˚.


EVENING TWILIGHT - 18th June
HYDRA
Regulus
LEO
MONOCEROS
CANCER
Procyon
CANIS MINOR
Praesepe (M44)
"Beehive Cluster"
Moon
Pollux
GEMINI
10˚
Castor
NW
General skyview. Approx. 1 hour after sunset.


DAWN SKY - 30th June
CETUS
Pleiades (M 45)
"The Seven Sisters"
ERIDANUS
Rigel
(The
Saucepan)
Hyades
TAURUS
Pleiades
(see insert)
Aldebaran
ORION
Venus
Mars
Betelgeuse
10˚
NE
Approx. 1 hour before sunrise. Separation of Mars and Venus is 4˚.

JULY

RISE/SET CHART



All times are AEST.

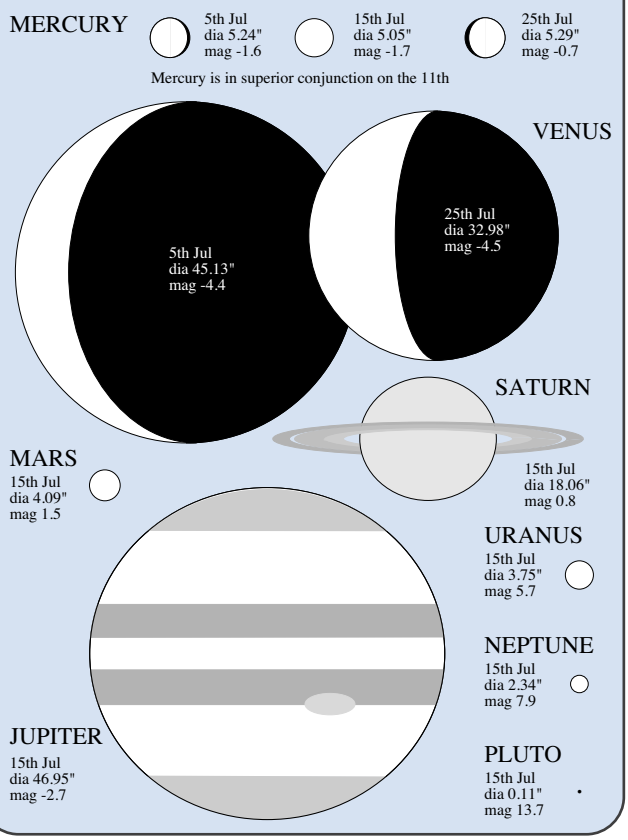
JULY HIGHLIGHTS

- Comet Kopff is at its brightest (mag. 7) and visible the whole night.
- Mercury moves into evening twilight sky (in later half of month).
- Venus well placed in the morning sky for the whole month. It is brightest on the 17th.
- Mars is in eastern morning sky (rising around 5am)
- Jupiter is visible the whole night (at opposition on 4th).
- Saturn moves into the evening sky.
- The Full Moon on 30th is 'Blue' (second full Moon in the month).

THE MOON

1st	Full Moon, 1:59pm.
2nd	Moon at perigee, 8am (closest to Earth - 357,949 km, size 33.4').
8th	Last Quarter, 4:56am.
12th	Occultation of Venus for north Africa, Europe across to central Russia. NOT visible from Australia.
16th	New Moon, 2:16am.
16th	Moon at apogee, midnight (furthest from Earth - 406,033 km, size 29.4).
24th	First Quarter, 3:50am.
30th	Moon at perigee, 6pm (closest to Earth - 356,948 km, size 33.5').
30th	Full Moon, 8:35pm.

APPEARANCE OF THE PLANETS



THE PLANETS

MERCURY is lost from view as it approaches the Sun and superior conjunction on the 11th. The planet then returns to the western evening sky and can be seen in twilight near the end of the month. Mercury moves through four zodiacal constellations this month: Taurus, Gemini, Cancer and finally Leo. As Mercury gains distance from the Sun and rises in the western evening sky, it nears 1st magnitude Regulus (Alpha Leonis), and finishes the month within 2° of the star (also see sky view for Aug. 1).

VENUS remains in Taurus for the entire month, beginning 4° from Mars and less than 3° from Aldebaran (Alpha Tauri) in the early morning sky (see sky view for Jun. 30). On the 12th, the 26 day old Moon can be seen separated 6° from Venus with Aldebaran between the two (see sky view). On the 13th, the 27 day old thin crescent Moon appears 6.5° below Venus. The planet is at its greatest brilliancy in the morning sky on the 17th at -4.5 magnitude.

MARS, moving very close to the plane of the ecliptic, will be in Taurus until the 26th when it moves into Gemini. Mars rises about 2 hours before sunrise in the eastern sky. As July opens, the red planet is about 4° from Venus (see sky view for Jun. 30); the separation increases to 10° by month's end. On the 13th, Mars (at magnitude 1.5) and the 27 day old Moon are 4.5° apart (see sky view for 12th). The morning sky at this time is interesting with Aldebaran, Venus and the Moon forming a straight line with the Moon and Mars at right angles.

JUPITER, at opposition on the 4th, rises in the east as the Sun sets and is visible throughout the night. Shining brightly at mag. -2.7, Jupiter is very prominent near the 'Teapot' in Sagittarius and gradually moves toward the globular star cluster M22 during the month. At this time Jupiter has an equatorial diameter of 47 arc seconds, the size expected when the planet is between 'good' and 'poor' oppositions. When an opposition occurs while Jupiter is at perihelion, the disc is around 50 arc seconds in diameter, and at aphelion about 44 are seconds. The next best oppositions are in 1998 and 1999 with the planet at perihelic opposition. The Moon appears near the planet on two occasions this month. On the 1st, the Full Moon is 6° from Jupiter (see sky view), and on the 28th the 12 day old Moon is 6° away (see sky view). For trivia buffs, it is interesting to note that when an outer planet, the Earth and Sun are in line, occasionally there will be a transit of the Earth over the Sun's disc (visible only from the outer planet of course!). During the period 1960 to 2020, this unobservable occurrence happens eight times as viewed from Jupiter. Four events have already passed: one occurs at this opposition and then again in 2002, 2008, and 2014.

SATURN's rings continue to widen and by the end of the month they measure 4.5 arc seconds across by 42 arc seconds on the major axis. Saturn slows in its eastern path as it nears its stationary point on the 20th, after this the planet will be in retrograde motion and moving toward opposition in September (see discussion on retrograde motion in part two). During the month the Moon appears near Saturn on two occasions. On the 7th, the 21 day old Moon will be 7° away (see sky view), and on the following evening 9º. With opposition only two months away, Saturn rises before midnight and transits the meridian at 5am.

CONSTELLATION OF THE MONTH - SAGITTARIUS (Sgr)

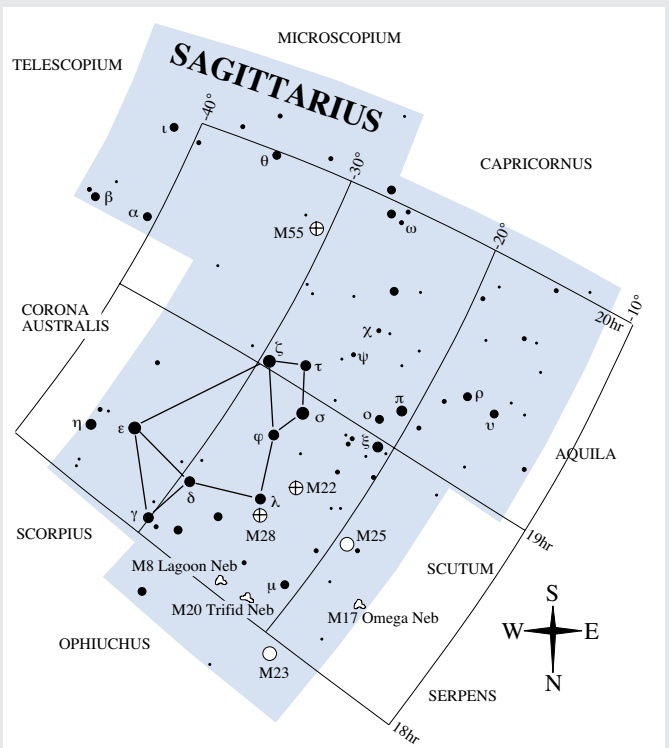
With Jupiter spending the entire year in Sagittarius (astrologically, Sagittarius was the house of Jupiter) and reaching opposition on 4th July, it seems appropriate to feature Sagittarius this month. Sagittarius, the Archer, is the 9th sign of the zodiac and has been known from classical times. It is represented by a centaur (a mythical half beast, half man creature). There has been some historical confusion over the identities of the two celestial centaurs ie. Sagittarius and Centaurus. Clearly Sagittarius was the ancient zodiacal group and the more southern Centaurus is probably of Greek origin.

The constellation is located east of the easily distinguishable Scorpius. The Archer faces the Scorpion, his bow drawn and aimed at its heart (the 1st magnitude star Antares). Rather than using the full figure of the Archer and his bow, most modern charts show a Teapot, made up of eight of the brighter stars in the constellation. The five stars representing the handle and lid of the Teapot are also known as the Milk Dipper. Interestingly our dipper was also known to the Chinese, over a thousand years ago, as the Ladle. With only two stars brighter than 2nd magnitude, the dipper is not particularly distinctive. The stars of the teapot are probably the easiest way to identify the constellation. The Archer culminates in early July at midnight and late August around 8pm.

The constellation is in the rich Milky Way region known as the Great Sagittarius Star Cloud, where an abundance of celestial wonders await the binocular or telescope user. In fact, there are more deep sky splendours in this constellation than in any other. Some of the best follow.

• Open star Clusters: NGC6494 (M23) and NGC6603 (M24).

• Globular Star Clusters: NGC6656 (M22) and NGC6626 (M28).



• Bright Nebulae: NGC6514 (M20) the Trifid Nebula, NGC6523 (M8) the Lagoon Nebula, NGC6618 (M17) the Omega Nebula.

There are also many worthy double and multiple stars, and some dark nebulae.

JULY

URANUS, NEPTUNE. Neptune is at opposition on the 19th and Uranus on the 25th. Both planets are visible the entire night.

MINOR PLANETS. At opposition this month is 12 Victoria on 16th in Aquila at mag. 8.7.

COMETS

Hale-Bopp. Spends most of the time in Scutum, moving into Serpens at the end of July. It will be visible the whole night at 6th magn (see sky views on 1st and 28th).

Kopff. The comet reaches perihelion on the 2nd and remains visible the whole night in Sagittarius at mag. 7.

Gunn. The comet reaches perihelion on the 24th and remains at mag. 12 in Scorpius for the entire month. By the end of July it will be setting around 3am

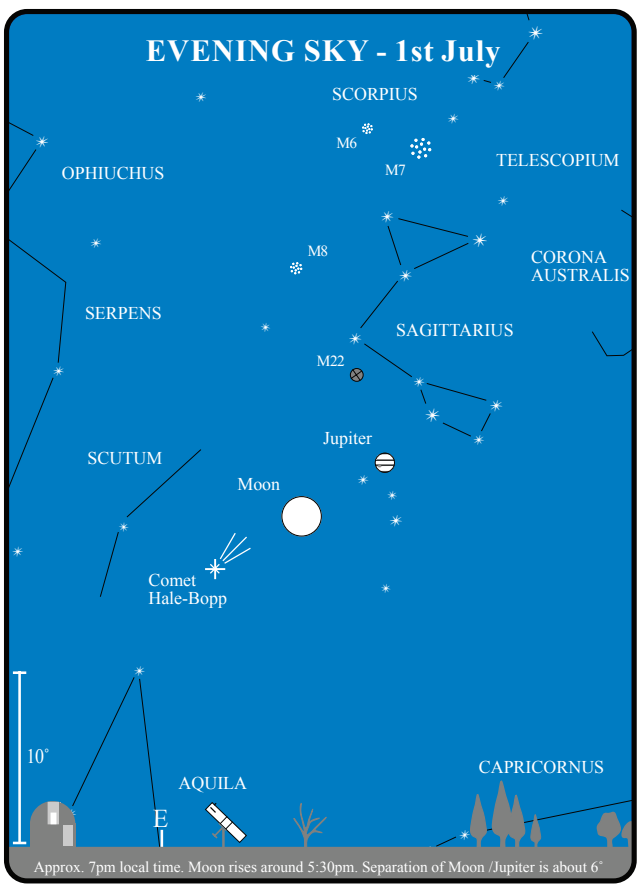
METEOR SHOWERS

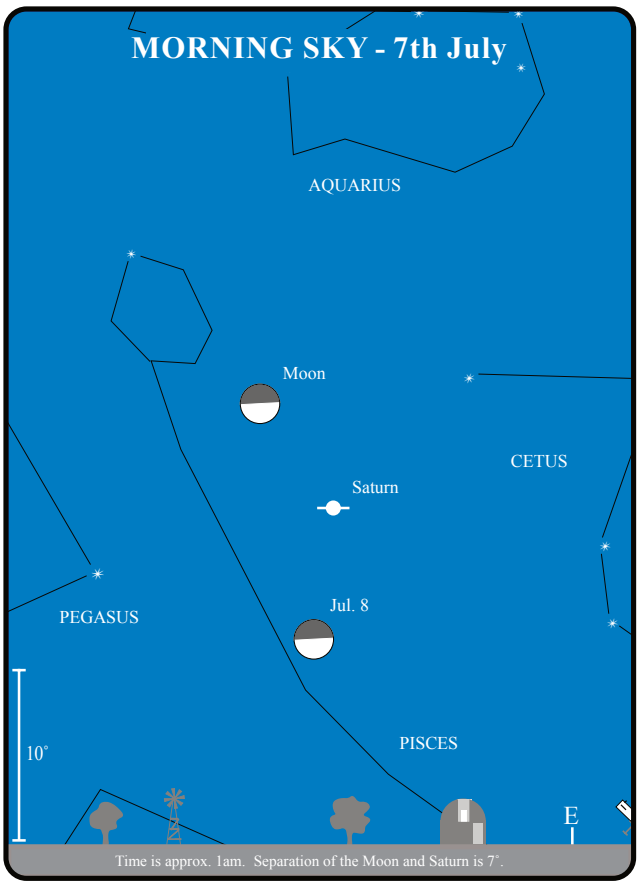
The **Pegasids** are a short lived shower, lasting only from the 7th to 13th, with maximum on the 11th. The shower is best viewed during the second half of the night, and produces faint, swift meteors. The zenith hourly rate is low and about 3 can be expected.

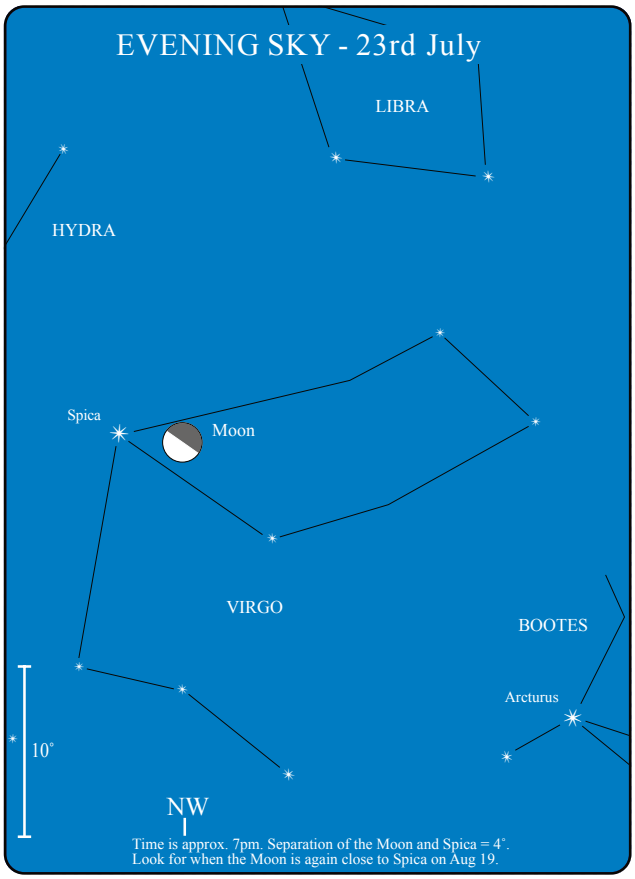
The **Phoenicids** (July) are a southern hemisphere shower and are best seen after midnight until dawn when the radiant is at its highest altitude. The Phoenicids are active from the 10th to 16th, with maximum on the 14th. Activity is variable but recent zenith hourly rates of 3-5 have been recorded.

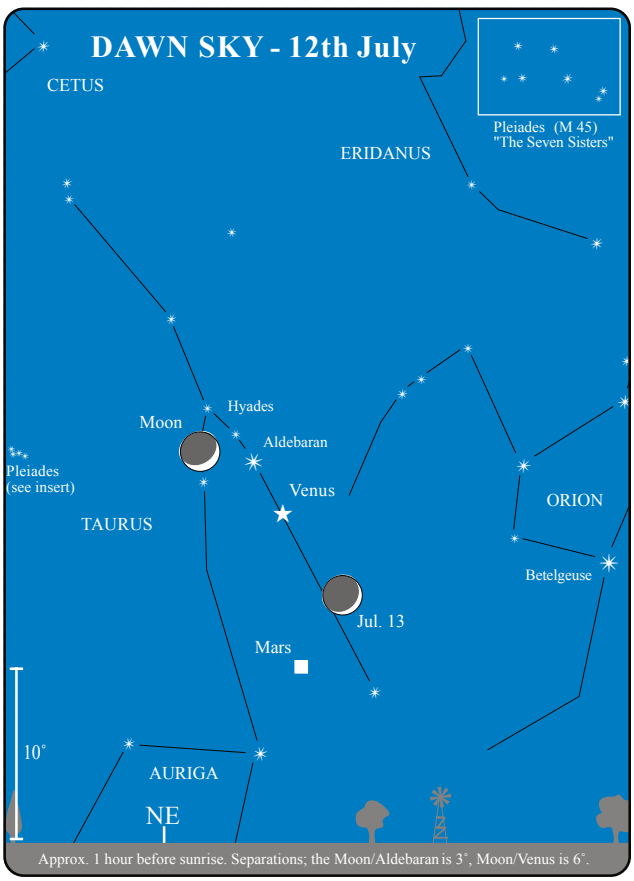
DIARY

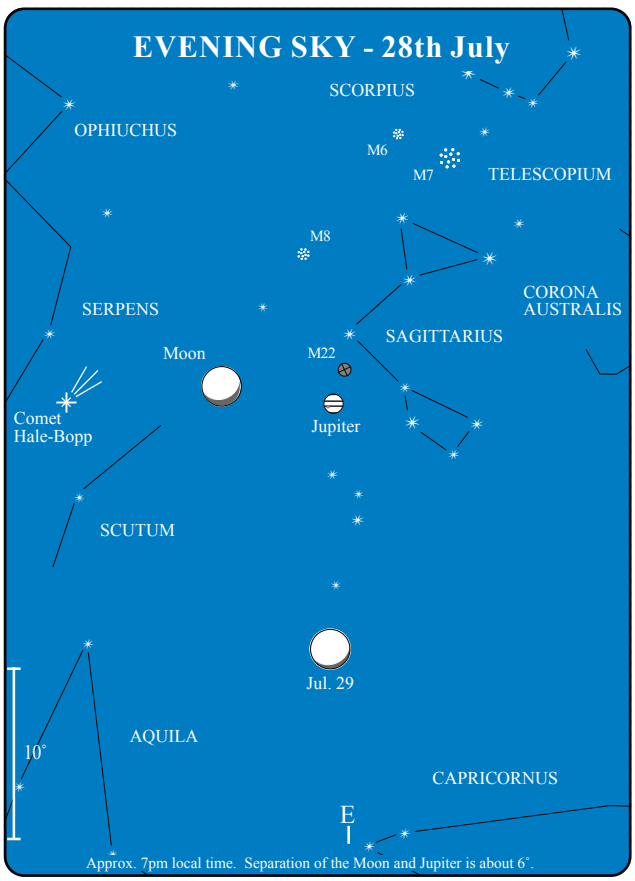
1st		Mercury at ascending node.
1st		Venus 2.5° NE of Aldebaran.
1st	1:58 PM	Full Moon.
1st	8 PM	Jupiter 5° South of Moon.
2nd	8 AM	Moon at perigee.
2nd	10 AM	Venus stationary.
2nd	6 PM	Neptune 4° South of Moon.
3rd	6 AM	Uranus 5º South of Moon.
4th	10 PM	Jupiter at opposition.
5th		Jupiter 0.2° South of NGC 6717 (GC) in Sagittarius.
6th	4 AM	Earth at aphelion.
6th		Mercury at perihelion.
7th		Mars 0.8° South of NGC 1746 (OC) in Taurus.
7th	4 PM	Saturn 3° South of Moon.
8th	4:55 AM	Last Quarter Moon.
8th		comet (1995 01) Hale-Bopp 2° South of M26 (OC) in Scutum.
11th	7 PM	Mercury in superior conjunction.
12th	7 PM	Venus 0.4° South of Moon Occn.
13th	9 AM	Mars 5º North of Moon.
13th		Venus at aphelion.
14th		m.p. 14 Irene 1.2° SW of m.p.354 Eleonora.
14th		m.p. 20 Massalia 1° NE of NGC 4030 (G) in Virgo.
16th	2:15 AM	New Moon.
16th		Mercury at greatest latitude North (Heliocentric).
16th	Midnight	Moon at apogee.
17th	7 PM	Venus greatest brilliancy.
19th	4 AM	Neptune at opposition.
19th		m.p. 2 Pallas 1° NE of Arcturus.
20th		g.d. anniversary of birth in Cancer.
20th	10 AM	Saturn stationary.
20th		Mercury 0.3° North of the Pleiades (M45) in Taurus.
21st	4 AM	m.p. 1 Ceres stationary.
21st		m.p. 44 Nysa 0.3° South of NGC 4123 (G) in Virgo.
23rd		m.p. 14 Irene 0.1° West of NGC 3489 (G) in Leo.
24th	3:49 AM	First Quarter Moon.
25th		m.p. 44 Nysa 0.6° North of NGC 4179 (G) in Virgo.
25th	5 PM	Uranus at opposition.
26th		Mars 0.6° North of NGC 2129 (OC) in Gemini.
28th		m.p. 532 Herculina 0.05° South of NGC 4216 (G) in Virgo.
29th	2 AM	Jupiter 5° South of Moon.
29th		Mars 0.5° South of M35 (OC) in Gemini.
30th	4 AM	Neptune 4° South of Moon.
30th		m.p. 14 Irene 0.5° SW of NGC 3593 (G) in Leo.
30th		m.p. 532 Herculina 0.2° SW of NGC 4267 (G) in Virgo.
30th	2 PM	Uranus 5º South of Moon.
30th	6 PM	Moon at perigee.
30th	8:35 PM	Full Moon.
31st		m.p. 354 Eleonora 0.5° South of NGC 3596 (G) in Leo.




MORNING SKY - 7th July
AQUARIUS
Moon
CETUS
Saturn
PEGASUS
Jul. 8
10˚
PISCES
E
Time is approx. 1am. Separation of the Moon and Saturn is 7˚.

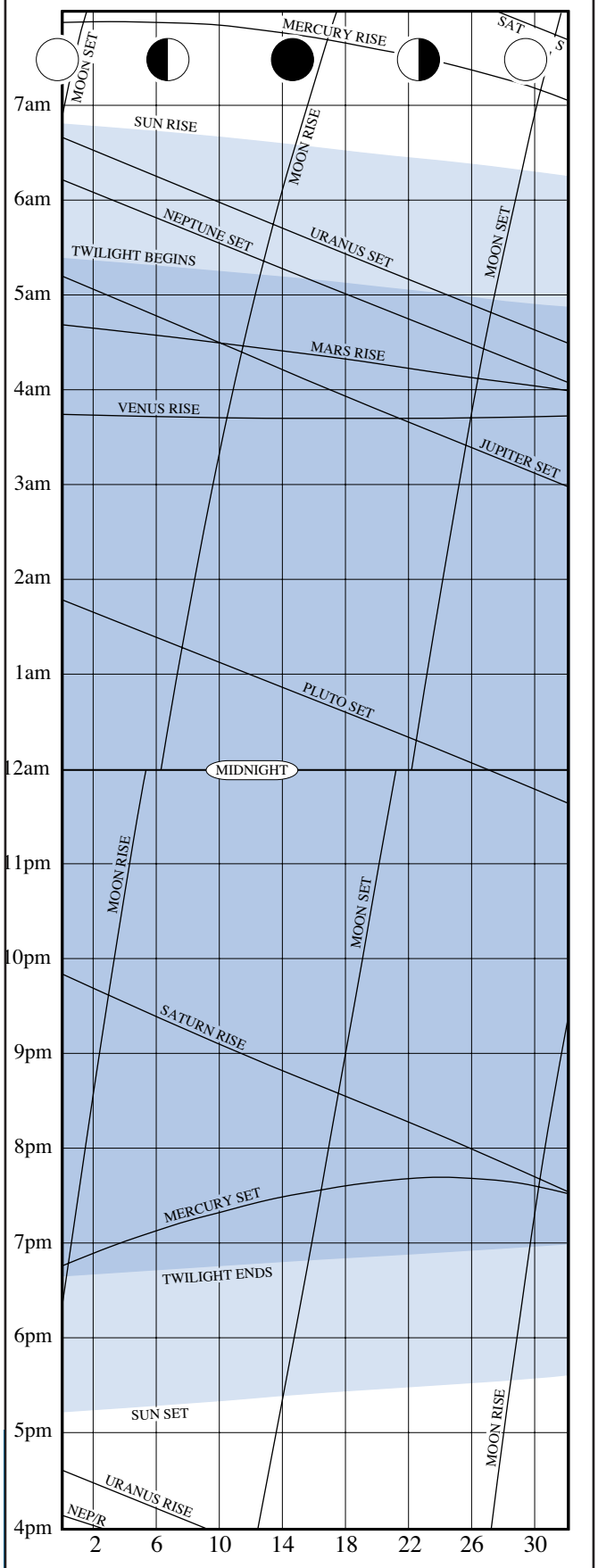

EVENING SKY - 23rd July
LIBRA
HYDRA
Spica
Moon
VIRGO
BOOTES
Arcturus
10˚
NW
Time is approx. 7pm. Separation of the Moon and Spica = 4˚.
Look for when the Moon is again close to Spica on Aug 19.


DAWN SKY - 12th July
CETUS
Pleiades (M 45)
"The Seven Sisters"
ERIDANUS
Hyades
Moon
Aldebaran
Pleiades
(see insert)
Venus
ORION
TAURUS
Betelgeuse
Jul. 13
Mars
10˚
AURIGA
NE
Approx. 1 hour before sunrise. Separations; the Moon/Aldebaran is 3˚, Moon/Venus is 6˚.


EVENING SKY - 28th July
SCORPIUS
OPHIUCHUS
M6
M7
TELESCOPIUM
M8
SERPENS
CORONA
AUSTRALIS
SAGITTARIUS
Moon
M22
Comet
Hale-Bopp
Jupiter
SCUTUM
Jul. 29
10˚
AQUILA
CAPRICORNUS
E
Approx. 7pm local time. Separation of the Moon and Jupiter is about 6˚.

AUGUST

RISE/SET CHART



All times are AEST.

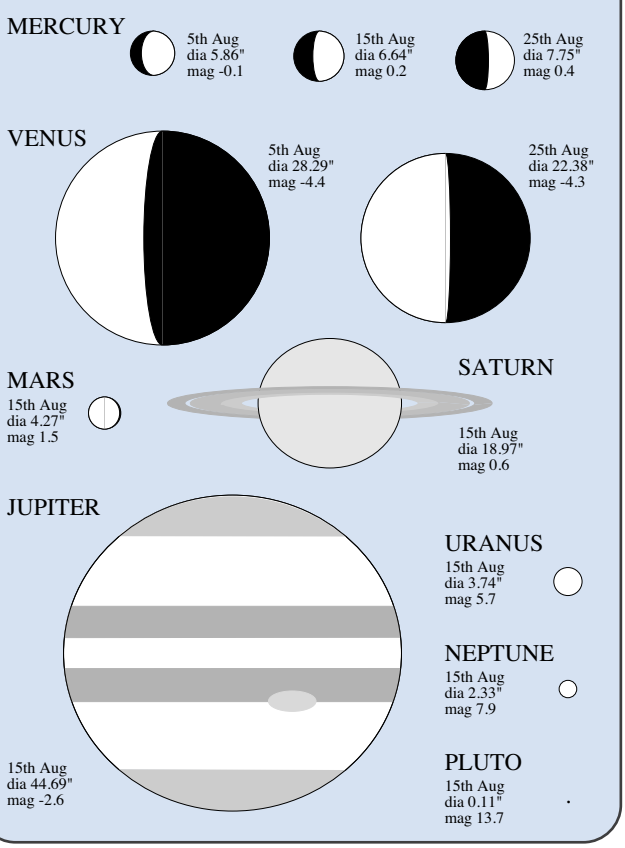
AUGUST HIGHLIGHTS

- Best view of Mercury, in the Evening sky, for 1996.
- Venus well placed in the morning sky.
- Mars is in eastern morning sky (rising one hour before morning twilight)
- Jupiter is still visible most of the night.
- Saturn now rising around 9pm (mid-month)

THE MOON

6th	Last Quarter, 3.26pm.
8th	Occultation of Aldebaran, not visible from Australia.
13th	Moon at apogee, 2;00am (furthest from Earth - 406,477 km, size 29.4').
14th	New Moon, 5:35pm.
17th	Occultation of Mercury for Pacific, South America, not visible from Australia.
22nd	First Quarter, 1:37pm.
28th	Moon at perigee, 3am (closest to Earth - 358,777 km, size 33.3').
29th	Full Moon, 3:53am.

APPEARANCE OF THE PLANETS



THE PLANETS

MERCURY is at its greatest elongation east of the Sun (27°) on the 22nd, providing the best opportunity this year to see the planet in the western evening sky. On the 1st, Mercury makes its closest approach to 1st magnitude Regulus (Alpha Leonis) at 0.5° (see sky view). The planet then continues its journey through Leo and enters Virgo on the 20th. The Moon appears within 5° of Mercury on two consecutive evenings. On the 16th (see sky view), a two day old thin crescent Moon will be seen below the planet and on the following evening, a three day old Moon appears above.

VENUS. Having resided for several months in Taurus, Venus moves into Orion on the 5th. By mid-month it changes constellations again when it crosses into Gemini. On the 10th, the 25 day old Moon appears 3° above the planet. On the following evening the Moon forms a triangle with Venus (8°N, above) and Mars (5°N, below)-see sky view for 9th. On the 22nd, 2nd magnitude Alhena (Gamma Geminorum), Venus and Mars appear in a straight line (distance 5.6° and 5.9° respectively). On the 31st, Venus and Mars are 3.5° apart and form a 'bow' with Castor and Pollux (Alpha and Beta Geminorum).

MARS at magnitude 1.5 is resident in Gemini for the entire month. It can be seen well above the eastern morning horizon before twilight. On the 11th, Mars, the Moon and Venus form a right angle triangle; the separation between the Moon and Mars is 5° , Moon and Venus 8° (see sky view for 9th). The 31st will see Mars and Venus 3.5° apart, and the pair continue their close association into September.

JUPITER is well placed for comfortable evening viewing this month, transiting the meridian high in the northern sky around 9pm. Now past opposition, a slight reduction in the planet's angular size and magnitude occurs. Jupiter spends the month near the impressive globular star cluster M22. Early in August, Jupiter is about 1.5° from the centre of M22 and this distance decreases to around 0.6° mid-month. The Moon is in Jupiter's territory on two consecutive days this month, on the 24th the 10 day old Moon will be 9° away (see sky view), and on the following evening 10°.

SATURN's rings are at their widest for this year at the beginning of the month, and measure 4.5 arc seconds across by 42 arc seconds on the major axis (the planet's disc measures 18.6 by 16.8 arc seconds, equatorial and polar diameters). Observers will have to wait until the year 2002 to see them at maximum opening. The planet has been hovering in a corner of Cetus since June. In late August it moves back into Pisces, where it will remain for the rest of the year. During the month the Moon appears near Saturn on two occasions: on the 3rd, the 20 day old Moon will be 3° away (see sky view), and on the 31st they will be 3° apart (see sky view for 30th). With opposition on the 27th September, the planet rises around 9pm (mid-month) and transits the meridian at 3am.

URANUS, NEPTUNE. Both planets are visible the entire night, setting around the time of morning twilight.

MINOR PLANETS at opposition this month include 21 Lutetia on 17th in Capricornus at mag. 9.3, 39 Laetitia on 20th in Aquarius at mag. 9.3, 192 Nausikaa on 8th in Capricornus at mag. 9.0 and 349 Dembowska on 17th in Piscis Austrinus.

COMETS

Hale-Bopp. Moves quickly into Ophiuchus and by the end of August it will be setting around 1am. The brightness is now around 5.4 magn (see sky view on 24th).

Kopff. The comet remains in Sagittarius for the month, visible most of the night. By end of month it has faded to approx. 8.5 mag.

Gunn. The comet spends all of August within 4° of Antares, having a close encounter with M4 mid-month. By the end of the month it will be mainly an evening object, setting around 1am. The comet fades slightly to mag. 12.5 during August.

IRAS. The comet spends the month in Tucana. It is circumpolar, with it being high in the south at midnight, by the end of the month. It is around mag. 12.

METEOR SHOWERS

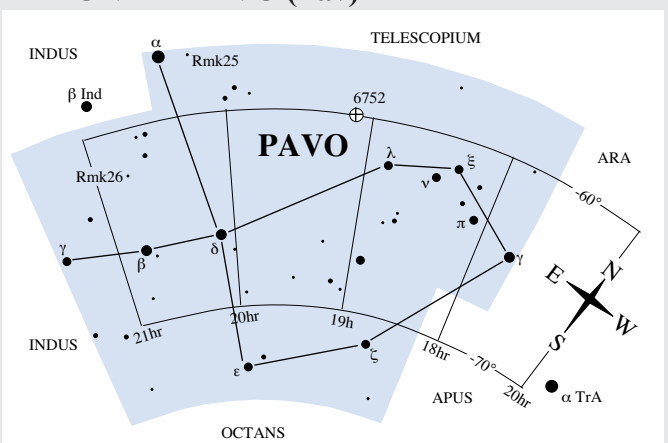
The **Perseids**, with their radiant below the northern horizon, are unfortunately not easily observable from the southern hemisphere. The Perseids are probably the most dependable of the showers, with records of their activity going back over one thousand years. The duration is from 17th July through to 24th August, with maximum on the 12th August. The zenith hourly rate is variable and has in the past being exceptional, 1991 and 1992 saw over 400, 1993 around 300 and 1994 was 220.

CONSTELLATION OF THE MONTH - PAVO (Pav)

Pavo, the Peacock, was introduced as a constellation in 1603 by German astronomer Johann Bayer in his Uranometria. Bayer's work was to be the first set of charts where star positions were plotted accurately and was based on observations by Danish astronomer Tycho Brahe. Pavo is circumpolar from latitude -35° and further south, culminating at the end of August at 9pm. The constellation's southern boundary joins that of Octans and is about 15 degrees from the south celestial pole. Interestingly, Pavo shares the southern skies with four other celestial birds: Apus - the bird of paradise, Grus - the crane, Phoenix - the phoenix and Tucana - the toucan.

The southern skies are graced with some of the finest globular clusters in the sky and Pavo is blessed with one of them, NGC6752 or Dunlop 295. Small telescopes show delicate strings of stars emanating from the condensed centre. Although not an official name, some local amateurs have appropriately dubbed NGC6752 the 'Starfish Cluster'. From a subjective viewpoint the globular clusters 47 Tucanae, Omega Centauri, NGC6656 (M22), and NGC6752 are probably some of the best examples of this class of object (a bit of southern bias here - for once). They are unmatched in elegance and beauty and are particularly well suited to small and medium telescopes.

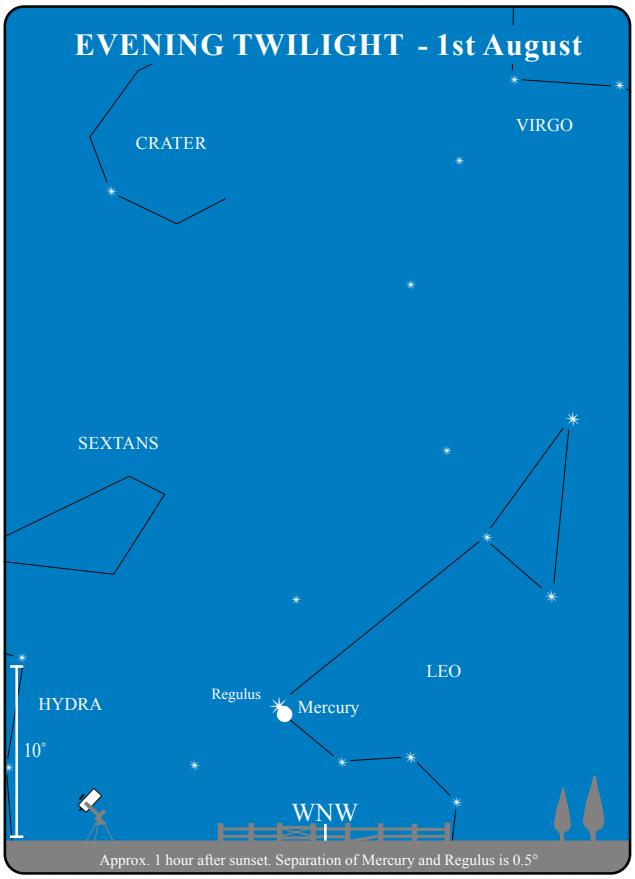
The constellation is quite faint with no star brighter than 2nd mag. The brightest star, Alpha Pavonis (or Peacock), is 2.12 magn but most of the prominent stars are around 3rd/4th magnitude. Pavo has a number of double and multiple stars and virtually all are below naked eye visibility. One exception is Xi Pavonis. This shows good colour contrast, being a 4th magnitude orange star with an 8th magnitude companion in an excellent star field. Many of the fainter pairs are worth tracking down. Some really exquisite gems are Rmk 25 (two 8th magnitude stars separated by 7.2 are seconds) and Rmk 26 (two equal 6.5 magnitude stars 2.3 arc seconds apart).

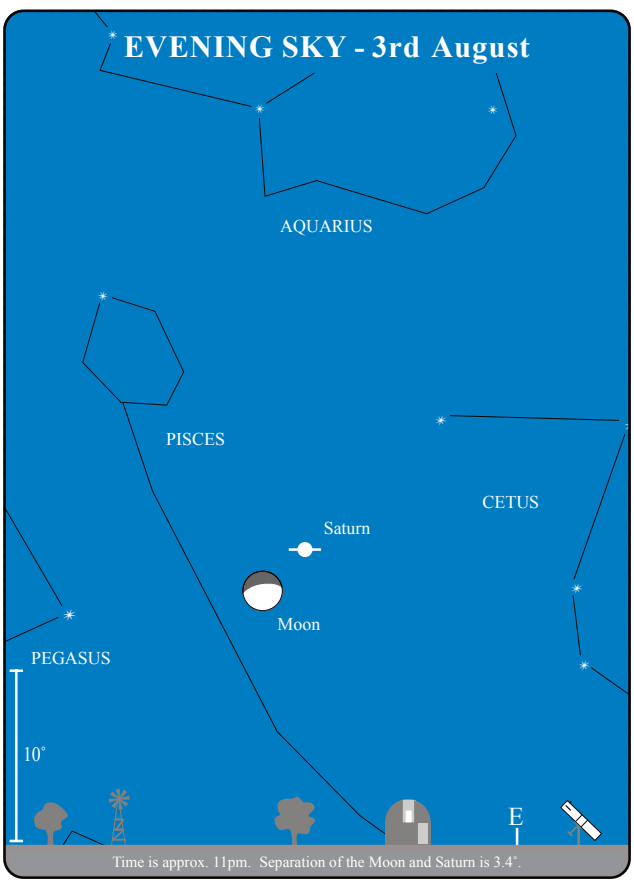


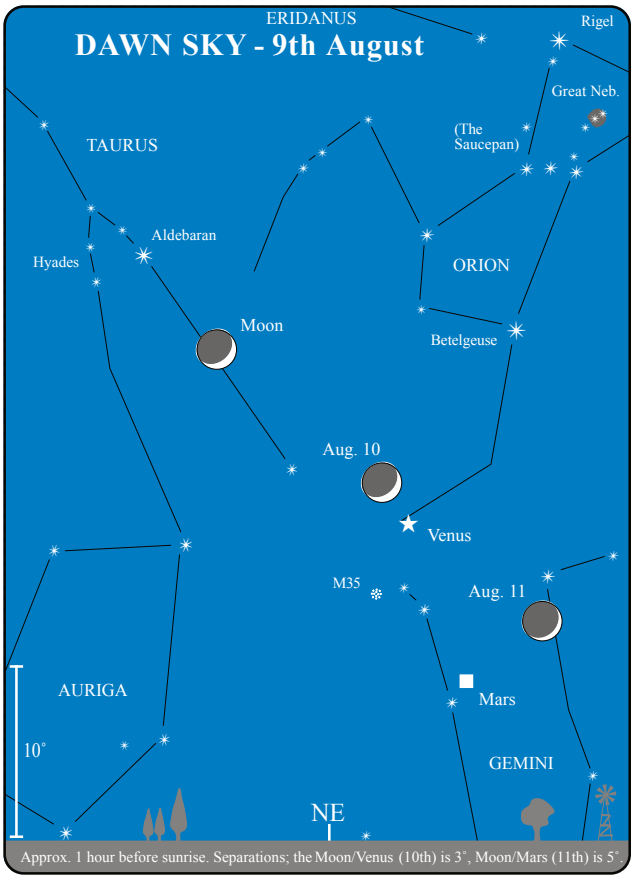
AUGUST

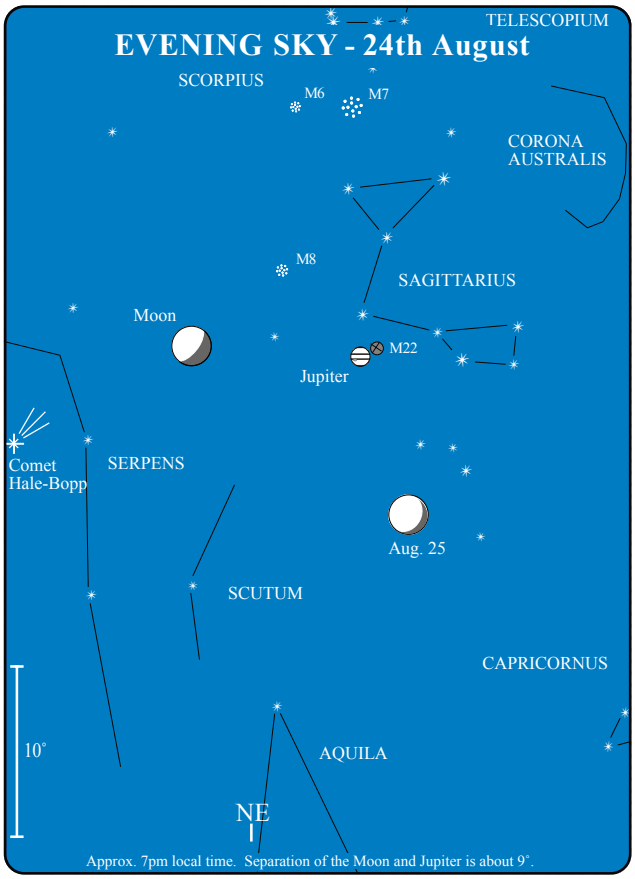
DIARY

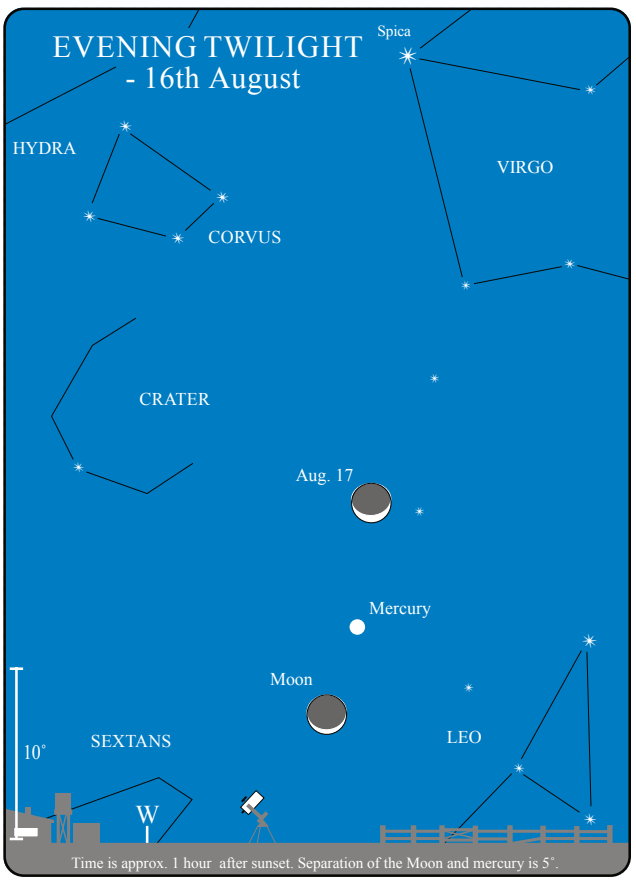
1st		m.p. 9 Metis 0.4° South of NGC 6520 (OC) in Sagittarius.
1st	8 PM	Mercury 0.5° North of Regulus.
3rd		m.p. 532 Herculina 0.2° East of NGC 4371 (G) in Virgo.
3rd	11 PM	Saturn 3° South of Moon.
4th		Venus at greatest latitude South (Heliocentric).
4th		m.p. 354 Eleonora 0.3° NE of NGC 3628 (G) in Leo.
4th	1 PM	m.p. 3 Juno 0.1 ° South of Moon Occn.
5th		m.p. 532 Herculina 0.5° NE of NGC 4429 (G) in Virgo.
6th		comet (1995 0 I) Hale-Bopp 0.8° South of NGC 6539 (GC) in Serpens.
6th		m.p. 20 Massalia 0.3° SE of NGC 4546 (G) in Virgo.
6th		m.p. 44 Nysa 0.4 ° South of NGC 4517 (G) in Virgo.
6th	3:25 PM	Last Quarter Moon.
8th		Mercury at descending node.
8th		comet (1995 01) Hale-Bopp 0.7° North of NGC 6517 (GC) in Ophiuchus.
8th	5 PM	Aldebaran 1.0° South of Moon Occn.
9th		m.p. 14 Irene IO NE of NGC 3705 (G) in Leo.
10th		m.p. 40 Harmonia 1 ° SW of NGC 5339 (G) in Virgo.
10th		m.p. 44 Nysa 0.4° SW of NGC 4592 (G) in Virgo.
10th	2 PM	Venus 1.2° North of Moon.
11th	7 AM	Mars 6° North of Moon.
11th		m.p. 532 Herculina 0.3° SW of NGC 4596 (G) in Virgo.
13th	2 AM	Moon at apogee.
14th	3 AM	Pluto stationary.
14th	5:34 PM	New Moon.
15th		m.p. 20 Massalia 0.6° NE of NGC 4697 (G) in Virgo.
17th	4 AM	Mercury 0.3° North of Moon Occn.
17th		comet (65P) Gunn 0.2° South of M4 (GC) in Scorpius.
17th		Jupiter 0.6° North of M22 (GC) in Sagittarius.
17th		m.p. 22 Kalliope 0.3° South of NGC 1647 (OC) in Taurus.
17th		m.p. 532 Herculina 0.2° NE of NGC 4698 (G) in Virgo.
19th		Mercury at aphelion.
20th	2 PM	Venus greatest elong West (46°).
22nd	2 AM	Mercury greatest elong. East (27°).
22nd	5 AM	m.p. 4 Vesta 0.9° South of Moon Occn.
22nd	1:36 PM	First Quarter Moon.
23rd		comet (65P) Gunn 0.7° South of Antares.
25th	8 AM	Jupiter 5° South of Moon.
26th	1 PM	Neptune 5° South of Moon.
26th	11 PM	Uranus 5° South of Moon.
27th		m.p. I Ceres 0.3° North of M80 (GC) in Scorpius.
28th	3 AM	Moon at perigee.
28th		m.p. 20 MassaJia 0.5° North of NGC 4995 (G) in Virgo.
29th	3:52 AM	Full Moon.
30th		Mars 0.8° North of NGC 2420 (OC) in Gemini.
31st	7 AM	Saturn 3° South of Moon.

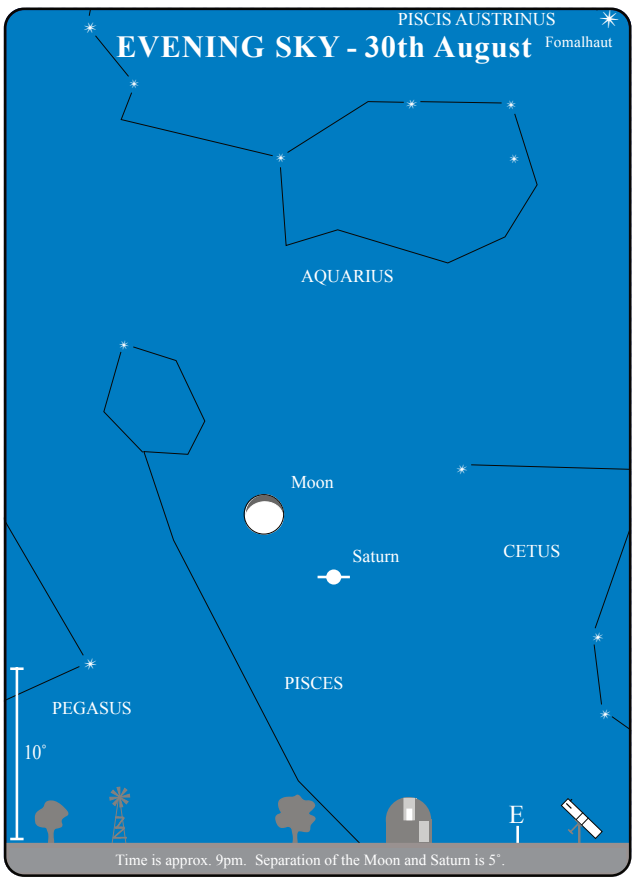





DAWN SKY - 9th August
ERIDANUS
Rigel
Great Neb.
(The Saucepan)
TAURUS
Aldebaran
Hyades
ORION
Moon
Betelgeuse
Aug. 10
Venus
M35
Aug. 11
Mars
AURIGA
10°
GEMINI
NE
Approx. 1 hour before sunrise. Separations; the Moon/Venus (10th) is 3°, Moon/Mars (11th) is 5°

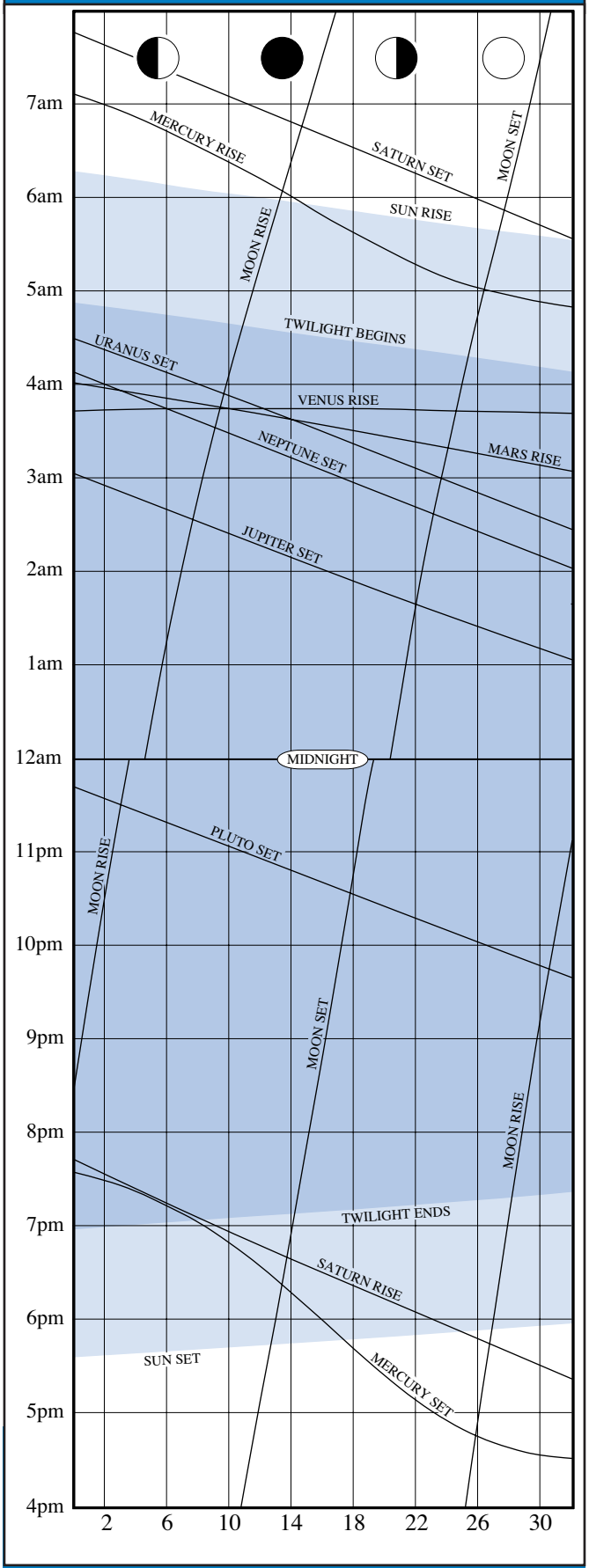

EVENING SKY - 24th August
TELESCOPIUM
SCORPIUS
M6
M7
CORONA AUSTRALIS
M8
SAGITTARIUS
Moon
M22
Jupiter
Comet Hale-Bopp
SERPENS
Aug. 25
SCUTUM
CAPRICORNUS
10°
AQUILA
NE
Approx. 7pm local time. Separation of the Moon and Jupiter is about 9°.


EVENING TWILIGHT - 16th August
Spica
HYDRA
VIRGO
CORVUS
CRATER
Aug. 17
Mercury
Moon
10°
SEXTANS
LEO
W
Time is approx. 1 hour after sunset. Separation of the Moon and mercury is 5°.


EVENING SKY - 30th August
PISCIS AUSTRINUS
Fomalhaut
AQUARIUS
Moon
Saturn
CETUS
PISCES
PEGASUS
10°
E
Time is approx. 9pm. Separation of the Moon and Saturn is 5°.

SEPTEMBER

RISE/SET CHART



All times are AEST.

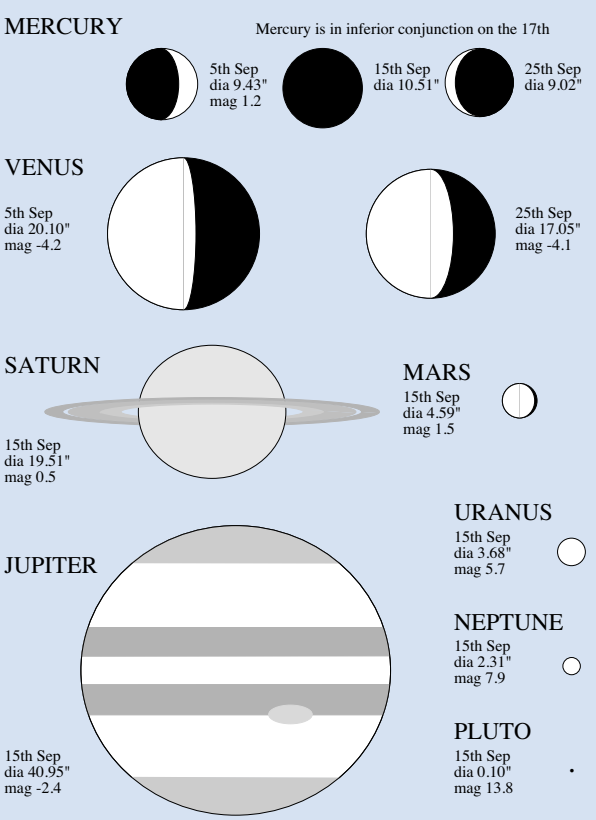
SEPTEMBER HIGHLIGHTS

- Early in the month, last chance to view Mercury in dark evening sky for this year.
- Venus still in the morning sky.
- Close approach of Venus, Mars and the Moon on the 9th (dawn sky).
- Jupiter, Uranus and Neptune are well placed in evening sky.
- Saturn visible the whole night (at opposition and brightest on 27th).
- Comet Machholz 1 can be seen briefly, early in Sept., low in the SW evening sky.

THE MOON

4th	Occultation of Aldebaran (approx. midnight), not visible from Australia. See sky view for 5th at 2am.
5th	Last Quarter, 5:07am.
9th	Moon at apogee, noon (furthest from Earth - 405,735 km, size 29.5).
13th	New Moon, 9:08am.
20th	First Quarter, 9:24pm.
25th	Moon at perigee, 8am (closest to Earth - 363,053 km, size 32.9').
27th	Full Moon, 12:52pm.
27th	Total Eclipse of the Moon, not visible from Australia.

APPEARANCE OF THE PLANETS



THE PLANETS

MERCURY rapidly loses altitude in the western evening sky as it moves toward the Sun and inferior conjunction (when Mercury is between the Earth and the Sun) on the 17th. Moving from Virgo into Leo at the time of conjunction, Mercury reappears in the morning eastern twilight sky.

VENUS spends 5 days in Gemini before crossing into Cancer, and moves into Leo during the last week of the month. Venus and Mars remain close companions early in September, and can be seen within 3° of each other between the 3rd and 7th (see sky view on 4th). The 26 day old thin crescent Moon shares the early morning sky with Venus on the 9th; the pair separated by 3°, with Mars a further 3.5° north of Venus (see sky view). After crossing Leo's border, Venus can be seen each day advancing toward the 1st magnitude star Regulus (Alpha Leonis), by the 30th the planet and star are 5° apart. Early next month Venus and Regulus continue to be drawn together, with closest approach on October 4th.

MARS, moving from Gemini and into Cancer on the 7th, remains a very close companion to Venus early in September (see notes in Venus above). On the 9th, the 26 day old Moon will be 5.5° south of Mars with Venus between the two forming a triangle (see sky view). The two planets then part company and by the end of the month are 13° apart. The Martian disc presents a very poor telescopic target for the amateur, being only 4.5 arc seconds in diameter. Attempts to see the polar caps or surface markings are best left until the planet is at opposition next year on the 17th of March.

JUPITER, having been in retrograde motion since May, reaches its stationary point on the 4th then returns to a west-to-east track (see discussion on retrograde motion and Jupiter finder chart in part two). The planet is near the magnificent globular star cluster M22 for the third month this year (see also February and August), the planet's retrograde motion being responsible for these three passes. The distance from Jupiter to the centre of M22 remains under 1° throughout the month, with closest approach of slightly over 0.5° on the 20th. On the 21st, Jupiter will be 6° south of the 8 day old Moon (see sky view).

SATURN is at opposition on the 27th. Rising in the east as the Sun sets, it is visible throughout the night. Opposition is an ideal time for telescopic study of the planet. Not only is the planet at its brightest (this time 0.5 magnitude), but it presents its largest angular size ie. 19.5 arc seconds equatorial diameter (compared with 15.75' at conjunction in March). On the evening of opposition (27th) the planet will be 5° south of the Full Moon (see sky view for 26th).

URANUS, NEPTUNE. Both planets are well placed for evening observations, setting around 3am.

COMETS

Hale-Bopp. Remains in Ophiuchus for the month. By the 30th it has become an evening object only, with the comet setting at approx. 11pm. (mag. is now 5). See sky view on 21st.

Kopff. The comet moves into Capricornus mid-month and is visible most of the night. At month's end it has faded to mag. 10 and is setting around 3am.

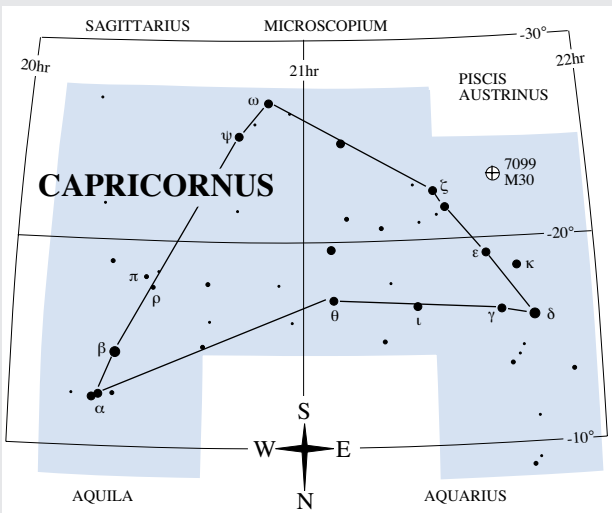
Machholz 1. The comet commences the month low in the SW early evening sky (in the first few days it passes through the Southern Cross). Machholz gets lower as the month progresses. It brightens rapidly. On the 1st it is mag. 13.9, by the 30th the comet will be 10.2.

IRAS. The comet heads north, moving into Grus. On the 23rd it passes within 2° of Alpha Gruis. By the end of the month it has brightened to its maximum mag. of 10.8 and will be crossing the meridian around 9pm.

CONSTELLATION OF THE MONTH - CAPRICORNUS (Cap)

Capricornus is an ancient constellation depicted as a goat with a fish tail. Being the tenth sign of the zodiac, this strange mixture of a goat and fish (also known as the Sea Goat or the Goat-Fish), is a medium-sized faint constellation that lies between Aquarius (to the east) and Sagittarius (to the west). Legend explains that the goat footed Pan was panicked by the monster Typhon and half of him was turned into a fish when he plunged into the Nile. Other constellations nearby with watery associations are Aquarius, Cetus and Piscis Austrinus. The doctrines of the Platonists held that men's souls travelled to heaven through Capricornus, and knew it as Gate of the Gods. Over two thousand years ago the Sun reached its furthest point south (the solstice) in Capricorn. This point became the Tropic of Capricorn, a name used today even though precession has now moved this point into Sagittarius.

Capricornus culminates on the 22nd September (9pm), and appears as a large, faint triangle in the northern sky. Amateurs in the northern hemisphere see the triangle upside down and have nicknamed it the 'Bikini Bottom'. The constellation's brightest star, Alpha Capricorni (Al Giedi - the Goat), is a naked-eye double about six are minutes apart. The duplicity of this pair is only a line of sight coincidence with the brightest, Alpha 2 at 36 light years distance and Alpha 1 about 500. Interestingly, the two stars are multiple star systems in their own right.

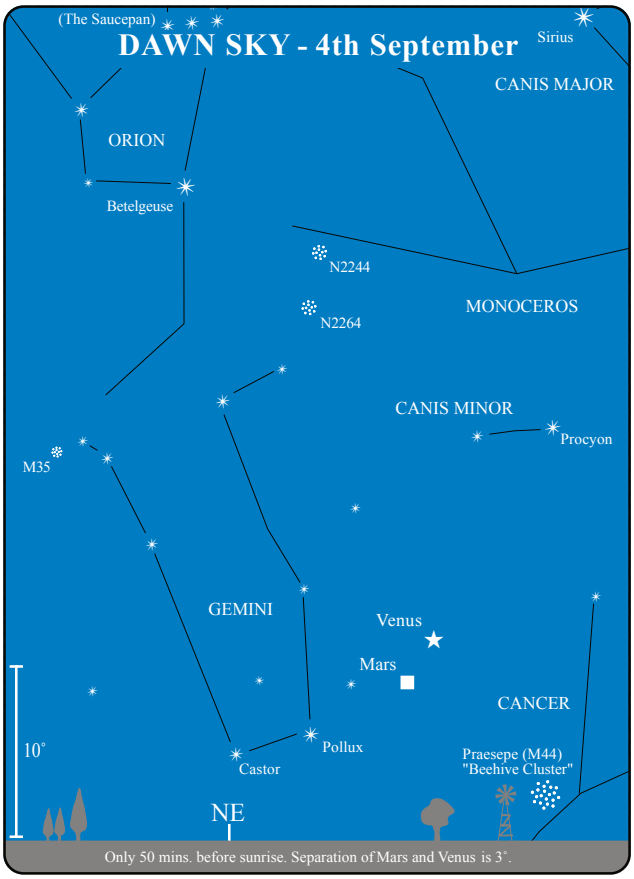


The only prominent deep sky object in the constellation is the globular cluster NGC7099, which Messier discovered in 1764, and is listed as M30 in his catalogue. It appears about 10 are minutes across and is partially resolvable in small instruments. A 5.5 magnitude star in the same field is a double, with its faint companion 5 arc seconds distant.

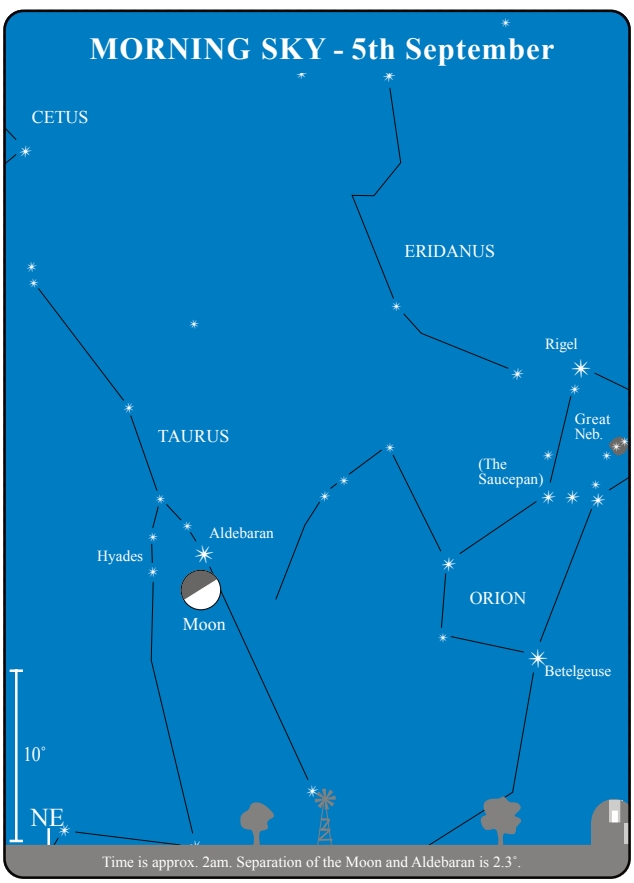
SEPTEMBER

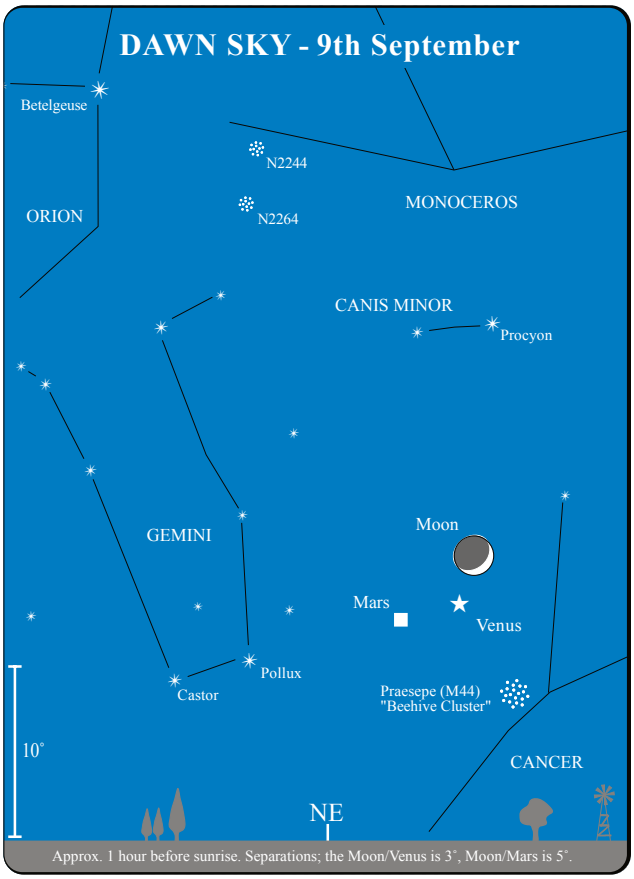
DIARY

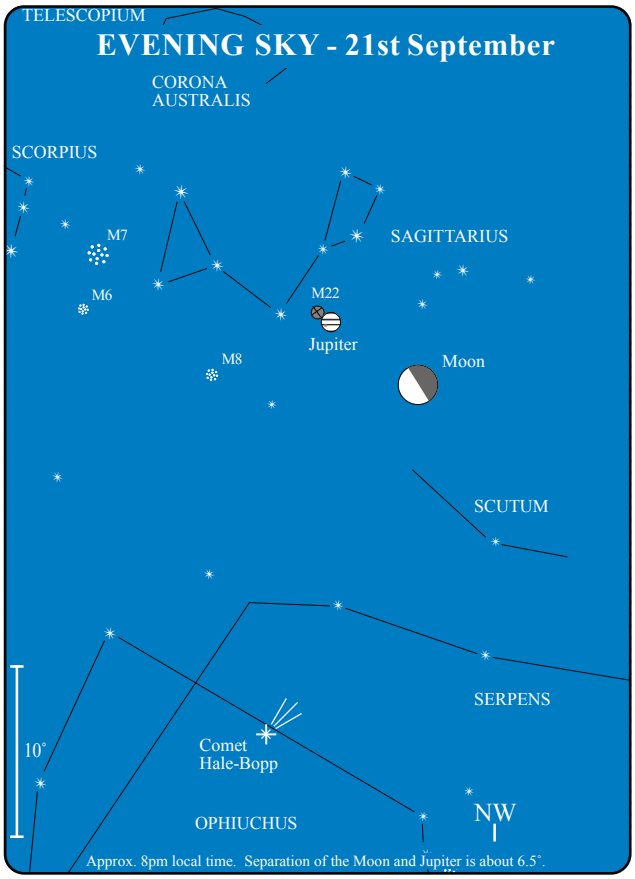
1st	3 AM	Mars 6° South of Pollux.
1st		comet (96P) Machholz I, 0.3° North of Alpha Crucis.
2nd	3 PM	Venus 9° South of Pollux.
2nd	9 PM	m.p. 3 Juno stationary.
3rd		Jupiter 0.6° East of NGC 6642 (GC) in Sagittarius.
3rd		Midnight Jupiter stationary.
4th	6 AM	Mercury stationary.
4th	Midnight	Aldebaran 0.9° South of Moon Occn.
5th	1 AM	Venus 3° South of Mars.
5th	5:06 AM	Last Quarter Moon.
5th		m.p. 9 Metis 0.3° South of NGC 6520 (OC) in Sagittarius.
6th		m.p. 3 Juno 1.5° East of IC 1613 (G) in Cetus.
8th		Mercury at greatest latitude South (Heliocentric).
8th		comet (96P) Machholz 1, 0.4° NW of Gamma Crucis.
9th	5 AM	Mars 6° North of Moon.
9th	9 AM	Venus 3° North of Moon.
9th	Noon	Moon at apogee.
12th		m.p. 3 Juno 0.7° West of NGC 428 (G) in Cetus.
13th	9:07 AM	New Moon.
14th		Venus 2.6° South of the Beehive cluster in Cancer.
17th	11 PM	Mercury in inferior conjunction.
18th		comet (P/1983 M1) IRAS 1.5° East of IC 5152 (G) in Indus.
20th		Jupiter 0.5° North of M22 (GC) in Sagittarius.
20th	9:23 PM	First Quarter Moon.
21st	4 PM	Jupiter 6° South of Moon.
22nd		Mars 0.5° South of the Beehive cluster in Cancer.
22nd	9 PM	Neptune 5° South of Moon.
23rd	4 AM	Equinox.
23rd	7 AM	Uranus 6° South of Moon.
23rd		comet (P/1983 M1) IRAS 1° NE of NGC 7145 (G) in Grus.
25th	8 AM	Moon at perigee.
25th		comet (65P) Gunn 0.5° North of NGC 6304 (GC) in Ophiuchus.
26th	8 AM	Mercury stationary.
27th	5 AM	Saturn at opposition.
27th		Mercury at ascending node.
27th	12:51 PM	Full Moon Eclipse.
27th	2 PM	Saturn 3° South of Moon.
28th		comet (1995 O1) Hale-Bopp 0.7° East of NGC 6366 (GC) in Ophiuchus.
29th		Venus at ascending node



All times are AEST. For daylight saving add 1 hour.







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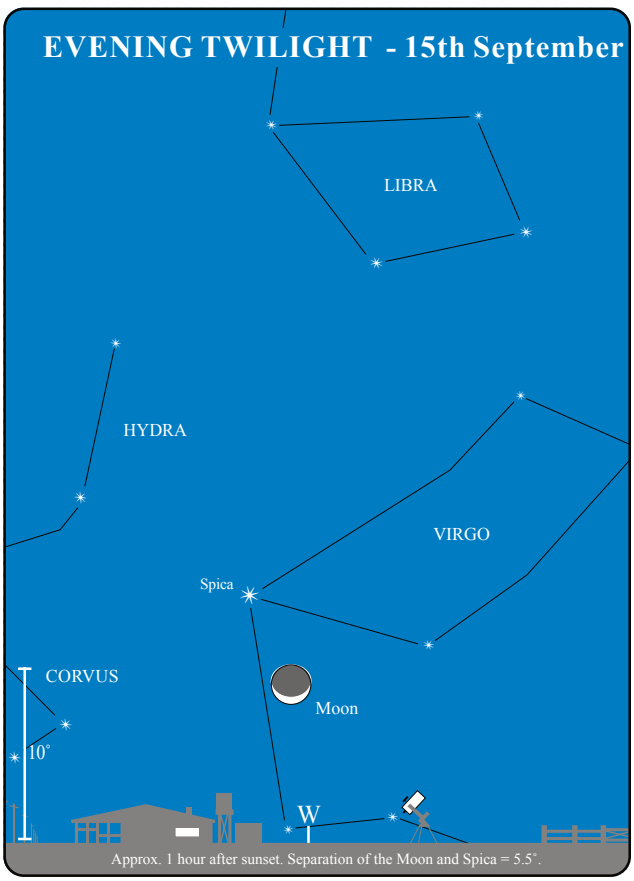
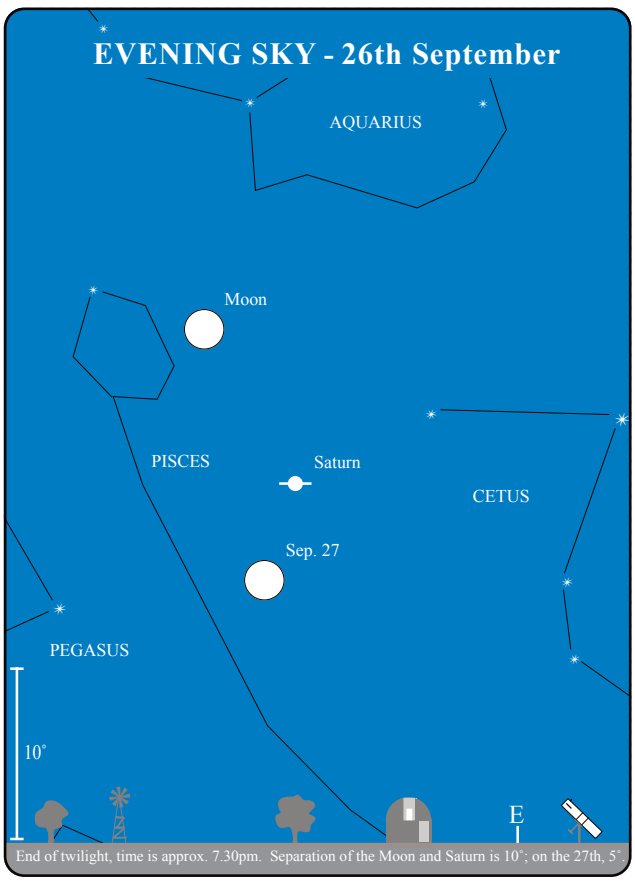
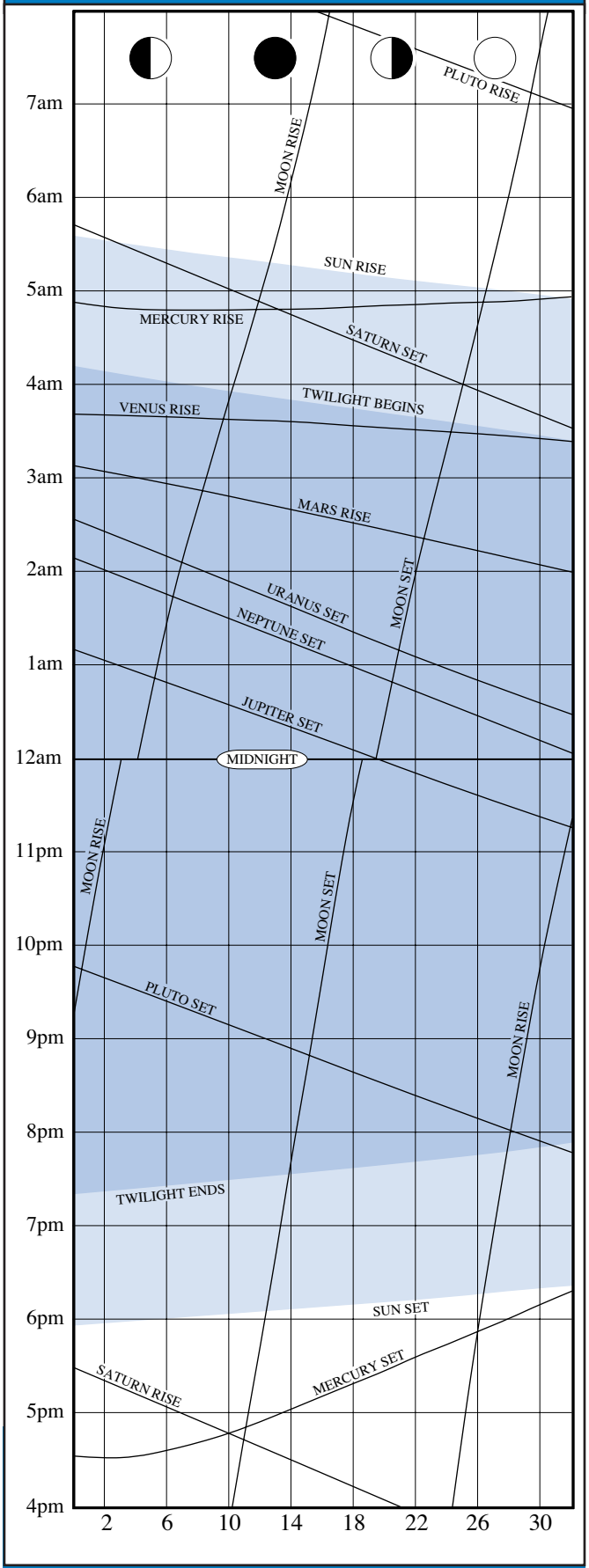




OCTOBER

RISE/SET CHART



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

OCTOBER HIGHLIGHTS

- Comet Hale-Bopp bright in the western evening sky. On 26th it has a close flyby of M14.
- Venus approaches to within 0.3° of Regulus on 4th.
- Jupiter now visible only in the evening sky.
- Saturn is still visible the whole night.
- Mars gains altitude in the eastern morning sky.
- Last chance to see Venus (out of twilight) for the year. Planet is low in eastern pre-twilight morning sky.

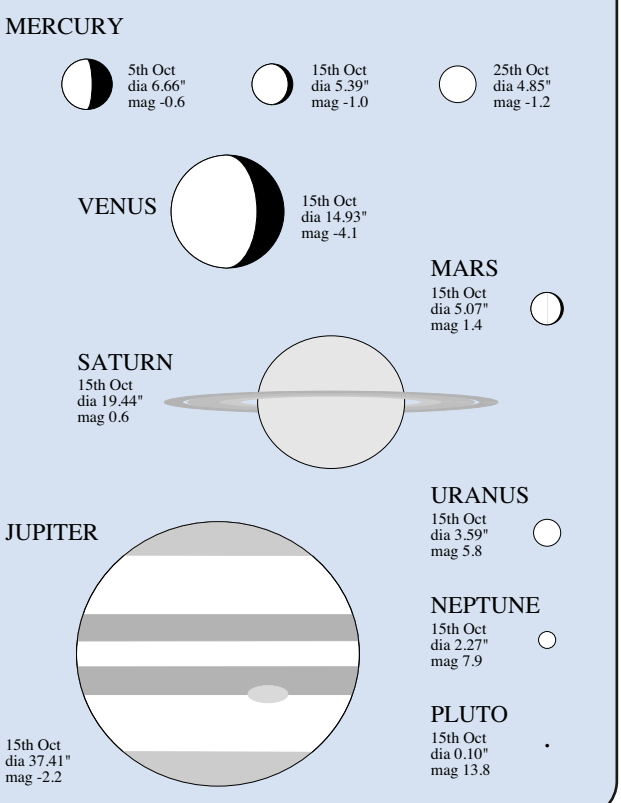
THE MOON

2nd	Occultation of Aldebaran, not visible from Australia (see sky view for 1st).
4th	Last Quarter, 10:05pm.
7th	Moon at apogee, 4am (furthest from Earth - 404,791 km, size 29.5').
13th	New Moon, 12:15am.
13th	Partial Eclipse of the Sun. NOT visible from Australia.
20th	First Quarter, 4:10am.
22nd	Moon at perigee, 7pm (closest to Earth - 368,350 km, size 32.4).
27th	Full Moon, 12:12am.
29th	Occultation of Aldebaran, not visible from Australia (see sky view for 29th).

THE PLANETS

MERCURY, in morning twilight, is too close to the Sun for observation. Reaching greatest western elongation (18°) on the 3rd, it moves from Leo into Virgo on the 4th, then into Libra at month's end.

APPEARANCE OF THE PLANETS



VENUS rises just prior to the beginning of astronomical twilight (1.5 hours before sunrise) in Leo, moving into Virgo on the 25th. Venus and 1st magnitude star Regulus (Alpha Leonis) will be a striking sight on the 4th when the two are separated by 0.3° (see sky view). The day before and after this close approach they will be seen 1° apart. On the 9th, the 26 day old Moon appears about 4° from Venus and Regulus, the trio forming a triangle (see sky view for 7th). On the following morning, the 27 day old Moon appears with Venus, Regulus and Mars in a line stretching northwards across Leo. The angular separation between the Moon/Venus will be 8.5°, Moon/Regulus 15°, and Moon/Mars 27°.

MARS and the 25 day old Moon come within 6° on the 8th (see sky view for 7th). The planet moves into Leo from Cancer at that time. On the 10th, Mars, Regulus (Alpha Leonis), Venus and the 27 day old Moon appear in a line stretching northwards across Leo (see Venus for full detail). Mars will be 10° north of Regulus, with Venus 10° south of the star; the trio forming a straight line. Following the close encounter of Venus with Regulus early in the month, Mars also comes close to the star at the end of the month. From 21st October to 8th November the red planet and 'the little king' (Regulus) will be within 5° of each other, closest approach of 1.2° happens on the 30th (see sky view on 28th). With Mars and Regulus of similar magnitude (about 1.5), the planet is easily identified by its distinctive orange colour.

JUPITER, now four months past opposition, transits the meridian at Spm and sets at midnight. For observations, early evening is best with Jupiter high in the western sky. During October, the planet begins to distance itself from the globular star cluster M22; starting 1° apart at the beginning of the month, increasing to 4.5° on the 31st. On the 18th, Jupiter will be 7° south of the 6 day old Moon (see sky view).

SATURN, just past opposition, can be seen high in the eastern sky after end of twilight, remaining visible for the rest of the night. Saturn's brightness gradually decreases over the coming months from 0.5 magnitude this month to 1st magnitude in December. The rings begin to close up slightly from the July/August period, and continue to do so until early December. On the 24th, Saturn will be 4° south of the 12 day old Moon (see sky view).

URANUS, NEPTUNE. Neptune opens the month still in retrograde motion. It is stationary on the 6th and then returns to its west-to-east path, Uranus follows on the 10th.

MINOR PLANETS. At opposition this month is 3 Juno on 8th in Cetus at mag. 7.5.

COMETS

Hale-Bopp remains in Ophiuchus for the month. On the 31st it is setting at approx. 9pm. On the 26th there is a close but brief encounter with the globular cluster M14. See sky view on 18th.

Kopff. remains in Capricornus and by month's end it has faded to mag. 11.5 (setting at 2am).

Machholz 1 commences the month low in the SW evening twilight sky, heading towards perihelion on 15th. Unfortunately it quickly moves out of sight (remaining close to the Sun) for the rest of 1996.

IRAS. reaches perihelion on the 31st and remains around mag. 11 .

Wild 2 heads north passing through Pisces Austrinus into Capricornus Towards the end of October it visits the globular cluster, M30. By 30th it will be setting around 2am.

DIARY

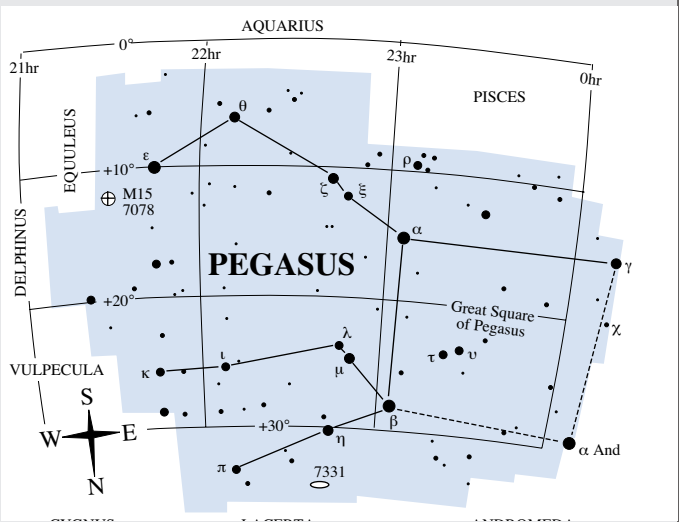
2nd	8 AM	Aldebaran 0.8° South of Moon Occn.
2nd		Mercury at perihelion.
2nd		m.p. 11 Parthenope 1.5° North of NGC 6235 (GC) in Ophiuchus.
3rd	4 PM	Mercury greatest elong. West (18°).
4th	10 AM	Venus 0.2° South of Regulus.
4th	10:04 PM	Last Quarter Moon.
5th	10 AM	m.p. 3 Juno at opposition.
5th		m.p. 22 Kalliope 0.2° NW of the Crab Nebula (M1) in Taurus.
6th	10 PM	Neptune stationary.
7th	4 AM	Moon at apogee.
7th		m.p. 1 Ceres 1° North of M19 (GC) in Ophiuchus.
8th	1 AM	Mars 6° North of Moon.
8th		m.p. 1 Ceres 0.5° South of NGC 6284 (GC) in Ophiuchus.
8th		m.p. 4 Vesta 0.3° North of NGC 6235 (GC) in Ophiuchus.
9th		k.w. anniversary of birth in Libra.
9th	2 PM	Venus 4° North of Moon.
10th	1 PM	Uranus stationary.
12th		Mercury at greatest latitude North (Heliocentric).
12th		m.p. 1 Ceres 1° North of NGC 6293 (GC) in Ophiuchus.

CONSTELLATION OF THE MONTH - PEGASUS (Peg)

Pegasus, the winged horse from classical mythology, is distinctive in the northern sky as it culminates mid-month (9pm). The outline of a winged horse is difficult to picture even for those in the northern hemisphere. The 'Great Square of Pegasus' is the body of the horse, and the easiest way to identify the constellation. The Great Square is formed by three stars of Pegasus and one of Andromeda (Alpha, Beta, and Gamma Pegasi, plus Alpha Andromedae). The square is large and unmistakable, its sides varying in length from about 13 to 17 degrees. Alpha Andromedae was formerly associated with Pegasus, but now marks the head of the chained maiden, Andromeda.

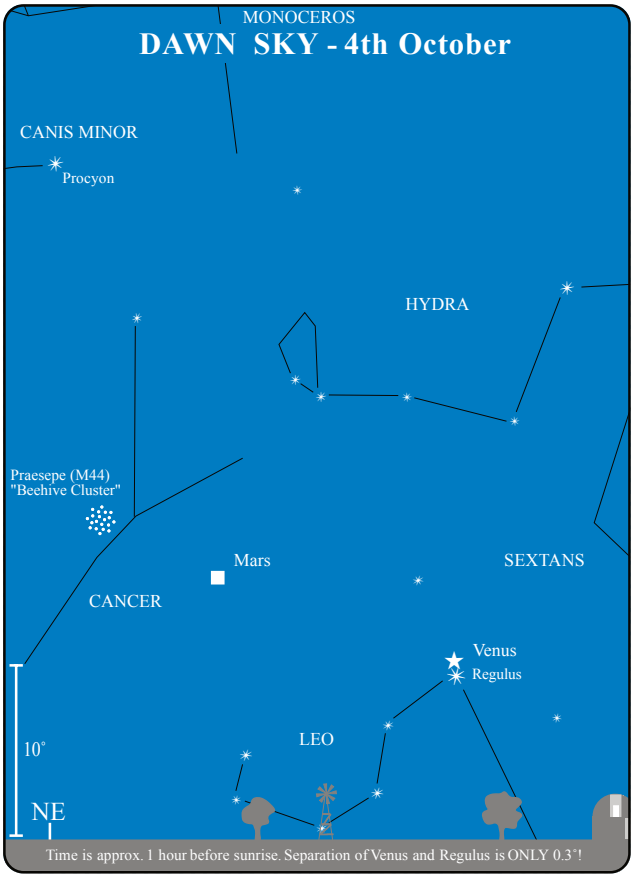
There are well over one hundred fine double and multiple stars in the constellation, many of which are ideally suited to small apertures. Charles Messier observed only one of the deep sky treasures of Pegasus, the only globular in the constellation, M15. It is a very rich and tightly compacted globular in a good field. Small telescopes will have trouble resolving individual stars, but the view is still grand.

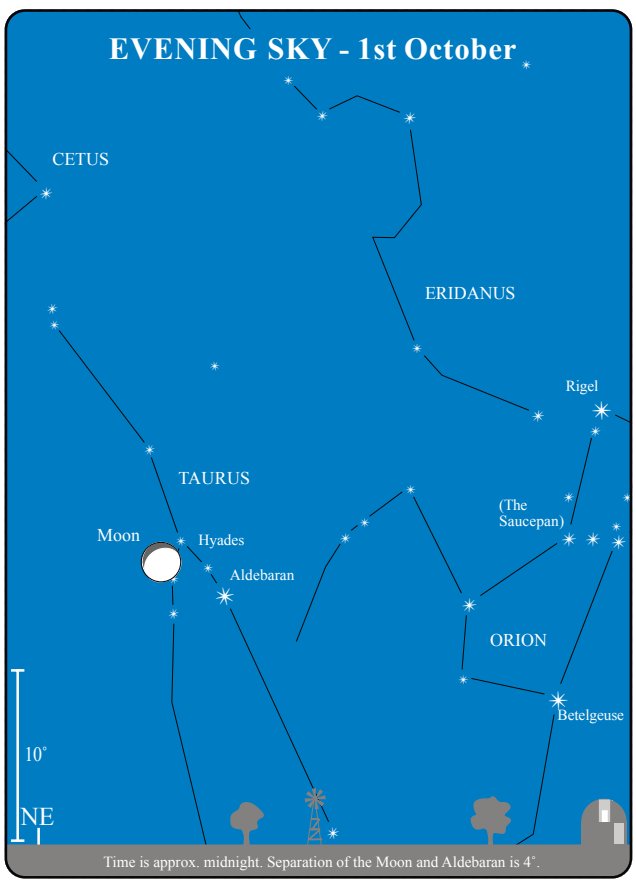
Many galaxies reside in Pegasus, including the famed Stephan's Quintet, a cluster of five galaxies. The members of this group appear to be interacting and show faint tidal streamers in photographs. An enigma of Stephan's Quintet is that not all the galaxies share the same red shift, as would be expected of galaxies in the same neighbourhood. To picture how our own Milky Way galaxy appears from intergalactic space, have a look at NGC7331. It is one of the constellation's brighter deep sky objects and is a good example of a spiral galaxy of similar form and size to our own, appearing tilted (about twenty degrees from edge-on).

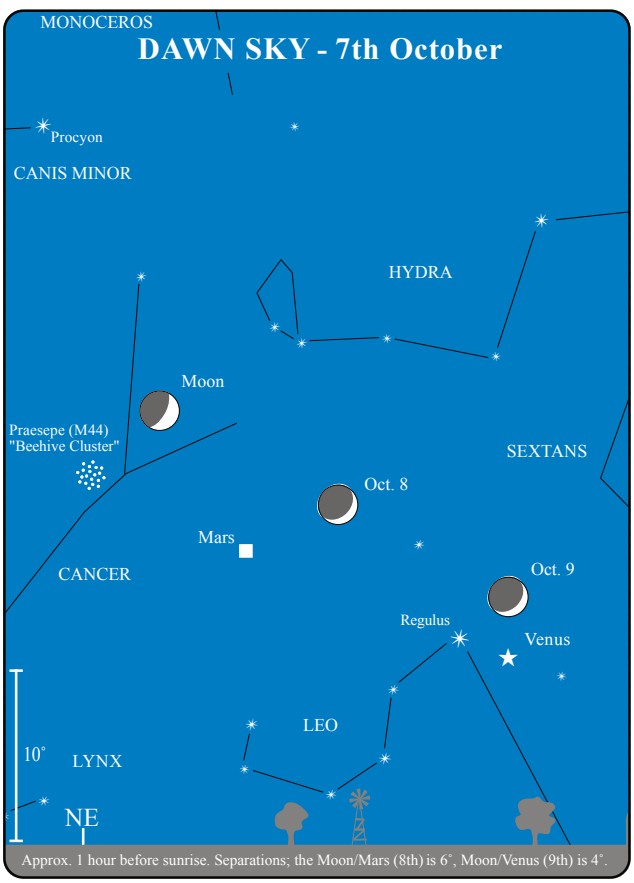


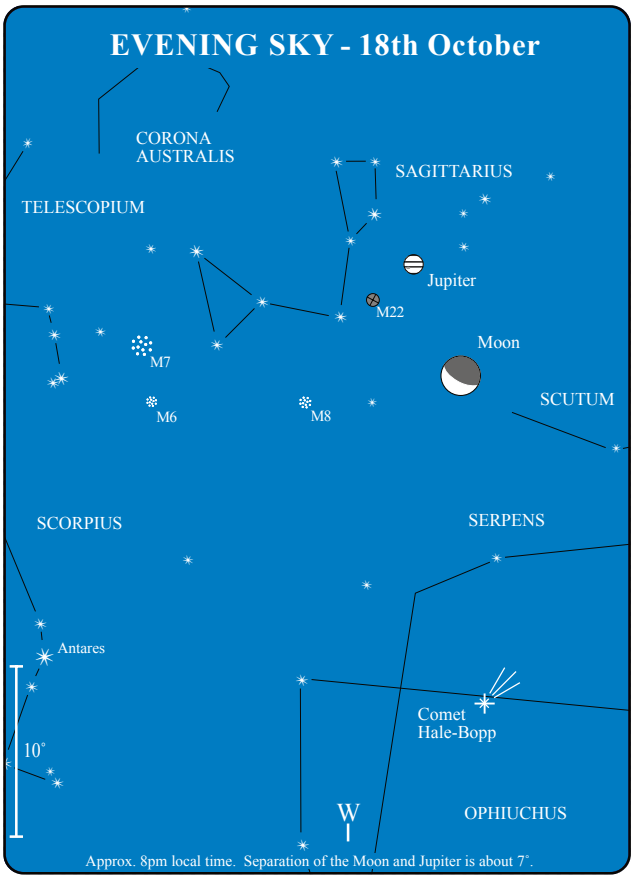
OCTOBER

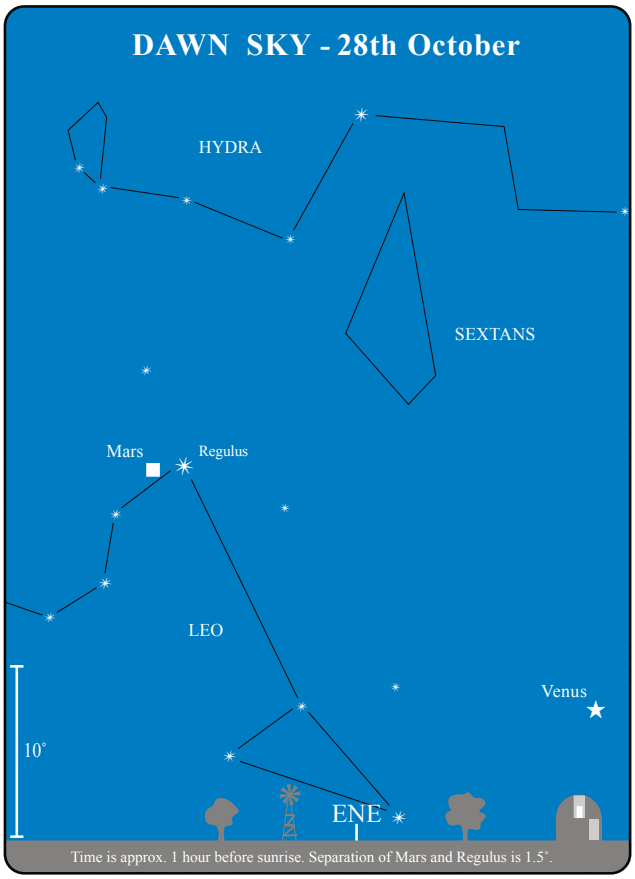
13th	12:14 AM	New Moon Eclipse.
14th		m.p. 4 Vesta 0.3° NE of NGC 6287 (GC) in Ophiuchus.
19th	2 AM	Jupiter 6° South of Moon.
20th	3 AM	Neptune 5° South of Moon.
20th	4:09 AM	First Quarter Moon.
20th		m.p. 4 Vesta 0.9° North of NGC 6325 (GC) in Ophiuchus.
20th	1 PM	Uranus 6° South of Moon.
22nd		m.p. 1 Ceres 0.5° NE of NGC 6355 (GC) in Ophiuchus.
22nd	7 PM	Moon at perigee.
23rd		comet (65P) Gunn 0.4° North of NGC 6522 (GC) in Sagittarius.
23rd		comet (P/1983 M1) IRAS 1.7° East of m.p. 349 Dembowska.
23rd		comet (P/1983 M1) IRAS 1° West of M30 (GC) in Capricornus.
24th	8 PM	Saturn 3° South of Moon.
26th		comet (1995 01) Hale-Bopp 0.5° South of M14 (GC) in Ophiuchus.
26th		m.p. 11 Parthenope 1.8° North of NGC 6401 (GC) in Ophiuchus.
27th	12:11 AM	Full Moon.
28th		comet (P/1983 M1) IRAS 3.4° East of comet (22P) Kopff.
29th		p.n. anniversary of birth in Scorpio
29th	2 PM	Mars 1.2° North of Regulus.
29th	6 PM	Aldebaran 0.9° South of Moon Occn.
30th		Jupiter 0.3° South of NGC 6717 (GC) in Sagittarius.
30th		m.p. 4 Vesta 0.5° North of NGC 6401 (GC) in Ophiuchus.



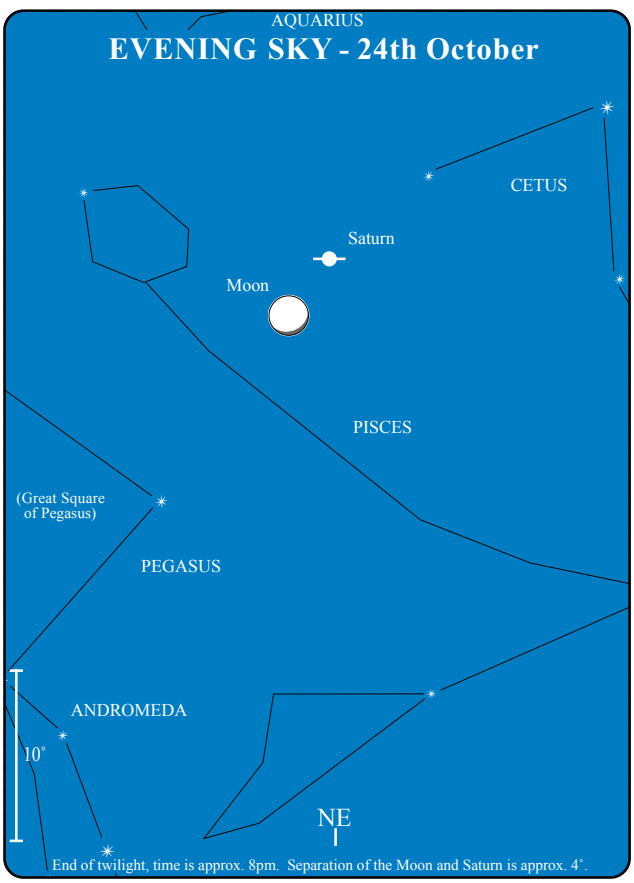


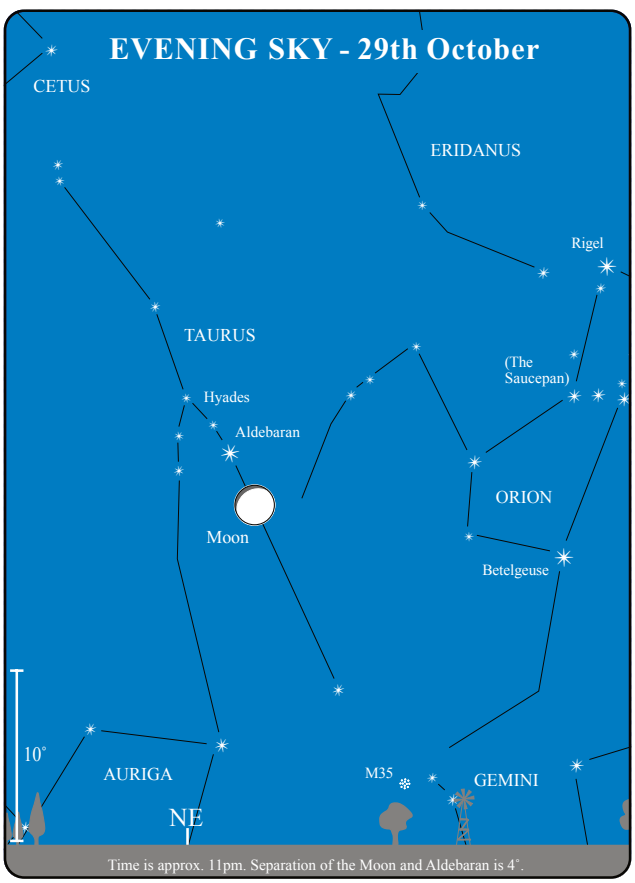






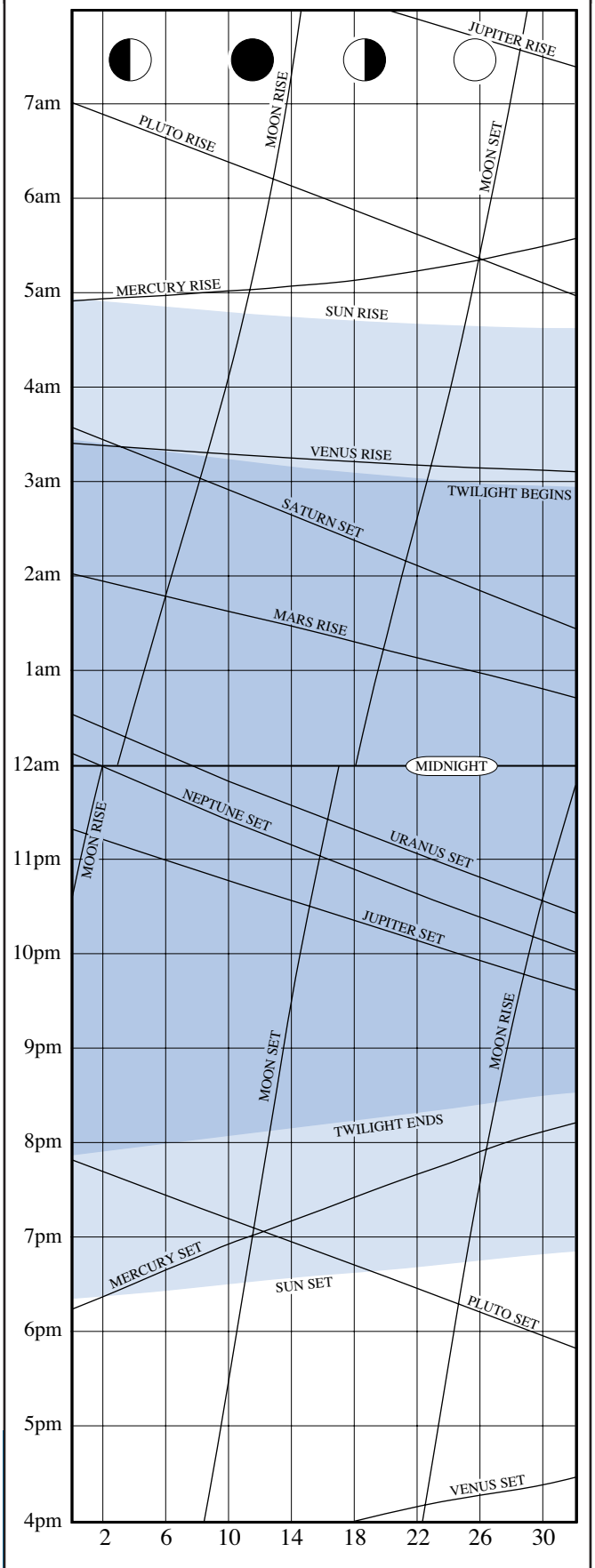
All times are AEST. For daylight saving add 1 hour.





NOVEMBER

RISE/SET CHART



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

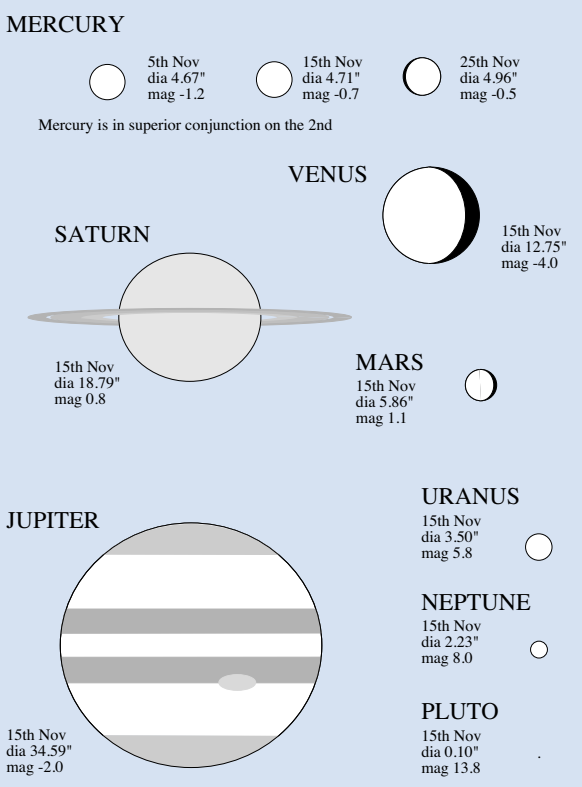
NOVEMBER HIGHLIGHTS

- Last chance to see comet Hale-Bopp for 1996.
- Look for the Leonid meteor shower.
- Late in November, Mercury reappears in the western evening sky, only visible in twilight.
- Venus now only visible in the eastern morning twilight sky.
- Mars is in the eastern morning sky (rising 1.30am).
- Get onto Jupiter early (setting 10pm).
- Saturn well placed for observation in the evening sky.

THE MOON

4th	Last Quarter, 5:51 pm.
3rd	Moon at apogee, midnight (furthest from Earth - 404,312 km, size 29.6').
11th	New Moon, 2:17pm.
16th	Moon at perigee, 3pm (closest to Earth - 369,460 km, size 32.3').
18th	First Quarter, 11:10am.
25th	Occultation of Aldebaran, not visible from Australia (see sky view for 25th).
25th	Full Moon, 2:11pm.

APPEARANCE OF THE PLANETS



THE PLANETS

MERCURY is at superior conjunction on the 2nd, and remains in the Sun's glare until reappearing in the evening western twilight later in the month. Although in the evening twilight, observers may like to locate Mercury when 3° north of 1st magnitude Antares (Alpha Scorpii) on the 20th and 21st. Using binoculars to 'sweep' the sky always helps when searching for planets and stars under twilight conditions. Mercury remains in Libra for half the month, moves into Scorpius on the 14th and into Ophiuchus (the 13th constellation of the Zodiac that the astrologers conveniently ignore) on the 20th.

VENUS rises in the eastern morning at the beginning of astronomical twilight, remaining in Virgo until the last day of the month when it crosses into Libra. On the 8th, the 26 day old Moon appears a little over 6° above and north of Venus (see sky view). On the following morning, the planet is 5° below and south, with 1st magnitude Spica (Alpha Virginis) 7° south of the Moon. As the month proceeds, Venus moves closer to Spica and between the 17th and 19th they will be 4° apart.

MARS rises around 1.30am, and brightens to 1st magnitude this month. In Leo for the entire period, the planet starts within 1.6° of Regulus on the 1st, thereafter the distance increases. On the 5th, the 23 day old Moon will be 6.5° above Mars with Regulus in between (see sky view). On the following morning the Moon will be 7° south of the planet.

JUPITER begins the month 3° from 2nd magnitude Sigma Sagittarii (one of the stars that form the handle of The Teapot, see July). By mid-month, Jupiter sets around 10.30pm and any telescopic observations should be done early in the evening before the planet loses too much altitude. On the 15th, Jupiter is 6.5° south of the 5 day old Moon (see sky view). At this time, the planet is very prominent in the western evening sky shinning at magnitude -2.0. Its disc has decreased to 35 arc seconds in diameter from the opposition size of 47 arc seconds.

SATURN is well placed for evening viewing, transiting the meridian at the end of twilight. As most of Saturn's satellites orbit in a similar plane to the rings, they will shuttle back and fourth like the Galilean satellites of Jupiter, when the rings are near edge-on. When the rings are fully open the task is more difficult, with the moons scattered around the planet and hard to distinguish from background stars. Most small instruments will detect four of Saturn's eighteen satellites. Certainly Titan the brightest, at 8.3 magnitude is easy, but Tethys (10.2), Dione (10.4) and Rhea (9.7) are also within reach. The best way to separate moons from background stars is to draw the positions over several nights, noting the ones that move along the ring plane. The expected positions can also be calculated (see part 2). On the 20th, Saturn will be 4° south of the 10 day old Moon (see sky view).

URANUS, NEPTUNE. Both planets are now only early evening objects, with them setting around 11pm.

COMETS

Hale-Bopp. The first half of November will be our last chance to see this visitor (see sky view on 1st) in dark skies, from the southern hemisphere for this year. It quickly moves into the glare of the evening twilight. Perihelion is not until March 31st, 1997.

Unfortunately for us Aussies, the high inclination of its orbit will sweep it too far north to be visible from 'down under' at this time. Our northern hemisphere friends will have a great view during perihelion. It will not be visible again, from Australia, until late April 1997, when it will be low in the western evening twilight sky (but still hopefully very bright!).

IRAS. The comet continues its northward march, moving into Aquarius. During November it becomes an evening object only, setting at 11pm by month's end. It fades slightly to mag. 11.7.

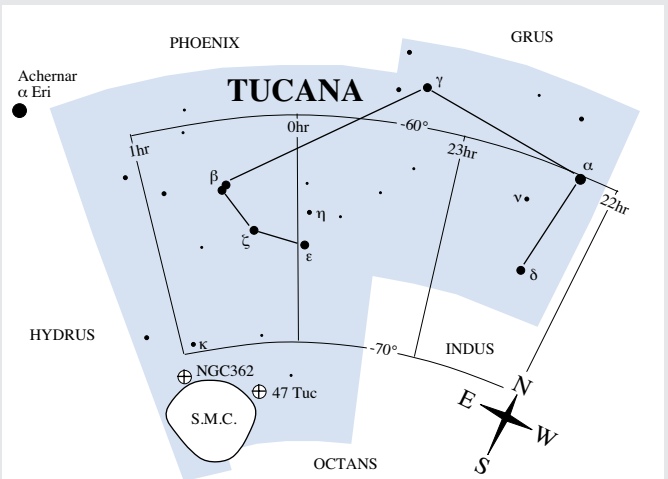
CONSTELLATION OF THE MONTH - TUCANA (Tuc)

Tucana, the Toucan bird, was introduced as a constellation in 1603 by German astronomer Johann Bayer. It shares the southern skies with three other celestial birds: Apus - the bird of paradise, Grus - the crane, and Pavo - the peacock. Tucana is circumpolar from latitudes -35° and further south, culminating at the beginning of November at 9pm. The constellation's southern boundary joins that of Octans and is about 15 degrees from the south celestial pole.

Tucana is identified by a few scattered bright stars. It is the home of many good double and multiple stars, several galaxies and two globular clusters (one of which is arguably the finest in the heavens), and the Small Magellanic Cloud or Nubecula Minor.

For sheer elegance and beauty the globular cluster 47 Tucanae (NGC104 or Dunlop 18) is hard to beat. It is easily visible to the unaided eye as a hazy 4.5 magnitude patch and about two degrees west of the Small Magellanic Cloud. Dark skies, away from city lights, are needed (if you can see the 'cloud' you should be able to see 47 Tuc.). It is only surpassed in brightness by Omega Centauri. Some would say that the brighter the cluster the better, but the fine delicate appearance of 47 Tucanae is lacking in the coarser, less compact, Omega Centauri.

The Small Magellanic Cloud (SMC) is one of two satellite galaxies of our own Milky Way, both of which are visible to the unaided eye. The other is the Large Magellanic Cloud or LMC (in Dorado and Mensa). They both resemble large detached portions of the Milky Way. Both galaxies were named in after the Portuguese explorer Magellan, after his circumnavigation of the world in 1518-20. The SMC tends to be overshadowed by the LMC due to the latter's proliferation of objects. Nevertheless the SMC is still an excellent object in binoculars and small instruments. The nearby globulars 47 Tucanae and NGC362 are not associated with the SMC, but are foreground objects in our own galaxy.



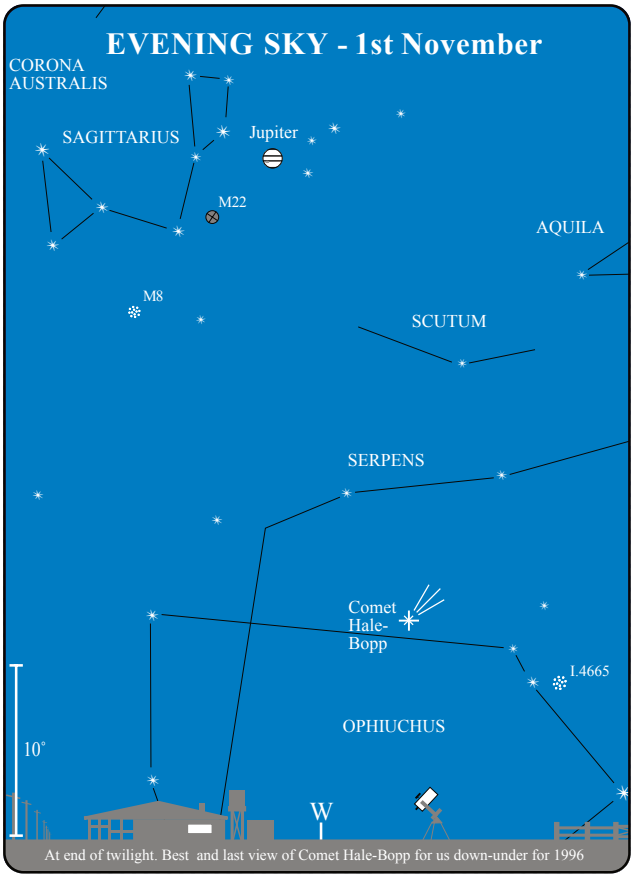
NOVEMBER

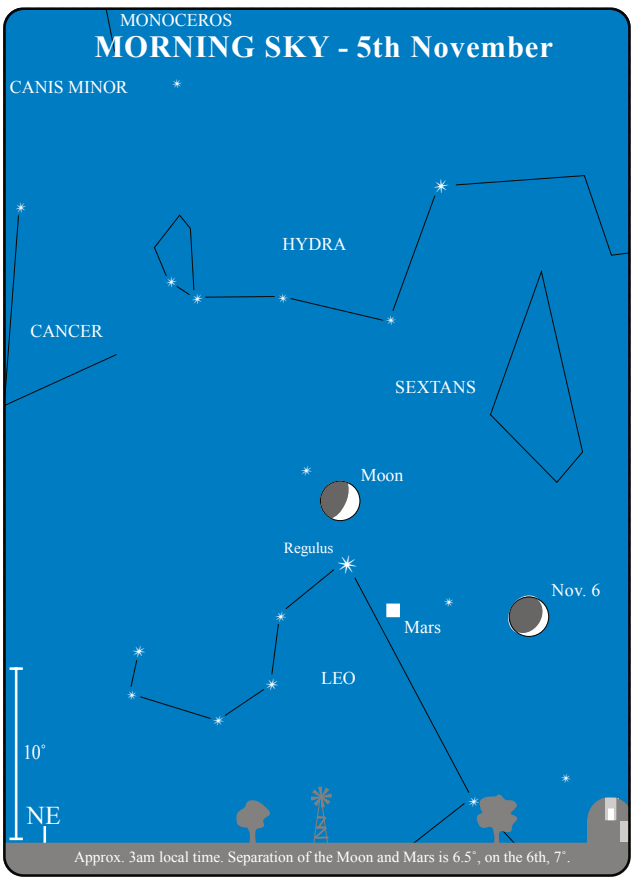
METEOR SHOWERS

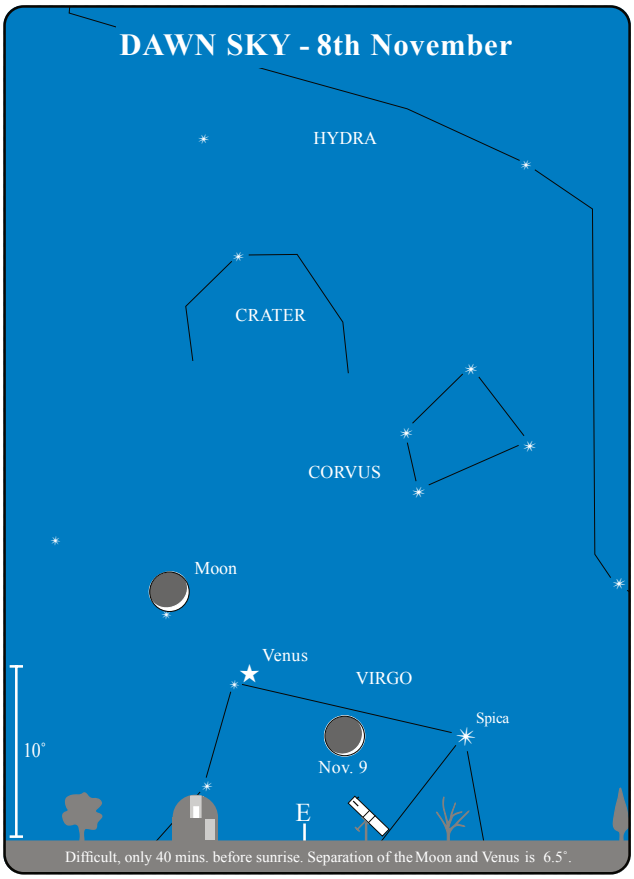
The **Leonids** is one of the best known showers, with storms occurring about every 33 years, when its associated comet, P/ Tempel-Tuttle, returns to perihelion. It is expected that storms will occur again in the years 1998 to 2000, with an increased activity in the years leading up (rates in 1994 were approximately 60 per hour). The shower is active from the 14th to 21st, with maximum on the 17th. They are best seen from midnight to dawn and this year is favourable for Australian observers. The International Meteor Organisation is very keen to obtain observations of this shower.

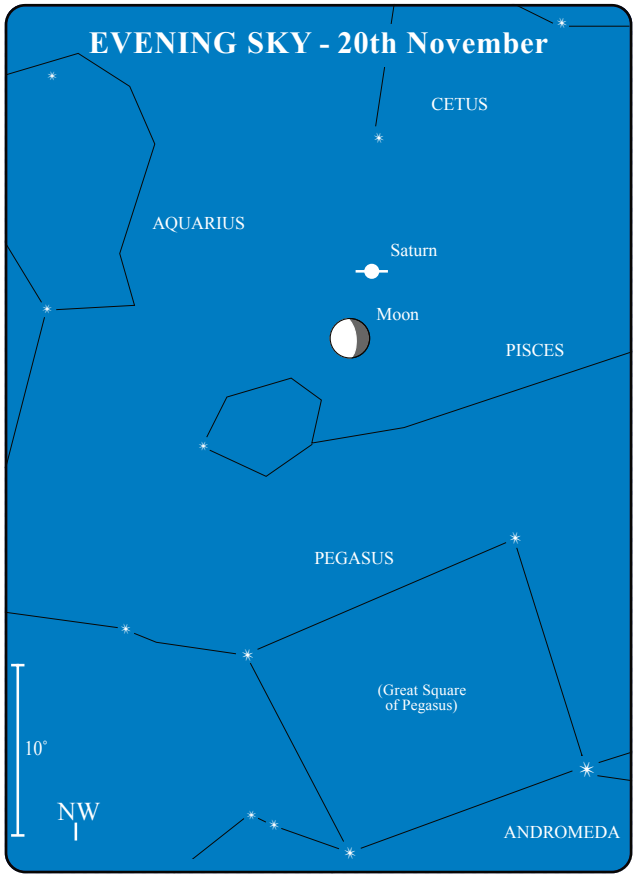
DIARY

2nd	10 AM	Mercury in superior conjunction.
2nd		Venus at perihelion.
2nd		comet (65P) Gunn 0.7° North of NGC 6624 (GC) in Sagittarius.
2nd		m.p. 11 Parthenope 0.2° East of NGC 6469 (OC) in Sagittarius.
3rd	5:50 PM	Last Quarter Moon.
3rd	Midnight	Moon at apogee.
4th		Mercury at descending node.
5th	6 PM	Mars 5º North of Moon.
7th		m.p. 11 Parthenope 0.1° North of M21 (OC) in Sagittarius.
7th		m.p. 3 Juno 0.6° SE of NGC 191 (G) in Cetus.
8th	8 PM	Venus 1.4° North of Moon.
11th		m.p. 4 Vesta 0.4° North of Lagoon Nebula in Sagittarius.
11th	2:16 PM	New Moon.
12th		m.p. 21 Lutetia 1° SE of m.p. 39 Laetitia.
13th		m.p. 4 Vesta 0.1° North of NGC 6559 (Neb.) in Sagittarius.
13th	Midnight	m.p. 3 Juno stationary.
15th		Mercury at aphelion.
15th	3 PM	Jupiter 5° South of Moon.
16th	9 AM	Neptune 4° South of Moon.
16th	3 PM	Moon at perigee.
16th	7 PM	Uranus 5° South of Moon.
17th	4 AM	Venus 4° North of Spica.
18th		comet (65P) Gunn 1° North of M54 (GC) in Sagittarius.
18th		m.p. 1 Ceres 0.8° South of NGC 6553 (GC) in Sagittarius.
18th	11:09 AM	First Quarter Moon.
20th		m.p. 11 Parthenope 1° North of NGC 6642 (GC) in Sagittarius.
20th		m.p. 4 Vesta 0.8° North of M28 (GC) in Sagittarius.
21st	1 AM	Saturn 3° South of Moon.
21st	3 AM	Mercury 3° North of Antares.
23rd		m.p. 11 Parthenope 1.5° North of M22 (GC) in Sagittarius.
24th		Venus at greatest latitude North (Heliocentric).
25th		m.p. 4 Vesta 0.1° South of M22 (GC) in Sagittarius.
25th	2:10 PM	Full Moon.
26th	3 AM	Aldebaran 0.9° South of Moon Occn.
27th	10 AM	Pluto in conjunction with Sun.
30th		comet (22P) Kopff 1° South of m.p. 39 Laetitia.

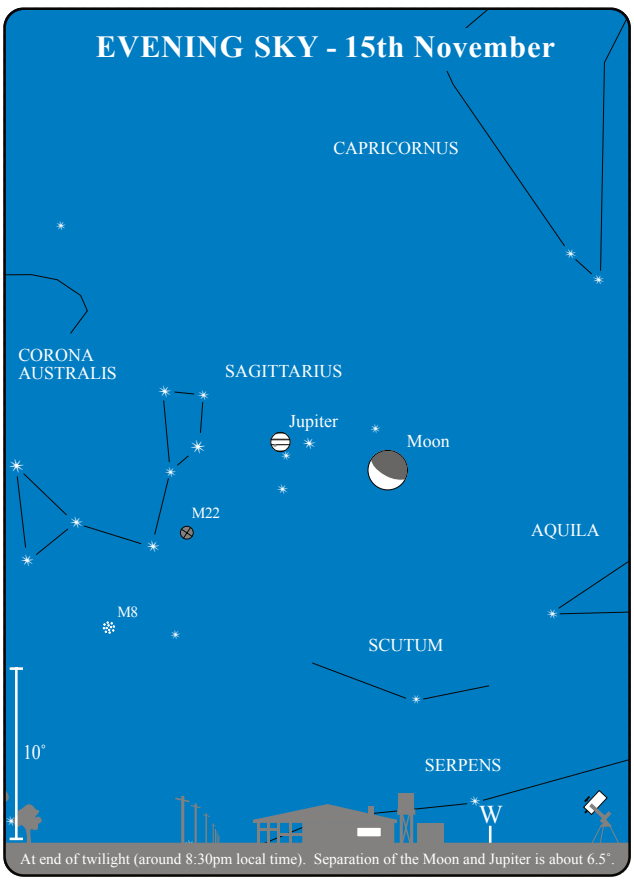


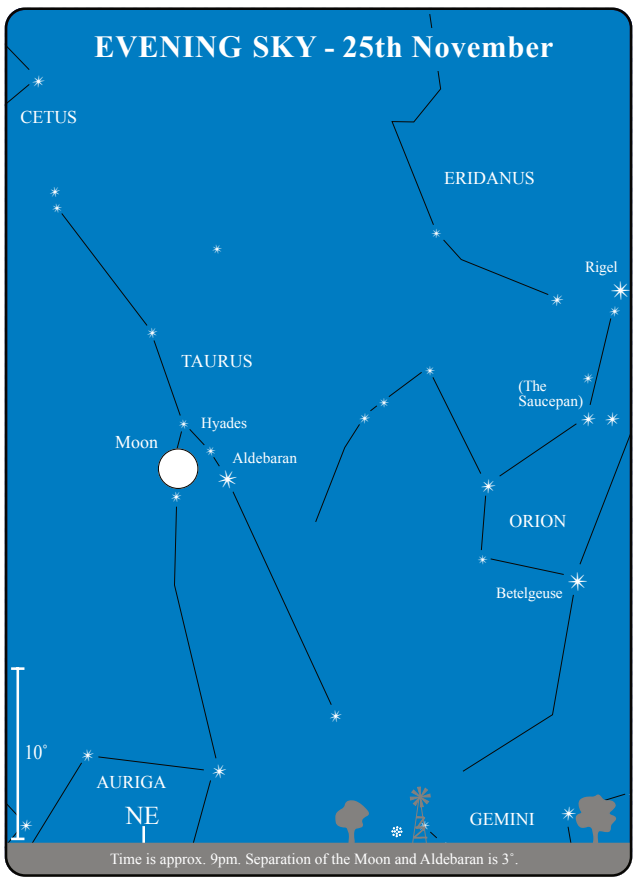






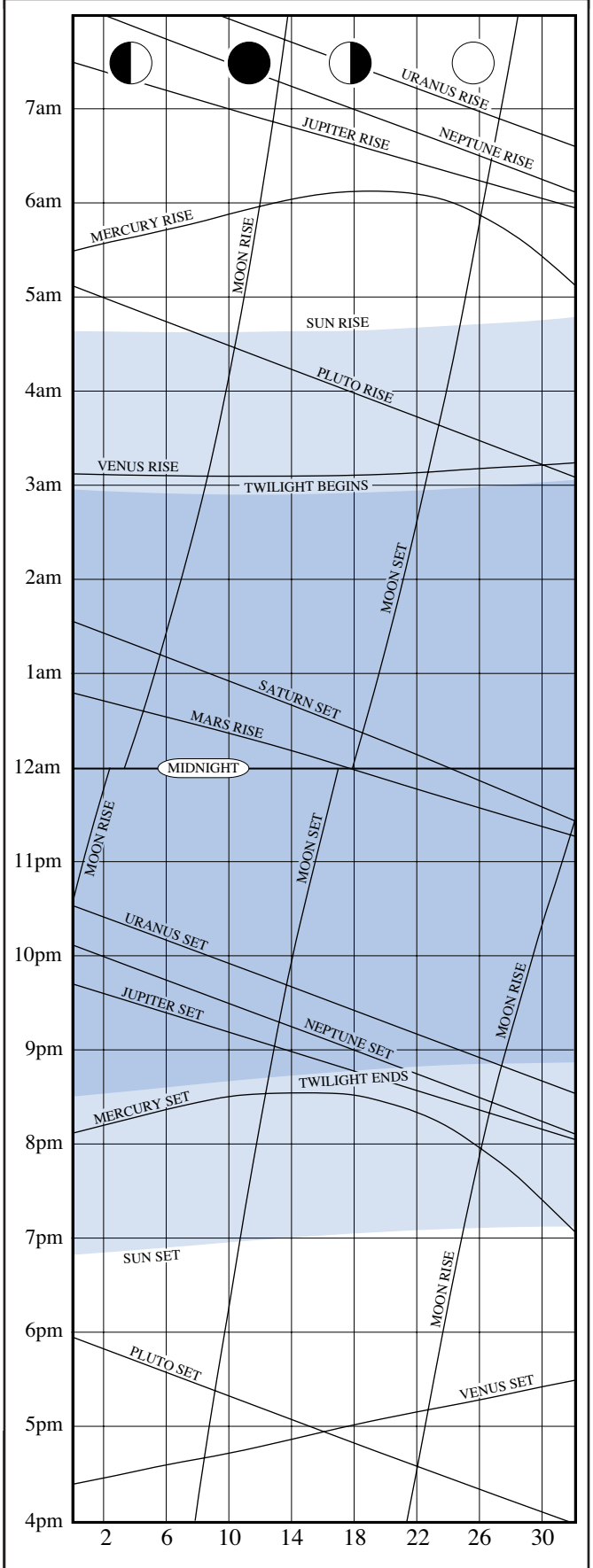
All times are AEST. For daylight saving add 1 hour.





DECEMBER

RISE/SET CHART



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

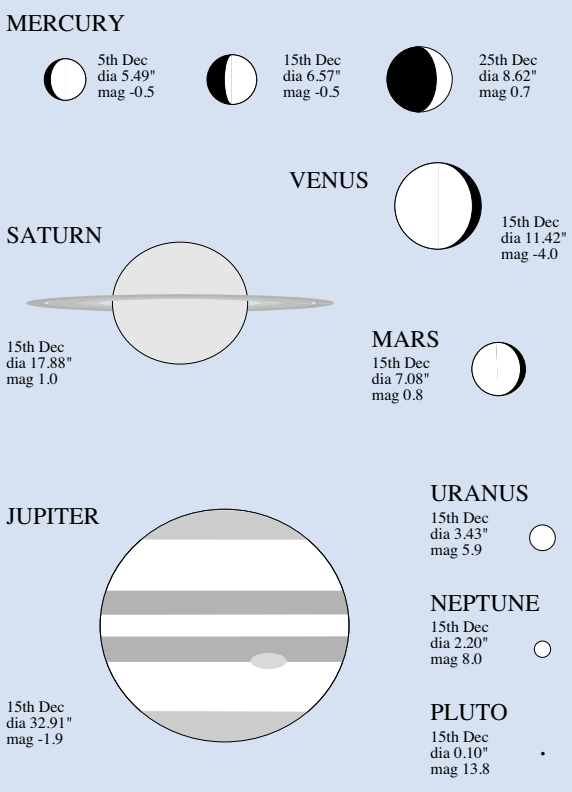
DECEMBER HIGHLIGHTS

- Mercury visible in the first half of December in the evening twilight sky.
- Venus rises at the beginning of morning twilight.
- Close approach of the Moon, Mars and Regulus in the morning sky of 3rd.
- Moon, Mercury and Jupiter form a nice triangle in the evening twilight sky on 12th.
- Saturn is now only visible in the evening sky.
- Look for the Geminid meteors.
- Close approach of Mercury to Jupiter in the evening twilight sky on 23rd.

THE MOON

1st	Moon at apogee, 9pm (furthest from Earth - 404,654 km, size 29.5').
3rd	Last Quarter, 3:07 pm.
11th	New Moon, 2:57am.
13th	Moon at perigee, 2pm (closest to Earth - 364,237 km, size 32.8').
17th	First Quarter, 7:32pm.
23rd	Occultation of Aldebaran, not visible from Australia (see sky view for 22nd).
25th	Full Moon, 6:42am.
29th	Moon at apogee, 3pm (furthest from Earth - 405,522 km, size 29.5').

APPEARANCE OF THE PLANETS



THE PLANETS

MERCURY moves from Ophiuchus into Sagittarius on the 2nd, where it remains until early February 1997. Mercury's greatest elongation east of the Sun (20°) occurs on the 16th, providing the last opportunity to observe the planet in the evening sky (still in twilight) until April next year. However, the year is finished off nicely by Mercury as it approaches Jupiter. From the 19th to the 25th the planets will be within 5° of each other; minimum separation of around 4° can be seen between the 21st and 23rd (see sky view for 23rd).

VENUS moves into Scorpius from Libra on the 20th, then into Ophiuchus on Christmas Eve. On the 8th the 26 day old Moon appears 10° to the north of Venus, and on the following evening 5° away and directly below (see sky view for 7th). Venus and 2.6 magnitude Graffias (Beta 1 Scorpii, one of the stars in the head of the scorpion) appear about 0.25° apart on the 20th. On the 24th Venus and 1st magnitude Antares (Alpha Scorpii - the heart of the scorpion) are separated by 6°.

MARS, rising around midnight, spends the first half of the month in Leo, then crosses into Virgo. The 23 day old Moon will be 3° above Mars on the 4th (see sky view for 3rd). With the planet next reaching opposition in March 1997, readers may have noticed Mars gradually increasing in brightness over the past six months. By the end of the month Mars will be 0.5 magnitude and its disc 8 arc seconds in diameter. Telescopic views will still be disappointing and best left until opposition. Even the coming March 1997 apparition is not a favourable one with the red planet reaching only 14 are seconds in diameter. The next best oppositions occur in the years 2001, 2003 and 2005; with disc diameters of 21, 25 and 20 arc seconds respectively.

JUPITER, low in the western evening sky at magnitude -1.9, moves into the twilight at the end of the month. December will be the last opportunity to see Jupiter in the evening sky for several months. Conjunction (when the planet is on the opposite side of the Sun to the Earth) occurs on the 19th January 1997. On the 13th, Jupiter will be 9° south of the 3 day old Moon (see sky view for 12th).

SATURN, in retrograde motion since late July, reaches its stationary point on the 4th and then returns to its west-to-east track (see discussion on retrograde motion in part two). Now at 1st magnitude, Saturn sets around midnight and any telescopic observation should begin early before too much altitude is lost. On the 17th, Saturn will be 6° south of the First Quarter Moon (see sky view), and on the following evening the pair will be 9º apart.

URANUS, NEPTUNE. Like Jupiter, these planets disappear into the western evening twilight sky by mid-month. Not the best month to observe these distant members of our Solar System.

MINOR PLANETS. At opposition this month is 22 Kalliope on the 9th in Taurus at mag. 9.9.

COMETS

Wild 2. The comet spends the month in Cancer, rising around 9pm mid-month. During December it brightens slightly from 12.9 to 11.7 mag. However there will be plenty of time to observe Wild 2 for it does not reach perihelion until May 1997 (the story will be continued in ASTRONOMY 1997).

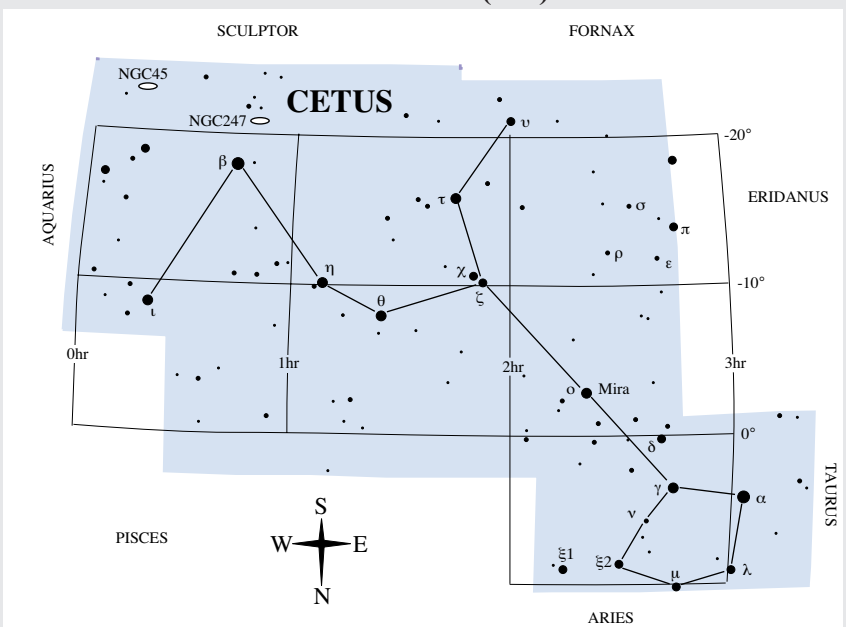
IRAS. The comet continues its northward march, moving into Pegasus. During December it fades to mag. 12.6, setting at month's end by 9pm.

METEOR SHOWERS

The **sigma-Hydrids** are active from the 3rd to 15th, reaching their peak on the 11th. They are normally swift and faint and a low rate of 2 meteors can be expected. The radiant is about ten degrees east of Procyon (Alpha Canis Minoris) and will be best viewed after midnight.

The **Geminids** are one of the best annual showers observable, but for southern observers the radiant is below or low to the horizon until after midnight. Visible from the 7th to 17th, with maximum on the 13th, the Geminids produce often bright, medium speed meteors. The zenith hourly rate is variable (but around 110 is normal) and worth watching for in the morning hours even though our northern counterparts will see the best of the Geminids. o

CONSTELLATION OF THE MONTH - CETUS (Cet)



Cetus, the Whale or Sea Monster, is a large constellation that sprawls just south of the ecliptic. In area it is the fourth largest of the constellations. Lying in a sparsely populated region, the Whale culminates high in the northern sky at the beginning of the month (9pm). In ancient mythology, Cetus was the sea monster who was sent to devour Andromeda, but was turned to stone at the sight of Medusa's head which was in the hand of Perseus.

Cetus is rich in double stars, multiple stars and galaxies, but contains no open clusters and only one planetary. Two of the galaxies, NGC45 and NGC247, belong to the South Galactic Pole (SP) group of galaxies, which is the nearest cluster of galaxies beyond our own local group. Four other members of the SGP group are in Sculptor, two of which are the famous NGC55 and NGC253.

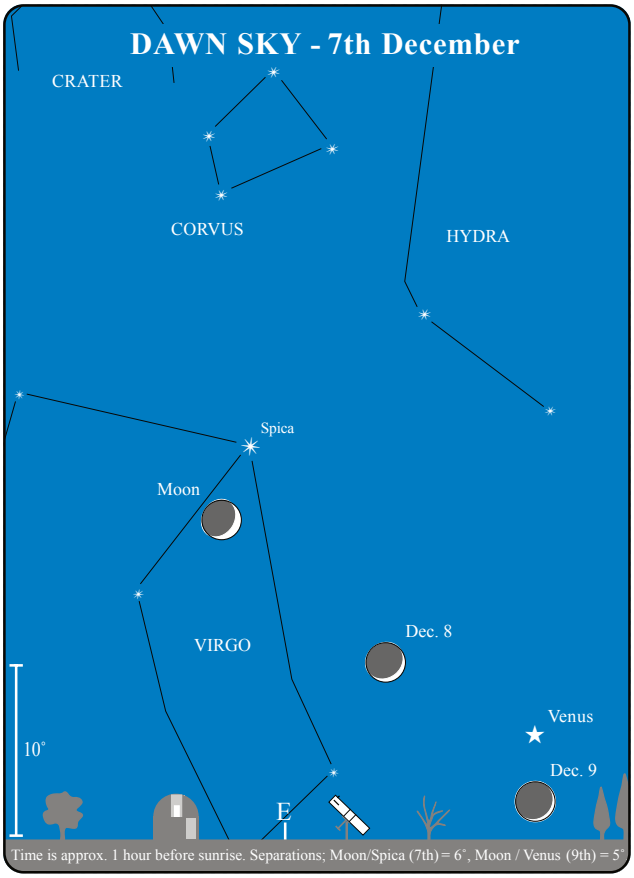
There are nearly a hundred double and multiple stars, some are easy, others more difficult. The most famous of these is not noted for its duplicity, but for its variability. Omicron Ceti, or Mira, "The Wonderful', was first noted by Dutch astronomer Fabricius in 1596, who believed the star to be a Nova. Its variability was recorded by his fellow countryman, Holwarda in 1638.

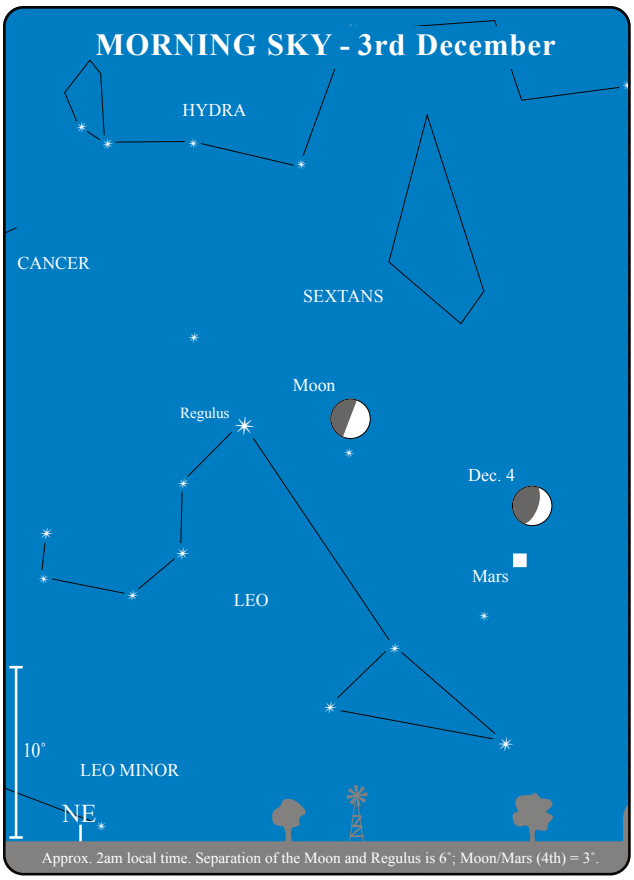
Mira, a red giant, is the brightest example of a long period pulsating variable, and is now the standard for this class of star. Mira's average period is 331 days, and its magnitude ranges from being naked eye, at 2.5, down to a faint 9th. When at maximum brightness, Mira is about 250 times brighter than the Sun, at minimum it is slightly fainter. Its faint companion, only visible in very large telescopes when Mira is at minimum, is also a variable star. In total, about 4000 Mira type variables have been discovered, the most common type of variable star.

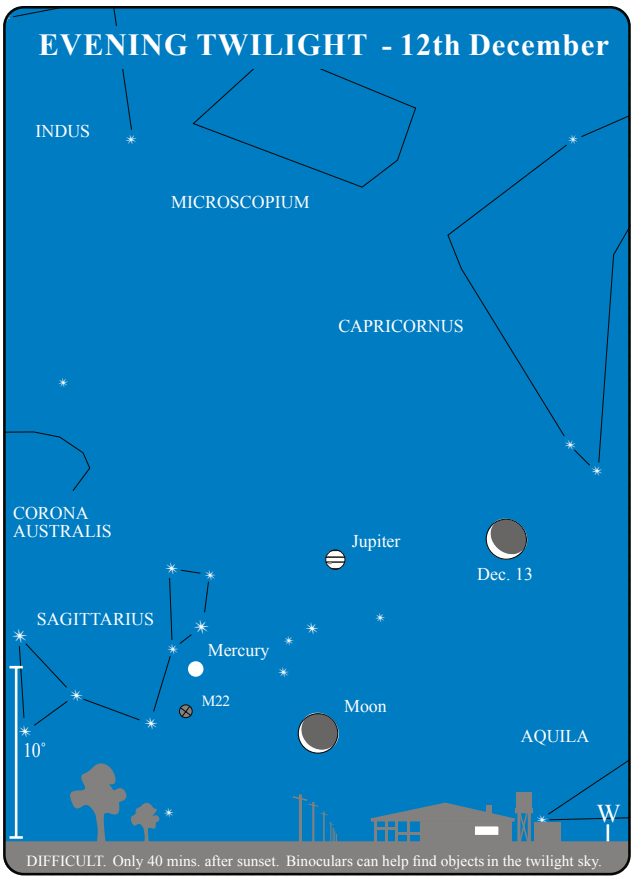
DECEMBER

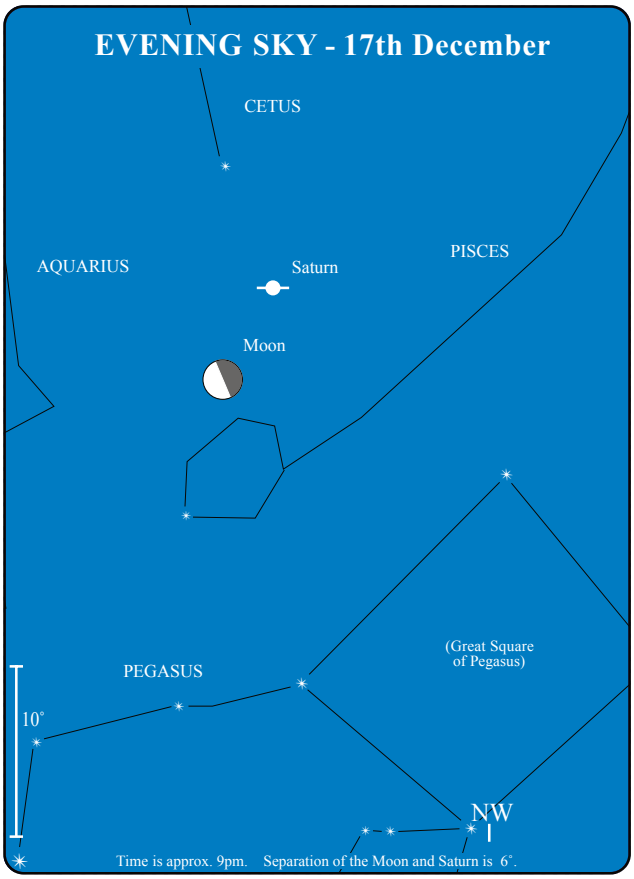
DIARY

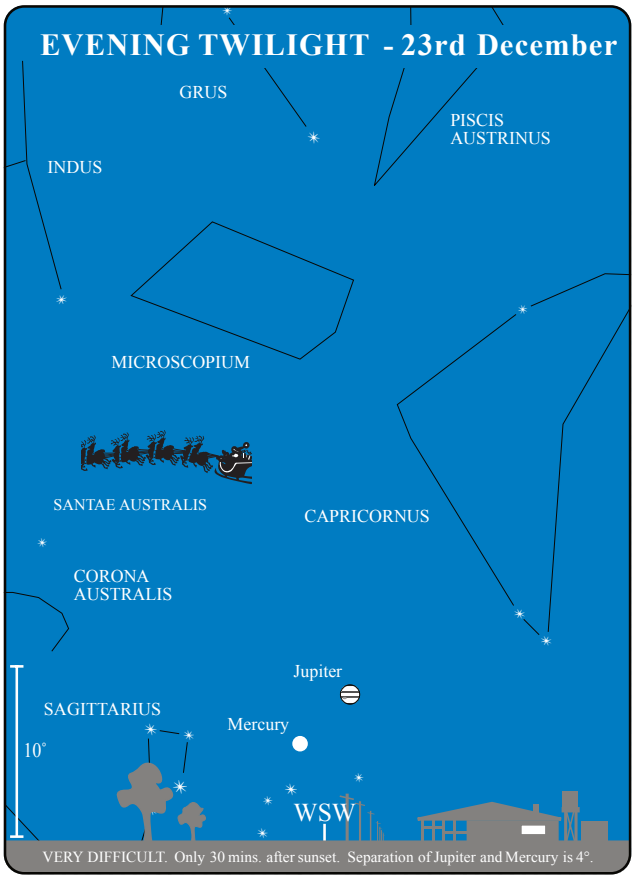
1st	9 PM	Moon at apogee.
3rd	3:06 PM	Last Quarter Moon.
4th	7 AM	Mars 4° North of Moon.
4th	9 PM	Saturn stationary.
5th		Mercury at greatest latitude South (Heliocentric).
8th	11 PM	Venus 2° South of Moon.
10th	3 PM	m.p. 2 Pallas in conjunction with Sun.
11th	2:56 AM	New Moon.
12th	3 PM	Mercury 7º South of Moon.
13th	9 AM	Jupiter 5° South of Moon.
13th	2 PM	Moon at perigee.
13th	5 PM	Neptune 4° South of Moon.
14th	4 AM	Uranus 5° South of Moon.
16th	5 AM	Mercury greatest elong. East (20°).
17th	7:31 PM	First Quarter Moon.
18th	6 AM	Saturn 3° South of Moon.
19th		m.p. 3 Juno 0.1° South of NGC 337 (G) in Cetus.
21st		Jupiter 0.5° South of m.p. 11 Parthenope.
21st		Midnight Solstice.
22nd		Mars at greatest latitude North (Heliocentric).
23rd	10 AM	Aldebaran 0.9° South of Moon Occn.
23rd		Midnight Mercury stationary.
24th		Mercury at ascending node.
24th		Jupiter 1.3° North of m.p. 4 Vesta.
24th	5 PM	Venus 6º North of Antares.
25th	6:41 AM	Full Moon.
25th		Venus 0.5° North of m.p. 20 Massalia.
28th		Neptune 0.4° North of m.p. 11 Parthenope.
28th		Venus 0.6° North of NGC 6235 (GC) in Ophiuchus.
29th		Mercury at perihelion.
29th	3 PM	Moon at apogee.
30th		Neptune 2.2° North of m.p. 4 Vesta.
30th		Venus 0.8° North of NGC 6287 (GC) in Ophiuchus



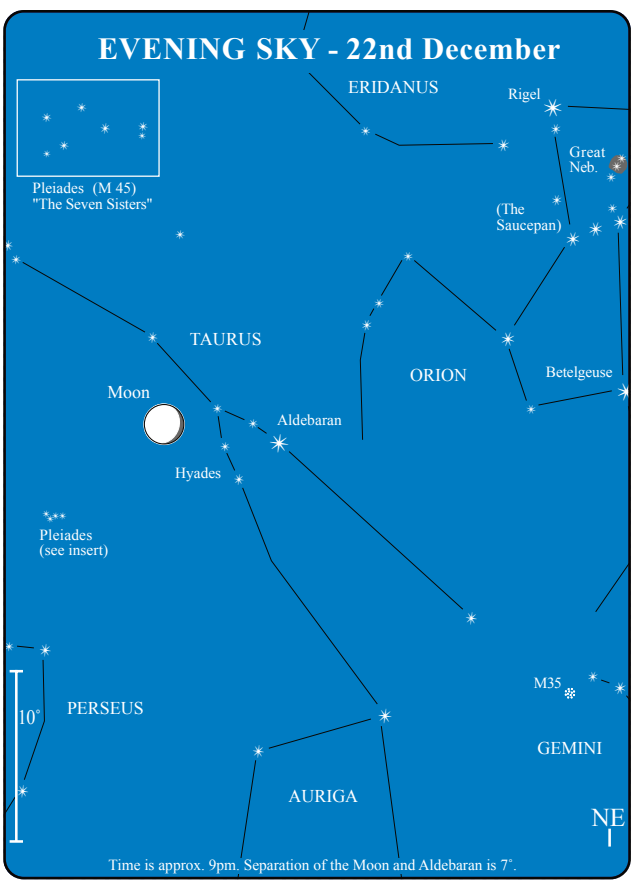








All times are AEST. For daylight saving add 1 hour.



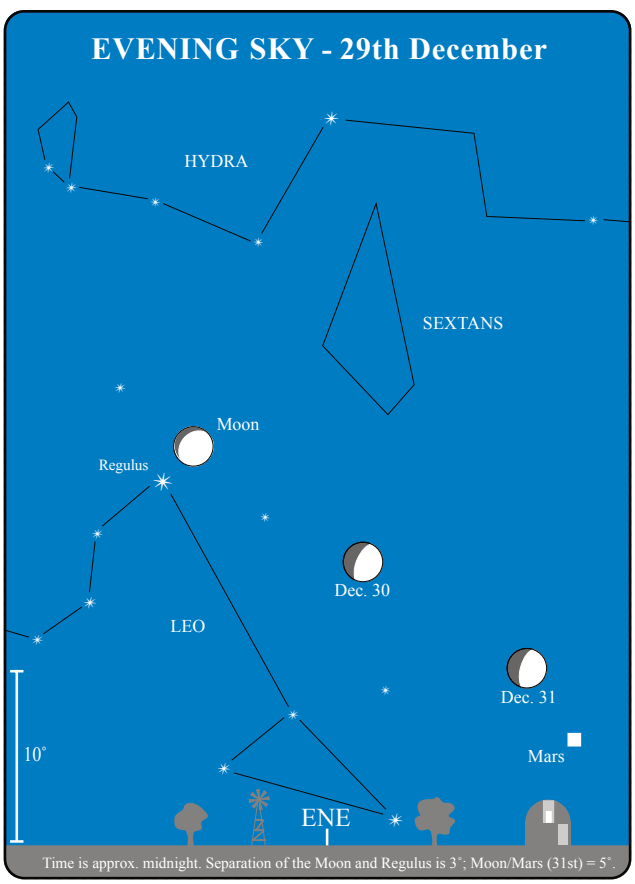
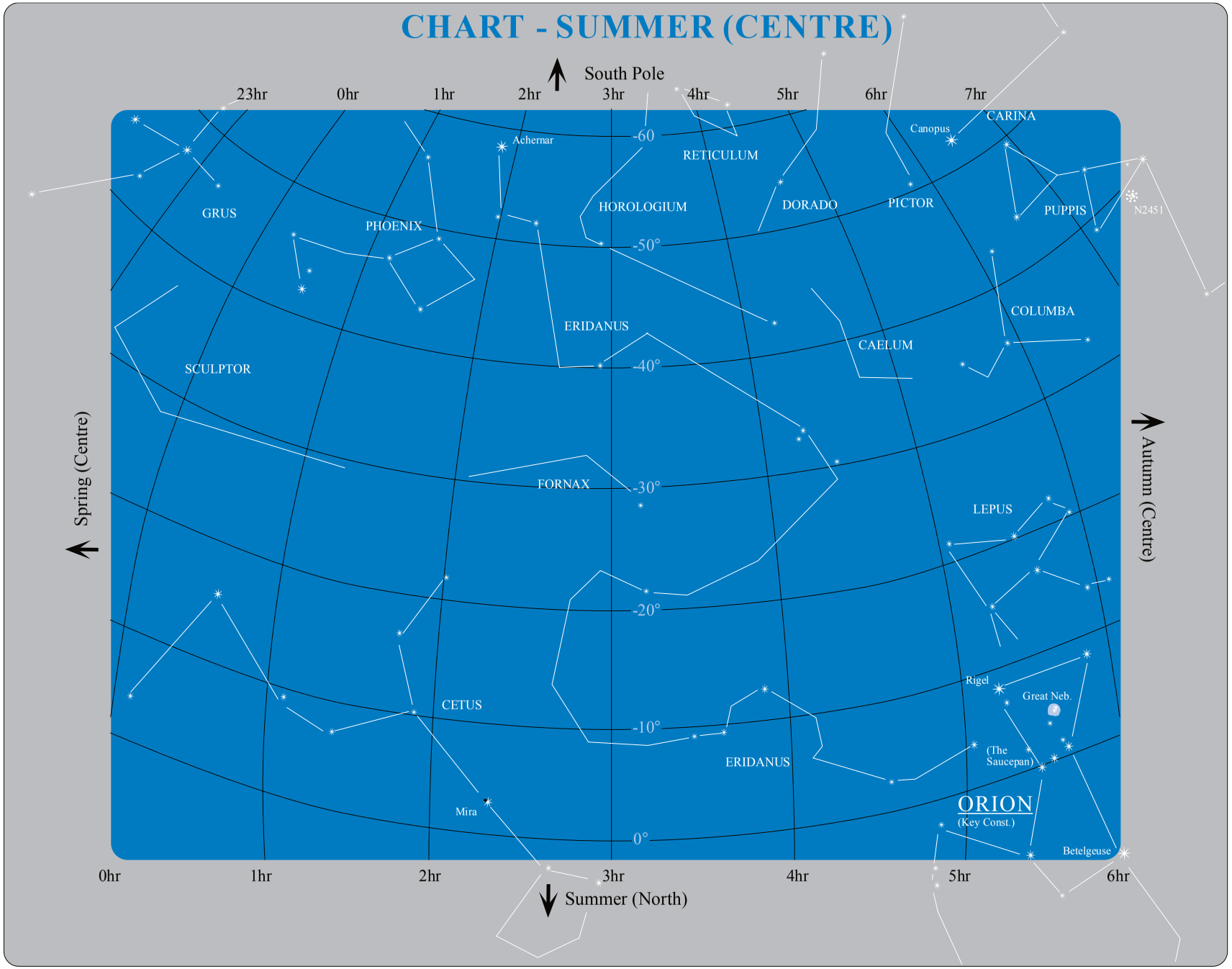


CHART - SUMMER (CENTRE)



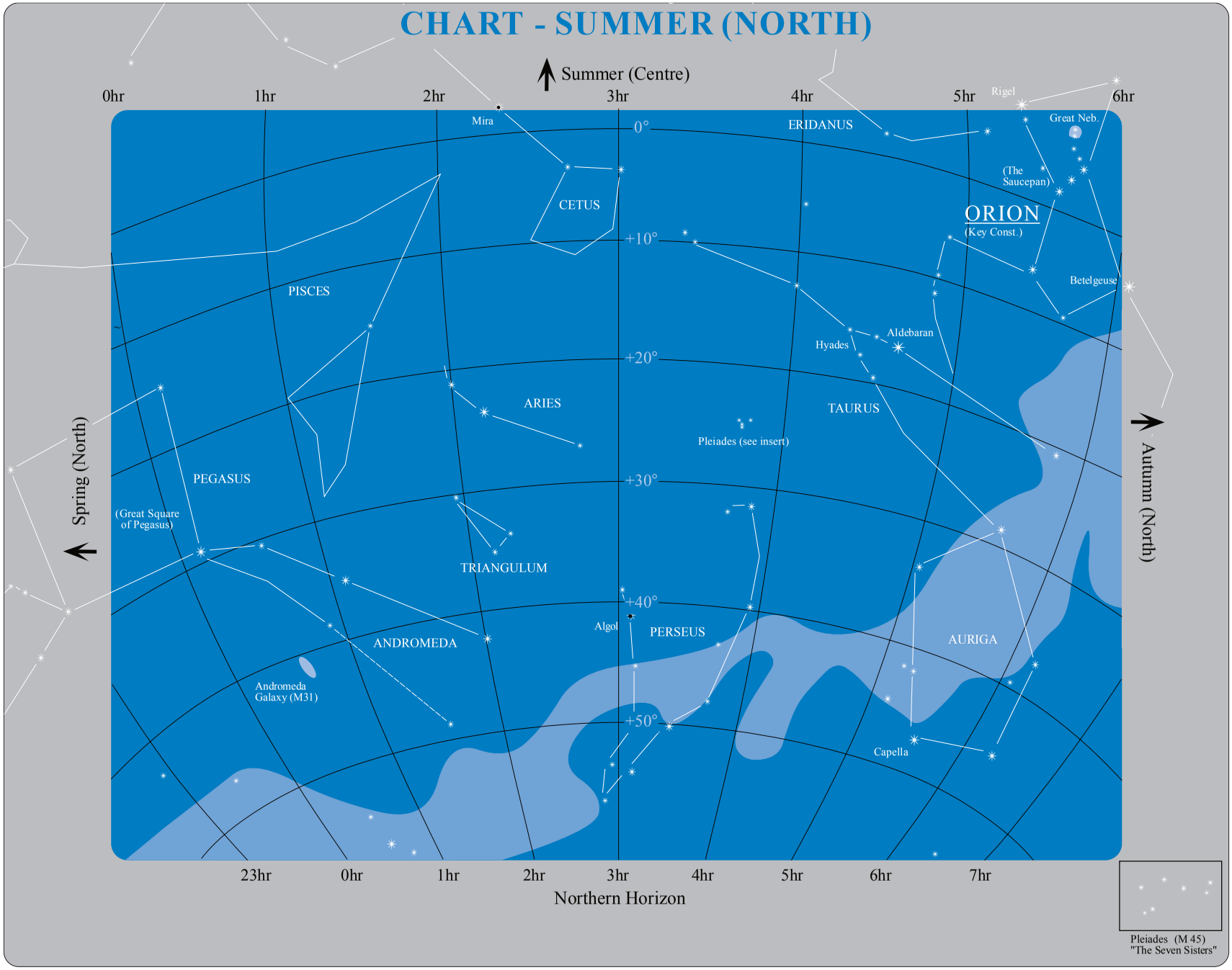
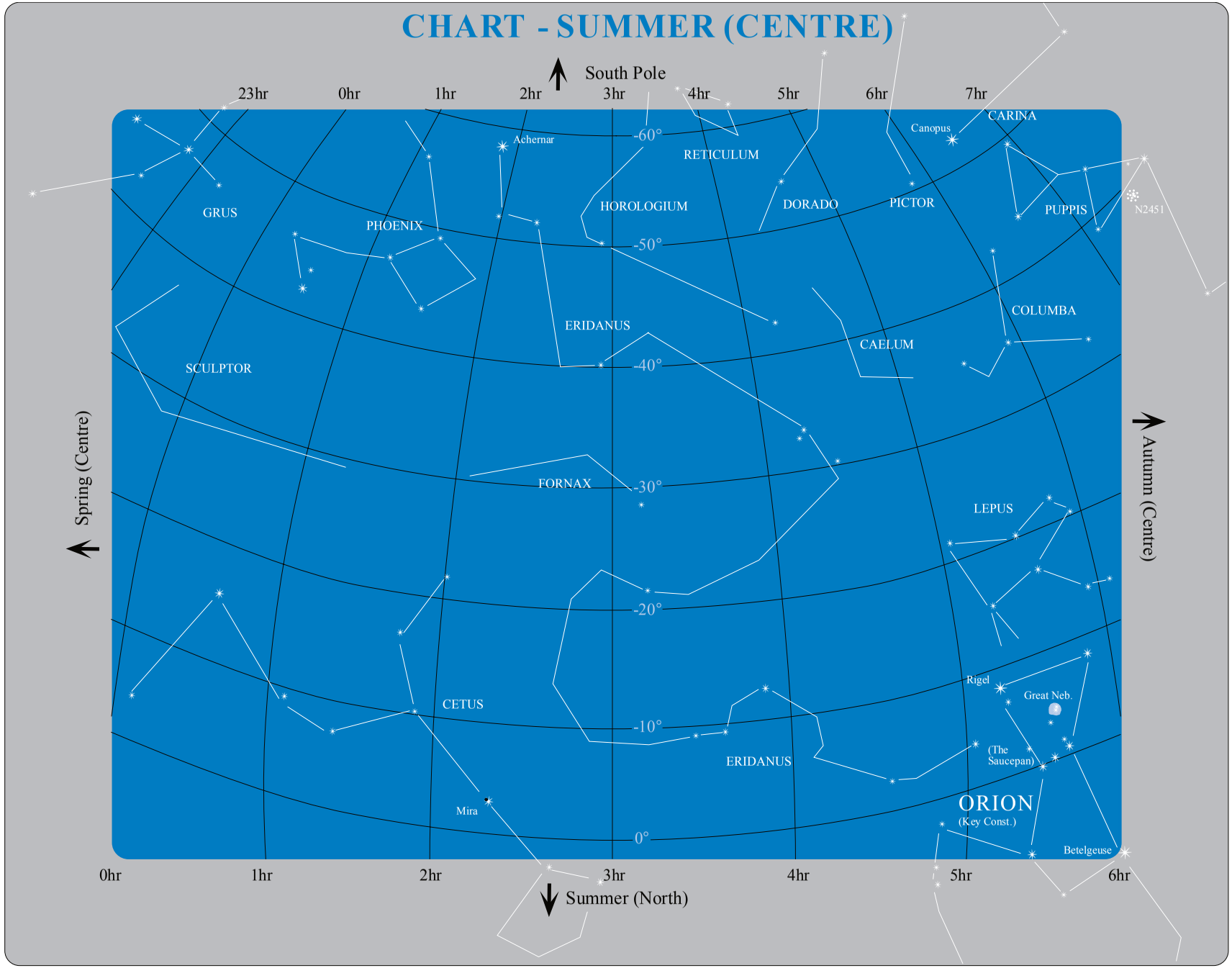


CHART - SUMMER (NORTH)
Summer (Centre)
0hr
1hr
2hr
3hr
4hr
5hr
6hr
Rigel
Mira
ERIDANUS
Great Neb.
(The Saucepan)
CETUS
ORION
(Key Const.)
0°
+10°
+20°
+30°
+40°
+50°
PISCES
Betelgeuse
Aldebaran
Hyades
ARIES
TAURUS
Pleiades (see insert)
Spring (North)
Autumn (North)
PEGASUS
(Great Square of Pegasus)
TRIANGULUM
Algol
PERSEUS
AURIGA
ANDROMEDA
Andromeda Galaxy (M31)
Capella
23hr
0hr
1hr
2hr
3hr
4hr
5hr
6hr
7hr
Northern Horizon
Pleiades (M 45)
"The Seven Sisters"

CHART - SUMMER (CENTRE)



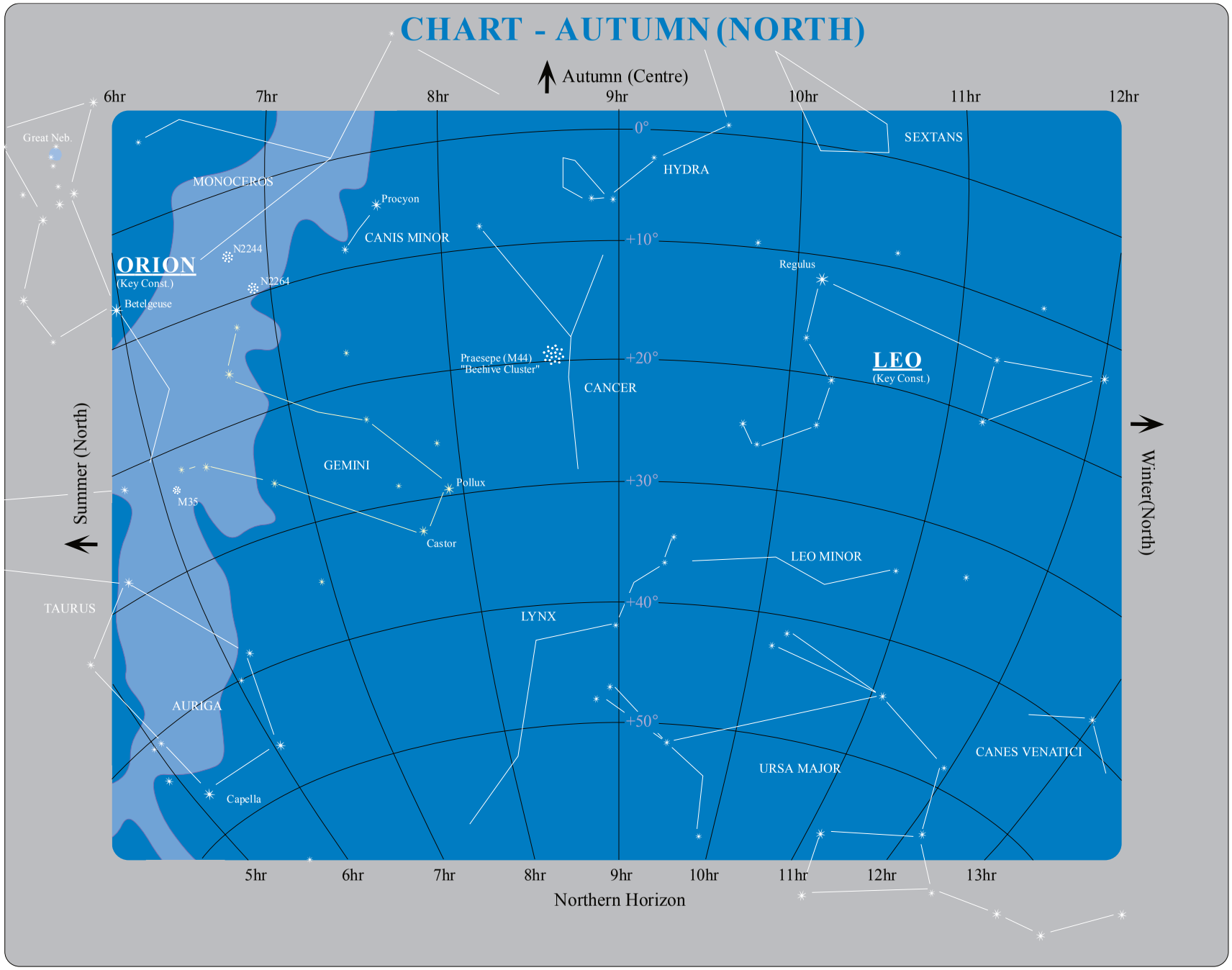
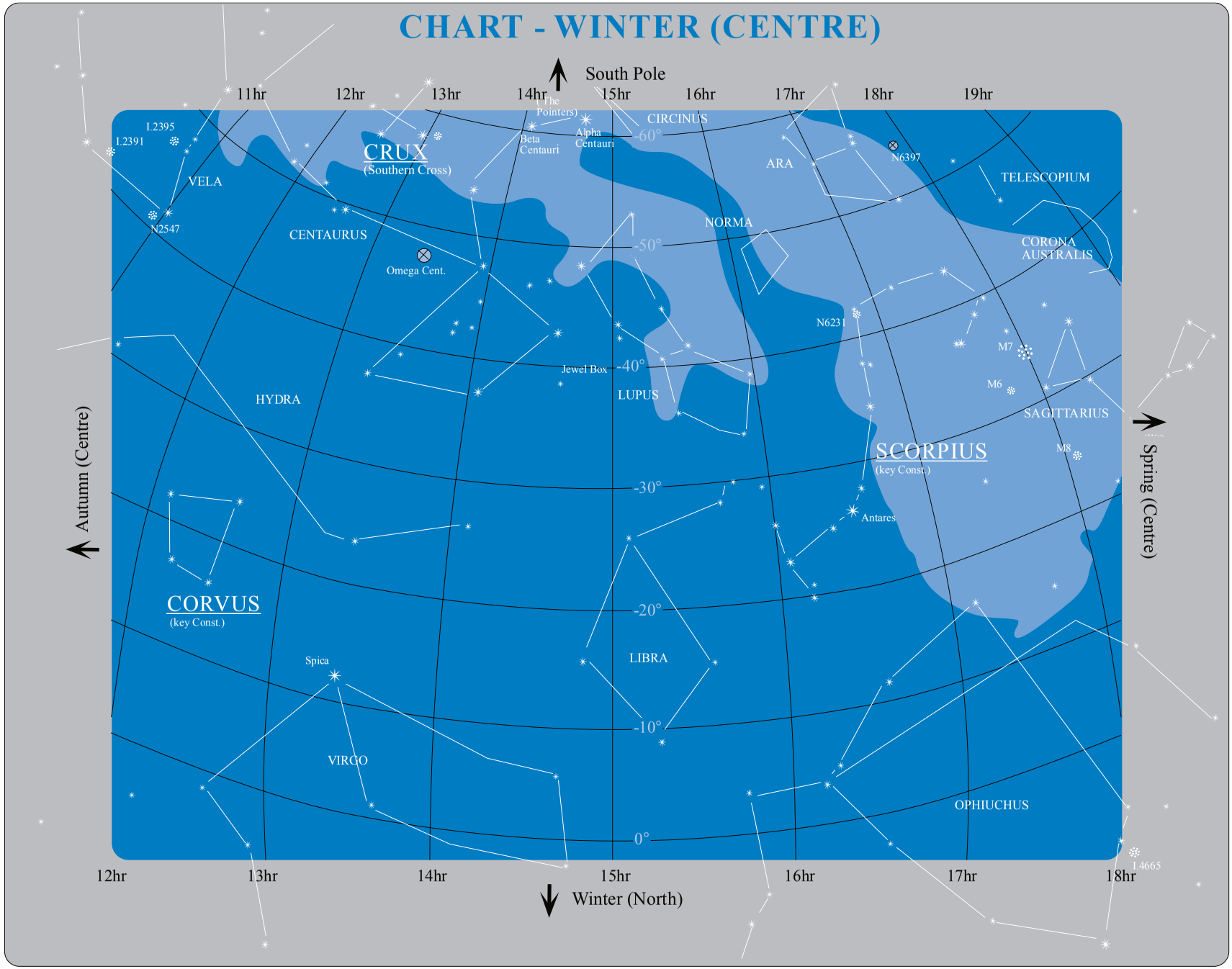


CHART - AUTUMN (NORTH)
Autumn (Centre)
6hr
7hr
8hr
9hr
10hr
11hr
12hr
0°
+10°
+20°
+30°
+40°
+50°
Great Neb.
MONOCEROS
Procyon
CANIS MINOR
N2244
ORION
(Key Const.)
N2264
Betelgeuse
HYDRA
SEXTANS
Regulus
LEO
(Key Const.)
Praesepe (M44)
"Beehive Cluster"
CANCER
GEMINI
Pollux
M35
Castor
LEO MINOR
LYNX
TAURUS
AURIGA
Capella
URSA MAJOR
CANES VENATICI
Summer (North)
Winter(North)
5hr
6hr
7hr
8hr
9hr
10hr
11hr
12hr
13hr
Northern Horizon

CHART - WINTER (CENTRE)



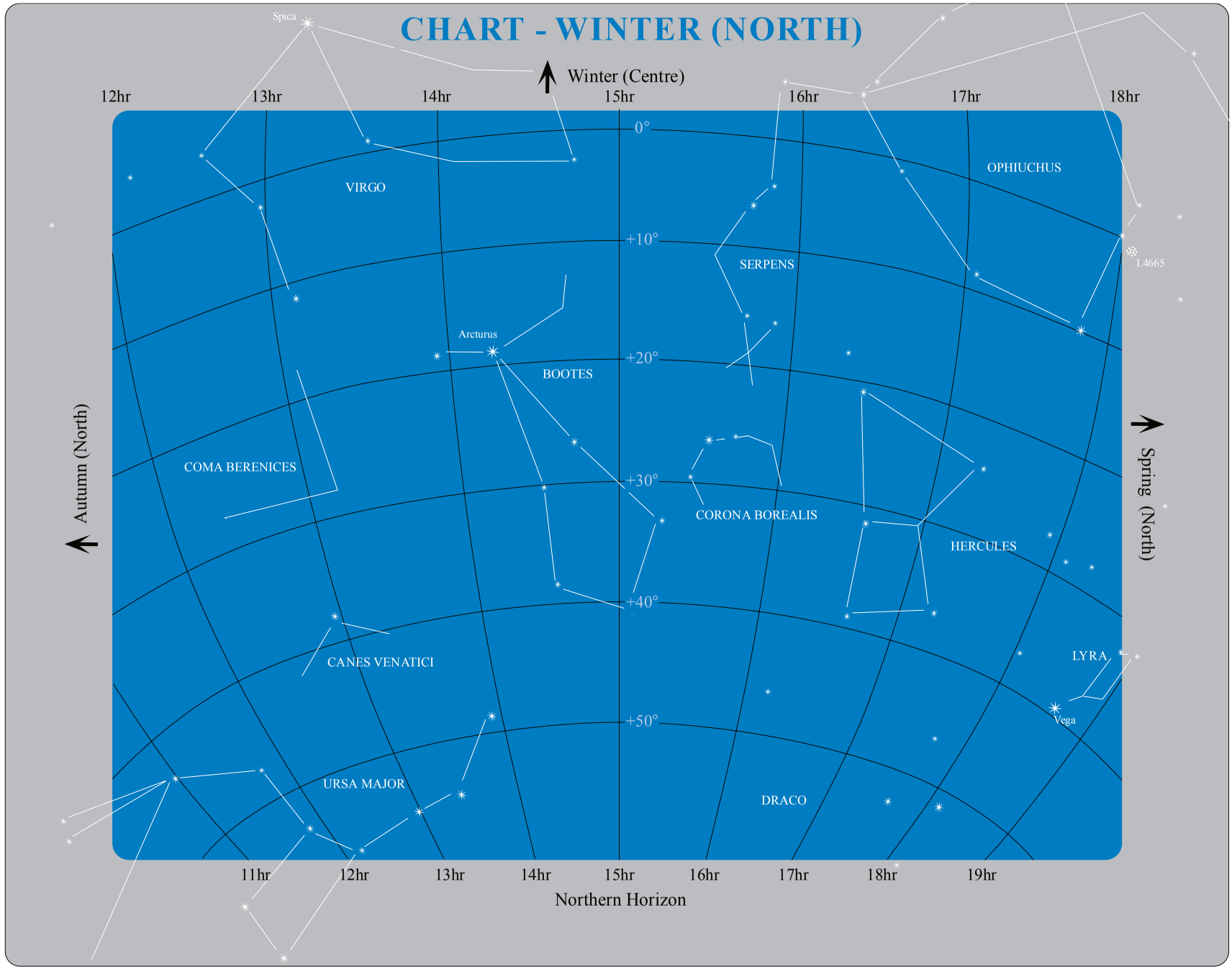
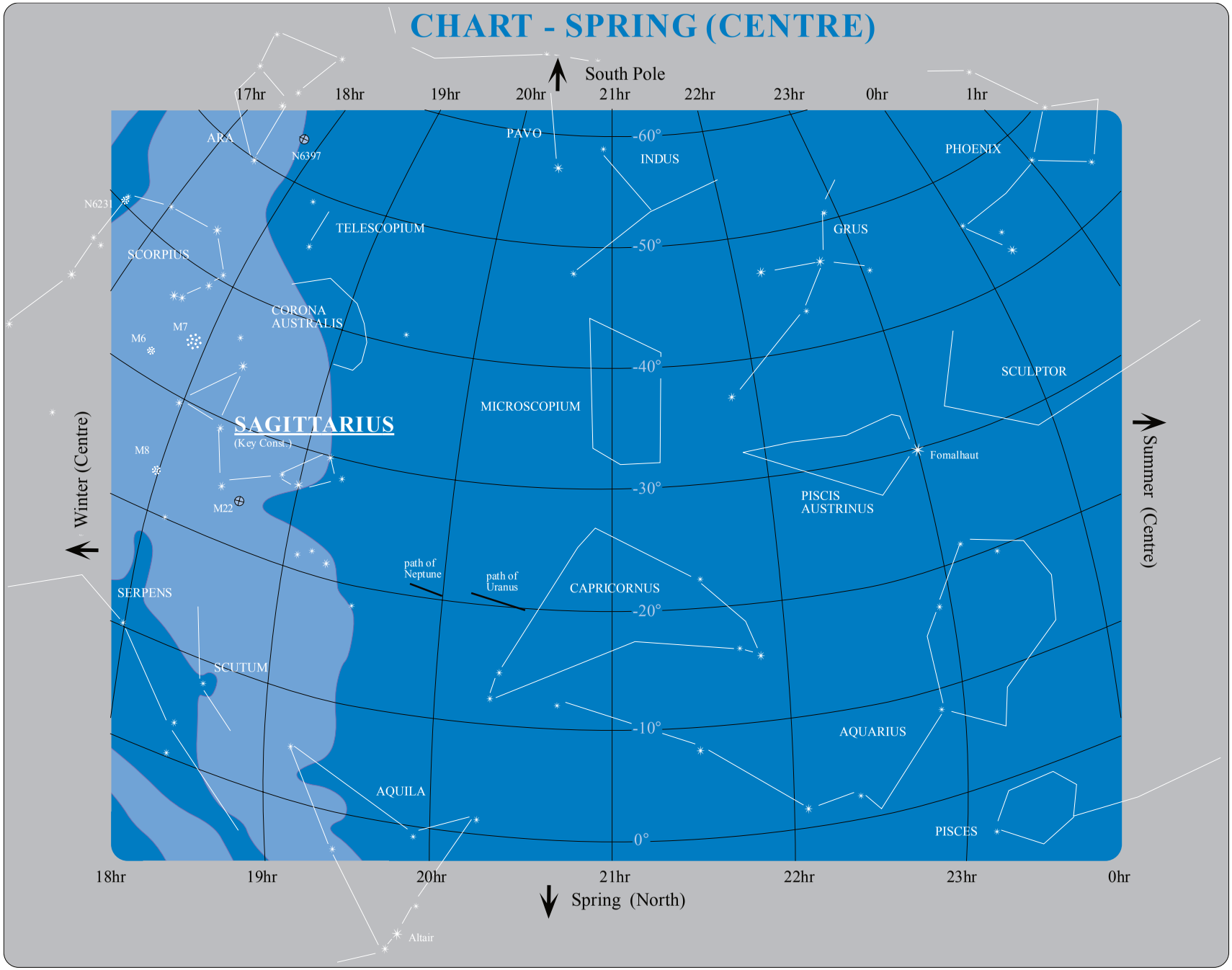


CHART - WINTER (NORTH)
Winter (Centre)
12hr
13hr
14hr
15hr
16hr
17hr
18hr
0°
+10°
+20°
+30°
+40°
+50°
Spica
VIRGO
OPHIUCHUS
SERPENS
I.4665
Arcturus
BOOTES
COMA BERENICES
CORONA BOREALIS
HERCULES
CANES VENATICI
LYRA
Vega
URSA MAJOR
DRACO
Autumn (North)
Spring (North)
11hr
12hr
13hr
14hr
15hr
16hr
17hr
18hr
19hr
Northern Horizon

CHART - SPRING (CENTRE)



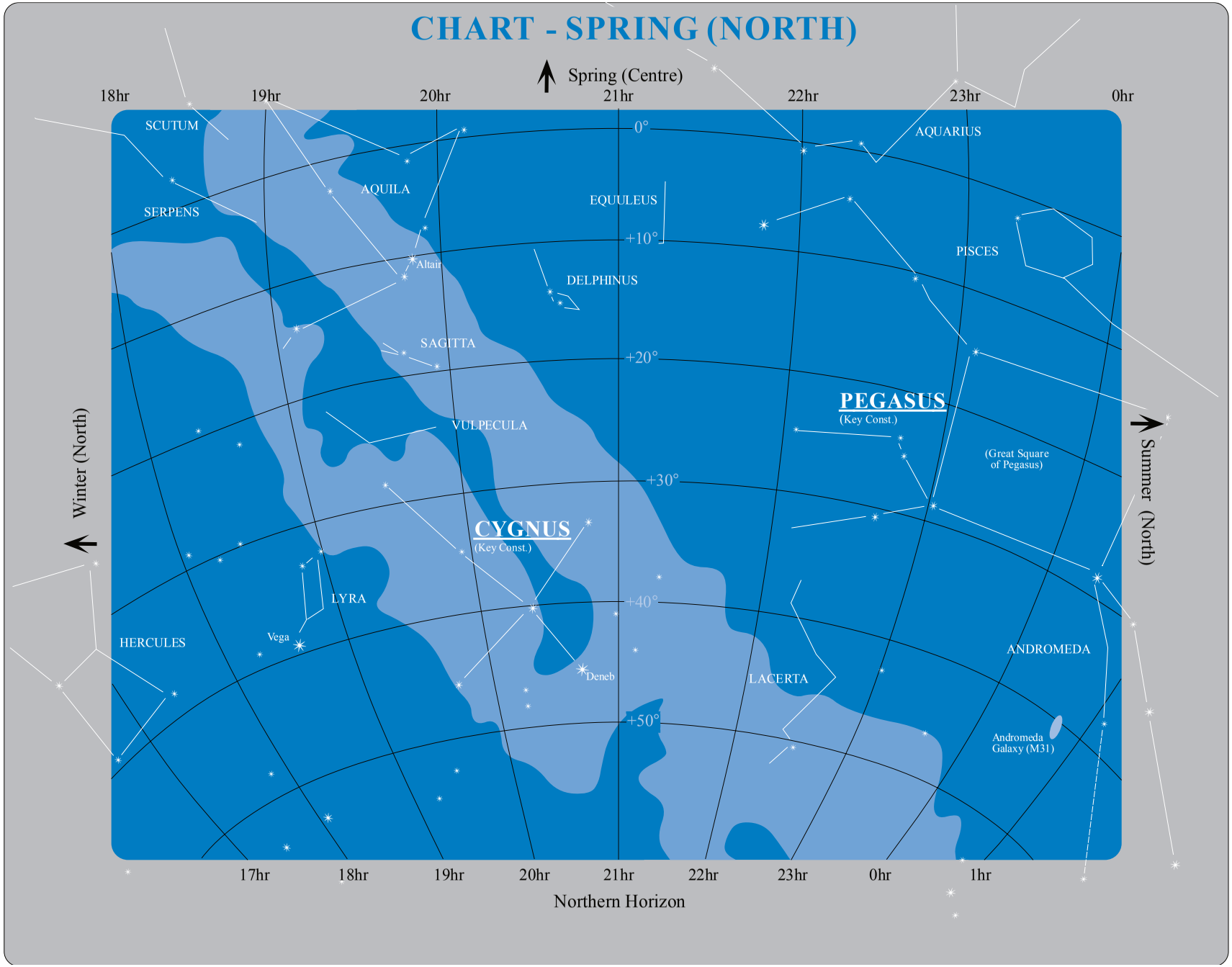


CHART - SPRING (NORTH)
Spring (Centre)
18hr
19hr
20hr
21hr
22hr
23hr
0hr
SCUTUM
AQUILA
SERPENS
EQUULEUS
AQUARIUS
0°
+10°
Altair
DELPHINUS
PISCES
SAGITTA
+20°
PEGASUS
(Key Const.)
VULPECULA
(Great Square
of Pegasus)
Winter (North)
Summer (North)
+30°
CYGNUS
(Key Const.)
LYRA
+40°
HERCULES
Vega
ANDROMEDA
Deneb
LACERTA
+50°
Andromeda
Galaxy (M31)
17hr
18hr
19hr
20hr
21hr
22hr
23hr
0hr
1hr
Northern Horizon

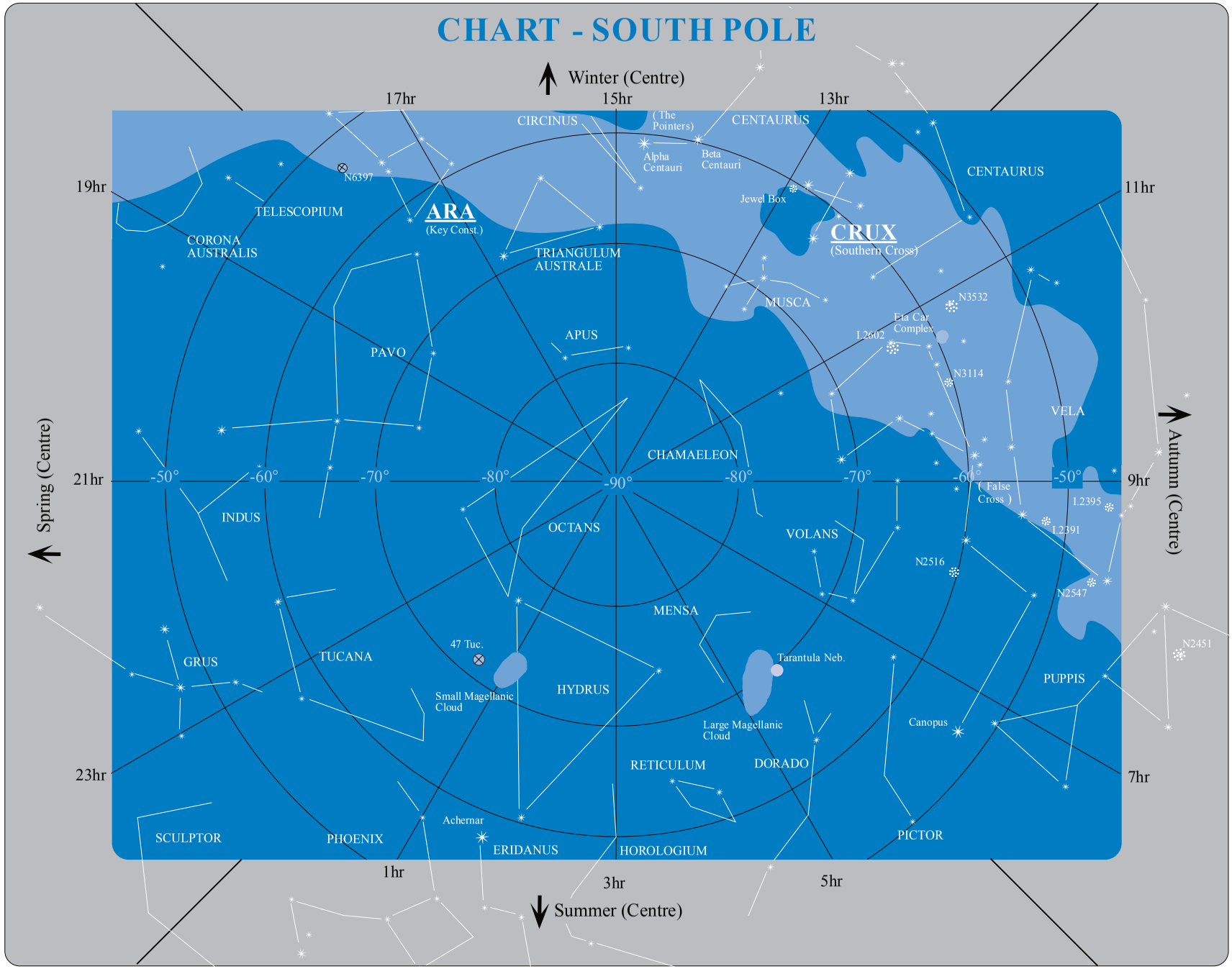


CHART - SOUTH POLE
Winter (Centre)
Summer (Centre)
Spring (Centre)
Autumn (Centre)
17hr
15hr
13hr
19hr
11hr
21hr
9hr
23hr
7hr
1hr
3hr
5hr
-50°
-60°
-70°
-80°
-90°
CIRCINUS
(The Pointers)
CENTAURUS
Alpha Centauri
Beta Centauri
N6397
TELESCOPIUM
ARA
(Key Const.)
Jewel Box
CRUX
(Southern Cross)
CORONA AUSTRALIS
TRIANGULUM AUSTRALE
MUSCA
N3532
Eta Car Complex
L2602
APUS
PAVO
N3114
VELA
CHAMAELEON
(False Cross)
L2395
L2391
INDUS
OCTANS
VOLANS
N2516
N2547
MENSA
47 Tuc.
Tarantula Nebula
N2451
GRUS
TUCANA
HYDRUS
PUPPIS
Small Magellanic Cloud
Large Magellanic Cloud
Canopus
RETICULUM
DORADO
Achernar
SCULPTOR
PHOENIX
ERIDANUS
HOROLOGIUM
PICTOR

SKY CHARTS (see pages 60 to 68)

INTRODUCTION

The sky view diagrams in the monthly (part 1) section of this book do not cover all the sky. As explained in the introduction to part 1, the 'sky views' were designed to help you find the planets. Therefore the sky views are restricted to a strip of sky that roughly follows the ecliptic and concentrates on the zodiac constellations. This results in a lot of sky not covered by the sky views. The **SKY CHARTS** (on the previous 9 pages) **cover the entire sky** visible from mid Australian latitudes. Note that the Sun, Moon and planets are not shown with the exception being the position of the Uranus/ Neptune finder charts.

WHAT ARE THEY?

The sky charts break up the sky into 3 regions. They are

1. The **North** region. This is the northern part of the sky.
2. The **Centre** region. This region stretches from the east to overhead and on to the west.
3. The **South Pole** region, which covers the southern sky.

The North and Centre regions are each broken into 4 charts(pages). Each of these charts are named after a season. The season indicates the time of the year when this part of the sky is well placed (high) in the evening sky. So the nine charts are: **Summer** (**north** and **centre**), **Autumn** (**north** and **centre**), **Winter** (**north** and **centre**), **Spring** (**north** and **centre**) and the **South Pole** Chart.

Each of the 'season' pairs are laid out on opposite pages ie. the centre chart is the left-hand page; the north is the right-hand page. The South pole chart is on its own and opposite this page.

To help people who have become used to the 'sky views', the 'sky charts' have been drawn to the same scale as the 'sky views' in part 1.

HOW DO I USE THEM?

To use the charts, the relevant 'season' double page is rotated clockwise 90°, so that the 'north' chart (with northern horizon marked at the bottom) is now under the 'centre' chart. Face north, and the bottom (north) chart will correspond to the north sky. As you move up the northern sky, you will cross over to the upper (centre) chart (the middle of this chart should be directly overhead). If you continue overhead, moving towards the south, the top of the 'centre' chart will adjoin the relevant quadrant in the 'south pole' chart (opposite). The dates/times chosen for the charts were as follows.

- 'Summer' charts, December 22 at 9pm.
- 'Autumn' charts, March 22 at 9pm.
- 'Winter' charts, June 22 at 9pm.
- 'Spring' charts, September 22 at 9pm

These star fields are slowly moving as the Earth rotates on its axis. If you are looking north, they will turn slightly anticlockwise as they move from east to west. Looking south, the motion appears clockwise and the rotation becomes more obvious as you get closer to the pole. To help you adjust to the changing orientation of the charts, it is always a good idea to find a few obvious constellations and memorise them. They will quickly become your starting points to discovering the rest of the sky. A bit like driving around a new part of a suburb; you start from the major roads that you know. A few suggested starting constellations are marked on the 'sky charts'. These 'Key Constellations' are marked in large letters that are bold and underlined eg. **ORION** (Key Const.).

The charts also have the RA and Declinations marked on them. The RA are the lines marked 'hr'. The middle 'hr', running up through the centre of the centre/north charts (still turned on their side) is the RA on the meridian. For example, the graph of 'Hours of RA on the Meridian' (page 128) shows the RA on Dec. 22 @ 9pm (Summer Chart) to be around 3 hours.

Suppose it is March 31 at 11.30pm (23.30hrs). From the graph on page 128 the RA on the meridian is 12 hours. The 12 hr line on the sky charts runs down the right-hand end of the Winter charts and the left side of the Spring charts ie. the border of these charts is now on the meridian. Therefore if you are looking north, the left side of the sky is the Winter chart, the right - the Spring chart.

Until now little has been said about the lone 'South Pole' chart. The stars in this chart never set, they just rotate around the centre (Declination -90°) of the field. To find out which way is up (at your date/time) is easy. Returning to our March 31 example, rotate the chart until the RA on the meridian is at the top. In this case it was 12 hours.

PART 2 - THE SOLAR SYSTEM

GENERAL COMMENTS

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

TIME There are three time zones used in part 2 of this book. They are Australian Eastern Standard Time (AEST) ie. used in part 1, Australian Central Standard Time (ACST) and Universal Time (UT). ACST is used only in data with have been specifically generated for Adelaide or Darwin ie. the rise and set (see the individual Sun, Moon and planet sections) and lunar occultation tables (pages 71 - 77) for these cities. The 24 hr clock is often used in astronomy eg. 16:00 hr is equal to 4:00pm. This avoids having to distinguish between 'am' and 'pm'. The 24hr approach is used a lot in Part 2 of this book, eg. for rise/set times. In some areas, it is convenient to use decimal hours. eg. 5.3hr is the same as 5hr 18 min or 5:18hr.

LOCATIONS Rise/Set and Lunar Occultation data are given for specific cities. The latitudes and longitudes used are:

Adelaide	34° 58'S 138° 38' E	Brisbane	27° 30'S 153° 01' E
Canberra	35° 15'S 149° 08' E	Darwin	12° 20'S 130° 50' E
Hobart	42° 48'S 147° 13' E	Melbourne	37° 50'S 145° 00' E
Sydney	33° 54'S 151° 15' E	Townsville	16° 16'S 146° 48' E

UNIVERSAL TIME, or UT, is the mean time for the meridian of Greenwich, England reckoned from midnight. AEST is 10 hours ahead of UT (ACST 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 coordinates. 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 divided into 24 one 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. Instead, 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, including 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 (see opposite sky chart).

POSITION TABLES. All Right Ascensions and Declinations have been calculated for 0 hr UT on the date listed (Epoch 2000). All positions are 'geocentric'. This means they have been calculated for a position at the centre of the Earth. There is no allowance for parallax effect of the observer being on the surface of the Earth. Except for the Moon, this slight shift is insignificant. Positions for the outer planets are given in weekly intervals and correspond to Saturdays. The Sun, Moon, Venus and Mercury are daily.

RISE AND SET TIMES. The rise and set times for various objects are given in AEST, except Adelaide and Darwin which use ACST (see above). The times given are when the upper limb of the object is coincident with the theoretical horizon. Atmospheric refraction is allowed for. 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 relative to where the celestial poles (+ and -90° in declination) will be in the year 2000. This epoch has now been adopted by most modern star atlases. There are still atlases around which use epoch 1950.0 and it is important to check your atlas before using (or buying) it to ensure it is epoch 2000.0. The precession over this 50 year period can cause a shift of up to one degree in the apparent position of a solar system object relative to the background stars. This may not be a problem when looking for the brighter planets, but high precision may be necessary to track down a 12th magnitude comet. The calculations required to convert (or 'precess') positions from one epoch to another, are not complicated considering the power of the calculators/ computers that are available today. Suggested references are 'Practical Astronomy with a Calculator' (Duffett-Smith) or 'Astronomical Formulae for Calculators' (Meeus).

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

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

RETROGRADE MOTION. The finder charts, for the outer planets, have one thing in common - an apparent motion with a 'loop' shape. This puzzled astronomers for centuries until it was finally recognised that the Earth orbited the Sun just like any of the other 'wanderers' or planets (unfortunately the Earth was no longer the centre of the Universe). The diagram (p.71) 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. All the outer planets reach opposition each year, except for Mars that is every 26 months. Mars does not reach opposition this year and you will notice on the finder charts (see page 97) that the red planet does not show the 'loop' this year. Returning to the 'Retrograde Motion Diagram', the shaded area represents the path of an outer planet against the celestial sphere. As the Earth moves around the Sun faster than this outer planet (let's call it Uranus), it overtakes it; 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 Uranus continues its west to east path and begins to slow to position 3 as the Earth catches up. Between 3 and 5 Uranus 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, Uranus continues its west to east direction.

Because all the orbits of the outer planets are inclined to that of the Earth's, the path can never be a straight line. It will always be a 'loop' or an 'S' shape. An 'S' shape will happen if it is near one of its nodes (the points where a planet crosses the plane of the Earth's orbit), at the time of opposition. During 1996, Jupiter shows an 'S' for it reaches a node about a month before opposition.

SECTION EXPLANATION

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

'**PLANETARY ANGULAR SIZE' DIAGRAM** (p. 74) The 'Y' axis of this diagram is arc seconds. It is interesting that Venus this year reaches inferior conjunction and grows to an angular size exceeding 50 arc seconds. There have been rare reports of people having the ability to see the crescent of Venus with the naked eye, around this time. It is certainly worthwhile trying to observe Venus' crescent in binoculars (it helps to keep the binoculars steady by mounting them on a tripod). Looking during twilight may also help, for there is less glare. See part 1 for the expected crescent shape.

'**MERIDIAN PASSAGE OF THE SUN AND PLANETS' DIAGRAM** (p. 75). In this diagram, the 'Y' axis represents the local mean time. It shows the time the Sun and planets cross the meridian (or culminates) for the year. When a planet culminates around midnight (0 or 24 hours), it is at opposition and visible the whole night. Ideally observations at night would be made as close as possible to the time of culmination. At that time it has reached its maximum altitude and the effects of atmospheric turbulence are minimised. Unfortunately this is not possible for Mercury or Venus.

MOON -RISE/SET DATA (pages 80 to 83). 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 the Moon's 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).

JUPITER and SATURN

Jupiter's Moons (see pages 103 to 105). Jupiter is like a miniature solar system with 16 moons orbiting the planet. Also, like the planets, these moons all lie in a similar plane. This plane is also very close to the Earth's orbit. Therefore, seen from Earth, the Moons appear to move from side-to-side (east-west) of Jupiter, occasionally passing across (a transit) or behind (an occultation) the planet. These diagrams show the patterns the four major moons of Jupiter make as they move from side-to-side. Each complete period represents one orbit of the satellite. The horizontal date line represents 10:00am AEST (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 pages 101 and 102). The same can be done with the occultation times ie. when the line disappears behind Jupiter. These four moons (Io, Europa, Ganymede and Callisto) are bright enough to be seen in binoculars (7x power or greater is recommended). It may be necessary to mount the binoculars on a tripod to help keep them steady. Initially, 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 evening of June 22. The power or magnification of the binoculars will determine how close to Jupiter you can follow a moon.

'Phases of the Eclipses' (below 'Jupiter's Moon' diagram) shows the positions of the eclipse events for each satellite for the month, relative to Jupiter. An eclipse is when the moon passes into (disappearance or d') or out of (reappearance or T') Jupiter's shadow. The table on the bottom of page 100 lists the position of these events in fractions of Jupiter radii.

Longitudes of Central Meridian. (pages 99 and 110) Unlike Mars, Jupiter and Saturn are 'Gas Giants' and they only allow us to view their upper atmospheric features. There is no one correct rotation period. The speed of movement of any feature on the surface depends on its latitude, hence the multiple rotation systems used. For Saturn, only the equatorial (System I) region is listed. To monitor the movement and development of any feature, amateurs often measure the time a feature crosses the central meridian of the planet. Features on Saturn are less obvious than those seen on Jupiter and a 20 to 25cm telescope is needed to glimpse any details.

The longitude can be worked out from the 'longitude of central meridian' tables. All the times on the main tables (ie. daily figures) are calculated for 0hrs UT (10:00am AEST) of date. 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 June 21 at 2:20am AEST would be calculated as follows:

The longitude. on June 20 is 290.0°. 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 527.5°; subtracting 360° gives a final answer of 167.5°.

Saturn's Rings. (p 110) The appearance of the planets diagrams in part 1, show how 'open' the rings are for 1996. The plane of the rings is tilted with respect to the plane of the ecliptic by 28°. The planet's 'year' is 29.5 (Earth) years. During this period the Earth can be up to 28° above or below the plane of the rings. Every 7 years, after each of these maximum ring 'openings', the Earth passes through the plane of the rings and they are seen 'edge-on'. As described in part 1, the rings were edge-on during 1995 and again in February this year. The rings were last wide open in 1988.

Satellites of Saturn (pages 108 and 109). To estimate the configuration or positions of the satellites, the 'Apparent Orbits' diagram (p. 108) 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. 108) and that gives the moon's position directly.

When the rings are 'edge-on' is a good opportunity to look for the inner satellites. While the rings are reduced to a faint line, the faint inner moons (which are normally invisible against the glare of the rings) can sometimes be glimpsed in medium to large amateur telescopes. Unfortunately, the February 1996 'edge-on' period is close to conjunction and this exercise becomes difficult.

URANUS / NEPTUNE / PLUTO

Finder Charts for Uranus and Neptune (see p. 114). To help locate these planets the position of these charts is marked on the 'Sky Chart' on p. 114.

Satellites of Uranus (see p. 112).Titania (I) 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

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II, are harder to observe and they would be a real test for a 40cm telescope. The orbits of the satellites are nearly face-on as seen from Earth (see diagram p. 112). The orbits' apparent minor axis (running east/west) is 70% that of the apparent major axis (north/south). For example, Oberon, at opposition, has a maximum elongation of 44' (see p. 73). Its minimum elongation would be 70% of this or 31'. To locate the approximate position angle (degrees east of north for a satellite, at your time of observation:

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

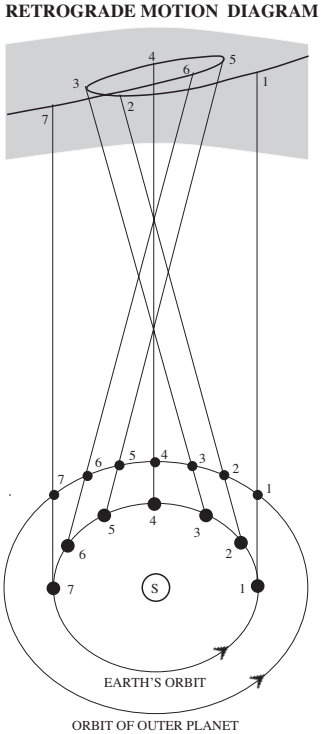
Satellites of Neptune (see p. 112). With typical amateur telescopes, Triton (1) is the only observable moon. To find Triton, use the approach as described above for the satellites of Uranus. Note that in this case, the apparent major axis is in the east/west direction. Like Uranus, the orbits of the Neptunian satellites are currently relatively open or 'face-on' (see diagram p. 112). In 1996, Triton's apparent orbit as seen from Earth is a pronounced ellipse with the minor axis being 76% of the major axis. Therefore Triton, at opposition, varies from 17' (see p. 73) down to 13'. To find the approximate position angle of Triton, the same approach is used as above for Uranus. The sidereal orbital period for Triton is 5.88 days and in step 3 add 90° to get the position angle from north. If the answer is greater than 360°, subtract 360°.

PLUTO (see pages 114 and 115). The pointer chart (p. 114) is designed to help people find the general area for Pluto. The shaded block shows the position of the main chart (p. 115). 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 comprehensive catalogue of stars available. It covers some 19 million stars and deep sky objects!

MINOR PLANETS (see pp. 122 and 123). 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 are found 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 several 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 several 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 bright (by amateur standards) and most of them only around their time of opposition. The ephemerides are for 20 of the minor planets (all returning to opposition) expected to reach magnitude 10 or brighter this year.

RETROGRADE MOTION DIAGRAM



PART 3 - THE APPENDICES

GENERAL NOTES

Brightest and Nearest Stars (p. 124) 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. 136). 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 star's 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 (see glossary).

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

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

It is interesting trying to see the colour in stars, but it is worthwhile knowing the limitations of the human eye. The photosensitive part of the eye is the retina. It consists of two types of light receptors, 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 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.

Hours of RA/ Constellations on the Meridian (p. 128) 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 affecting 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 11 Parthenope (p. 122) in mid May 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 midnight (0 or 24 hours). Therefore this object will be up most of the night and it would be expected to be near opposition (opposition is May 22). Another example; supposing it is November 1 and you wish to go out and observe the Andromeda galaxy. Looking along the line that marks the beginning of November, the diagonal RA line for the constellation Andromeda (0 hr) is found at 21:30 hours (9:30pm). It is therefore best to observe this object early in the evening. When an object is on the meridian, its right ascension (RA) also corresponds to the sidereal time. The RA's of the brightest, deep sky objects, visible from the southern hemisphere, are listed in the 'Non Stellar Objects' (page 125). The dates that all the constellations cross the meridian at 9pm are listed in the 'Constellations' appendix (page 128).

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SOLAR SYSTEM DATA — THE PLANETS

NAME	MEAN DISTANCE FROM SUN (x 10^3 km)	(Earth = 1)	MAG at OPP	EQUATORIAL DIAMETER (km).	FLATTENING [1]	No of MOONS	MASS (x10^{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.

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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.

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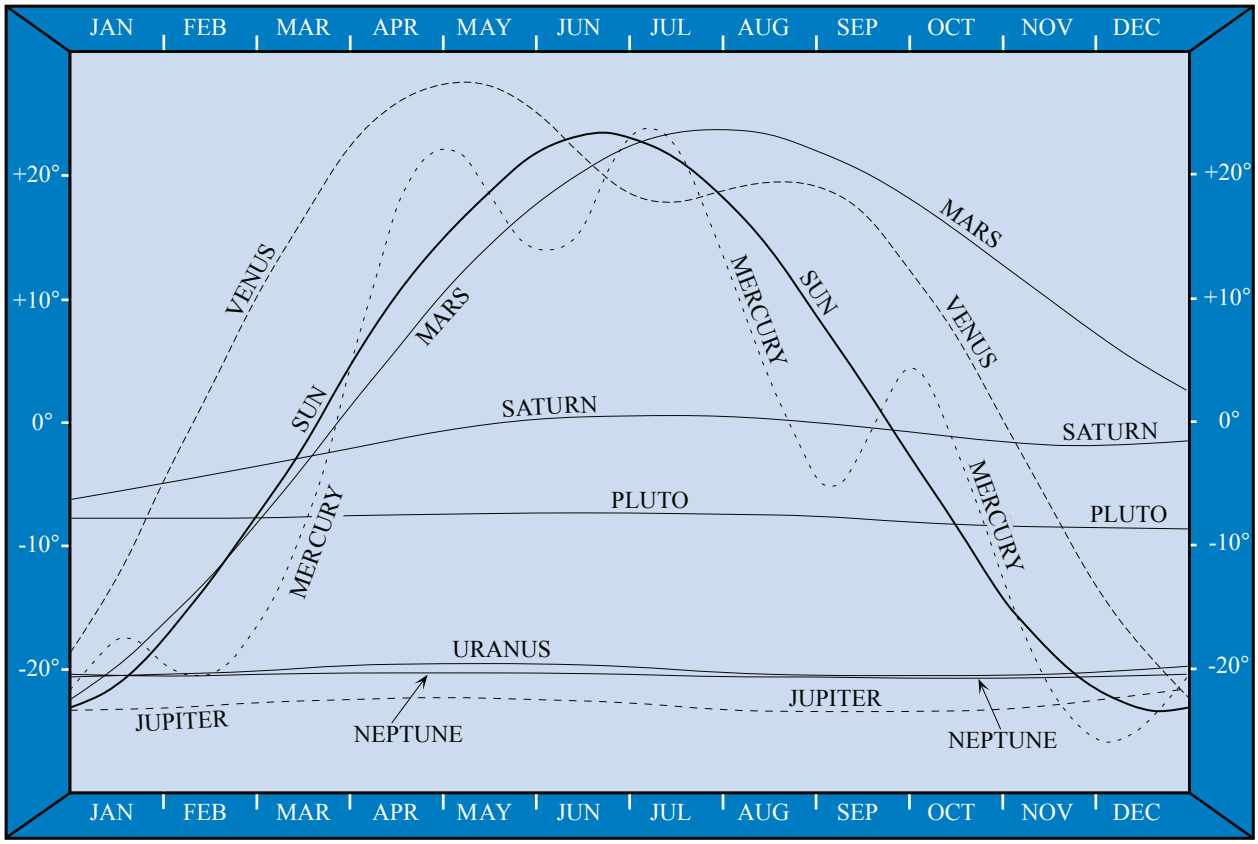
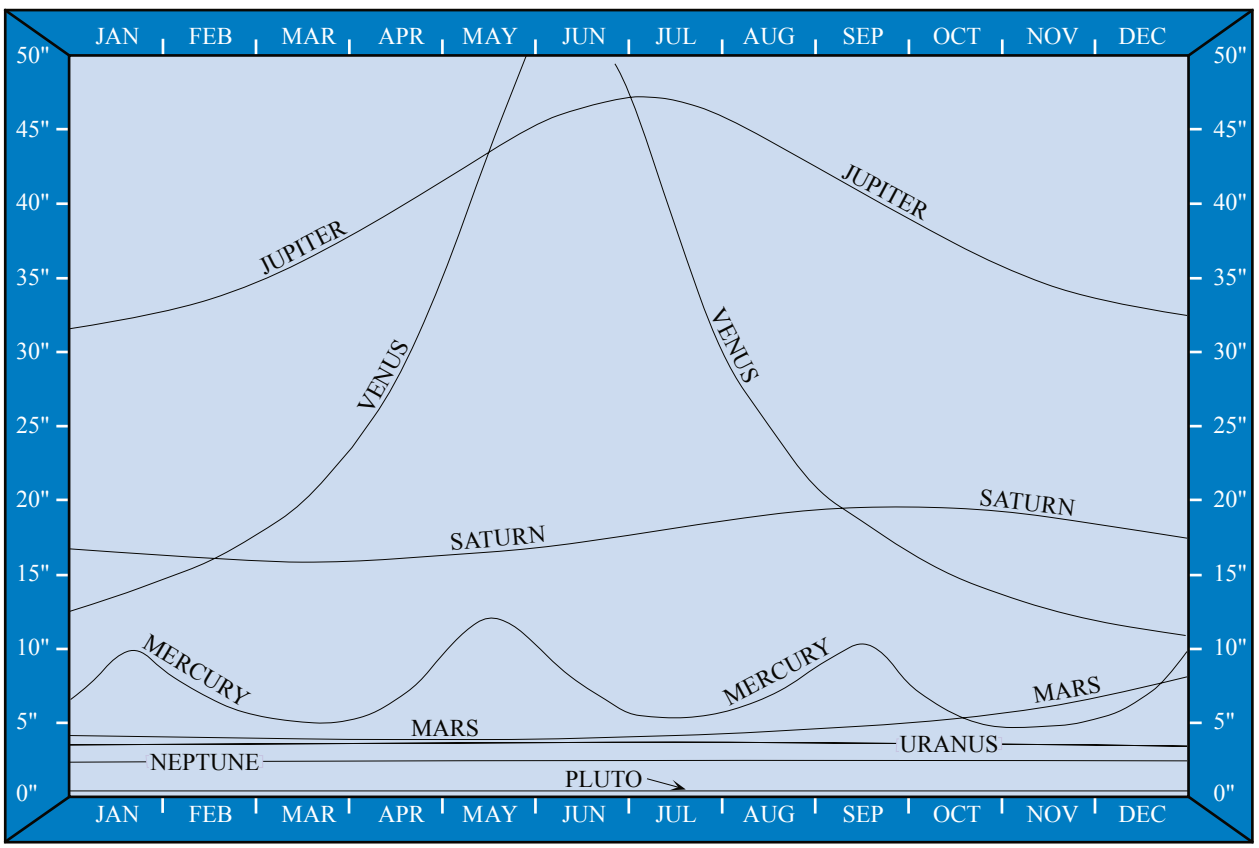
DECLINATIONS of the SUN and PLANETS



PLANETARY ANGULAR SIZE



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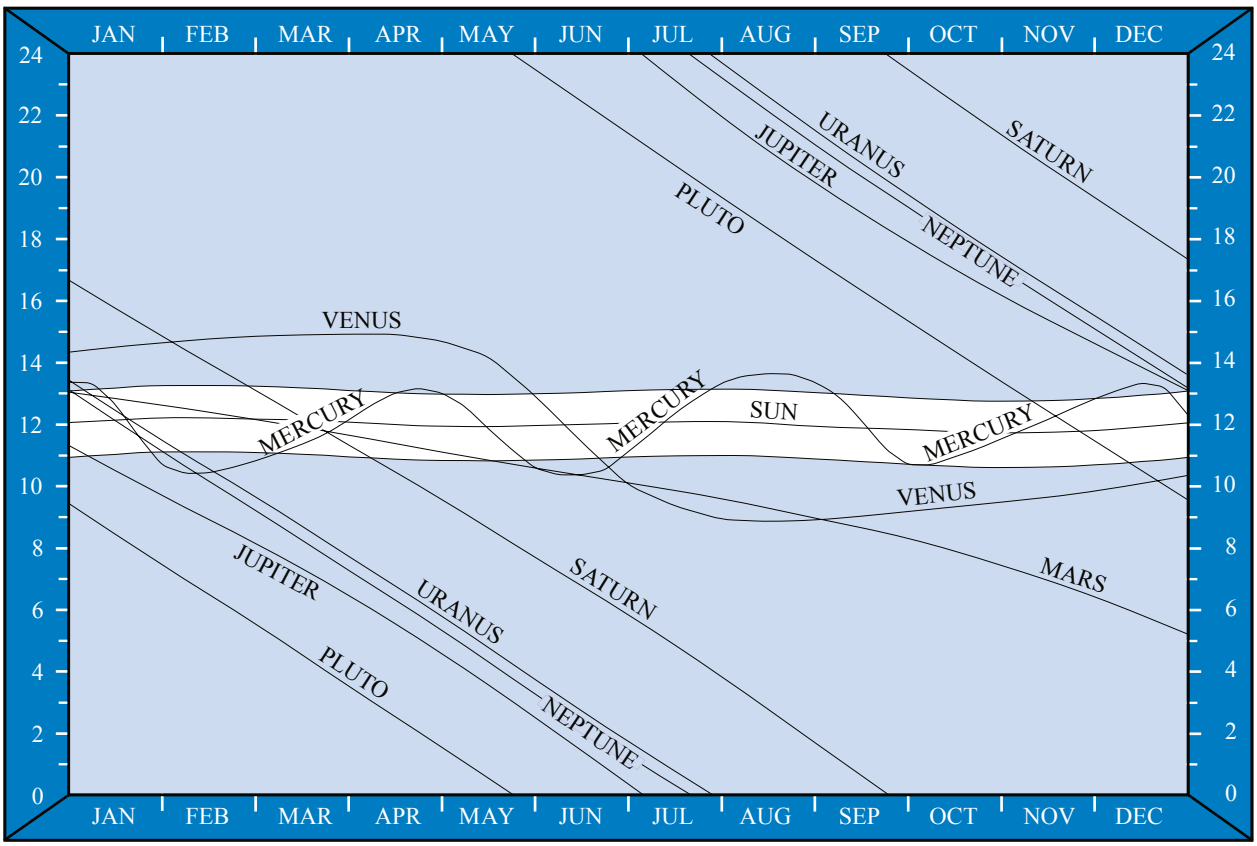
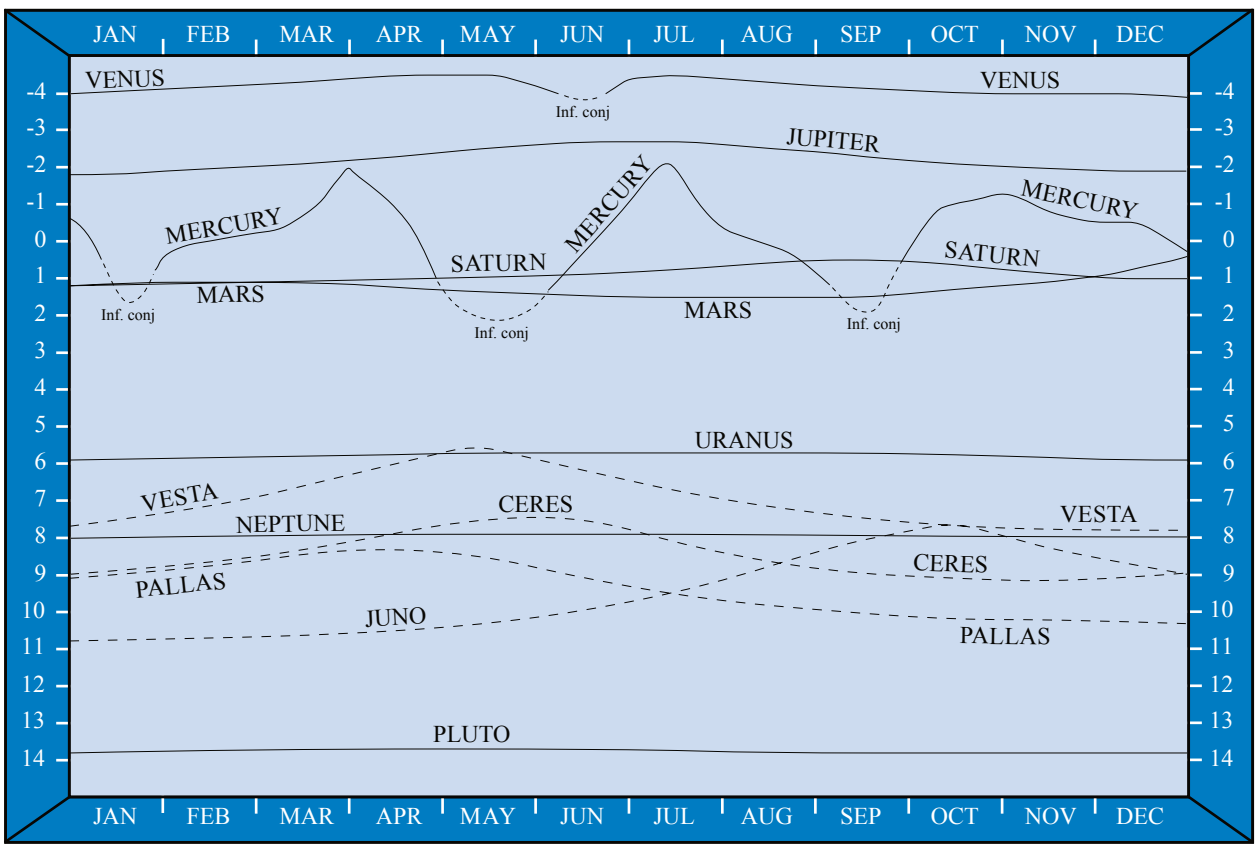
MERIDIAN PASSAGE of the SUN and PLANETS



MAGNITUDES of the PLANETS and MAJOR ASTEROIDS



SUN RISE, SUN SET AND ASTRONOMICAL TWILIGHT

AEST (Adelaide & Darwin ACST)

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

SUN RISE, SUN SET AND ASTRONOMICAL TWILIGHT

AEST

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

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

ORIENTATION OF THE SUN

DATE (0hr UT)		P°	B_o°	L_o°
Jan	6	- 0.04	- 3.53	145.60
	13	- 3.40	- 4.29	053.42
	20	- 6.67	- 4.98	321.25
	27	- 9.79	- 5.60	229.09
Feb	3	- 12.71	- 6.13	136.92
	10	- 15.40	- 6.56	044.75
	17	- 17.84	- 6.89	312.58
	24	- 20.00	- 7.12	220.40
Mar	2	- 21.86	- 7.23	128.20
	9	- 23.41	- 7.24	035.97
	16	- 24.64	- 7.14	303.72
	23	- 25.54	- 6.94	211.44
	30	- 26.09	- 6.63	119.12
Apr	6	- 26.30	- 6.23	026.76
	13	- 26.15	- 5.74	294.36
	20	- 25.63	- 5.17	201.92
	27	- 24.76	- 4.53	109.45
May	4	- 23.54	- 3.82	016.93
	11	- 21.96	- 3.07	284.38
	18	- 20.05	- 2.28	191.81
	25	- 17.84	- 1.46	099.20
Jun	1	- 15.34	- 0.62	006.57
	8	- 12.61	+ 0.22	273.93
	15	- 9.69	+ 1.06	181.28
	22	- 6.63	+ 1.89	088.62
	29	- 3.48	+ 2.69	355.96
Jul	6	- 0.31	+ 3.45	263.31
	13	+ 2.85	+ 4.17	170.67
	20	+ 5.93	+ 4.83	078.05
	27	+ 8.89	+ 5.43	345.44
Aug	3	+ 11.71	+ 5.95	252.85
	10	+ 14.34	+ 6.39	160.29
	17	+ 16.76	+ 6.75	067.76
	24	+ 18.95	+ 7.02	335.25
	31	+ 20.88	+ 7.18	242.77
Sep	7	+ 22.55	+ 7.25	150.32
	14	+ 23.93	+ 7.22	057.89
	21	+ 25.01	+ 7.08	325.48
	28	+ 25.78	+ 6.84	233.09
Oct	5	+ 26.20	+ 6.50	140.72
	12	+ 26.28	+ 6.06	048.37
	19	+ 26.00	+ 5.54	316.04
	26	+ 25.34	+ 4.93	223.72
Nov	2	+ 24.30	+ 4.24	131.41
	9	+ 22.87	+ 3.49	039.12
	16	+ 21.06	+ 2.69	306.84
	23	+ 18.89	+ 1.84	214.56
	30	+ 16.39	+ 0.96	122.30
Dec	7	+ 13.58	+ 0.07	030.06
	14	+ 10.54	- 0.83	297.83
	21	+ 7.30	- 1.71	205.61
	28	+ 3.96	- 2.57	113.40

VARIATION OF L_o

DAILY

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

HOURLY

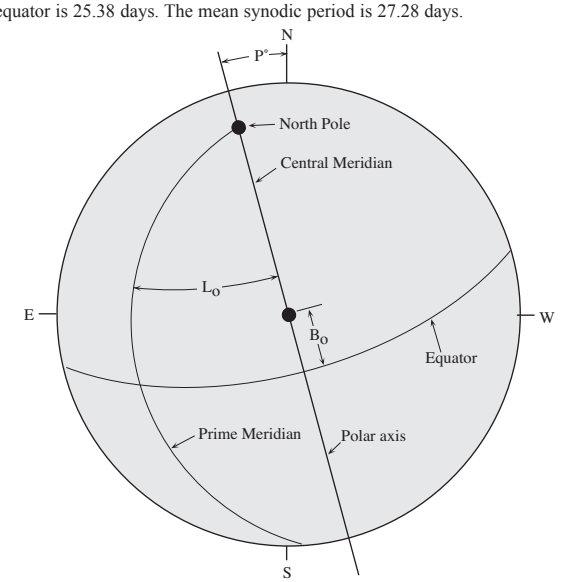
1	0.55
2	1.10
3	1.65
4	2.20
5	2.75
6	3.30
7	3.84
8	4.39
9	4.94
10	5.49
11	6.04
12	6.59
13	7.14
14	7.69
15	8.24
16	8.79
17	9.34
18	9.89
19	10.43
20	10.98
21	11.53
22	12.08
23	12.63
24	13.18

SYNODIC ROTATION NUMBERS (UT)

		d.dd
1905	Jan	17.06
1906	Feb	13.40
1907	Mar	11.73
1908	Apr	8.03
1909	May	5.28
1910	Jun	1.50
1911	Jun	28.70
1912	Jul	25.90
1913	Aug	22.13
1914	Sep	18.38
1915	Oct	15.67
1916	Nov	11.97
1917	Dec	9.28

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

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.
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 AND LUNAR ECLIPSES

During 1996 there are four eclipses, two of the Sun and two of the Moon. Both solar eclipses are partial, and both lunar eclipses are total. None of the eclipses are visible from Australia, except for the beginning of the umbral phase of the April 4th total lunar eclipse, and this can only be seen from the extreme western coast of Western Australia. New Zealand is on the northern limit of the April 18th partial solar eclipse, and will see a small portion of the Sun covered by the Moon.

4th April

TOTAL ECLIPSE of the MOON

The eclipse will be seen in its entirety from Africa, Europe, United Kingdom, Iceland, North and South Atlantic Oceans, and the extreme eastern portion of South America. The beginning of the umbral phase can be seen from the extreme western coast of Western Australia just prior to moonset.

18th April

PARTIAL ECLIPSE of the SUN

Visible from New Zealand except parts north of Auckland, part of Antarctica, southern Pacific Ocean.

27th September

TOTAL ECLIPSE of the MOON

The eclipse will be seen in its entirety from the western portion of northern Africa, western Europe, United Kingdom, Iceland, Greenland, eastern and central regions of the United States and Canada, Central and South America, Hawaii, the Atlantic Ocean.

13th October

PARTIAL ECLIPSE of the SUN

Visible from northern regions of Africa, western Europe, United Kingdom, Iceland, Greenland, eastern parts of Canada, North Atlantic Ocean.

MOON PHASES (AEST)

Lunation	New Moon	First Quarter	Full Moon	Last Quarter
	d h:m	d h:m	d h:m	d h:m
903			Jan 06 06:51	Jan 14 06:45
904	Jan 20 22:50	Jan 27 21:14	Feb 05 01:58	Feb 12 18:37
905	Feb 19 09:30	Feb 26 15:52	Mar 05 19:23	Mar 13 03:15
906	Mar 19 20:45	Mar 27 11:31	Apr 04 10:07	Apr 11 09:36
907	Apr 18 08:49	Apr 26 06:40	May 03 21:48	May 10 15:04
908	May 17 21:46	May 26 00:13	Jun 02 06:47	Jun 08 21:05
909	Jun 16 11:36	Jun 24 15:23	Jul 01 13:58	Jul 08 04:55
910	Jul 16 02:15	Jul 24 03:49	Jul 30 20:35	Aug 06 15:25
911	Aug 14 17:34	Aug 22 13:36	Aug 29 03:52	Sep 05 05:06
912	Sep 13 09:07	Sep 20 21:23	Sep 27 12:51	Oct 04 22:04
913	Oct 13 00:14	Oct 20 04:09	Oct 27 00:11	Nov 03 17:50
914	Nov 11 14:16	Nov 18 11:09	Nov 25 14:10	Dec 03 15:06
915	Dec 11 02:56	Dec 17 19:31	Dec 25 06:41	

MOON DISTANCE (AEST)

APOGEE				PERIGEE			
d hh		d hh		d hh		d hh	
Jan	05 22	Jul	17 00	Jan	20 09	Jul	02 08
Feb	02 02	Aug	13 02	Feb	17 19	Jul	30 18
Feb	29 17	Sep	09 12	Mar	16 16	Aug	28 03
Mar	28 13	Oct	07 04	Apr	11 13	Sep	25 08
Apr	25 08	Nov	04 00	May	07 08	Oct	22 19
May	23 02	Dec	01 21	Jun	04 02	Nov	16 15
Jun	19 16	Dec	29 15			Dec	13 14

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MOON RISE AND SET

ADELAIDE — ACST

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

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

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

Note: DNR means Moon does not rise on that day, DNS means Moon does not set. See explanation page 70.

BRISBANE — AEST

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

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

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

MOON RISE AND SET

CANBERRA — AEST

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

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

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

Note: DNR means Moon does not rise on that day, DNS means Moon does not set. See explanation page 70.

DARWIN — ACST

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

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

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

MOON RISE AND SET

HOBART — AEST

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

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

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

Note: DNR means Moon does not rise on that day, DNS means Moon does not set. See explanation page 70.

MELBOURNE — AEST

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

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

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

MOON RISE AND SET

SYDNEY — AEST

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

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

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

Note: DNR means Moon does not rise on that day, DNS means Moon does not set. See explanation page 70.

TOWNSVILLE — AEST

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

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

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

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

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

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 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 the Moon occults are listed in the Zodiacal Catalogue (ZC). There are about 3500 stars in the ZC.

The Moon moves from west to east, so it rises and sets 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.

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 1996 as predicted for **Adelaide**, **Brisbane, Canberra, Darwin, Hobart, Melbourne** and **Sydney.** Both events, 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 (e.g. 1194) as a reference are required. For multiple events, the amateur may tape record simultaneously a shortwave radio time signal with his own voice calling out the events (e.g., 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!

For further information on timing methods for occultations it would be worthwhile contacting your local astronomical society (p. 132).

LUNAR OCCULTATION TABLES

The faintest stars, which have occultation predictions on the following pages, are approximately 8th magnitude. The criteria for selection are complex involving the Sun and Moon altitude, star magnitude and whether it is a bright or dark limb event.

EXPLANATION

AEST	Is the date and time of the occultation. Hr & min are in AEST for all except Adelaide and Darwin which are ACST	
OBJECT	nnnn	ZC catalogue no.
	nnnnn or nnnnnn	SAO catalogue number
	X nnnnn	USNO XZ catalogue no.
	Name of planet or satellite.	
PD	This is the event which consists of one or two letters. The first letter is the type of Event: 'D' = Disappearance and 'R' = Reappearance. The second letter represents: 'D' = Dark limb, 'B' = a bright limb event. A 'G' indicates a graze at or near the location.	
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 true 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' (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 East, negative(-) if West

'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.

WORKED EXAMPLE

An observer wishes to calculate a more accurate time for the disappearance of ZC 0658 on Oct 2 for their location in Parkes (NSW) (148° 10' E, 33° 05' S), see page 126. 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 04:25 AEST and the values of A and B are –2.5 and –0.4 respectively.

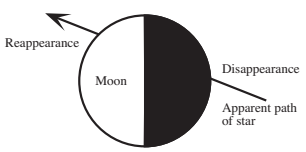
Therefore the equation becomes:-

04:25 – (–2..5 * 0.96) + (–0.4 * 2°.17)

= 04:25 – (–2.4) + (+0.9)

= 04:25 – 3.3 = 04:21.7 (approx.)

The event will be visible from Parkes approximately 3.3 mins earlier than Canberra, i.e., about 4:22 AM (AEST) on Oct 2nd.



ADELAIDE (34° 58' S, 138° 38'E)

ACST	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Jan 03 01:21	0639	DD	6.0	145	17	70	- 1.4	+ 1.7
Jan 04 20:37	0895	DD	5.9	165	24	40	- 1.0	+ 0.9
Jan 09 02:16	1381	RD	6.3	149	44	237	- 3.9	+ 2.1
Jan 13 04:08	1795	RD	7.1	103	55	272	- 2.4	- 0.6
Jan 17 03:07	2308	RD	7.6	53	15	267	- 0.2	- 1.0
Jan 27 20:37	0340	DD	7.1	90	31	111	- 2.0	+ 0.2
Jan 28 22:41	X04181	DD	7.6	102	17	44	- 1.4	+ 2.6
Jan 29 22:08	0593	DD	5.8	113	27	7	- 3.1	+ 8.9
Jan 30 23:08	X06273	DD	7.6	124	25	106	- 1.6	+ 0.5
Jan 31 20:18	X07312	DD	7.8	134	34	46	- 2.2	+ 1.3
Feb 07 00:45	1555	RD	7.6	158	47	324	- 1.6	- 2.3
Feb 07 01:14	X15947	RD	7.6	158	49	294	- 2.2	- 1.1
Feb 11 01:53	X19844	RD	7.9	111	43	322	- 0.8	- 2.5
Feb 12 01:07	X20634	RD	7.9	99	25	333	+ 0.0	- 2.8
Feb 12 02:04	X20649	RD	8.0	98	37	271	- 1.1	- 1.1
Feb 12 03:13	X20704	RD	7.4	98	50	314	- 1.0	- 2.3
Feb 13 00:59	2247	RD	5.6	86	14	322	+ 0.3	- 2.2
Feb 15 03:05	2555	RD	7.5	59	18	284	- 0.1	- 1.4
Feb 15 05:12	X24119	RD	7.7	57	43	314	- 0.7	- 2.7
Feb 16 03:48	2737	RD	6.8	44	14	320	+ 0.4	- 2.7
Feb 25 21:03	0532	DD	7.2	81	19	21	- 2.1	+ 4.5
Feb 28 19:50	X08598	DD	7.7	114	36	36	- 2.9	+ 2.8
Feb 28 20:22	0947	DD	5.2	114	36	81	- 2.7	+ 0.5
Feb 28 21:23	X08683	DD	7.8	115	33	96	- 2.3	+ 0.4
Feb 28 21:40	X08698	DD	7.3	115	31	102	- 2.1	+ 0.3
Feb 28 22:13	X08716	DD	7.3	115	28	119	- 1.6	- 0.1
Mar 04 03:31	1428	DD	3.8	160	14	95	- 0.7	+ 1.0
Mar 09 04:55	1973	RD	6.2	140	53	278	- 1.9	+ 0.4
Mar 10 03:03	X20462	RD	7.4	128	67	260	- 2.6	+ 0.2
Mar 10 23:35	2208	RD	7.4	117	22	301	- 0.2	- 1.8
Mar 13 04:32	X23658	RD	7.8	89	60	236	- 2.2	+ 1.0
Mar 13 05:19	X23681	RD	7.1	89	68	268	- 2.1	- 0.4
Mar 14 01:48	2674	RD	6.0	77	16	241	- 0.5	- 0.2
Mar 15 03:10	X27115	RD	7.8	63	20	257	- 0.5	- 0.7
Mar 15 04:28	X27210	RD	7.6	62	36	201	- 1.7	+ 3.2
Mar 17 04:59	3154	RD	7.4	35	16	267	- 0.4	- 1.0
Mar 26 19:11	X07838	DD	7.9	83	33	167	- 0.8	- 5.1
Mar 26 20:43	X07934	DD	7.9	83	23	56	- 2.2	+ 2.5
Mar 26 21:55	0904	DD	7.1	84	12	137	- 0.3	- 0.5
Mar 27 20:28	X09810	DD	7.7	94	31	111	- 1.9	+ 0.0
Mar 27 20:46	1040	DD	6.2	94	29	143	- 1.2	- 1.2
Mar 28 20:31	X11419	DD	6.7	105	36	101	- 2.3	+ 0.1
Mar 29 23:05	1271	DD	5.9	117	27	165	- 0.1	- 2.5
Mar 30 23:18	1381	DD	6.3	128	33	108	- 1.7	+ 0.2
Mar 31 23:09	1478	DD	7.2	139	43	160	- 0.8	- 2.4
Apr 03 03:33	1708	DD	6.2	164	22	84	- 0.9	+ 1.5
Apr 08 23:01	2460	RD	6.1	121	19	309	+ 0.1	- 2.0
Apr 09 03:30	2485	RD	7.4	119	70	307	- 1.9	- 2.2
Apr 10 05:15	X25075	RD	7.2	105	73	305	- 2.4	- 2.0
Apr 12 05:24	X28225	RD	7.4	79	58	219	- 1.7	+ 1.8
Apr 21 18:23	0710	DD	7.1	40	18	63	- 1.6	+ 2.0
Apr 22 19:39	X07208	DD	7.8	52	13	129	- 0.6	- 0.1
Apr 23 18:30	0985	DD	6.9	63	30	105	- 1.9	+ 0.3
Apr 23 19:45	X09116	DD	8.0	63	20	71	- 1.8	+ 1.8
Apr 23 20:17	X09124	DD	7.8	63	15	153	- 0.1	- 1.5
Apr 27 18:40	1428	DD	3.8	107	44	170	- 0.9	- 3.9
Apr 27 19:33	1428	RB	3.8	107	45	240	- 3.8	+ 1.9
Apr 28 19:11	Xl5712	DD	7.8	118	46	174	- 0.6	- 4.1
Apr 30 23:42	X18174	DD	7.4	143	49	150	- 1.2	- 1.9
May 04 20:25	2247	RD	5.6	166	24	287	- 0.4	- 1.4
May 05 05:34	2291	RD	5.5	163	32	278	- 0.9	+ 0.8
May 06 01:27	2426	RD	7.7	151	70	247	- 2.3	+ 0.8
May 06 23:42	X24119	RD	7.7	138	42	277	- 1.1	- 1.2
May 07 22:39	2737	RD	6.8	125	17	292	- 0.1	- 1.6
May 08 01:04	X26138	RD	7.8	124	46	224	- 1.7	+ 1.2
May 08 03:31	X26247	RD	8.0	123	70	258	- 2.2	+ 0.2
May 10 03:03	3065	RD	7.5	96	44	275	- 1.4	- 1.2
May 10 05:32	3075	RD	7.1	95	66	264	- 2.3	+ 0.1
May 12 03:07	X30992	RD	7.8	70	20	230	- 0.6	+ 0.3
May 12 03:07	3344	RD	7.3	70	20	230	- 0.6	+ 0.3
May 13 03:32	3489	RD	7.7	57	12	286	- 0.5	- 1.8
May 13 05:39	X31871	RD	8.0	56	36	267	- 1.5	- 0.9
May 20 18:04	X08343	DD	7.7	32	16	129	- 0.7	- 0.2
May 26 20:24	Xl6540	DD	8.0	99	47	158	- 1.0	- 2.3
May 26 22:27	Xl6618	DD	7.1	100	28	87	- 1.4	+ 1.3
May 27 20:50	1708	DD	6.2	111	52	156	- 1.1	- 2.4
May 28 20:56	1814	DD	7.0	123	59	138	- 1.7	- 1.8
May 29 01:18	Xl8763	DD	7.3	125	18	76	- 0.6	+ 1.8
May 29 22:49	1946	DD	7.2	136	57	85	- 2.3	+ 0.9
May 29 23:02	X19483	DD	7.7	136	55	77	- 2.3	+ 1.4
May 29 23:35	1948	DD	7.4	136	50	99	- 1.8	+ 0.4
May 30 18:41	X20216	DD	7.5	147	39	77	- 1.5	- 0.6
May 30 19:58	2060	DD	6.3	148	53	97	- 1.7	- 1.0
May 30 20:55	2064	DD	6.5	148	62	52	- 3.5	+ 2.2
May 31 21:28	2196	DD	6.7	162	61	125	- 1.5	- 1.9
Jun 03 03:23	X23681	RD	7.1	167	55	279	- 1.7	+ 0.4
Jun 03 21:51	2674	RD	6.0	156	34	284	- 0.7	- 1.5
Jun 04 23:36	2856	RD	6.6	141	42	239	- 1.4	+ 0.2
Jun 04 23:38	X27210	RD	7.6	141	42	252	- 1.3	- 0.3
Jun 05 02:44	2876	RD	5.4	140	71	188	- 0.9	+ 6.8
Jun 05 04:03	2880	RD	5.1	139	67	209	- 1.2	+ 3.3
Jun 05 23:10	3002	RD	6.2	128	24	222	- 0.8	+ 0.7
Jun 06 04:03	3024	RD	7.8	126	68	246	- 2.0	+ 1.0
Jun 07 04:18	3172	RD	8.0	112	63	292	- 2.8	- 1.6
Jun 07 06:39	3185	RD	5.3	111	55	208	- 0.9	+ 2.8
Jun 09 03:42	3460	RD	7.1	86	38	196	- 0.6	+ 2.5
Jun 09 03:43	X31609	RD	7.8	86	38	257	- 1.4	- 0.5
Jun 10 03:46	X00367	RD	8.0	73	27	245	- 0.9	- 0.2
Jun 10 05:48	X00439	RD	8.0	72	45	228	- 1.5	+ 1.0
Jun 11 04:42	0180	RD	5.6	60	25	209	- 0.5	+ 1.3
Jun 11 04:43	0181	RD	6.5	60	25	209	- 0.5	+ 1.3
Jun 14 08:50	Mercury	DB	0.5	23	31	140	- 4.4	- 5.3
Jun 14 09:31	Mercury	RD	0.5	23	35	187	- 0.1	+ 5.0
Jun 19 18:32	Xl2657	DD	7.4	36	17	115	- 0.8	+ 0.3
Jun 21 18:51	1458	DD	5.9	58	32	179	+ 0.4	- 4.2
Jun 26 22:32	X19941	DD	7.8	117	48	159	- 1.3	- 2.8
Jun 27 18:26	X20704	DD	7.4	129	52	162	- 0.4	- 3.7
Jun 29 00:09	2291	DD	5.5	144	54	105	- 1.7	+ 0.2
Jul 02 22:28	2936	RD	6.8	159	43	253	- 1.3	- 0.3
Jul 03 04:27	X28225	RD	7.4	157	49	259	- 1.4	+ 1.2
Jul 03 06:39	2975	RD	7.0	156	23	204	+ 0.2	+ 2.7
Jul 04 23:13	3248	RD	6.6	131	25	254	- 0.7	- 0.5
Jul 05 06:33	3281	RD	7.5	128	42	258	- 1.4	+ 1.3
Jul 06 06:09	X31425	RD	7.7	115	50	320	- 5.6	- 5.6
Jul 06 06:28	X31429	RD	7.9	115	48	250	- 1.7	+ 1.4
Jul 08 04:26	0136	RD	6.0	90	42	241	- 1.6	+ 0.4
Jul 09 06:22	X02650	RD	7.0	77	44	240	- 1.9	+ 0.8
Jul 10 03:20	0394	RD	7.7	66	11	279	- 0.9	- 1.5
Jul 11 06:07	X04629	RD	7.8	53	28	280	- 2.0	- 1.3
Jul 12 05:53	0663	RD	6.9	42	18	290	- 1.6	- 1.9
Jul 23 19:16	1962	DD	5.2	86	57	110	- 2.1	- 0.3
Jul 23 20:40	1962	RB	5.2	86	43	292	- 1.5	+ 0.1
Jul 24 21:32	2088	DD	6.2	99	46	88	- 1.6	+ 1.1
Jul 25 18:36	2208	DD	7.4	111	67	107	- 2.0	- 1.1
Jul 27 22:30	X23658	DD	7.8	139	68	131	- 2.3	- 1.8
Jul 27 22:59	X23681	DD	7.1	139	64	104	- 2.0	+ 0.0
Jul 29 02:55	2722	DD	7.1	154	30	105	- 0.9	+ 0.6
Jul 29 18:49	X27180	DD	7.2	165	28	151	+ 0.2	- 4.5
Jul 29 18:59	2856	DD	6.6	165	29	93	- 0.7	- 1.1
Jul 29 22:17	2876	DD	5.4	166	66	112	- 2.1	- 1.5
Jul 29 23:16	2880	DD	5.1	167	71	94	- 2.2	- 0.3
Aug 01 00:24	3187	RD	5.9	163	61	257	- 2.0	+ 0.1
Aug 01 02:52	3199	RD	6.8	162	58	222	- 1.3	+ 2.1
Aug 01 22:45	3328	RD	7.0	149	33	267	- 1.1	- 0.9
Aug 03 03:24	X31898	RD	7.9	134	55	240	- 1.9	+ 1.1
Aug 03 03:54	3502	RD	7.4	134	54	278	- 2.5	+ 0.0
Aug 04 00:14	0075	RD	7.8	122	24	272	- 1.1	- 1.2
Aug 04 06:22	X00955	RD	8.0	119	39	213	- 1.2	+ 2.5
Aug 07 03:31	0478	RD	7.7	83	24	227	- 0.8	+ 0.5
Aug 08 04:43	0620	RD	6.3	71	26	193	+ 0.0	+ 2.9
Aug 09 06:21	0764	DB	5.0	59	31	131	- 2.9	- 2.8
Aug 10 04:46	X07838	RD	7.9	49	10	241	- 0.6	- 0.3
Aug 11 06:05	X09810	RD	7.7	38	16	212	- 0.3	+ 1.5
Aug 20 21:13	X20216	DD	7.5	69	24	153	- 0.9	- 1.8
Aug 21 20:49	X21075	DD	7.9	81	40	74	- 1.2	+ 1.8
Aug 21 21:08	2180	DD	7.1	81	37	110	- 1.2	+ 0.3
Aug 23 19:06	2454	DD	7.2	106	73	42	- 2.6	+ 3.3
Aug 23 21:16	2460	DD	6.1	107	58	62	- 1.7	+ 2.0
Aug 25 19:13	2789	DD	7.3	133	59	121	- 1.7	- 2.2
Aug 26 18:40	2936	DD	6.8	147	40	96	- 1.1	- 1.2
Aug 27 00:41	X28225	DD	7.4	150	51	80	- 1.4	+ 1.2
Aug 27 03:25	2975	DD	7.0	151	19	144	- 1.5	- 1.9
Aug 29 23:22	3411	RD	7.2	168	51	238	- 1.6	+ 0.6
Sep 01 04:44	0180	RD	5.6	139	40	277	- 2.1	+ 0.6
Sep 01 04:45	0181	RD	6.5	139	39	277	- 2.1	+ 0.6
Sep 03 05:56	0449	RD	8.0	113	37	225	- 1.9	+ 2.0
Sep 04 04:14	0581	RD	6.9	102	37	216	- 1.5	+ 1.5
Sep 05 04:27	X06142	RD	7.8	90	32	309	- 3.0	- 2.6
Sep 06 03:04	X07208	RD	7.8	79	14	289	- 1.4	- 1.8
Sep 08 04:27	X10921	RD	7.9	56	13	344	- 2.7	- 6.7
Sep 16 20:03	X20016	DD	8.0	39	13	133	- 0.5	- 0.4
Sep 18 21:40	X21858	DD	8.0	65	17	110	- 0.4	+ 0.5
Sep 20 19:43	2555	DD	7.5	89	62	133	- 2.4	- 1.8
Sep 21 22:02	2737	DD	6.8	103	47	72	- 1.2	+ 1.5
Sep 23 21:56	3045	DD	6.0	131	64	52	- 1.6	+ 1.8
Sep 24 01:50	3065	DD	7.5	132	22	68	- 0.3	+ 1.5
Sep 24 19:43	3187	DD	5.9	144	52	67	- 1.7	+ 0.2
Sep 24 22:24	3199	DD	6.8	145	63	96	- 2.4	+ 0.0
Sep 28 04:03	0104	RD	5.8	172	27	201	- 0.8	+ 3.0
Sep 30 00:18	0372	RD	7.6	147	35	267	- 1.9	- 0.6
Oct 02 00:25	0648	DB	3.9	122	18	86	- 1.2	- 0.9
Oct 02 01:41	0648	RD	3.9	122	29	244	- 1.5	+ 0.0
Oct 02 02:02	0653	RD	4.8	122	31	198	- 0.6	+ 2.6
Oct 02 02:20	0658	DB	4.3	121	33	34	- 1.3	+ 1.4
Oct 02 03:26	0658	RD	4.3	121	37	300	- 2.8	- 1.4
Oct 03 01:42	0787	RD	7.5	110	21	201	- 0.2	+ 2.2
Oct 04 04:59	X08582	RD	7.5	98	36	307	- 2.6	- 1.6
Oct 05 03:20	Xl0283	RD	7.7	87	22	246	- 1.3	- 0.3
Oct 07 03:51	1301	RD	8.0	65	15	287	- 1.1	- 1.7
Oct 17 21:09	X23712	DD	8.0	60	22	114	- 0.6	+ 0.4
Oct 18 22:07	X25575	DD	8.0	73	21	46	+ 0.1	+ 2.2
Oct 18 22:33	2705	DD	6.8	74	16	64	+ 0.0	+ 1.6
Oct 19 19:30	X27115	DD	7.8	86	62	63	- 1.6	+ 1.7
Oct 21 23:06	3154	DD	7.4	114	38	354	+ 1.3	+ 6.4
Oct 24 02:09	3460	DD	7.1	142	18	91	- 0.6	+ 1.1
Oct 25 23:30	0180	DD	5.6	167	48	17	- 1.0	+ 2.8
Oct 25 23:31	0181	DD	6.5	167	48	17	- 1.0	+ 2.8
Oct 28 22:05	0581	RD	6.9	155	18	254	- 0.9	- 0.6
Oct 29 01:50	0590	RD	6.3	154	38	323	- 3.5	- 3.5
Oct 30 23:37	0871	RD	6.9	131	14	216	- 0.3	+ 0.9
Oct 31 03:05	0884	RD	7.8	130	36	303	- 2.6	- 1.3
Nov 01 04:08	X09695	RD	7.7	118	37	294	- 2.5	- 0.9
Nov 13 19:52	2485	DD	7.4	29	12	158	- 1.4	- 2.8
Nov 14 20:34	X25030	DD	7.5	42	15	49	+ 0.2	+ 2.0
Nov 16 21:30	X28225	DD	7.4	69	25	84	- 0.5	+ 1.2
Nov 18 19:58	3248	DD	6.6	95	57	55	- 1.6	+ 1.7
Nov 22 01:48	0136	DD	6.0	137	13	38	- 0.6	+ 2.4
Nov 25 01:16	0527	DD	6.3	173	34	21	- 1.9	+ 3.5
Nov 25 20:33	0658	RD	4.3	175	15	315	- 2.1	- 3.7
Nov 27 23:25	X08716	RD	7.3	151	24	249	- 1.5	- 0.3
Nov 30 00:50	1210	RD	5.9	129	25	272	- 1.7	- 1.1
Dec 01 03:27	1328	RD	7.0	117	39	258	- 2.7	+ 0.0
Dec 05 02:22	1730	RD	6.5	73	13	342	- 0.3	- 3.2
Dec 15 21:09	3216	DD	6.6	65	22	77	- 0.5	+ 1.4
Dec 17 21:22	X31898	DD	7.9	91	34	352	+ 0.6	+ 6.1
Dec 21 21:38	0478	DD	7.7	141	40	84	- 2.4	+ 0.2
Dec 22 22:16	0620	DD	6.3	153	38	125	- 3.0	- 1.6
Dec 23 23:19	0764	DD	5.0	165	37	128	- 2.7	- 1.5
Dec 28 01:50	1284	RD	6.3	149	39	353	- 1.0	- 4.8
Dec 31 00:50	Xl6391	RD	7.6	117	24	284	- 1.2	- 1.6

BRISBANE (27° 30' S, 153° 01'E)

AEST	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Jan 04 21:43	0895	DD	5.9	165	40	27	- 2.1	+ 3.7
Jan 09 03:35	1381	RD	6.3	149	44	286	- 2.2	- 0.1
Jan 10 03:26	1478	RD	7.2	138	53	269	- 3.1	+ 0.4
Jan 17 03:32	2308	RD	7.6	53	25	301	- 0.3	- 1.7
Jan 27 21:34	0340	DD	7.1	90	21	93	- 1.2	+ 0.9
Jan 30 22:53	0730	DD	5.1	124	28	140	- 1.1	- 1.5
Feb 02 23:30	1116	DD	7.4	156	42	140	- 1.8	- 1.7
Feb 07 01:58	X15947	RD	7.6	158	56	337	- 1.2	- 2.8
Feb 08 03:15	X17212	RD	7.7	146	57	285	- 2.5	- 0.3
Feb 08 03:26	X17216	RD	7.6	146	55	275	- 2.6	+ 0.2
Feb 09 00:28	X18174	RD	7.4	135	48	225	- 4.8	+ 4.1
Feb 09 22:42	1865	RD	7.2	124	19	243	- 0.9	+ 0.1
Feb 12 02:41	X20649	RD	8.0	98	52	309	- 1.2	- 2.1
Feb 13 01:02	X21607	RD	7.4	86	20	262	- 0.5	- 0.7
Feb 14 01:15	2399	RD	5.0	73	12	251	- 0.3	- 0.3
Feb 15 03:22	2555	RD	7.5	59	26	324	+ 0.1	- 2.9
Feb 27 20:34	X06874	DD	7.8	103	36	129	- 2.0	- 1.1
Feb 28 20:14	X08582	DD	7.5	114	42	101	- 2.8	- 0.2
Feb 28 21:45	0947	DD	5.2	114	33	45	- 3.3	+ 3.5
Feb 28 22:35	X08683	DD	7.8	115	26	59	- 2.4	+ 2.4
Feb 28 22:48	X08698	DD	7.3	115	24	66	- 2.0	+ 2.0
Feb 28 23:09	X08716	DD	7.3	115	20	83	- 1.5	+ 1.2
Feb 29 22:48	X10430	DD	7.1	125	32	134	- 1.2	- 1.0
Mar 01 21:43	1190	DD	7.1	136	45	163	- 1.1	- 3.7
Mar 01 23:59	1197	DD	6.0	137	30	155	- 0.5	- 2.0
Mar 07 22:18	X18763	RD	7.3	155	39	281	- 1.4	- 1.3
Mar 10 04:05	X20462	RD	7.4	128	71	300	- 2.3	- 1.2
Mar 10 23:49	2208	RD	7.4	117	31	342	+ 0.2	- 3.5
Mar 11 23:21	2352	RD	6.7	105	14	280	- 0.1	- 1.1
Mar 14 01:40	X25294	RD	8.0	77	19	307	+ 0.0	- 2.1
Mar 14 02:21	2674	RD	6.0	77	28	278	- 0.6	- 1.1
Mar 15 03:40	X27115	RD	7.8	63	32	292	- 0.7	- 1.7
Mar 26 19:50	X07838	DD	7.9	83	32	122	- 1.6	- 0.5
Mar 27 19:20	X09695	DD	7.7	93	41	24	****	****
Mar 27 21:31	X09810	DD	7.7	94	24	74	- 1.9	+ 1.7
Mar 27 21:33	1040	DD	6.2	94	24	103	- 1.3	+ 0.4
Mar 28 21:46	X11419	DD	6.7	105	30	56	- 2.9	+ 3.0
Mar 29 18:37	X12657	DD	7.4	115	45	77	- 3.0	+ 0.2
Mar 29 23:37	1271	DD	5.9	117	20	117	- 0.8	- 0.1
Mar 31 00:23	1381	DD	6.3	128	22	58	- 2.0	+ 3.2
Mar 31 23:50	1478	DD	7.2	139	38	114	- 1.6	- 0.2
Apr 10 03:48	K07294	RD	8.0	106	73	233	- 2.5	+ 1.7
Apr 13 01:42	3093	DB	4.5	67	7	87	- 0.1	- 0.8
Apr 13 02:41	3093	RD	4.5	67	20	251	- 0.6	- 0.3
Apr 23 19:34	0985	DD	6.9	63	22	67	- 1.8	+ 1.9
Apr 25 20:21	X12215	DD	7.8	85	32	142	- 0.9	- 1.3
Apr 27 19:17	1428	DD	3.8	107	53	126	- 2.3	- 1.4
Apr 27 20:50	1428	RB	3.8	107	45	289	- 2.1	- 0.2
Apr 28 19:45	X15712	DD	7.8	118	56	128	- 2.2	- 1.6
Apr 30 00:59	1652	DD	5.5	132	22	144	- 0.5	- 1.2
May 01 00:26	X18174	DD	7.4	143	40	110	- 1.5	+ 0.0
May 01 20:58	1865	DD	7.2	155	63	132	- 1.7	- 2.1
May 04 20:47	2247	RD	5.6	166	35	324	- 0.3	- 2.6
May 05 02:46	2271	RD	4.3	164	61	219	- 2.0	+ 4.5
May 06 02:34	2426	RD	7.7	151	75	278	- 2.4	- 0.1
May 06 21:56	2555	RD	7.5	139	26	284	- 0.5	- 1.3
May 07 00:16	X24119	RD	7.7	138	56	316	- 1.3	- 2.9
May 08 02:05	X26138	RD	7.8	124	66	259	- 2.2	+ 0.0
May 08 04:36	X26247	RD	8.0	123	74	275	- 2.5	+ 0.0
May 09 02:27	2913	RD	5.0	110	57	221	- 1.9	+ 1.8
May 09 23:54	3045	RD	6.0	98	12	259	- 0.3	- 0.5
May 10 03:49	3065	RD	7.5	96	61	300	- 2.6	- 2.6
May 12 03:50	X30992	RD	7.8	70	36	250	- 1.3	- 0.1
May 12 03:50	3344	RD	7.3	70	36	250	- 1.3	- 0.1
May 13 03:54	3489	RD	7.7	57	24	319	- 1.9	- 6.5
May 21 18:44	X10156	DD	7.1	43	17	139	- 0.4	- 0.9
May 26 21:06	X16540	DD	8.0	99	41	113	- 1.7	- 0.2
May 26 21:16	1599	DD	5.0	99	39	139	- 1.1	- 1.3
May 26 22:27	1599	RB	5.0	99	25	273	- 1.1	+ 0.9
May 27 21:34	1708	DD	6.2	111	47	112	- 1.8	- 0.2
May 28 21:50	1814	DD	7.0	123	55	96	- 2.3	+ 0.3
May 30 00:38	1948	DD	7.4	136	34	63	- 1.2	+ 2.4
May 30 21:17	2060	DD	6.3	148	74	34	****	****
May 31 22:21	2196	DD	6.7	162	77	85	- 2.7	+ 0.2
Jun 01 02:08	2210	DD	6.8	163	40	147	- 1.6	- 2.1
Jun 02 22:37	2508	RD	6.3	170	63	249	- 2.3	+ 0.4
Jun 03 04:17	X23681	RD	7.1	167	39	290	- 1.3	+ 0.1
Jun 03 22:15	2674	RD	6.0	156	45	328	- 0.6	- 4.0
Jun 04 23:43	X27180	RD	7.2	142	51	224	- 1.8	+ 1.5
Jun 05 00:26	X27210	RD	7.6	141	60	281	- 2.0	- 1.1
Jun 05 00:29	2856	RD	6.6	141	60	269	- 2.0	- 0.5
Jun 05 04:01	2876	RD	5.4	140	67	207	- 1.1	+ 3.5
Jun 05 05:09	2880	RD	5.1	139	53	215	- 0.8	+ 2.8
Jun 05 23:56	3002	RD	6.2	128	40	255	- 1.3	- 0.2
Jun 06 03:39	3021	RD	7.6	126	76	188	- 0.7	+ 5.4
Jun 06 05:10	3024	RD	7.8	126	63	249	- 1.9	+ 1.3
Jun 07 05:23	3172	RD	8.0	112	67	296	- 3.4	- 1.3
Jun 09 04:37	X31609	RD	7.8	86	56	264	- 2.4	- 0.2
Jun 09 04:43	3460	RD	7.1	86	57	205	- 1.2	+ 2.5
Jun 10 04:34	X00367	RD	8.0	73	44	253	- 1.8	+ 0.0
Jun 11 05:34	0180	RD	5.6	60	43	214	- 1.1	+ 1.6
Jun 11 05:34	0181	RD	6.5	60	43	214	- 1.1	+ 1.6
Jun 12 04:26	0301	RD	6.8	49	20	214	- 0.3	+ 1.2
Jun 13 04:40	X03838	RD	7.8	37	11	245	- 0.4	- 0.1
Jun 14 09:42	Mercury	DB	0.5	23	45	133	- 4.6	- 3.7
Jun 14 10:46	Mercury	RD	0.5	23	45	200	- 2.4	+ 5.0
Jun 21 19:18	1458	DD	5.9	58	27	126	- 0.9	- 0.5
Jun 26 18:14	X19844	DD	7.9	116	66	120	- 2.0	- 1.7
Jun 26 23:12	X19941	DD	7.8	117	36	124	- 1.2	- 0.5
Jun 27 18:00	X20649	DD	8.0	128	56	170	- 0.1	- 4.6
Jun 27 18:56	X20704	DD	7.4	129	67	116	- 1.9	- 1.5
Jun 27 21:37	2130	DD	7.9	129	67	129	- 2.1	- 1.5
Jun 29 01:04	2291	DD	5.5	144	37	86	- 1.1	+ 1.0
Jun 29 20:23	2426	DD	7.7	156	64	103	- 1.9	- 1.1
Jun 30 00:02	2441	DD	6.5	157	64	131	- 2.3	- 1.6
Jul 02 20:40	2927	RD	7.2	161	27	238	- 0.9	+ 0.3
Jul 02 23:17	2936	RD	6.8	159	60	279	- 2.0	- 1.0
Jul 03 05:22	X28225	RD	7.4	157	33	260	- 0.8	+ 1.1
Jul 04 23:53	3248	RD	6.6	131	40	278	- 1.5	- 1.2
Jul 08 05:29	0136	RD	6.0	90	56	239	- 2.2	+ 1.2
Jul 10 03:58	0394	RD	7.7	66	27	286	- 1.9	- 1.7
Jul 12 03:42	0648	RD	3.9	43	3	194	+ 0.9	+ 2.9
Jul 12 04:23	0658	DB	4.3	42	11	76	- 0.6	- 0.5
Jul 12 05:36	0658	RD	4.3	42	24	252	- 1.2	- 0.3
Jul 23 20:21	1962	DD	5.2	86	44	72	- 1.9	+ 1.9
Jul 23 21:24	1962	RB	5.2	86	30	324	- 1.0	- 1.4
Jul 24 22:31	208S	DD	6.2	99	28	61	- 0.7	+ 2.3
Jul 25 19:44	2208	DD	7.4	111	74	67	- 2.9	+ 1.7
Jul 27 18:40	2508	DD	6.3	137	59	171	+ 0.3	- 8.6
Jul 27 23:25	X23658	DD	7.8	139	55	111	- 2.0	- 0.2
Jul 27 23:58	X23681	DD	7.1	139	48	90	- 1.5	+ 0.8
Jul 28 18:30	2674	DD	6.0	151	43	40	- 1.9	+ 1.8
Jul 29 19:09	X27180	DD	7.2	165	38	105	- 1.0	- 1.4
Jul 29 19:42	2856	DD	6.6	165	45	59	- 1.5	+ 0.5
Jul 29 23:15	2876	DD	5.4	166	78	93	- 2.5	- 0.1
Jul 30 00:20	2880	DD	5.1	167	68	83	- 2.1	+ 0.7
Aug 01 01:28	3187	RD	5.9	163	70	262	- 2.4	+ 0.5
Aug 01 03:54	3199	RD	6.8	162	45	222	- 0.9	+ 2.2
Aug 01 23:30	3328	RD	7.0	149	50	284	- 2.2	- 1.5
Aug 03 04:31	X31898	RD	7.9	134	53	238	- 1.7	+ 1.6
Aug 03 05:01	3502	RD	7.4	134	47	276	- 2.2	+ 0.5
Aug 04 00:57	0075	RD	7.8	122	41	282	- 2.1	- 1.5
Aug 05 00:09	0214	RD	6.4	109	19	180	+ 0.6	+ 4.5
Aug 07 04:24	0478	RD	7.7	83	41	227	- 1.6	+ 1.1
Aug 08 03:02	0610	RD	6.2	72	19	294	- 1.7	- 2.1
Aug 08 03:37	X05391	RD	7.6	72	25	267	- 1.5	- 0.8
Aug 10 05:29	X07838	RD	7.9	49	27	246	- 1.4	+ 0.0
Aug 20 21:46	X20216	DD	7.5	69	11	129	- 0.4	- 0.4
Aug 21 18:47	X20984	DD	7.4	80	61	96	- 2.3	+ 0.3
Aug 21 21:46	X21075	DD	7.9	81	23	51	- 0.3	+ 2.7
Aug 21 21:55	2180	DD	7.1	81	21	93	- 0.5	+ 0.8
Aug 23 22:21	2460	DD	6.1	107	40	45	- 0.7	+ 2.9
Aug 25 20:05	2789	DD	7.3	133	77	94	- 2.5	- 0.4
Aug 26 19:29	2936	DD	6.8	147	58	68	- 1.9	+ 0.3
Aug 27 01:37	X28225	DD	7.4	150	35	78	- 0.9	+ 1.2
Aug 30 00:24	3411	RD	7.2	168	65	240	- 2.0	+ 1.2
Aug 31 00:21	0019	RD	7.8	154	57	246	- 2.1	+ 0.6
Sep 04 01:38	X04954	RD	7.5	103	27	278	- 1.8	- 1.2
Sep 06 01:10	0832	RD	4.2	80	2	255	- 0.2	- 0.5
Sep 06 03:14	X07177	RD	7.4	79	25	259	- 1.5	- 0.5
Sep 06 03:47	X07208	RD	7.8	79	30	294	- 2.3	- 1.8
Sep 07 02:44	0985	RD	6.9	68	11	313	- 1.5	- 2.9
Sep 07 03:46	X09116	RD	8.0	68	22	321	- 2.4	- 3.6
Sep 07 04:05	X09124	RD	7.8	68	26	230	- 1.1	+ 0.7
Sep 17 18:49	X20752	DD	7.9	51	34	97	- 1.1	+ 0.6
Sep 20 20:38	2555	DD	7.5	89	47	117	- 1.9	- 0.4
Sep 21 19:40	2722	DD	7.1	102	71	88	- 2.4	+ 0.5
Sep 21 22:56	2737	DD	6.8	103	30	67	- 0.5	+ 1.5
Sep 23 23:00	3045	DD	6.0	131	51	50	- 1.1	+ 2.1
Sep 24 20:45	3187	DD	5.9	144	70	56	- 2.0	+ 1.3
Sep 24 23:29	3199	DD	6.8	145	55	96	- 2.2	+ 0.4
Sep 25 19:39	3328	DD	7.0	157	47	27	- 1.1	+ 2.2
Sep 30 01:19	0372	RD	7.6	147	49	267	- 2.7	+ 0.0
Oct 02 01:12	0648	DB	3.9	122	34	83	- 2.0	- 0.5
Oct 02 02:41	0648	RD	3.9	122	44	247	- 2.4	+ 0.6
Oct 02 03:09	0653	RD	4.8	122	45	205	- 1.8	+ 3.1
Oct 02 03:29	0658	DB	4.3	121	45	27	- 2.0	+ 3.1
Oct 02 04:27	0658	RD	4.3	121	43	314	- 2.8	- 2.0
Oct 03 02:40	0787	RD	7.5	110	38	209	- 1.4	+ 2.5
Oct 04 01:52	X08330	RD	7.9	99	24	280	- 1.7	- 1.3
Oct 04 01:55	X08343	RD	7.7	99	25	310	- 2.3	- 2.7
Oct 05 01:26	X10156	RD	7.1	88	12	238	- 0.5	+ 0.1
Oct 05 04:15	X10283	RD	7.7	87	39	258	- 2.5	- 0.1
Oct 19 20:32	X27115	DD	7.8	86	45	58	- 1.0	+ 1.9
Oct 20 19:06	X28413	DD	8.0	98	72	11	- 0.6	+ 5.2
Oct 20 19:41	2983	DD	7.9	99	67	78	- 2.1	+ 1.0
Oct 26 00:38	0180	DD	5.6	167	45	17	- 1.1	+ 3.4
Oct 26 00:39	0181	DD	6.5	167	45	17	- 1.1	+ 3.5
Oct 28 22:52	0581	RD	6.9	155	34	256	- 1.8	- 0.2
Oct 30 23:02	0863	RD	6.7	131	17	311	- 1.9	- 2.9
Oct 31 00:02	X07481	RD	7.5	131	28	261	- 1.6	- 0.5
Oct 31 00:25	0871	RD	6.9	131	31	223	- 1.3	+ 1.2
Oct 31 01:00	X07541	RD	7.6	131	36	241	- 1.9	+ 0.5
Oct 31 01:18	X07560	RD	7.6	131	38	255	- 2.3	+ 0.0
Oct 31 01:56	X07600	RD	7.8	130	41	213	- 2.1	+ 2.7
Oct 31 03:58	0884	RD	7.8	130	41	330	- 2.1	- 3.0
Nov 01 00:40	X09459	RD	7.7	119	26	238	- 1.3	+ 0.4
Nov 02 02:40	1141	RD	5.6	108	38	213	- 2.2	+ 3.5
Nov 17 19:15	X29383	DD	8.0	81	57	79	- 1.9	+ 1.1
Nov 18 21:01	3248	DD	6.6	95	44	56	- 1.2	+ 1.8
Nov 19 19:18	X31194	DD	7.6	108	66	102	- 3.1	- 0.5
Nov 21 19:25	0104	DD	5.8	134	53	14	- 0.7	+ 3.1
Nov 25 19:55	0648	RD	3.9	175	17	262	- 0.9	- 0.6
Nov 25 21:14	0658	RD	4.3	175	30	320	- 3.7	- 4.8
Nov 26 03:09	0684	RD	6.2	173	26	260	- 1.6	+ 1.2
Nov 27 21:39	0943	RD	6.2	152	17	212	- 0.1	+ 1.7
Nov 27 22:21	0947	RD	5.2	152	24	338	- 3.8	- 7.2
Nov 27 23:55	X08698	RD	7.3	151	37	281	- 2.5	- 1.0
Nov 28 00:23	X08716	RD	7.3	151	40	258	- 2.5	+ 0.0
Nov 29 23:35	1198	RD	6.2	129	22	280	- 1.4	- 1.3
Nov 30 01:43	1210	RD	5.9	129	41	288	- 2.6	- 1.3
Dec 14 19:49	3061	DD	8.0	50	24	127	- 1.2	- 0.7
Dec 20 22:57	0355	DD	7.5	129	34	129	- 2.1	- 1.3
Dec 21 22:47	0478	DD	7.7	141	41	77	- 2.3	+ 1.1
Dec 22 20:13	0610	DD	6.2	152	39	36	- 1.4	+ 1.7
Dec 22 20:35	X05391	DD	7.6	152	42	61	- 2.1	+ 0.6
Dec 22 23:20	0620	DD	6.3	153	41	111	- 2.5	- 0.4
Dec 24 00:19	0764	DD	5.0	165	39	108	- 2.3	- 0.1
Dec 28 00:45	X12916	RD	7.6	149	44	303	- 2.5	- 1.7
Dec 31 01:27	X16391	RD	7.6	117	39	309	- 1.7	- 2.2

CANBERRA (35° 15' S, 149° 08'E)

AEST	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Jan 04 21:22	0895	DD	5.9	165	30	52	- 1.8	+ 0.6
Jan 09 03:21	1381	RD	6.3	149	40	256	- 2.9	+ 1.2
Jan 10 02:59	1478	RD	7.2	138	47	227	- 5.4	+ 4.5
Jan 17 03:41	2308	RD	7.6	53	25	276	- 0.5	- 1.2
Jan 27 21:24	0340	DD	7.1	90	21	114	- 1.3	+ 0.4
Jan 31 21:12	X07312	DD	7.8	134	35	50	- 2.6	+ 1.6
Feb 07 01:31	1555	RD	7.6	158	49	340	- 1.1	- 2.7
Feb 07 02:07	X15947	RD	7.6	158	48	308	- 1.8	- 1.2
Feb 08 03:00	X17212	RD	7.7	146	52	251	- 3.3	+ 1.5
Feb 08 03:02	X17216	RD	7.6	146	52	234	- 4.5	+ 3.8
Feb 11 02:33	X19844	RD	7.9	111	52	336	- 0.7	- 3.2
Feb 12 01:38	X20634	RD	7.9	99	34	348	+ 0.2	- 3.8
Feb 12 02:49	X20649	RD	8.0	98	48	282	- 1.4	- 1.3
Feb 12 03:56	X20704	RD	7.4	98	59	327	- 1.1	- 2.9
Feb 13 01:02	X21607	RD	7.4	86	18	232	- 0.8	+ 0.2
Feb 13 01:28	2247	RD	5.6	86	23	333	+ 0.2	- 2.8
Feb 14 01:11	2399	RD	5.0	73	10	215	- 0.8	+ 1.3
Feb 15 03:38	2555	RD	7.5	59	27	292	- 0.4	- 1.7
Feb 16 04:17	2737	RD	6.8	44	22	334	+ 0.5	- 4.2
Feb 27 20:45	X06874	DD	7.8	103	30	167	- 0.5	- 5.7
Feb 28 20:08	X08582	DD	7.5	114	36	122	- 2.4	- 0.9
Feb 28 20:52	X08598	DD	7.7	114	33	29	- 3.8	+ 5.1
Feb 28 21:19	0947	DD	5.2	114	31	76	- 2.4	+ 1.2
Feb 28 22:14	X08683	DD	7.8	115	26	87	- 1.9	+ 1.0
Feb 28 22:30	X08698	DD	7.3	115	24	93	- 1.7	+ 0.9
Feb 28 22:57	X08716	DD	7.3	115	20	109	- 1.2	+ 0.5
Feb 29 23:01	X10430	DD	7.1	125	27	174	+ 0.6	- 4.5
Mar 04 04:07	1428	DD	3.8	160	4	88	- 0.4	+ 1.3
Mar 07 22:20	X18763	RD	7.3	155	34	256	- 1.5	- 0.7
Mar 10 03:59	X20462	RD	7.4	128	67	270	- 2.4	+ 0.2
Mar 11 00:09	2208	RD	7.4	117	32	311	- 0.4	- 2.1
Mar 11 23:27	2352	RD	6.7	105	14	255	- 0.3	- 0.7
Mar 14 01:52	X25294	RD	8.0	77	20	278	- 0.3	- 1.3
Mar 14 02:25	2674	RD	6.0	77	26	250	- 0.7	- 0.5
Mar 15 03:47	X27115	RD	7.8	63	30	263	- 0.8	- 0.9
Mar 15 05:14	X27210	RD	7.6	62	47	206	- 1.8	+ 2.7
Mar 26 19:53	X07838	DD	7.9	83	27	153	- 0.9	- 2.0
Mar 27 21:16	X0981Q	DD	7.7	94	23	101	- 1.5	+ 0.7
Mar 27 21:28	1040	DD	6.2	94	22	131	- 0.9	- 0.3
Mar 28 21:23	X11419	DD	6.7	105	30	90	- 2.0	+ 0.9
Mar 29 23:39	1271	DD	5.9	117	19	149	- 0.3	- 1.1
Mar 31 00:04	1381	DD	6.3	128	24	96	- 1.3	+ 0.9
Mar 31 23:50	1478	DD	7.2	139	36	144	- 1.0	- 1.2
Apr 03 04:09	1708	DD	6.2	164	12	82	- 0.5	+ 1.5
Apr 06 22:10	X20984	RD	7.4	148	32	325	- 0.2	- 2.6
Apr 08 23:33	2460	RD	6.1	121	28	320	- 0.1	- 2.6
Apr 09 04:23	2485	RD	7.4	119	72	308	- 2.2	- 1.9
Apr 13 01:52	3093	DB	4.5	67	8	118	+ 0.1	- 2.0
Apr 13 02:37	3093	RD	4.5	67	17	220	- 0.6	+ 0.7
Apr 15 04:18	3381	RD	7.9	40	111	297	- 0.3	- 2.4
Apr 23 19:18	0985	DD	6.9	63	22	96	- 1.5	+ 0.9
Apr 27 19:24	1428	DD	3.8	107	45	154	- 1.4	- 2.4
Apr 27 20:37	1428	RB	3.8	107	41	259	- 2.8	+ 1.2
Apr 28 19:54	X15712	DD	7.8	118	48	155	- 1.3	- 2.6
May 01 00:25	X18174	DD	7.4	143	40	140	- 1.1	- 1.1
May 01 21:14	1865	DD	7.2	155	57	163	- 0.8	- 3.4
May 04 21:01	2247	RD	5.6	166	34	296	- 0.6	- 1.7
May 06 02:21	2426	RD	7.7	151	72	249	- 2.2	+ 1.1
May 06 22:02	2555	RD	7.5	139	24	257	- 0.6	- 0.7
May 07 00:26	X24119	RD	7.7	138	53	283	- 1.4	- 1.3
May 07 23:12	2737	RD	6.8	125	26	300	- 0.3	- 2.0
May 08 01:52	X26138	RD	7.8	124	57	228	- 1.9	+ 1.3
May 08 04:23	X26247	RD	8.0	123	71	252	- 2.1	+ 1.0
May 09 04:23	X27861	RD	7.8	109	68	329	- 3.7	- 7.9
May 09 23:54	3045	RD	6.0	98	10	229	- 0.3	+ 0.2
May 10 03:51	3065	RD	7.5	96	55	270	- 1.9	- 0.7
May 12 03:44	X30992	RD	7.8	70	29	224	- 0.8	+ 0.6
May 12 03:44	3344	RD	7.3	70	29	224	- 0.8	+ 0.6
May 13 04:11	3489	RD	7.7	57	22	278	- 0.9	- 1.5
May 22 17:58	1176	DD	7.4	54	30	161	- 0.5	- 2.3
May 26 21:06	X16540	DD	8.0	99	39	143	- 1.1	- 1.3
May 26 21:32	1599	DD	5.0	99	35	182	+ 0.3	- 4.8
May 26 22:04	1599	RB	5.0	99	30	230	- 2.5	+ 4.9
May 26 23:08	X16618	DD	7.1	100	18	80	- 0.9	+ 1.7
May 27 21:34	1708	DD	6.2	111	45	142	- 1.3	- 1.4
May 28 21:45	1814	DD	7.0	123	53	126	- 1.7	- 0.9
May 29 23:40	1946	DD	7.2	136	46	79	- 1.8	+ 1.5
May 29 23:52	X19483	DD	7.7	136	44	71	- 1.8	+ 2.0
May 30 00:21	1948	DD	7.4	136	38	96	- 1.3	+ 0.8
May 30 19:31	X20216	DD	7.5	147	50	61	- 2.5	+ 0.6
May 30 20:50	2060	DD	6.3	148	62	84	- 2.4	- 0.2
May 31 22:17	2196	DD	6.7	162	69	115	- 1.9	- 1.3
Jun 02 22:12	2508	RD	6.3	170	53	199	- 4.3	+ 9.1
Jun 03 04:08	X23681	RD	7.1	167	44	268	- 1.2	+ 1.0
Jun 03 22:31	2674	RD	6.0	156	44	291	- 1.1	- 1.7
Jun 05 00:22	2856	RD	6.6	141	53	240	- 1.7	+ 0.4
Jun 05 00:23	X27210	RD	7.6	141	53	253	- 1.7	- 0.1
Jun 05 04:37	2880	RD	5.1	139	60	184	+ 0.4	+ 6.5
Jun 05 23:50	3002	RD	6.2	128	34	224	- 1.1	+ 0.7
Jun 06 04:51	3024	RD	7.8	126	64	232	- 1.6	+ 1.8
Jun 07 05:16	3172	RD	8.0	112	63	273	- 2.4	+ 0.1
Jun 09 04:12	3460	RD	7.1	86	44	169	+ 1.2	+ 8.3
Jun 09 04:29	X31609	RD	7.8	86	47	244	- 1.7	+ 0.3
Jun 10 04:27	X00367	RD	8.0	73	36	232	- 1.2	+ 0.5
Jun 11 05:15	0180	RD	5.6	60	32	188	- 0.1	+ 3.0
Jun 11 05:16	0181	RD	6.5	60	32	188	- 0.1	+ 3.0
Jun 12 04:09	0301	RD	6.8	49	10	177	+ 1.0	+ 5.0
Jun 13 05:42	0431	RD	7.7	36	16	301	- 1.7	- 2.8
Jun 18 18:06	1141	DD	5.6	25	101	131	- 0.3	- 0.2
Jun 21 19:24	1458	DD	5.9	58	25	160	- 0.3	- 1.9
Jun 26 18:25	X19844	DD	7.9	116	59	149	- 1.2	- 2.8
Jun 26 23:17	X19941	DD	7.8	117	37	158	- 1.1	- 2.5
Jun 27 19:07	X20704	DD	7.4	129	61	146	- 1.2	- 2.8
Jun 27 21:52	2130	DD	7.9	129	63	171	- 1.2	- 5.5
Jun 29 00:55	2291	DD	5.5	144	42	111	- 1.3	+ 0.2
Jun 29 20:31	2426	DD	7.7	156	59	134	- 1.3	- 2.5
Jul 02 23:14	2936	RD	6.8	159	54	252	- 1.6	+ 0.0
Jul 03 05:08	X28225	RD	7.4	157	39	245	- 0.8	+ 1.6
Jul 04 23:53	3248	RD	6.6	131	35	251	- 1.1	- 0.3
Jul 05 03:03	X30508	RD	7.6	130	61	314	- 4.2	- 4.7
Jul 08 05:12	0136	RD	6.0	90	47	224	- 1.5	+ 1.3
Jul 10 04:02	0394	RD	7.7	66	20	264	- 1.2	- 0.9
Jul 12 05:34	0658	RD	4.3	42	16	234	- 0.7	+ 0.0
Jul 23 20:06	1962	DD	5.2	86	47	104	- 1.7	+ 0.3
Jul 23 21:24	1962	RB	5.2	86	32	293	- 1.1	+ 0.2
Jul 24 22:15	2088	DD	6.2	99	35	91	- 1.1	+ 1.1
Jul 25 19:29	2208	DD	7.4	111	70	99	- 2.3	- 0.3
Jul 27 23:25	X23658	DD	7.8	139	57	142	- 2.3	- 2.3
Jul 27 23:49	X23681	DD	7.1	139	52	113	- 1.7	- 0.1
Jul 28 18:22	2674	DD	6.0	151	38	75	- 1.1	- 0.5
Jul 29 03:32	2722	DD	7.1	154	20	120	- 0.7	+ 0.2
Jul 29 19:24	X27180	DD	7.2	165	37	141	- 0.5	- 3.6
Jul 29 19:39	2856	DD	6.6	165	40	89	- 1.1	- 0.9
Jul 29 23:12	2876	DD	5.4	166	71	121	- 2.5	- 1.7
Jul 30 00:10	2880	DD	5.1	167	67	106	- 2.3	- 0.4
Aug 01 01:14	3187	RD	5.9	163	64	244	- 1.8	+ 1.0
Aug 01 03:31	3199	RD	6.8	162	49	204	- 0.6	+ 2.8
Aug 01 23:29	3328	RD	7.0	149	44	259	- 1.5	- 0.4
Aug 02 03:03	3344	RD	7.3	148	57	303	- 3.4	- 1.8
Aug 03 04:11	X31898	RD	7.9	134	51	224	- 1.4	+ 1.9
Aug 03 04:47	3502	RD	7.4	134	47	261	- 1.9	+ 1.0
Aug 04 00:57	0075	RD	7.8	122	34	259	- 1.4	- 0.6
Aug 07 04:09	0478	RD	7.7	83	31	209	- 0.8	+ 1.5
Aug 08 03:09	0610	RD	6.2	72	13	273	- 1.0	- 1.3
Aug 08 03:36	X05391	RD	7.6	72	18	249	- 1.0	- 0.4
Aug 10 05:23	X07838	RD	7.9	49	18	227	- 0.8	+ 0.4
Aug 20 21:53	X20216	DD	7.5	69	14	165	- 0.8	- 2.9
Aug 21 18:41	X20984	DD	7.4	80	61	125	- 2.0	- 1.0
Aug 21 21:28	X21075	DD	7.9	81	30	80	- 0.8	+ 1.5
Aug 21 21:48	2180	DD	7.1	81	26	117	- 0.8	+ 0.2
Aug 23 19:59	2454	DD	7.2	106	68	43	- 2.1	+ 3.3
Aug 23 22:00	2460	DD	6.1	107	47	71	- 1.2	+ 1.7
Aug 25 20:05	2789	DD	7.3	133	69	124	- 2.2	- 2.2
Aug 26 19:25	2936	DD	6.8	147	51	96	- 1.6	- 1.1
Aug 27 01:25	X28225	DD	7.4	150	40	94	- 1.2	+ 0.9
Aug 30 00:07	3411	RD	7.2	168	56	222	- 1.5	+ 1.5
Sep 01 05:32	0180	RD	5.6	139	30	268	- 1.5	+ 1.14
Sep 01 05:33	0181	RD	6.5	139	30	268	- 1.5	+ 1.14
Sep 02 02:03	0301	RD	6.8	127	40	293	- 2.8	- 1.7
Sep 04 01:40	X04954	RD	7.5	103	20	259	- 1.2	- 0.7
Sep 04 04:58	0581	RD	6.9	102	38	200	- 1.4	+ 3.0
Sep 05 05:28	X06142	RD	7.8	90	36	296	- 2.7	- 1.2
Sep 06 03:12	X07177	RD	7.4	79	17	242	- 0.9	- 0.2
Sep 06 03:51	X07208	RD	7.8	79	23	276	- 1.7	- 1.2
Sep 07 03:52	X09124	RD	7.8	68	16	203	+ 0.0	+ 2.4
Sep 07 03:59	X09116	RD	8.0	68	17	297	- 1.6	- 2.1
Sep 08 05:24	X10921	RD	7.9	56	23	326	- 2.1	- 3.4
Sep 16 18:46	X19947	DD	7.3	39	26	46	- 0.7	+ 4.1
Sep 17 18:43	X20752	DD	7.9	51	38	124	- 1.3	- 0.3
Sep 20 20:40	2555	DD	7.5	89	49	151	- 2.7	- 3.6
Sep 21 19:32	2722	DD	7.1	102	70	114	- 2.4	- 0.9
Sep 21 22:42	2737	DD	6.8	103	36	85	- 0.9	+ 1.2
Sep 23 22:41	3045	DD	6.0	131	55	66	- 1.5	+ 1.5
Sep 24 20:23	3185	DD	5.3	143	59	4	- 0.5	+ 5.2
Sep 24 20:32	3187	DD	5.9	144	60	77	- 2.0	+ 0.1
Sep 24 23:20	3199	DD	6.8	145	55	117	- 2.6	- 0.7
Sep 25 19:26	3328	DD	7.0	157	39	54	- 1.2	+ 0.4
Sep 30 01:09	0372	RD	7.6	147	41	251	- 2.0	+ 0.2
Oct 02 01:11	0648	DB	3.9	122	26	101	- 1.9	- 1.3
Oct 02 02:28	0648	RD	3.9	122	34	231	- 1.7	+ 0.8
Oct 02 03:06	0658	DB	4.3	121	36	48	- 1.9	+ 1.1
Oct 02 04:25	0658	RD	4.3	121	36	291	- 2.5	- 0.4
Oct 04 01:55	X08330	RD	7.9	99	17	262	- 1.2	- 0.9
Oct 04 02:04	X08343	RD	7.7	99	19	289	- 1.6	- 1.7
Oct 05 04:06	X10283	RD	7.7	87	29	238	- 1.9	+ 0.3
Oct 07 04:36	1301	RD	8.0	65	24	282	- 1.6	- 1.5
Oct 15 19:16	2223	RB	4.0	33	18	321	- 0.7	- 0.8
Oct 17 20:35	2527	DD	6.9	59	25	14	+ 1.0	+ 5.8
Oct 17 21:45	X23712	DD	8.0	60	12	129	- 0.5	- 0.1
Oct 19 20:15	X27115	DD	7.8	86	51	76	- 1.4	+ 1.4
Oct 20 19:28	2983	DD	7.9	99	66	98	- 2.3	+ 0.0
Oct 21 23:31	3154	DD	7.4	114	31	20	- 0.1	+ 3.0
Oct 26 00:12	0180	DD	5.6	167	44	35	- 1.4	+ 2.1
Oct 26 00:13	0181	DD	6.5	167	44	35	- 1.4	+ 2.1
Oct 28 22:47	0581	RD	6.9	155	26	240	- 1.2	+ 0.0
Oct 29 02:51	0590	RD	6.3	154	34	312	- 2.4	- 1.2
Oct 30 23:13	0863	RD	6.7	131	12	288	- 1.2	- 1.8
Oct 31 00:08	0871	RD	6.9	131	21	194	+ 0.3	+ 3.6
Oct 31 00:49	X07541	RD	7.6	131	26	222	- 1.2	+ 0.9
Oct 31 01:09	X07560	RD	7.6	131	29	238	- 1.6	+ 0.2
Oct 31 04:01	0884	RD	7.8	130	35	302	- 2.2	- 0.7
Nov 16 22:03	X28225	DD	7.4	69	15	95	- 0.3	+ 1.0
Nov 18 20:43	3248	DD	6.6	95	47	71	- 1.5	+ 1.4
Nov 25 02:04	0527	DD	6.3	173	26	23	- 1.9	+ 3.6
Nov 25 21:26	0658	RD	4.3	175	24	293	- 2.0	- 1.9
Nov 27 22:40	0947	RD	5.2	152	19	306	- 1.9	- 2.4
Nov 27 23:53	X08698	RD	7.3	151	29	265	- 1.9	- 0.6
Nov 28 00:13	X08716	RD	7.3	151	31	240	- 1.9	+ 0.3
Nov 29 23:39	1198	RD	6.2	129	15	262	- 1.0	- 1.0
Nov 30 01:41	1210	RD	5.9	129	32	270	- 2.2	- 0.8
Dec 05 02:58	1730	RD	6.5	73	22	347	- 0.4	- 3.6
Dec 13 20:25	2913	DD	5.0	37	10	124	- 0.4	+ 0.1
Dec 15 21:43	3216	DD	6.6	65	13	86	- 0.3	+ 1.2
Dec 17 21:51	X31898	DD	7.9	91	26	13	- 0.4	+ 3.4
Dec 21 22:33	0478	DD	7.7	141	37	93	- 2.3	+ 0.4
Dec 22 23:17	0620	DD	6.3	153	35	135	- 2.5	- 1.6
Dec 24 00:15	0764	DD	5.0	165	33	131	- 2.1	- 1.0
Dec 26 21:41	1158	RD	5.2	161	16	347	- 2.7	- 6.9
Dec 28 00:45	X12916	RD	7.6	149	36	283	- 2.3	- 1.0
Dec 31 01:35	X16391	RD	7.6	117	34	288	- 1.6	- 1.6

MELBOURNE (37° 50' S, 145° 00'E)

AEST	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Jan 03 01:54	0639	DD	6.0	145	10	73	- 1.1	+ 1.7
Jan 04 21:14	0895	DD	5.9	165	25	56	- 1.6	+ 0.2
Jan 09 03:03	1381	RD	6.3	149	40	238	- 3.6	+ 2.3
Jan 17 03:43	2308	RD	7.6	53	22	265	- 0.4	- 1.0
Jan 27 21:18	0340	DD	7.1	90	23	121	- 1.5	+ 0.1
Jan 29 22:36	0593	DD	5.8	113	21	21	- 2.3	+ 4.5
Feb 07 01:31	1555	RD	7.6	158	46	325	- 1.5	- 2.0
Feb 07 02:01	X15947	RD	7.6	158	46	295	- 2.0	- 0.8
Feb 11 02:37	X19844	RD	7.9	111	48	322	- 0.9	- 2.5
Feb 12 01:47	X20634	RD	7.9	99	32	332	- 0.2	- 2.8
Feb 12 02:46	X20649	RD	8.0	98	43	270	- 1.4	- 1.1
Feb 12 03:57	X20704	RD	7.4	98	56	313	- 1.2	- 2.2
Feb 13 00:56	X21607	RD	7.4	86	14	211	- 1.5	+ 2.3
Feb 13 01:35	2247	RD	5.6	86	21	320	+ 0.1	- 2.3
Feb 15 03:41	2555	RD	7.5	59	25	281	- 0.4	- 1.4
Feb 16 04:26	2737	RD	6.8	44	21	314	+ 0.1	- 2.6
Feb 25 21:32	0532	DD	7.2	81	13	29	- 1.7	+ 3.6
Feb 28 20:01	X08582	DD	7.5	114	33	130	- 2.3	- 1.3
Feb 28 20:30	X08598	DD	7.7	114	32	44	- 2.8	+ 2.2
Feb 28 21:07	0947	DD	5.2	114	31	85	- 2.4	+ 0.7
Feb 28 22:04	X08683	DD	7.8	115	27	98	- 1.9	+ 0.6
Feb 28 22:21	X08698	DD	7.3	115	25	104	- 1.7	+ 0.5
Feb 28 22:51	X08716	DD	7.3	115	21	121	- 1.2	+ 0.1
Mar 04 04:02	1428	DD	3.8	160	8	100	- 0.5	+ 0.9
Mar 07 22:16	X18763	RD	7.3	155	29	244	- 1.4	- 0.4
Mar 09 05:34	1973	RD	6.2	140	45	271	- 1.6	+ 1.0
Mar 10 03:48	X20462	RD	7.4	128	65	257	- 2.5	+ 0.7
Mar 11 00:13	2208	RD	7.4	117	29	300	- 0.4	- 1.9
Mar 11 23:28	2352	RD	6.7	105	11	244	- 0.3	- 0.5
Mar 13 05:12	X23658	RD	7.8	89	64	227	- 2.3	+ 1.9
Mar 14 01:54	X25294	RD	8.0	77	17	267	- 0.2	- 1.1
Mar 14 02:22	2674	RD	6.0	77	23	237	- 0.7	- 0.1
Mar 15 03:46	X27115	RD	7.8	63	27	252	- 0.7	- 0.6
Mar 17 05:35	3154	RD	7.4	35	22	257	- 0.6	- 0.8
Mar 26 21:18	X07934	DD	7.9	83	16	58	- 1.8	+ 2.4
Mar 27 21:09	X09810	DD	7.7	94	25	113	- 1.5	+ 0.3
Mar 27 21:26	1040	DD	6.2	94	23	144	- 0.8	- 0.9
Mar 28 21:13	X11419	DD	6.7	105	30	101	- 2.0	+ 0.4
Mar 29 18:52	1257	DD	7.5	115	34	184	- 0.2	- 9.2
Mar 29 23:43	1271	DD	5.9	117	19	168	+ 0.2	- 2.4
Mar 30 23:56	1381	DD	6.3	128	26	109	- 1.3	+ 0.4
Mar 31 23:51	1478	DD	7.2	139	36	160	- 0.6	- 2.1
Apr 03 04:04	1708	DD	6.2	164	16	93	- 0.6	+ 1.2
Apr 06 04:14	2060	RD	6.3	159	48	347	- 1.2	- 4.0
Apr 06 22:15	X20984	RD	7.4	148	29	313	- 0.3	- 2.2
Apr 08 23:38	2460	RD	6.1	121	26	307	- 0.2	- 2.1
Apr 09 04:19	2485	RD	7.4	119	70	297	- 2.1	- 1.3
Apr 10 06:04	X25075	RD	7.2	105	68	289	- 2.2	- 0.6
Apr 12 05:56	X28225	RD	7.4	79	60	199	- 1.4	+ 3.7
Apr 13 02:32	3093	RD	4.5	67	13	204	- 0.6	+ 1.5
Apr 21 18:51	K02424	DD	7.1	40	12	66	- 1.3	+ 1.9
Apr 21 18:56	0710	DD	7.1	40	11	66	- 1.2	+ 1.9
Apr 23 19:10	0985	DD	6.9	63	23	107	- 1.5	+ 0.5
Apr 23 20:19	X09116	DD	8.0	63	14	73	- 1.4	+ 1.8
Apr 27 19:27	1428	DD	3.8	107	42	170	- 0.8	- 3.4
Apr 27 20:20	1428	RB	3.8	107	41	241	- 3.5	+ 2.1
Apr 28 19:57	X15712	DD	7.8	118	46	172	- 0.6	- 3.6
May 05 00:24	X18174	DD	7.4	143	41	155	- 0.9	- 1.9
May 01 21:24	1865	DD	7.2	155	54	185	+ 0.7	- 5.9
May 04 21:02	2247	RD	5.6	166	31	285	- 0.6	- 1.5
May 05 06:05	2291	RD	5.5	163	26	263	- 0.5	+ 1.3
May 06 02:08	2426	RD	7.7	151	70	237	- 2.3	+ 1.6
May 07 00:23	X24119	RD	7.7	138	48	272	- 1.3	- 1.0
May 07 23:15	2737	RD	6.8	125	24	288	- 0.3	- 1.6
May 08 01:40	X26138	RD	7.8	124	51	213	- 1.9	+ 2.3
May 08 04:13	X26247	RD	8.0	123	69	245	- 2.0	+ 1.1
May 09 04:23	X27861	RD	7.8	109	64	313	- 2.6	- 3.5
May 10 03:46	3065	RD	7.5	96	49	262	- 1.6	- 0.6
May 10 06:14	3075	RD	7.1	95	64	247	- 1.9	+ 0.9
May 12 03:39	X30992	RD	7.8	70	24	215	- 0.7	+ 0.9
May 12 03:39	3344	RD	7.3	70	24	215	- 0.7	+ 0.9
May 13 04:11	3489	RD	7.7	57	18	271	- 0.7	- 1.3
May 13 06:20	X31871	RD	8.0	56	40	250	- 1.5	- 0.1
May 22 18:11	1176	DD	7.4	54	28	191	****	****
May 26 21:07	X16540	DD	8.0	99	39	159	- 0.8	- 2.1
May 26 23:01	X16618	DD	7.1	100	22	93	- 1.0	+ 1.2
May 27 21:34	1708	DD	6.2	111	45	158	- 1.0	- 2.2
May 28 21:41	1814	DD	7.0	123	53	139	- 1.5	- 1.5
May 29 23:30	1946	DD	7.2	136	49	92	- 1.8	+ 0.8
May 29 23:40	X19483	DD	7.7	136	47	84	- 1.8	+ 1.2
May 30 00:14	1948	DD	7.4	136	42	107	- 1.4	+ 0.4
May 30 19:23	X20216	DD	7.5	147	45	77	- 1.7	- 0.6
May 30 20:42	2060	DD	6.3	148	57	97	- 1.9	- 0.9
May 30 21:40	2064	DD	6.5	148	63	55	- 3.2	+ 2.1
May 31 22:14	2196	DD	6.7	162	65	128	- 1.6	- 1.8
Jun 03 04:00	X23681	RD	7.1	167	48	264	- 1.3	+ 1.2
Jun 03 22:31	2674	RD	6.0	156	41	279	- 1.0	- 1.3
Jun 05 00:14	2856	RD	6.6	141	48	229	- 1.5	+ 0.8
Jun 05 00:17	X27210	RD	7.6	141	48	243	- 1.5	+ 0.1
Jun 05 23:43	3002	RD	6.2	128	29	211	- 1.0	+ 1.4
Jun 06 04:40	3024	RD	7.8	126	64	229	- 1.5	+ 1.8
Jun 07 05:06	3172	RD	8.0	112	61	271	- 2.3	+ 0.0
Jun 09 04:22	X31609	RD	7.8	86	42	241	- 1.4	+ 0.2
Jun 10 04:21	X00367	RD	8.0	73	31	228	- 0.9	+ 0.4
Jun 10 06:22	X00439	RD	8.0	72	46	208	- 1.1	+ 1.8
Jun 11 05:07	0180	RD	5.6	60	27	182	+ 0.3	+ 3.7
Jun 11 05:07	0181	RD	6.5	60	27	182	+ 0.3	+ 3.7
Jun 13 05:43	0431	RD	7.7	36	12	296	- 1.3	- 2.5
Jun 18 18:06	1141	DD	5.6	25	11	146	- 0.1	- 0.7
Jun 19 19:05	X12657	DD	7.4	36	10	118	- 0.5	+ 0.4
Jun 21 19:32	1458	DD	5.9	58	25	184	+ 0.9	- 5.2
Jun 26 18:30	X19844	DD	7.9	116	56	166	- 0.5	- 3.7
Jun 26 23:22	X19941	DD	7.8	117	38	179	- 1.0	- 6.9
Jun 27 19:11	X20704	DD	7.4	129	57	163	- 0.6	- 3.8
Jun 29 00:49	2291	DD	5.5	144	46	118	- 1.4	- 0.1
Jun 29 20:34	2426	DD	7.7	156	56	150	- 0.8	- 3.5
Jul 02 23:07	2936	RD	6.8	159	49	243	- 1.5	+ 0.2
Jul 03 05:00	X28225	RD	7.4	157	43	243	- 0.9	+ 1.7
Jul 03 22:54	3093	RD	4.5	145	33	323	- 0.8	- 5.2
Jul 04 23:50	3248	RD	6.6	131	31	243	- 0.9	- 0.2
Jul 05 02:58	X30508	RD	7.6	130	57	307	- 3.2	- 3.2
Jul 08 05:03	0136	RD	6.0	90	43	223	- 1.4	+ 1.1
Jul 10 04:00	0394	RD	7.7	66	16	261	- 0.9	- 0.9
Jul 11 06:52	X04629	RD	7.8	53	30	263	- 1.9	- 0.5
Jul 12 05:31	0658	RD	4.3	42	12	231	- 0.5	+ 0.0
Jul 12 06:38	0663	RD	6.9	42	21	272	- 1.6	- 1.2
Jul 18 18:29	X14676	DD	8.1	29	14	44	- 2.1	+ 5.7
Jul 23 19:59	1962	DD	5.2	86	50	116	- 1.7	- 0.2
Jul 23 21:18	1962	RB	5.2	86	36	283	- 1.2	+ 0.6
Jul 24 22:08	2088	DD	6.2	99	39	99	- 1.2	+ 0.8
Jul 25 19:22	2208	DD	7.4	111	67	111	- 2.0	- 1.0
Jul 27 23:23	X23658	DD	7.8	139	59	154	- 2.5	- 4.4
Jul 27 23:42	X23681	DD	7.1	139	55	120	- 1.9	- 0.5
Jul 28 18:20	2674	DD	6.0	151	34	87	- 0.8	- 1.0
Jul 29 03:29	2722	DD	7.1	154	24	124	- 0.8	+ 0.1
Jul 29 19:38	2856	DD	6.6	165	36	99	- 0.9	- 1.4
Jul 29 23:08	2876	DD	5.4	166	68	130	- 2.4	- 2.7
Jul 30 00:02	2880	DD	5.1	167	67	111	- 2.3	- 0.8
Aug 01 01:04	3187	RD	5.9	163	61	240	- 1.7	+ 0.9
Aug 01 03:21	3199	RD	6.8	162	52	203	- 0.7	+ 2.9
Aug 01 23:25	3328	RD	7.0	149	39	253	- 1.3	- 0.4
Aug 02 02:54	3344	RD	7.3	148	56	301	- 3.1	- 1.7
Aug 03 04:00	X31898	RD	7.9	134	51	223	- 1.4	+ 1.7
Aug 03 04:37	3502	RD	7.4	134	48	260	- 1.9	+ 0.9
Aug 03 06:15	3508	RD	5.8	133	34	313	- 2.4	- 1.3
Aug 04 00:54	0075	RD	7.8	122	29	255	- 1.1	- 0.5
Aug 07 04:03	0478	RD	7.7	83	26	206	- 0.6	+ 1.4
Aug 08 03:34	X05391	RD	7.6	72	13	246	- 0.7	- 0.5
Aug 10 05:20	X07838	RD	7.9	49	13	224	- 0.5	+ 0.3
Aug 21 18:37	X20984	DD	7.4	80	62	137	- 1.8	- 1.8
Aug 21 21:21	X21075	DD	7.9	81	34	87	- 1.0	+ 1.3
Aug 21 21:45	2180	DD	7.1	81	30	124	- 1.0	- 0.1
Aug 23 19:43	2454	DD	7.2	106	69	56	- 2.2	+ 2.0
Aug 23 21:51	2460	DD	6.1	107	51	77	- 1.4	+ 1.4
Aug 25 02:11	2646	DD	6.0	122	13	28	+ 0.6	+ 2.9
Aug 25 20:04	2789	DD	7.3	133	65	136	- 2.0	- 3.3
Aug 26 19:22	2936	DD	6.8	147	47	106	- 1.4	- 1.6
Aug 27 01:17	X28225	DD	7.4	150	44	96	- 1.4	+ 0.8
Aug 29 23:58	3411	RD	7.2	168	52	220	- 1.3	+ 1.4
Sep 01 05:23	0180	RD	5.6	139	33	264	- 1.6	+ 1.1
Sep 01 05:24	0181	RD	6.5	139	32	265	- 1.6	+ 1.1
Sep 02 01:56	0301	RD	6.8	127	36	291	- 2.5	- 1.7
Sep 04 01:37	X04954	RD	7.5	103	15	257	- 0.9	- 0.8
Sep 04 04:45	0581	RD	6.9	102	35	196	- 1.0	+ 3.0
Sep 05 05:20	X06142	RD	7.8	90	32	292	- 2.5	- 1.2
Sep 06 03:09	X07177	RD	7.4	79	13	239	- 0.7	- 0.3
Sep 06 03:48	X07208	RD	7.8	79	18	273	- 1.4	- 1.2
Sep 07 03:59	X09116	RD	8.0	68	13	294	- 1.3	- 2.0
Sep 08 05:23	X10921	RD	7.9	56	19	320	- 1.9	- 2.9
Sep 18 22:11	X21858	DD	8.0	65	12	126	- 0.4	+ 0.1
Sep 21 19:26	2722	DD	7.1	102	69	122	- 2.3	- 1.5
Sep 21 22:35	2737	DD	6.8	103	40	88	- 1.1	+ 1.1
Sep 23 22:31	3045	DD	6.0	131	58	69	- 1.6	+ 1.3
Sep 24 20:09	3185	DD	5.3	143	53	14	- 1.0	+ 3.4
Sep 24 20:24	3187	DD	5.9	144	55	82	- 1.9	- 0.3
Sep 24 23:11	3199	DD	6.8	145	56	119	- 2.7	- 1.0
Sep 25 19:21	3328	DD	7.0	157	34	61	- 1.0	+ 0.0
Sep 30 01:00	0372	RD	7.6	147	36	250	- 1.8	+ 0.1
Oct 02 01:07	0648	DB	3.9	122	21	103	- 1.7	- 1.5
Oct 02 02:19	0648	RD	3.9	122	30	228	- 1.4	+ 0.6
Oct 02 02:56	0658	DB	4.3	121	32	51	- 1.7	+ 0.7
Oct 02 04:15	0658	RD	4.3	121	34	287	- 2.4	- 0.4
Oct 04 02:03	X08343	RD	7.7	99	14	286	- 1.3	- 1.7
Oct 05 03:59	X10283	RD	7.7	87	24	233	- 1.5	+ 0.2
Oct 07 04:34	1301	RD	8.0	65	19	278	- 1.3	- 1.4
Oct 15 19:15	2223	RB	4.0	33	21	314	- 0.7	- 0.3
Oct 17 20:25	2527	DD	6.9	59	31	23	+ 0.3	+ 4.4
Oct 17 21:43	X23712	DD	8.0	60	16	133	- 0.6	- 0.2
Oct 18 22:31	X25575	DD	8.0	73	17	62	+ 0.0	+ 1.7
Oct 18 22:58	2705	DD	6.8	74	12	77	+ 0.0	+ 1.3
Oct 19 20:05	X27115	DD	7.8	86	55	79	- 1.6	+ 1.2
Oct 20 19:19	2983	DD	7.9	99	65	102	- 2.3	- 0.4
Oct 21 23:22	3154	DD	7.4	114	35	22	- 0.2	+ 3.0
Oct 26 00:01	0180	DD	5.6	167	43	36	- 1.4	+ 1.9
Oct 26 00:02	0181	DD	6.5	167	43	36	- 1.4	+ 1.9
Oct 26 21:02	0301	DD	6.8	178	26	346	****	****
Oct 26 21:13	0301	RD	6.8	178	27	327	****	****
Oct 28 22:42	0581	RD	6.9	155	21	237	- 0.9	- 0.1
Oct 29 02:44	0590	RD	6.3	154	33	306	- 2.4	- 0.9
Oct 31 01:03	X07560	RD	7.6	131	24	235	- 1.3	+ 0.1
Oct 31 03:54	0884	RD	7.8	130	33	295	- 2.3	- 0.6
Nov 14 20:57	X25030	DD	7.5	42	12	64	+ 0.2	+ 1.6
Nov 16 21:59	X28225	DD	7.4	69	20	98	- 0.4	+ 1.0
Nov 18 20:33	3248	DD	6.6	95	50	72	- 1.6	+ 1.3
Nov 25 01:48	0527	DD	6.3	173	28	33	- 1.8	+ 2.6
Nov 25 21:23	0658	RD	4.3	175	20	290	- 1.7	- 1.8
Nov 27 22:39	0947	RD	5.2	152	15	303	- 1.6	- 2.3
Nov 27 23:47	X08698	RD	7.3	151	24	262	- 1.7	- 0.7
Nov 28 00:05	X08716	RD	7.3	151	26	236	- 1.6	+ 0.2
Nov 29 23:37	1198	RD	6.2	129	11	259	- 0.8	- 1.0
Nov 30 01:35	1210	RD	5.9	129	28	264	- 1.9	- 0.8
Dec 05 03:04	1730	RD	6.5	73	19	336	- 0.4	- 2.9
Dec 15 21:38	3216	DD	6.6	65	17	89	- 0.4	+ 1.2
Dec 17 21:41	X31898	DD	7.9	91	30	17	- 0.5	+ 3.1
Dec 21 22:22	0478	DD	7.7	141	36	96	- 2.3	+ 0.2
Dec 22 23:11	0620	DD	6.3	153	34	143	- 2.8	- 2.5
Dec 24 00:09	0764	DD	5.0	165	32	140	- 2.2	- 1.6
Dec 26 21:45	1158	RD	5.2	161	12	338	- 1.9	- 4.5
Dec 28 02:39	1284	RD	6.3	149	37	351	- 0.8	- 3.7
Dec 31 01:33	X16391	RD	7.6	117	29	281	- 1.5	- 1.5

SYDNEY (33° 54' S, 151° 15'E)

AEST	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Jan 04 21:27	0895	DD	5.9	165	32	50	- 2.0	+ 0.9
Jan 09 03:28	1381	RD	6.3	149	40	264	- 2.6	+ 0.9
Jan 10 03:12	1478	RD	7.2	138	48	241	- 4.0	+ 2.2
Jan 17 03:41	2308	RD	7.6	53	26	281	- 0.5	- 1.3
Jan 27 21:27	0340	DD	7.1	90	20	110	- 1.2	+ 0.5
Jan 31 21:21	X07312	DD	7.8	134	36	45	- 2.8	+ 2.1
Feb 07 01:28	1555	RD	7.6	158	50	349	- 0.7	- 3.4
Feb 07 02:09	X15947	RD	7.6	158	49	314	- 1.7	- 1.4
Feb 08 03:08	X17212	RD	7.7	146	52	260	- 2.9	+ 1.0
Feb 08 03:14	X17216	RD	7.6	146	52	247	- 3.4	+ 2.1
Feb 11 02:30	X19844	RD	7.9	111	53	345	- 0.5	- 3.8
Feb 12 01:31	X20634	RD	7.9	99	35	1	+ 1.1	- 5.6
Feb 12 03:53	X20704	RD	7.4	98	61	336	- 0.9	- 3.5
Feb 13 01:04	X21607	RD	7.4	86	20	240	- 0.8	- 0.2
Feb 13 01:23	2247	RD	5.6	86	24	342	+ 0.4	- 3.4
Feb 14 01:14	2399	RD	5.0	73	12	226	- 0.6	+ 0.5
Feb 15 03:37	2555	RD	7.5	59	29	299	- 0.4	- 1.9
Feb 24 19:48	X03753	DD	8.3	69	22	80	- 1.4	+ 1.4
Feb 27 20:42	X06874	DD	7.8	103	31	155	- 1.2	- 2.9
Feb 28 20:12	X08582	DD	7.5	114	36	118	- 2.4	- 0.7
Feb 28 21:26	0947	DD	5.2	114	31	70	- 2.5	+ 1.5
Feb 28 22:20	X08683	DD	7.8	115	25	82	- 1.9	+ 1.3
Feb 28 22:35	X08698	DD	7.3	115	23	88	- 1.7	+ 1.1
Feb 28 23:01	X08716	DD	7.3	115	19	103	- 1.2	+ 0.7
Feb 29 19:30	X10283	DD	7.7	124	37	167	- 2.1	- 5.6
Feb 29 22:57	X10430	DD	7.1	125	27	161	- 0.3	- 2.5
Mar 04 04:10	1428	DD	3.8	160	3	81	- 0.4	+ 1.5
Mar 07 22:22	X18763	RD	7.3	155	36	263	- 1.5	- 0.8
Mar 10 04:04	X20462	RD	7.4	128	67	277	- 2.3	+ 0.0
Mar 11 00:07	2208	RD	7.4	117	33	317	- 0.4	- 2.3
Mar 11 23:27	2352	RD	6.7	105	15	261	- 0.3	- 0.8
Mar 14 02:26	2674	RD	6.0	77	28	256	- 0.8	- 0.6
Mar 15 03:48	X27115	RD	7.8	63	32	269	- 0.8	- 1.0
Mar 15 05:08	2856	RD	6.6	62	48	190	- 2.2	+ 7.1
Mar 26 19:53	X07838	DD	7.9	83	27	144	- 1.1	- 1.4
Mar 27 18:50	X09695	DD	7.7	93	37	58	- 3.0	+ 1.6
Mar 27 21:20	X09810	DD	7.7	94	23	95	- 1.5	+ 0.9
Mar 27 21:30	1040	DD	6.2	94	21	124	- 1.0	- 0.1
Mar 28 21:29	X11419	DD	6.7	105	29	83	- 2.1	+ 1.2
Mar 29 18:42	1257	DD	7.5	115	39	157	- 1.8	- 3.3
Mar 29 23:39	1271	DD	5.9	117	18	141	- 0.4	- 0.8
Mar 31 00:08	1381	DD	6.3	128	23	88	- 1.4	+ 1.2
Mar 31 23:51	1478	DD	7.2	139	35	137	- 1.1	- 0.9
Apr 03 04:12	1708	DD	6.2	164	10	76	- 0.4	+ 1.7
Apr 06 22:07	X20984	RD	7.4	148	33	332	- 0.1	- 2.9
Apr 08 23:29	2460	RD	6.1	121	29	328	+ 0.1	- 3.1
Apr 09 04:25	2485	RD	7.4	119	73	314	- 2.3	- 2.4
Apr 13 02:39	3093	RD	4.5	67	19	226	- 0.6	+ 0.4
Apr 15 04:15	3381	RD	7.9	40	12	304	- 0.4	- 2.9
Apr 23 19:22	0985	DD	6.9	63	21	90	- 1.5	+ 1.1
Apr 25 20:34	X12215	DD	7.8	85	27	174	+ 0.4	- 3.7
Apr 27 19:24	1428	DD	3.8	107	46	146	- 1.6	- 2.0
Apr 27 20:44	1428	RB	3.8	107	41	267	- 2.5	+ 0.8
Apr 28 19:53	X15712	DD	7.8	118	50	148	- 1.5	- 2.2
Apr 30 01:13	1652	DD	5.5	132	18	182	+ 0.2	- 5.2
May 01 00:26	X18174	DD	7.4	143	39	133	- 1.2	- 0.8
May 01 21:11	1865	DD	7.2	155	59	154	- 1.1	- 2.9
May 04 21:00	2247	RD	5.6	166	36	302	- 0.6	- 1.9
May 06 02:27	2426	RD	7.7	151	72	255	- 2.2	+ 0.9
May 06 22:02	2555	RD	7.5	139	26	263	- 0.6	- 0.8
May 07 00:27	X24119	RD	7.7	138	55	289	- 1.5	- 1.6
May 07 23:10	2737	RD	6.8	125	27	307	- 0.3	- 2.3
May 08 01:58	X26138	RD	7.8	124	60	234	- 2.0	+ 1.0
May 08 04:30	X26247	RD	8.0	123	71	255	- 2.1	+ 0.9
May 09 23:55	3045	RD	6.0	98	11	235	- 0.3	+ 0.0
May 10 03:54	3065	RD	7.5	96	57	273	- 2.0	- 0.8
May 12 03:47	X30992	RD	7.8	70	32	228	- 1.0	+ 0.6
May 12 03:47	3344	RD	7.3	70	32	228	- 1.0	+ 0.6
May 13 04:11	3489	RD	7.7	57	24	282	- 1.1	- 1.7
May 21 18:56	X1O156	DD	7.1	43	13	173	+ 1.1	- 4.1
May 22 17:57	1176	DD	7.4	54	30	152	- 0.8	- 1.6
May 26 21:27	1599	DD	5.0	99	35	169	- 0.4	- 3.0
May 26 22:13	1599	RB	5.0	99	27	243	- 1.8	+ 3.0
May 26 23:13	X16618	DD	7.1	100	16	73	- 0.9	+ 2.1
May 27 21:36	1708	DD	6.2	111	44	135	- 1.4	- 1.0
May 28 21:47	1814	DD	7.0	123	52	119	- 1.8	- 0.6
May 29 23:46	1946	DD	7.2	136	44	72	- 1.8	+ 2.0
May 29 23:59	X19483	DD	7.7	136	41	63	- 1.7	+ 2.6
May 30 00:25	1948	DD	7.4	136	36	91	- 1.3	+ 1.0
May 30 19:39	X20216	DD	7.5	147	54	49	- 3.4	+ 2.2
May 30 20:55	2060	DD	6.3	148	65	76	- 2.6	+ 0.3
May 31 22:20	2196	DD	6.7	162	71	109	- 2.1	- 0.9
Jun 02 22:24	2508	RD	6.3	170	57	216	- 2.6	+ 2.8
Jun 03 04:11	X23681	RD	7.1	167	41	270	- 1.1	+ 0.9
Jun 03 22:31	2674	RD	6.0	156	46	297	- 1.1	- 2.0
Jun 05 00:26	2856	RD	6.6	141	56	246	- 1.8	+ 0.3
Jun 05 00:27	X27210	RD	7.6	141	56	258	- 1.8	- 0.2
Jun 05 04:44	2880	RD	5.1	139	57	188	+ 0.1	+ 5.5
Jun 05 23:53	3002	RD	6.2	128	37	231	- 1.2	+ 0.5
Jun 06 04:57	3024	RD	7.8	126	63	233	- 1.5	+ 1.8
Jun 09 04:19	3460	RD	7.1	86	48	175	+ 0.4	+ 5.9
Jun 09 04:33	X31609	RD	7.8	86	50	246	- 1.8	+ 0.3
Jun 10 04:30	X00367	RD	8.0	73	38	234	- 1.3	+ 0.5
Jun 11 05:19	0180	RD	5.6	60	35	191	- 0.2	+ 2.8
Jun 11 05:20	0181	RD	6.5	60	35	191	- 0.2	+ 2.8
Jun 12 04:13	0301	RD	6.8	49	13	184	+ 0.6	+ 3.5
Jun 13 05:42	0431	RD	7.7	36	18	304	- 1.9	- 3.1
Jun 14 05:53	0554	RD	8.4	25	10	218	- 0.1	+ 0.7
Jun 21 19:23	1458	DD	5.9	58	24	152	- 0.4	- 1.4
Jun 25 18:33	X19074	DD	8.3	103	62	129	- 1.9	- 1.7
Jun 26 17:37	1997	DD	6.8	115	54	102	- 1.9	- 1.2
Jun 26 17:40	1996	DD	6.9	115	55	57	- 3.2	+ 1.4
Jun 26 18:24	X19844	DD	7.9	116	62	141	- 1.4	- 2.4
Jun 26 23:16	X19941	DD	7.8	117	35	151	- 1.1	- 1.8
Jun 27 19:06	X20704	DD	7.4	129	63	138	- 1.4	- 2.4
Jun 27 21:49	2130	DD	7.9	129	63	160	- 1.5	- 3.6
Jun 29 00:58	2291	DD	5.5	144	40	107	- 1.2	+ 0.4
Jun 29 20:30	2426	DD	7.7	156	61	127	- 1.5	- 2.1
Jul 02 20:33	2927	RD	7.2	161	25	207	- 1.1	+ 1.8
Jul 02 23:17	2936	RD	6.8	159	57	256	- 1.8	- 0.1
Jul 03 05:12	X28225	RD	7.4	157	36	245	- 0.7	+ 1.6
Jul 04 23:55	3248	RD	6.6	131	38	255	- 1.2	- 0.4
Jul 05 03:05	X30508	RD	7.6	130	63	318	- 5.2	- 6.3
Jul 08 05:17	0136	RD	6.0	90	49	224	- 1.6	+ 1.4
Jul 10 04:03	0394	RD	7.7	66	23	266	- 1.3	- 0.9
Jul 12 05:35	0658	RD	4.3	42	19	235	- 0.8	+ 0.1
Jul 23 20:11	1962	DD	5.2	86	45	98	- 1.7	+ 0.6
Jul 23 21:26	1962	RB	5.2	86	30	298	- 1.0	+ 0.0
Jul 24 22:19	2088	DD	6.2	99	32	86	- 1.0	+ 1.3
Jul 25 19:34	2208	DD	7.4	111	70	93	- 2.4	+ 0.0
Jul 27 23:27	X23658	DD	7.8	139	55	137	- 2.2	- 1.7
Jul 27 23:53	X23681	DD	7.1	139	50	110	- 1.7	+ 0.1
Jul 28 18:24	2674	DD	6.0	151	40	69	- 1.3	- 0.2
Jul 29 19:21	X27180	DD	7.2	165	38	132	- 0.7	- 2.9
Jul 29 19:40	2856	DD	6.6	165	42	83	- 1.2	- 0.7
Jul 29 23:15	2876	DD	5.4	166	72	117	- 2.5	- 1.4
Jul 30 00:14	2880	DD	5.1	167	67	103	- 2.2	- 0.2
Aug 01 01:19	3187	RD	5.9	163	65	245	- 1.9	+ 1.1
Aug 01 03:36	3199	RD	6.8	162	48	205	- 0.6	+ 2.8
Aug 01 23:32	3328	RD	7.0	149	46	262	- 1.7	- 0.5
Aug 02 03:08	3344	RD	7.3	148	56	305	- 3.5	- 1.9
Aug 03 04:17	X31898	RD	7.9	134	51	224	- 1.4	+ 1.9
Aug 03 04:52	3502	RD	7.4	134	46	261	- 1.8	+ 1.0
Aug 04 01:00	0075	RD	7.8	122	36	261	- 1.5	- 0.6
Aug 07 04:13	0478	RD	7.7	83	34	210	- 0.9	+ 1.6
Aug 08 03:10	0610	RD	6.2	72	16	274	- 1.2	- 1.3
Aug 08 03:38	X05391	RD	7.6	72	20	250	- 1.1	- 0.4
Aug 10 05:26	X07838	RD	7.9	49	21	229	- 0.9	+ 0.4
Aug 20 21:52	X20216	DD	7.5	69	12	158	- 0.7	- 2.0
Aug 21 18:44	X20984	DD	7.4	80	60	119	- 2.0	- 0.7
Aug 21 21:32	X21075	DD	7.9	81	28	76	- 0.7	+ 1.6
Aug 21 21:50	2180	DD	7.1	81	24	114	- 0.7	+ 0.3
Aug 23 20:08	2454	DD	7.2	106	66	36	- 1.9	+ 4.3
Aug 23 22:05	2460	DD	6.1	107	45	68	- 1.1	+ 1.8
Aug 25 20:07	2789	DD	7.3	133	71	118	- 2.3	- 1.7
Aug 26 19:27	2936	DD	6.8	147	54	91	- 1.7	- 0.8
Aug 27 01:28	X28225	DD	7.4	150	38	93	- 1.1	+ 0.9
Aug 30 00:12	3411	RD	7.2	168	58	223	- 1.5	+ 1.6
Sep 02 02:07	0301	RD	6.8	127	42	294	- 3.0	- 1.7
Sep 04 01:41	X04954	RD	7.5	103	22	261	- 1.3	- 0.7
Sep 04 05:05	0581	RD	6.9	102	39	202	- 1.6	+ 3.0
Sep 06 03:14	X07177	RD	7.4	79	20	243	- 1.1	- 0.2
Sep 06 03:53	X07208	RD	7.8	79	25	277	- 1.8	- 1.2
Sep 07 03:55	X09124	RD	7.8	68	19	206	- 0.3	+ 2.1
Sep 16 18:53	X19947	DD	7.3	39	23	36	- 0.4	+ 5.6
Sep 17 18:45	X20752	DD	7.9	51	36	120	- 1.2	- 0.1
Sep 20 18:40	2548	DD	7.5	89	69	42	- 2.0	+ 3.2
Sep 20 20:42	2555	DD	7.5	89	47	145	- 2.4	- 2.6
Sep 21 19:36	2722	DD	7.1	102	69	110	- 2.4	- 0.6
Sep 21 22:46	2737	DD	6.8	103	34	84	- 0.8	+ 1.2
Sep 23 22:46	3045	DD	6.0	131	53	65	- 1.4	+ 1.6
Sep 24 20:31	3185	DD	5.3	143	62	358	+ 0.0	+ 6.9
Sep 24 20:36	3187	DD	5.9	144	63	75	- 2.1	+ 0.3
Sep 24 23:25	3199	DD	6.8	145	54	116	- 2.6	- 0.5
Sep 25 19:29	3328	DD	7.0	157	41	51	- 1.2	+ 0.6
Sep 30 01:13	0372	RD	7.6	147	43	252	- 2.1	+ 0.3
Oct 02 01:13	0648	DB	3.9	122	29	99	- 2.0	- 1.2
Oct 02 02:32	0648	RD	3.9	122	37	232	- 1.9	+ 0.9
Oct 02 03:12	0658	DB	4.3	121	38	46	- 2.0	+ 1.3
Oct 02 04:29	0658	RD	4.3	121	37	294	- 2.5	- 0.5
Oct 04 01:57	X08330	RD	7.9	99	20	264	- 1.3	- 0.9
Oct 04 02:06	X08343	RD	7.7	99	21	290	- 1.7	- 1.7
Oct 05 04:11	X10283	RD	7.7	87	32	241	- 2.1	+ 0.3
Oct 15 19:17	2223	RB	4.0	33	16	325	- 0.7	- 1.1
Oct 17 20:41	2527	DD	6.9	59	22	7	+ 2.0	+ 8.3
Oct 19 20:20	X27115	DD	7.8	86	49	75	- 1.3	+ 1.4
Oct 20 19:34	2983	DD	7.9	99	65	96	- 2.3	+ 0.2
Oct 21 23:35	3154	DD	7.4	114	28	18	+ 0.0	+ 3.1
Oct 26 00:18	0180	DD	5.6	167	44	34	- 1.4	+ 2.3
Oct 26 00:19	0181	DD	6.5	167	44	34	- 1.4	+ 2.3
Oct 28 22:49	0581	RD	6.9	155	28	241	- 1.3	+ 0.1
Oct 29 02:54	0590	RD	6.3	154	35	316	- 2.3	- 1.6
Oct 30 23:13	0863	RD	6.7	131	14	290	- 1.3	- 1.8
Oct 31 00:02	X07481	RD	7.5	131	22	246	- 1.2	- 0.2
Oct 31 00:12	0871	RD	6.9	131	24	198	- 0.1	+ 3.1
Oct 31 00:53	X07541	RD	7.6	131	29	224	- 1.4	+ 0.9
Oct 31 01:13	X07560	RD	7.6	131	31	240	- 1.8	+ 0.3
Oct 31 04:05	0884	RD	7.8	130	35	307	- 2.2	- 0.9
Nov 03 00:54	1246	RD	6.6	97	9	319	- 1.1	- 2.8
Nov 16 22:05	X28225	DD	7.4	69	13	94	- 0.2	+ 0.9
Nov 18 20:48	3248	DD	6.6	95	46	70	- 1.4	+ 1.5
Nov 25 21:28	0658	RD	4.3	175	27	294	- 2.2	- 1.9
Nov 27 22:40	0947	RD	5.2	152	22	308	- 2.0	- 2.5
Nov 27 23:56	X08698	RD	7.3	151	31	267	- 2.1	- 0.6
Nov 28 00:18	X08716	RD	7.3	151	33	242	- 2.1	+ 0.3
Nov 29 23:40	1198	RD	6.2	129	18	264	- 1.2	- 1.0
Nov 30 01:45	1210	RD	5.9	129	35	273	- 2.3	- 0.8
Dec 05 02:53	1730	RD	6.5	73	23	354	- 0.2	- 4.2
Dec 15 21:45	3216	DD	6.6	65	11	84	- 0.2	+ 1.2
Dec 17 21:56	X31898	DD	7.9	91	24	10	- 0.3	+ 3.6
Dec 18 20:03	0075	DD	7.8	103	47	346	+ 1.9	+ 8.5
Dec 21 22:38	0478	DD	7.7	141	37	91	- 2.3	+ 0.6
Dec 22 20:04	0610	DD	6.2	152	32	52	- 1.5	+ 0.5
Dec 22 20:30	X05391	DD	7.6	152	35	76	- 2.0	- 0.1
Dec 22 23:20	0620	DD	6.3	153	36	131	- 2.4	- 1.2
Dec 24 00:18	0764	DD	5.0	165	34	126	- 2.1	- 0.7
Dec 26 21:28	1158	DD	5.2	161	16	9	****	****
Dec 26 21:35	1158	RD	5.2	161	17	357	****	****
Dec 28 00:49	X12916	RD	7.6	149	38	287	- 2.4	- 1.1
Dec 31 01:37	X16391	RD	7.6	117	36	293	- 1.7	- 1.7

LUNAR OCCULTATION TABLE

DARWIN (12° 23' S, 130° 44' E)

ACST	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Jan 02 01:07	0505	DD	7.0	134	30	83	- 1.6	+ 0.7
Jan 03 02:10	0643	DD	6.7	145	26	87	- 1.4	+ 0.6
Jan 09 01:51	1381	RD	6.3	149	62	294	- 2.9	- 1.4
Jan 15 03:18	2036	RD	6.9	79	30	285	- 0.9	- 1.0
Jan 30 00:29	0600	DD	6.8	114	21	148	- 0.1	- 3.0
Jan 30 21:11	0730	DD	5.1	124	59	98	- 3.6	- 0.4
Feb 07 05:02	1565	RD	6.3	157	47	284	- 2.0	- 0.3
Feb 13 04:42	2271	DB	4.3	84	54	89	- 2.2	- 0.3
Feb 17 05:44	2913	RD	5.0	30	14	276	- 0.3	- 0.6
Feb 22 12:06	Venus	DD	-3.7	42	34	69	- 1.4	+ 0.5
Feb 22 13:34	Venus	RB	-3.7	43	54	234	- 2.0	+ 1.4
Mar 01 22:23	1197	DD	6.0	137	62	139	- 2.5	- 2.6
Mar 06 04:57	1635	RD	5.4	175	31	313	- 0.9	- 1.3
Mar 09 03:54	1973	RD	6.2	140	83	0	- 0.1	- 7.0
Mar 15 04:27	2856	RD	6.6	62	27	274	- 0.8	- 0.5
Mar 16 04:47	3002	RD	6.2	48	18	256	- 0.6	+ 0.1
Mar 25 21:34	0764	DD	5.0	72	25	90	- 1.3	+ 0.5
Mar 27 20:18	1040	DD	6.2	94	56	85	- 3.4	+ 0.5
Mar 29 22:28	1271	DD	5.9	117	53	103	- 2.7	- 0.4
Apr 07 04:57	2193	RD	6.1	145	63	254	- 2.6	+ 1.2
Apr 10 03:17	2647	RD	6.4	106	53	229	- 2.6	+ 2.0
Apr 10 03:58	M24	RD	4.6	106	62	240	- 2.7	+ 1.3
Apr 14 04:00	3248	RD	6.6	53	10	230	- 0.4	+ 1.0
Apr 27 19:07	1428	RB	3.8	107	64	297	- 2.9	- 1.5
Apr 29 23:47	1652	DD	5.5	132	55	114	- 2.2	- 0.8
May 05 01:38	2271	RD	4.3	164	85	276	- 2.9	- 0.3
May 06 04:50	2441	RD	6.5	150	60	290	- 2.5	- 0.7
May 09 01:27	2913	RD	5.0	110	30	271	- 1.0	- 0.5
May 11 04:39	3216	RD	6.6	82	48	217	- 1.6	+ 2.1
May 21 20:40	1072	DD	5.9	44	13	77	- 0.9	+ 1.0
May 26 19:41	1599	DD	5.0	99	74	128	- 2.5	- 1.9
May 27 19:58	1708	DD	6.2	111	77	100	- 3.3	- 0.7
May 28 20:14	1814	DD	7.0	123	76	82	- 3.7	+ 0.4
May 31 20:57	2196	DD	6.7	162	52	62	- 2.9	+ 1.3
Jun 01 00:42	2210	DD	6.8	163	74	86	- 2.9	+ 0.4
Jun 02 21:26	2508	RD	6.3	170	32	276	- 1.0	- 0.6
Jun 03 23:02	2686	RD	5.2	155	40	232	- 1.9	+ 1.4
Jun 04 00:02	2690	RD	7.0	155	54	244	- 2.3	+ 0.9
Jun 04 23:04	2856	RD	6.6	141	27	320	- 0.2	- 3.0
Jun 05 02:57	2876	RD	5.4	140	80	289	- 3.1	- 1.2
Jun 05 04:04	2880	RD	5.1	139	82	302	- 3.7	- 2.2
Jun 05 22:56	3002	RD	6.2	128	11	300	+ 0.0	- 1.6
Jun 09 05:07	3467	RD	6.5	85	58	216	- 1.5	+ 2.2
Jun 11 04:27	0180	RD	5.6	60	24	306	- 1.9	- 3.2
Jun 11 04:28	0181	RD	6.5	60	24	307	- 1.9	- 3.3
Jun 14 08:01	Mercury	DB	0.5	24	35	46	- 1.1	+ 1.7
Jun 14 09:35	Mercury	RD	0.5	23	52	274	- 3.6	- 0.6
Jun 28 20:04	2271	DD	4.3	143	59	152	- 0.9	- 3.3
Jun 29 22:28	2441	DD	6.5	157	77	76	- 3.0	+ 0.6
Jul 03 04:17	2969	DB	3.2	157	62	114	- 3.0	- 1.1
Jul 03 05:05	2968	RD	6.2	157	50	207	- 0.6	+ 2.9
Jul 03 05:10	2969	RD	3.2	157	49	202	- 0.4	+ 3.2
Jul 23 23:21	1973	DD	6.2	87	18	151	- 0.9	- 2.4
Jul 28 19:52	2690	DD	7.0	152	46	120	- 1.3	- 1.7
Aug 05 02:15	0226	RD	6.6	108	38	206	- 0.6	+ 2.4
Aug 08 04:45	0620	RD	6.3	71	35	283	- 2.2	- 1.1
Aug 11 05:58	1040	RD	6.2	38	20	264	- 1.0	- 0.2
Aug 12 06:04	X11419	RD	6.7	27	11	275	- 0.6	- 0.6
Aug 20 22:19	2060	DD	6.3	70	15	109	- 0.6	- 0.3
Aug 27 03:04	2972	DD	6.7	151	28	72	- 0.7	+ 1.0
Aug 28 22:19	3269	DD	4.3	176	56	127	- 3.1	- 3.5
Sep 01 04:52	0184	RD	6.2	139	60	205	- 1.5	+ 3.2
Sep 04 03:59	0581	RD	6.9	102	51	295	- 3.6	- 2.0
Sep 10 05:41	1344	RD	6.8	34	14	283	- 0.8	- 0.9
Sep 18 22:04	2280	DD	6.8	65	15	71	- 0.2	+ 1.1
Sep 23 01:38	2913	DD	5.0	118	17	117	- 0.9	- 0.7
Sep 24 22:50	3199	DD	6.8	145	82	3	- 0.2	+ 5.5
Sep 25 02:37	3216	DD	6.6	146	29	96	- 1.1	+ 0.2
Sep 28 04:34	0104	RD	5.8	172	36	269	- 1.5	+ 0.5
Sep 29 01:48	0247	RD	6.7	159	69	201	- 1.3	+ 3.4
Sep 30 02:26	0384	RD	5.7	146	65	194	- 1.1	+ 4.2
Oct 02 02:01	0653	RD	4.8	122	43	283	- 2.6	- 1.0
Oct 04 04:54	0943	RD	6.2	98	54	292	- 3.3	- 1.4
Oct 05 03:20	1072	RD	5.9	87	29	266	- 1.5	- 0.3
Oct 08 05:26	1409	RD	5.1	53	29	346	- 1.6	- 5.2
Oct 19 21:33	2856	DD	6.6	86	45	75	- 1.5	+ 1.0
Oct 20 22:29	3002	DD	6.2	100	45	61	- 1.2	+ 1.5
Oct 25 23:18	0184	DD	6.2	167	70	81	- 2.9	+ 0.4
Oct 31 03:10	0886	RD	7.0	130	57	217	- 2.7	+ 3.5
Nov 02 01:38	1141	RD	5.6	108	25	280	- 1.4	- 0.9
Nov 22 20:02	0257	DD	4.5	147	49	64	- 1.8	+ 0.8
Nov 26 01:50	0684	RD	6.2	173	57	298	- 3.3	- 1.5
Nov 27 05:04	0832	RD	4.2	161	34	233	- 2.4	+ 2.4
Dec 01 02:41	1328	RD	7.0	117	47	314	- 2.4	- 2.6
Dec 02 05:03	1433	RD	6.8	105	65	284	- 3.3	- 0.9
Dec 13 20:15	2913	DD	5.0	37	17	34	+ 0.2	+ 2.2
Dec 15 21:59	3216	DD	6.6	65	18	350	+ 1.7	+ 8.6
Dec 19 21:46	0226	DD	6.6	117	61	91	- 3.1	+ 0.2
Dec 22 21:53	0620	DD	6.3	153	57	50	- 2.3	+ 1.8
Dec 23 22:50	0764	DD	5.0	165	56	58	- 2.7	+ 1.4

LUNAR OCCULTATION TABLE

HOBART (42° 48' S, 147° 13‘E)

AEST	CATALOG	PD	Mag	Elg	Alt	PA	A	B
Jan 03 22:37	0760	DD	6.5	155	27	22	- 2.0	+ 3.1
Jan 04 21:18	0895	DD	5.9	165	22	68	- 1.6	- 0.3
Jan 27 21:21	0340	DD	7.1	90	18	136	- 1.2	- 0.4
Jan 29 22:24	0593	DD	5.8	113	18	37	- 1.8	+ 2.7
Feb 12 04:10	X20704	RD	7.4	98	55	302	- 1.4	- 1.7
Feb 13 01:46	2247	RD	5.6	86	25	310	- 0.2	- 2.1
Feb 28 21:08	0947	DD	5.2	114	26	93	- 2.0	+ 0.5
Mar 04 03:59	1428	DD	3.8	160	5	115	- 0.3	+ 0.6
Mar 09 01:01	1962	RD	5.2	142	49	359	+ 0.2	- 4.8
Mar 10 03:47	X20462	RD	7.4	128	60	239	- 2.6	+ 1.9
Mar 11 00:23	2208	RD	7.4	117	32	291	- 0.6	- 1.7
Mar 11 23:31	2352	RD	6.7	105	14	232	- 0.5	- 0.2
Mar 14 02:24	2674	RD	6.0	77	25	220	- 1.0	+ 0.5
Mar 27 21:33	1040	DD	6.2	94	17	159	- 0.2	- 1.5
Mar 28 21:15	X11419	DD	6.7	105	25	110	- 1.6	+ 0.3
Mar 30 23:57	1381	DD	6.3	128	22	120	- 1.0	+ 0.3
Apr 06 04:28	2060	RD	6.3	159	42	322	- 1.2	- 1.1
Apr 08 23:49	2460	RD	6.1	121	30	295	- 0.4	- 1.9
Apr 09 04:27	2485	RD	7.4	119	65	280	- 1.9	- 0.3
Apr 13 05:19	3104	RD	6.5	66	43	299	- 1.5	- 2.6
Apr 23 19:10	0985	DD	6.9	63	18	116	- 1.2	+ 0.4
Apr 27 19:48	1428	DD	3.8	107	37	188	+ 1.1	- 6.1
Apr 27 20:13	1428	RB	3.8	107	36	221	- 4.9	+ 5.4
May 04 21:11	2247	RD	5.6	166	34	276	- 0.8	- 1.4
May 05 05:57	2291	RD	5.5	163	26	246	- 0.3	+ 2.0
May 07 23:24	2737	RD	6.8	125	27	275	- 0.5	- 1.4
May 12 03:32	3344	RD	7.3	70	23	189	- 0.4	+ 2.8
May 26 22:58	X16618	DD	7.1	100	19	108	- 0.7	+ 0.7
May 27 21:50	1708	DD	6.2	111	38	178	- 0.1	- 4.0
May 28 21:52	1814	DD	7.0	123	47	154	- 1.1	- 2.0
May 29 23:31	1946	DD	7.2	136	45	107	- 1.5	+ 0.3
May 30 20:51	2060	DD	6.3	148	55	108	- 1.6	- 1.1
May 30 21:39	2064	DD	6.5	148	58	73	- 2.3	+ 0.6
May 31 22:28	2196	DD	6.7	162	62	143	- 1.3	- 2.4
Jun 03 22:39	2674	RD	6.0	156	43	266	- 1.1	- 0.9
Jun 05 00:10	2856	RD	6.6	141	47	206	- 1.5	+ 2.4
Jun 05 05:32	2883	RD	5.5	139	48	300	- 1.8	- 0.2
Jun 28 23:06	2280	DD	6.8	143	57	46	- 1.8	+ 3.3
Jun 29 00:54	2291	DD	5.5	144	42	139	- 1.4	- 0.9
Jun 30 03:50	2460	DD	6.1	159	22	48	+ 0.0	+ 2.4
Jul 02 23:08	2936	RD	6.8	159	48	224	- 1.4	+ 0.9
Jul 03 23:13	3093	RD	4.5	145	37	295	- 1.1	- 2.3
Jul 04 23:51	3248	RD	6.6	131	31	224	- 0.8	+ 0.4
Jul 08 04:59	0136	RD	6.0	90	38	205	- 0.9	+ 1.7
Jul 12 05:31	0658	RD	4.3	42	10	212	- 0.2	+ 0.6
Jul 23 20:05	1962	DD	5.2	86	44	131	- 1.4	- 0.7
Jul 24 22:07	2088	DD	6.2	99	36	116	- 1.1	+ 0.3
Jul 25 19:32	2208	DD	7.4	111	62	125	- 1.7	- 1.4
Jul 27 23:52	X23681	DD	7.1	139	50	144	- 1.9	- 2.0
Jul 28 18:28	2674	DD	6.0	151	37	100	- 0.8	- 1.5
Jul 29 19:48	2856	DD	6.6	165	39	116	- 0.8	- 2.0
Jul 30 00:15	2880	DD	5.1	167	61	137	- 2.6	- 2.7
Aug 01 00:28	3185	RD	5.3	163	55	287	- 2.1	- 1.1
Aug 01 01:01	3187	RD	5.9	163	56	223	- 1.3	+ 1.5
Aug 01 03:03	3199	RD	6.8	162	50	176	+ 0.7	+ 5.5
Aug 01 23:28	3328	RD	7.0	149	38	235	- 1.1	+ 0.2
Aug 21 18:52	X20984	DD	7.4	80	55	159	- 1.4	- 3.2
Aug 21 21:49	2180	DD	7.1	81	27	146	- 1.0	- 0.9
Aug 23 19:40	2454	DD	7.2	106	64	75	- 1.9	+ 0.9
Aug 23 21:48	2460	DD	6.1	107	48	94	- 1.4	+ 0.9
Aug 25 01:58	2646	DD	6.0	122	15	47	+ 0.2	+ 2.1
Aug 26 19:36	2936	DD	6.8	147	49	126	- 1.4	- 2.7
Aug 27 19:49	3093	DD	4.5	161	39	16	- 1.0	+ 2.7
Sep 01 05:20	0180	RD	5.6	139	28	254	- 1.3	+ 1.4
Sep 01 05:21	0181	RD	6.5	139	28	254	- 1.3	+ 1.4
Sep 02 02:07	0301	RD	6.8	127	33	272	- 1.9	- 0.7
Sep 21 19:M	2722	DD	7.1	102	63	152	- 2.8	- 5.4
Sep 21 22:33	2737	DD	6.8	103	38	104	- 1.1	+ 0.8
Sep 23 22:29	3045	DD	6.0	131	53	84	- 1.6	+ 0.9
Sep 24 20:01	3185	DD	5.3	143	50	39	- 1.3	+ 1.3
Sep 24 20:06	3184	DD	7.1	143	50	25	- 1.1	+ 2.1
Sep 24 20:31	3187	DD	5.9	144	53	101	- 1.9	- 1.0
Oct 02 01:21	0648	DB	3.9	122	21	121	- 2.0	- 2.2
Oct 02 02:18	0648	RD	3.9	122	26	212	- 1.1	+ 1.1
Oct 02 04:21	0658	RD	4.3	121	29	276	- 2.1	+ 0.1
Oct 17 20:09	2527	DD	6.9	59	32	48	- 0.3	+ 2.6
Oct 18 22:52	2705	DD	6.8	74	13	91	+ 0.0	+ 1.2
Oct 21 23:10	3154	DD	7.4	114	34	38	- 0.5	+ 2.3
Oct 25 23:56	0180	DD	5.6	167	38	50	- 1.5	+ 1.4
Oct 25 23:57	0181	DD	6.5	167	38	50	- 1.5	+ 1.4
Oct 29 02:51	0590	RD	6.3	154	28	293	- 2.0	+ 0.0
Nov 14 20:34	2646	DD	6.0	42	15	28	+ 0.5	+ 2.9
Nov 16 21:56	X28225	DD	7.4	69	19	112	- 0.5	+ 0.8
Nov 25 21:34	0658	RD	4.3	175	19	274	- 1.4	- 1.2
Nov 27 22:51	0947	RD	5.2	152	15	288	- 1.4	- 1.7
Nov 29 23:43	1198	RD	6.2	129	11	246	- 0.8	- 0.8
Nov 30 01:42	1210	RD	5.9	129	25	254	- 1.8	- 0.5
Dec 15 21:33	3216	DD	6.6	65	16	101	- 0.4	+ 1.1
Dec 26 22:05	1158	RD	5.2	161	14	318	- 1.5	- 2.6
Dec 28 02:54	1284	RD	6.3	149	31	337	- 1.1	- 1.9

MERCURY

RISE AND SET TIMES AEST (Adelaide & Darwin ACST)

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

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

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

VENUS

RISE AND SET TIMES AEST (Adelaide & Darwin ACST)

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

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

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

MARS

RISE AND SET TIMES

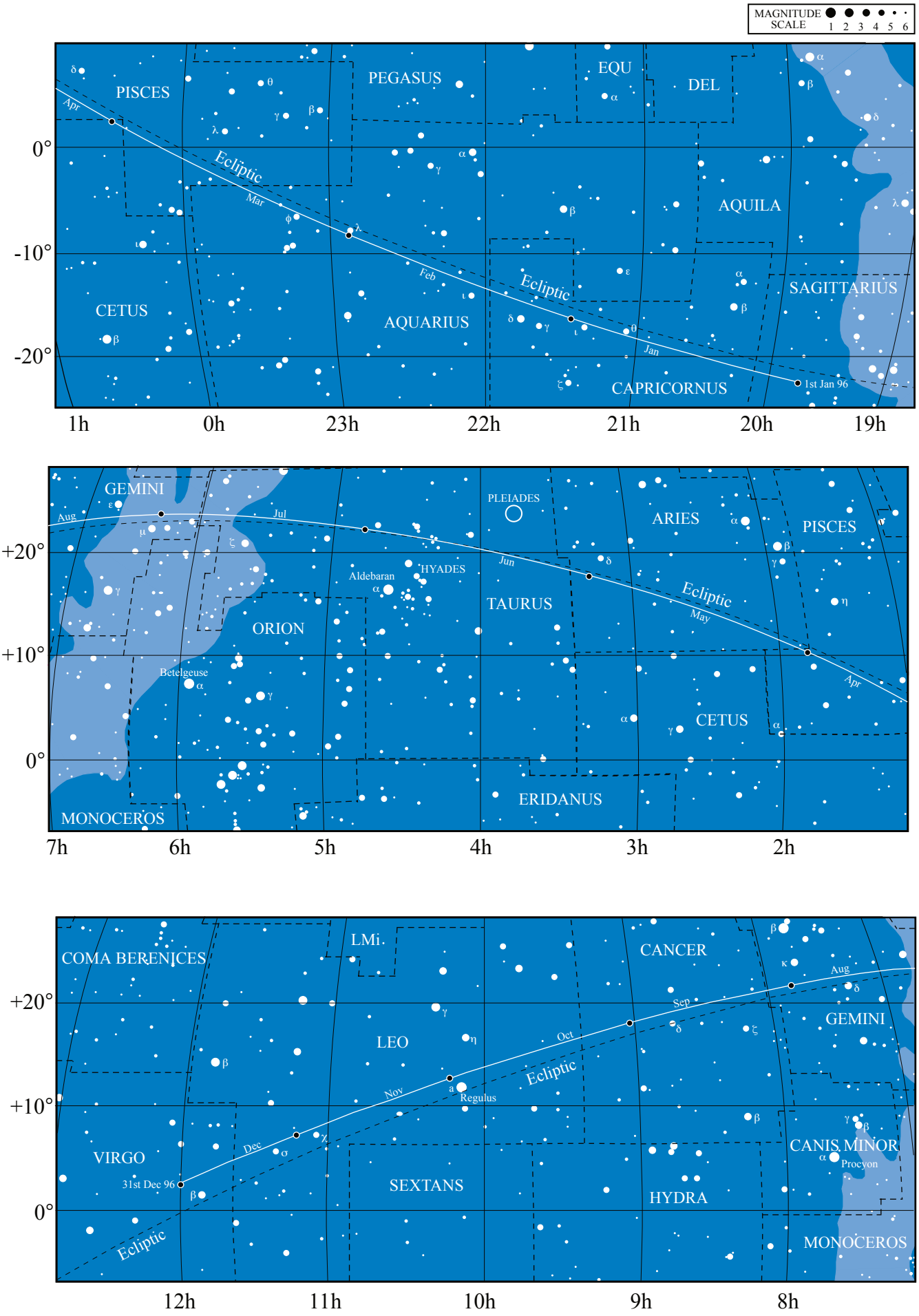
AEST (Adelaide & Darwin ACST)

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

POSITION

(0hrs UT Epoch 2000.0)

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


MAGNITUDE SCALE 1 2 3 4 5 6
PISCES
PEGASUS
EQU
DEL
AQUILA
SAGITTARIUS
CAPRICORNUS
AQUARIUS
CETUS
Ecliptic
Apr
Mar
Feb
Jan
1st Jan 96
0°
-10°
-20°
1h
0h
23h
22h
21h
20h
19h
GEMINI
PLEIADES
ARIES
PISCES
TAURUS
ORION
HYADES
Aldebaran
Betelgeuse
CETUS
ERIDANUS
MONOCEROS
Aug
Jul
Jun
May
Apr
+20°
+10°
0°
7h
6h
5h
4h
3h
2h
COMA BERENICES
LMi.
CANCER
LEO
GEMINI
VIRGO
SEXTANS
HYDRA
CANIS MINOR
Procyon
MONOCEROS
Regulus
31st Dec 96
Aug
Sep
Oct
Nov
Dec
Ecliptic
+20°
+10°
0°
12h
11h
10h
9h
8h

JUPITER

RISE AND SET TIMES

AEST (Adelaide & Darwin ACST)

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

POSITION

(0hrs UT Epoch 2000.0)

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

JUPITER — LONGITUDE OF CENTRAL MERIDIAN

SYSTEM I (0hr UT)

DATE	JAN °	FEB °	MAR °	APR °	MAY °	JUN °	JUL °	AUG °	SEP °	OCT °	NOV °	DEC °	DATE
1	294.0	143.1	038.4	251.5	309.2	167.2	228.4	086.5	301.4	355.0	203.8	253.4	1
2	091.6	300.8	196.3	049.4	107.2	325.3	026.4	244.5	099.3	152.8	001.4	051.1	2
3	249.3	098.6	354.1	207.3	265.2	123.3	184.5	042.4	257.1	310.5	159.1	208.7	3
4	047.0	256.3	151.9	005.2	063.1	281.3	342.5	200.4	054.9	108.2	316.8	006.4	4
5	204.7	054.1	309.7	163.1	221.1	079.4	140.5	358.3	212.7	266.0	114.5	164.0	5
6	002.4	211.8	107.5	321.0	019.1	237.4	298.6	156.2	010.6	063.7	272.1	321.7	6
7	160.1	009.6	265.3	118.9	177.1	035.4	096.6	314.2	168.4	221.4	069.8	119.3	7
8	317.8	167.3	063.1	276.8	335.1	193.5	254.6	112.1	326.2	019.1	227.4	277.0	8
9	115.5	325.1	220.9	074.7	133.0	351.5	052.6	270.1	124.0	176.8	025.1	074.6	9
10	273.2	122.8	018.8	232.6	291.0	149.6	210.7	068.0	281.8	334.6	182.8	232.2	10
11	070.9	280.6	176.6	030.5	089.0	307.6	008.7	225.9	079.6	132.3	340.4	029.9	11
12	228.6	078.4	334.4	188.4	247.0	105.6	166.7	023.8	237.4	290.0	138.1	187.5	12
13	026.3	236.1	132.3	346.3	045.0	263.7	324.7	181.7	035.2	087.7	295.7	345.2	13
14	184.0	033.9	290.1	144.2	203.0	061.7	122.7	339.7	193.0	245.4	093.4	142.8	14
15	341.8	191.7	087.9	302.2	001.0	219.8	280.7	137.6	350.8	043.1	251.1	300.5	15
16	139.5	349.4	245.8	100.1	159.0	017.8	078.7	295.5	148.6	200.8	048.7	098.1	16
17	297.2	147.2	043.6	258.0	317.0	175.8	236.7	093.4	306.4	358.5	206.4	255.8	17
18	094.9	305.0	201.5	055.9	115.0	333.9	034.8	251.3	104.2	156.2	004.0	053.4	18
19	252.6	102.7	359.3	213.9	273.0	131.9	192.8	049.2	261.9	313.9	161.7	211.0	19
20	050.3	260.5	157.2	011.8	071.0	290.0	350.8	207.1	059.7	111.6	319.3	008.7	20
21	208.0	058.3	315.0	169.7	229.0	088.0	148.7	004.9	217.5	269.3	117.0	166.3	21
22	005.8	216.1	112.9	327.7	027.0	246.0	306.7	162.8	015.3	067.0	274.6	324.0	22
23	163.5	013.9	270.7	125.6	185.0	044.1	104.7	320.7	173.0	224.7	072.3	121.6	23
24	321.2	171.7	068.6	283.6	343.1	202.1	262.7	118.6	330.8	022.4	229.9	279.3	24
25	118.9	329.5	226.4	081.5	141.1	000.2	060.7	276.4	128.5	180.0	027.6	076.9	25
26	276.7	127.3	024.3	239.5	299.1	158.2	218.7	074.3	286.3	337.7	185.2	234.6	26
27	074.4	285.0	182.2	037.4	097.1	316.3	016.7	232.2	084.0	135.4	342.9	032.2	27
28	232.1	082.8	340.0	195.4	255.1	114.3	174.6	030.0	241.8	293.1	140.5	189.9	28
29	029.9	240.6	137.9	353.3	053.2	272.3	332.6	187.9	039.5	090.8	298.2	347.5	29
30	187.6		295.8	151.3	211.2	070.4	130.6	345.7	197.3	248.4	095.8	145.2	30
31	345.3		093.7		009.2		288.5	143.6		046.1		302.8	31

SYSTEM II (0hr UT)

DATE	JAN °	FEB °	MAR °	APR °	MAY °	JUN °	JUL °	AUG °	SEP °	OCT °	NOV °	DEC °	DATE
1	261.7	234.3	268.3	244.9	073.7	055.1	247.4	228.9	207.3	032.1	004.3	185.1	1
2	051.7	024.4	058.5	035.1	224.0	205.5	037.8	019.3	357.5	182.2	154.4	335.1	2
3	201.8	174.5	208.7	185.4	014.3	355.9	188.2	169.6	147.8	332.3	304.4	125.1	3
4	351.9	324.6	358.9	335.7	164.7	146.3	338.6	319.9	298.0	122.4	094.4	275.1	4
5	141.9	114.7	149.0	125.9	315.0	296.7	129.0	110.2	088.2	272.5	244.5	065.2	5
6	292.0	264.8	299.2	276.2	105.4	087.1	279.4	260.5	238.3	062.6	034.5	215.2	6
7	082.1	055.0	089.4	066.4	255.7	237.5	069.8	050.8	028.5	212.7	184.5	005.2	7
8	232.1	205.1	239.6	216.7	046.1	027.9	220.2	201.2	178.7	002.8	334.6	155.2	8
9	022.2	355.2	029.8	007.0	196.4	178.3	010.6	351.5	328.9	152.9	124.6	305.2	9
10	172.3	145.3	180.0	157.3	346.8	328.7	160.9	141.8	119.1	302.9	274.6	095.2	10
11	322.3	295.5	330.2	307.5	137.1	119.2	311.3	292.0	269.3	093.0	064.7	245.2	11
12	112.4	085.6	120.4	097.8	287.5	269.6	101.7	082.3	059.4	243.1	214.7	035.3	12
13	262.5	235.7	270.6	248.1	077.8	060.0	252.1	232.6	209.6	033.2	004.7	185.3	13
14	052.6	025.9	060.8	038.4	228.2	210.4	042.5	022.9	359.8	183.3	154.8	335.3	14
15	202.6	176.0	211.0	188.7	018.6	000.8	192.9	173.2	149.9	333.3	304.8	125.3	15
16	352.7	326.1	001.2	339.0	168.9	151.2	343.3	323.5	300.1	123.4	094.8	275.3	16
17	142.8	116.3	151.4	129.3	319.3	301.6	133.6	113.7	090.2	273.5	244.8	065.3	17
18	292.9	266.4	301.6	279.6	109.7	092.0	284.0	264.0	240.4	063.6	034.8	215.3	18
19	083.0	056.6	091.8	069.9	260.1	242.4	074.4	054.3	030.5	213.6	184.9	005.4	19
20	233.1	206.7	242.1	220.2	050.4	032.9	224.7	204.5	180.7	003.7	334.9	155.4	20
21	023.2	356.9	032.3	010.5	200.8	183.3	015.1	354.8	330.8	153.7	124.9	305.4	21
22	173.2	147.0	182.5	160.8	351.2	333.7	165.5	145.0	121.0	303.8	274.9	095.4	22
23	323.3	297.2	332.7	311.1	141.6	124.1	315.8	295.3	271.1	093.9	065.0	245.4	23
24	113.4	087.3	123.0	101.4	292.0	274.5	106.2	085.5	061.2	243.9	215.0	035.4	24
25	263.5	237.5	273.2	251.7	082.4	064.9	256.5	235.8	211.4	034.0	005.0	185.4	25
26	053.6	027.7	063.4	042.0	232.7	215.3	046.9	026.0	001.5	184.0	155.0	335.5	26
27	203.7	177.8	213.7	192.4	023.1	005.7	197.2	176.2	151.6	334.1	305.0	125.5	27
28	353.8	328.0	003.9	342.7	173.5	156.1	347.6	326.5	301.7	124.1	095.0	275.5	28
29	143.9	118.2	154.1	133.0	323.9	306.6	137.9	116.7	091.8	274.2	245.1	065.5	29
30	294.0		304.4	283.3	114.3	097.0	288.3	266.9	242.0	064.2	035.1	215.5	30
31	084.2		094.6		264.7		078.6	057.1		214.3		005.6	31

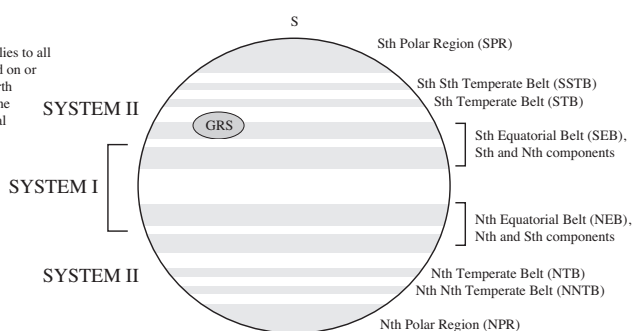
SYSTEM I
Rotation: 9h 50m 30.003s

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

Increase in longitude

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

SYSTEM II applies to the remainder of the surface.



SYSTEM II
Rotation: 9h 55m 40.062s

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

Increase in longitude

For further explanation see page 66

JUPITER SATELLITE EVENTS

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 suggested calling them the 'Medicean Stars'), are bright enough to be visible in small telescopes (or moderate sized binoculars). The dance of these moons, as they pass back and forth across Jupiter, is illustrated in the monthly 'Jupiter's Moons' on pages 103-105. All the moons orbit in roughly the same plane, which is very close to the Earth's orbit. Hence we see the Jovian system as 'edge-on'. This is the key point to understanding the satellite phenomena. From our perspective on Earth, we see four types of events. They are:-

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

2 The shadow of a satellite can move across the 'surface' of the planet. This is called a **Satellite Shadow Transit.** The start of a satellite or shadow transit is called its ingress, the finish, its 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 1996 is July 4th.

3 A satellite can go into **occultation** i.e., pass behind the disc of Jupiter.

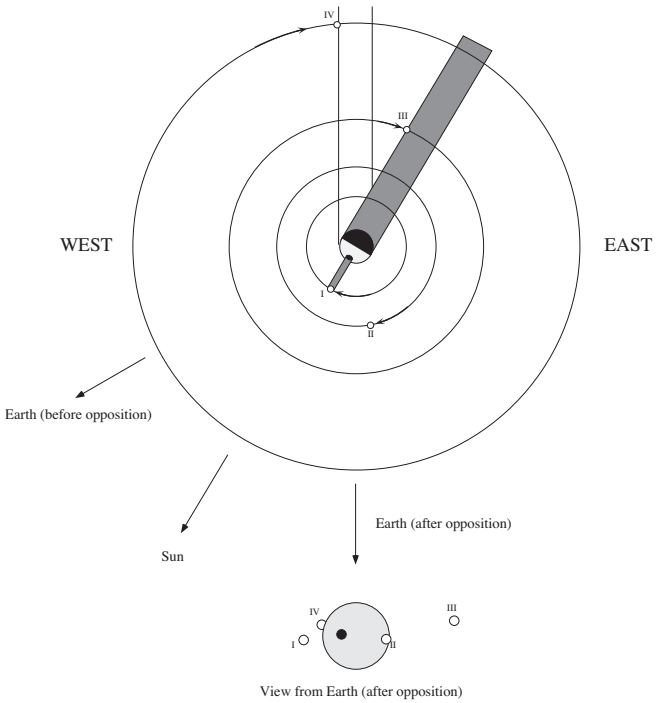
4 A satellite can be **eclipsed** as it passes into Jupiter's shadow. The closer Jupiter is to opposition, the more likely the eclipse events, or at least one event (disappearance or reappearance) will be hidden by the planet's disc. This is especially relevant for the close-in satellites. In fact, Io is so close to Jupiter, it is impossible to see both the disappearance and reappearance for the same eclipse. Positions for the disappearance (d) and reappearance (r) for each moon, relative to Jupiter, for each month, are presented in the diagram below.

The diagram above right 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.

JUPITER SATELLITE EVENT TABLESLegend

Column 1 Date & time (in AEST). 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

Note: Only events occurring when Jupiter is above the horizon and the Sun has set are shown. (Approximately one third of events). For the same reason it is possible that the eclipse are given in the table below while no eclipse is shown in the tables on the following 2 pages.

JUPITER ECLIPSE CO-ORDINATES

MONTH	I Ec D	I Ec R	2 Ec D	2 Ec R	3 Ec D	3 Ec R	4 Ec D	4 Ec R
Jan	1.4W, 0.2S	—	1.5W, 0.3S	—	1.9W, 0.6S	—	—	—
Feb	1.SW, 0.2S	—	2.2W, 0.3S	—	2.8W, 0.5S	1.3W, 0.6S	—	—
Mar	2.0W, 0.2S	—	2.6W, 0.3S	—	3.5W, 0.5S	1.9W, 0.5S	4.8W, 0.8S	4.4W, 0.8S
Apr	2.1W, 0.2S	—	2.7W, 0.2S	—	3.6W, 0.5S	2.0W, 0.5S	5.4W, 0.8S	4.7W, 0.8S
May	1.9W, 0.2S	—	2.4W, 0.2S	—	3.2W, 0.5S	1.6W, 0.5S	4.5W, 0.7S	3.5W, 0.7S
Jun	1.4W, 0.2S	—	1.6W, 0.2S	—	1.8W, 0.5S	—	2.1W, 0.7S	1.0W, 0.7S
Jul	—	1.2E, 0.2S	—	1.3E, 0.2S	—	1.5E, 0.5S	1.0E, 0.7S	2.3E, 0.7S
Aug	—	1.8E, 0.2S	—	2.2E, 0.2S	1.1E, 0.5S	2.8E, 0.5S	2.3E, 0.7S	3.7E, 0.7S
Sep	—	2.1E, 0.2S	—	2.7E, 0.2S	1.9E, 0.5S	3.7E, 0.5S	4.1E, 0.7S	5.5E, 0.7S
Oct	—	2.1E, 0.2S	—	2.7E, 0.2S	1.9E, 0.4S	3.7E, 0.4S	4.2E, 0.7S	5.8E, 0.7S
Nov	—	1.9E, 0.2S	—	2.4E, 0.2S	1.4E, 0.4S	3.2E, 0.4S	3.1E, 0.6S	4.8E, 0.6S
Dec	—	1.5E, 0.1S	—	1.9E, 0.1S	—	2.3E, 0.4S	1.2E, 0.5S	3.0E, 0.5S

These coordinates represent the distance (in Jupiter radii) and direction of the satellites from Jupiter's centre at the time of mid-eclipse.

JUPITER'S MOONS (AEST)

JANUARY

11	03:36	II	Oc	R
15	04:17	III	Sh	E
	05:10	I	Ec	D
16	04:32	I	Sh	E
	05:01	I	Tr	E
22	05:32	III	Sh	I
23	04:13	I	Sh	I
	04:48	1	Tr	I
24	04:23	I	Oc	R
25	05:16	II	Ec	D
27	03:04	II	Sh	E
	04:23	II	Tr	E
31	03:27	I	Ec	D

FEBRUARY

1	02:48	I	Sh	E
	03:32	I	Tr	E
2	02:29	III	Oc	D
	05:22	III	Oc	R
3	02:57	II	Sh	I
	04:27	II	Tr	I
	05:40	II	Sh	E
7	05:20	I	Ec	D
8	02:29	I	Sh	I
	03:18	I	Tr	I
	04:42	I	Sh	E
	05:31	I	Tr	E
9	02:54	I	Oc	R
	03:30	III	Ec	D
10	05:32	II	Sh	I
12	04:11	II	Oc	R
14	05:30	IV	Tr	I
15	04:23	1	Sh	I
	05:17	I	Tr	I
16	04:53	I	Oc	R
17	02:00	I	Tr	E
19	02:16	II	Ec	D
20	04:15	III	Tr	E
21	02:08	II	Tr	E
23	03:36	I	Ec	D
24	01:45	I	Tr	I
	02:58	I	Sh	I
	03:59	I	Tr	E
25	01:21	I	Oc	R
26	04:50	II	Ec	D
27	01:23	III	Sh	I
	04:12	III	Sh	E
	05:38	III	Tr	I
28	02:08	II	Tr	I
	02:43	II	Sh	E
	04:53	II	Tr	E

MARCH

1	05:30	I	Ec	D
2	01:08	IV	Tr	I
	02:38	I	Sh	I
	03:04	IV	Tr	E
	03:43	I	Tr	I
	04:51	I	Sh	E
	05:57	1	Tr	E
3	03:19	1	Oc	R
5	05:21	III	Sh	I
6	02:35	II	Sh	I
	04:50	II	Tr	I
	05:18	II	Sh	E
8	01:48	II	Oc	R
9	03:01	III	Oc	R
	04:32	I	Sh	I
	05:41	I	Tr	I
10	01:51	I	Ec	D
	01:59	IV	Ec	D
	02:55	IV	Ec	R
	05:16	I	Oc	R
11	01:13	I	Sh	E
	02:24	I	Tr	E
13	05:10	II	Sh	I
15	04:30	II	Oc	R
16	02:13	III	Ec	R
	04:12	III	Oc	D
	06:25	I	Sh	I
17	03:45	I	Ec	D
18	00:54	I	Sh	I
	02:06	I	Tr	I
	03:07	I	Sh	E
	04:20	I	Tr	E
19	01:42	I	Oc	R
22	01:52	II	Ec	D
23	03:18	III	Ec	D
	06:12	III	Ec	R
24	02:15	II	Tr	E
	05:38	I	Ec	D
25	02:47	I	Sh	I
	04:02	I	Tr	I
	05:00	I	Sh	E
	06:16	I	Tr	E
26	00:06	I	Ec	D
	03:37	I	Oc	R
27	00:45	I	Tr	E
	01:22	III	Tr	E
29	04:27	II	Ec	D
30	23:36	II	Sh	I
31	02:07	II	Tr	I
	02:19	II	Sh	E
	04:52	II	Tr	E

APRIL

1	04:41	I	Sh	I
	05:57	I	Tr	I
2	02:00	I	Ec	D
	05:32	I	Oc	R
3	00:07	III	Sh	E
	00:25	I	Tr	I
	01:22	I	Sh	E
	02:23	III	Tr	I
	02:39	I	Tr	E
	05:25	III	Tr	E
4	00:00	I	Oc	R
	02:56	IV	Sh	I
	04:25	IV	Sh	E
7	02:09	II	Sh	I
	04:42	II	Tr	I
	04:53	II	Sh	E
8	06:34	I	Sh	I
9	01:45	II	Oc	R
	03:53	I	Ec	D
10	01:02	I	Sh	I
	01:11	III	Sh	I
	02:19	I	Tr	I
	03:16	I	Sh	E
	04:05	III	Sh	E
	04:33	I	Tr	E
	06:22	III	Tr	I
11	01:53	I	Oc	R
	23:02	I	Tr	E
13	01:19	IV	Oc	D
	04:03	IV	Oc	R
	23:26	III	Oc	R
14	04:43	II	Sh	I
15	22:54	II	Ec	D
16	04:20	II	Oc	R
	05:46	I	Ec	D
17	02:56	I	Sh	I
	04:12	I	Tr	I
	05:09	III	Sh	I
	05:09	I	Sh	E
	06:26	I	Tr	E
	23:16	II	Tr	E
18	00:14	I	Ec	D
	03:45	I	Oc	R
	22:40	I	Tr	I
	23:38	I	Sh	E
19	00:54	I	Tr	E
	22:13	I	Oc	R
20	22:37	IV	Sh	E
21	00:13	III	Oc	D
	03:19	III	Oc	R
23	01:30	II	Ec	D
	06:52	II	Oc	R
24	04:49	I	Sh	I
	06:04	I	Tr	I
	23:00	II	Tr	I
	23:17	II	Sh	E
25	01:45	II	Tr	E
	02:08	I	Ec	D
	05:37	I	Oc	R
	23:18	I	Sh	I
26	00:31	I	Tr	I
	01:32	I	Sh	E
	02:46	I	Tr	E
27	00:04	I	Oc	R
	23:06	III	Ec	D
28	02:06	III	Ec	R
	04:00	III	Oc	D
30	04:05	II	Ec	D

MAY

1	06:43	I	Sh	I
	23:07	II	Sh	I
2	01:27	II	Tr	I
	01:51	II	Sh	E
	04:01	I	Ec	D
	04:13	II	Tr	E
3	01:11	I	Sh	I
	02:22	I	Tr	I
	03:25	I	Sh	E
	04:36	I	Tr	E
	22:29	I	Ec	D
	22:37	II	Oc	R
4	01:54	I	Oc	R
	21:54	I	Sh	E
	23:04	I	Tr	E
5	03:04	III	Ec	D
	06:04	III	Ec	R
7	06:41	II	Ec	D
8	01:08	IV	Tr	I
	03:59	IV	Tr	E
	21:35	III	Tr	I
9	00:40	III	Tr	E
	01:40	II	Sh	I
	03:52	II	Tr	I
	04:25	II	Sh	E
	05:54	I	Ec	D
	06:38	II	Tr	E
10	03:05	I	Sh	I
	04:11	I	Tr	I
	05:19	I	Sh	E
	06:26	I	Tr	E
11	00:22	I	Ec	D
	01:04	II	Oc	R
	03:43	I	Oc	R
	21:33	I	Sh	I
	22:38	I	Tr	I
	23:48	I	Sh	E
12	00:53	I	Tr	E
	07:03	III	Ec	D
	22:10	I	Oc	R
15	21:02	III	Sh	I
16	00:02	III	Sh	E
	01:12	III	Tr	I
	01:22	IV	Ec	D
	03:43	TV	Ec	R
	04:14	II	Sh	I
	04:17	III	Tr	E
	06:15	II	Tr	I
	06:58	II	Sh	E
17	04:59	I	Sh	I
	05:59	I	Tr	I
	22:36	II	Ec	D
18	02:16	I	Ec	D
	03:29	II	Oc	R
	05:30	I	Oc	R
	23:27	I	Sh	I
19	00:26	I	Tr	I
	01:42	I	Sh	E
	02:41	I	Tr	E
	20:15	II	Sh	E
	20:44	I	Ec	D
	22:12	II	Tr	E
	23:57	I	Oc	R
20	20:10	I	Sh	E
	21:08	I	Tr	E
23	01:00	III	Sh	I
	04:01	III	Sh	E
	04:44	III	Tr	I
	06:47	II	Sh	I
24	06:52	I	Sh	I
25	01:12	II	Ec	D
	04:09	I	Ec	D
	05:52	II	Oc	R
	07:17	I	Oc	R
26	01:21	I	Sh	I
	02:14	I	Tr	I
	03:36	I	Sh	E
	04:29	I	Tr	E
	20:04	II	Sh	I
	21:36	III	Oc	R
	21:45	II	Tr	I
	22:37	I	Ec	D
	22:49	II	Sh	E
27	00:32	II	Tr	E
	01:44	I	Oc	R
	19:49	I	Sh	I
	20:40	I	Tr	I
	22:04	I	Sh	E
	22:55	I	Tr	E
28	20:10	1	Oc	R
30	04:58	m	Sh	I

JUNE

1	03:48	II	Ec	D
	06:02	I	Ec	D
	21:52	IV	Ec	R
2	02:11	IV	Oc	D
	03:15	I	Sh	I
	04:00	I	Tr	I
	05:11	IV	Oc	R
	05:30	I	Sh	E
	06:15	I	Tr	E
	22:37	II	Sh	I
3	00:03	II	Tr	I
	00:31	I	Ec	D
	01:02	III	Oc	R
	01:23	II	Sh	E
	02:50	II	Tr	E
	03:29	I	Oc	R
	21:43	I	Sh	I
	22:26	I	Tr	I
	23:58	I	Sh	E
4	00:42	I	Tr	E
	21:22	II	Oc	R
	21:55	I	Oc	R
5	19:08	I	Tr	E
8	06:25	II	Ec	D
9	05:09	I	Sh	I
	05:45	I	Tr	I
	07:24	I	Sh	E
	22:55	III	Ec	D
10	01:10	II	Sh	I
	02:19	II	Tr	I
	02:24	I	Ec	D
	02:32	IV	Sh	I
	03:56	II	Sh	E
	04:24	III	Oc	R
	05:06	II	Tr	E
	05:09	IV	Sh	E
	05:14	I	Oc	R
	23:37	I	Sh	I
11	00:11	I	Tr	I
	01:53	I	Sh	E
	02:27	I	Tr	E
	19:43	II	Ec	D
	20:53	I	Ec	D
	23:40	II	Oc	R
	23:40	I	Oc	R
12	18:38	I	Tr	I
	20:21	I	Sh	E
	20:53	I	Tr	E
16	07:03	I	Sh	I
17	02:54	III	Ec	D
	03:44	II	Sh	I
	04:18	I	Ec	D
	04:34	II	Tr	I
	06:30	II	Sh	E
	06:58	I	Oc	R
	07:21	II	Tr	E
18	01:32	I	Sh	I
	01:56	I	Tr	I
	03:47	I	Sh	E
	04:12	I	Tr	E
	19:51	IV	Oc	R
	22:19	II	Ec	D
	22:46	I	Ec	D
19	01:24	I	Oc	R
	01:57	II	Oc	R
	20:00	I	Sh	I
	20:22	I	Tr	I
	22:16	I	Sh	E
	22:38	I	Tr	E
20	18:19	TTI	Tr	I
	19:47	II	Sh	E
	19:50	1	Oc	R
	20:01	III	Sh	E
	20:28	II	Tr	E
	21:26	III	Tr	E
24	06:12	I	Ec	D
	06:18	II	Sh	I
	06:48	II	Tr	I
	06:52	III	Ec	D
25	03:26	I	Sh	I
	03:40	I	Tr	I
	05:42	1	Sh	E
	05:56	I	Tr	E
26	00:40	1	Ec	D
	00:56	II	Ec	D
	03:08	I	Oc	R
	04:13	II	Oc	R
	20:30	IV	Sh	I
	21:55	1	Sh	I
	22:06	I	Tr	I
	22:19	TV	Tr	I
	23:20	IV	Sh	E
27	00:10	I	Sh	E
	00:22	1	Tr	E
	01:15	IV	Tr	E
	19:09	I	Ec	D
	19:35	II	Sh	I
	19:55	II	Tr	I
	20:54	III	Sh	I
	21:34	I	Oc	R
	21:36	III	Tr	I
	22:21	II	Sh	E
	22:42	II	Tr	E
28	00:01	III	Sh	E
	00:43	III	Tr	E
	18:39	I	Sh	E
	18:48	I	Tr	E
29	17:21	n	Oc	R

JULY

2	05:20	I	Sh	I
	05:24	I	Tr	I
3	02:34	I	Ec	D
	03:33	II	Ec	D
	04:51	I	Oc	R
	06:28	II	Oc	R
	2 3:49	I	Sh	I
	23:50	I	Tr	I
4	02:05	I	Sh	E
	02:06	I	Tr	E
	21:02	I	Oc	D
	22:08	II	Tr	I
	22:08	II	Sh	1
	23:17	I	Ec	R
5	00:52	III	Tr	I
	00:53	III	Sh	I
	00:55	IT	Tr	E

JUPITER'S MOONS (AEST)

5	00:55	II	Sh	E
	03:59	III	Tr	E
	04:01	III	Sh	E
	07:06	IV	Oc	D
	18:16	I	Tr	I
	18:18	I	Sh	I
	20:32	I	Tr	E
	20:34	I	Sh	E
6	16:47	II	Oc	D
	17:46	I	Ec	R
	19:42	II	Ec	R
8	17:59	III	Ec	R
10	04:20	I	Oc	D
	05:54	II	Oc	D
	06:43	I	Ec	R
11	01:35	I	Tr	I
	01:44	I	Sh	I
	03:50	I	Tr	E
	04:00	I	Sh	E
	22:46	I	Oc	D
12	00:22	II	Tr	I
	00:43	II	Sh	I
	01:12	I	Ec	R
	03:08	II	Tr	E
	03:30	II	Sh	E
	04:08	III	Tr	I
	04:52	III	Sh	I
	20:01	I	Tr	I
	20:12	I	Sh	I
	22:16	I	Tr	E
	22:28	I	Sh	E
13	17:12	I	Oc	D
	17:31	IV	Sh	E
	19:02	II	Oc	D
	19:40	I	Ec	R
	22:20	II	Ec	R
14	16:42	I	Tr	E
	16:57	I	Sh	E
15	16:47	II	Sh	E
	17:45	III	Oc	D
	21:59	III	Ec	R
17	06:04	I	Oc	D
18	03:19	I	Tr	I
	03:39	I	Sh	I
	05:35	I	Tr	E
	05:55	I	Sh	E
19	00:30	I	Oc	D
	02:36	II	Tr	I
	03:06	I	Ec	R
	03:17	11	Sh	I
	05:22	II	Tr	E
	06:04	II	Sh	E
	21:45	I	Tr	I
	22:07	I	Sh	I
20	00:01	I	Tr	E
	00:23	I	Sh	E
	18:56	I	Oc	D
	21:19	II	Oc	D
	21:34	I	Ec	R
21	00:57	II	Ec	R
	18:27	I	Tr	E
	18:52	I	Sh	E
	21:21	IV	Oc	D
22	00:20	IV	Oc	R
	01:12	IV	Ec	D
	04:21	IV	Ec	R
	18:30	II	Tr	E
	19:22	11	Sh	E
	21:03	III	Oc	D
23	01:59	III	Ec	R
25	05:04	I	Tr	I
	05:34	I	Sh	I
26	02:15	I	Oc	D
	04:51	II	Tr	I
	05:00	I	Ec	R
	23:30	I	Tr	I
27	00:02	I	Sh	I
	01:46	I	Tr	E
	02:18	I	Sh	E
	20:41	I	Oc	D
27	23:29	I	Ec	R
	23:36	II	Oc	D
28	03:35	II	Ec	R
	17:57	I	Tr	I
	18:31	I	Sh	I
	20:12	I	Tr	E
	20:47	I	Sh	E
29	17:57	I	Ec	R
	17:59	II	Tr	I
	19:09	II	Sh	I
	20:45	II	Tr	E
	21:56	II	Sh	E
30	00:24	III	Oc	D
	02:54	IV	Tr	I
31	16:53	II	Ec	R

AUGUST

2	04:00	I	Oc	D
	16:52	III	Sh	I
	17:16	III	Tr	E
	20:03	III	Sh	E
3	01:16	I	Tr	I
	01:57	I	Sh	I
	03:32	I	Tr	E
	04:13	I	Sh	E
	22:26	I	Oc	D
4	01:23	I	Ec	R
	01:55	II	Oc	D
	19:43	I	Tr	I
	20:26	I	Sh	I
	21:58	I	Tr	E
	22:42	I	Sh	E
5	16:53	I	Oc	D
	19:52	I	Ec	R
	20:16	II	Tr	I
	21:44	II	Sh	I
	23:03	II	Tr	E
6	00:31	II	Sh	E
	03:47	III	Oc	D
	17:11	I	Sh	E
7	19:13	IV	Ec	D
	19:31	II	Ec	R
	22:32	IV	Ec	R
9	17:35	III	Tr	I
	20:42	III	Tr	E
	20:52	III	Sh	I
10	00:04	III	Sh	E
	03:03	I	Tr	I
	03:53	I	Sh	I
11	00:13	I	Oc	D
	03:18	I	Ec	R
	04:16	II	Oc	D
	21:30	I	Tr	I
	22:21	I	Sh	I
	23:45	I	Tr	E
12	00:37	I	Sh	E
	18:39	I	Oc	D
	21:47	I	Ec	R
	22:36	11	Tr	I
13	00:19	II	Sh	I
	01:22	II	Tr	E
	03:06	II	Sh	E
	18:12	I	Tr	E
	19:06	I	Sh	E
14	17:27	II	Oc	D
	22:08	11	Ec	R
15	17:56	IV	Tr	I
	20:53	IV	Tr	E
16	02:33	IV	Sh	I
	21:05	III	Tr	I
17	00:12	III	Tr	E
	00:52	III	Sh	I
18	02:00	I	Oc	D
	23:18	I	Tr	I
19	00:17	I	Sh	I
	01:33	I	Tr	E
	02:32	I	Sh	E
	20:27	I	Oc	D
	23:42	I	Ec	R
20	00:57	II	Tr	I
	02:54	II	Sh	I
	03:43	II	Tr	E
	17:46	I	Tr	I
	18:00	III	Ec	R
	18:45	I	Sh	I
	20:01	I	Tr	E
	21:01	I	Sh	E
21	18:11	I	Ec	R
	19:51	II	Oc	D
22	00:46	II	Ec	R
23	18:59	II	Sh	E
24	00:38	III	Tr	I
	03:31	IV	Oc	D
26	01:08	I	Tr	I
	02:12	I	Sh	I
	03:23	I	Tr	E
	22:16	I	Oc	D
27	01:37	I	Ec	R
	17:31	III	Oc	R
	18:47	III	Ec	D
	19:35	I	Tr	I
	20:41	I	Sh	I
	21:50	I	Tr	E
	22:01	III	Ec	R
	22:56	I	Sh	E
28	20:06	I	Ec	R
	22:16	II	Oc	D
29	17:25	I	Sh	E
30	18:47	II	Sh	I
	19:20	II	Tr	E
	21:35	II	Sh	E

SEPTEMBER

1	20:37	IV	Sh	I
2	00:06	IV	Sh	E
3	00:06	I	Oc	D
	18:04	III	Oc	D
	21:13	III	Oc	R
	21:26	I	Tr	I
	22:36	I	Sh	I
	22:47	III	Ec	D
	23:41	I	Tr	E
4	00:51	I	Sh	E
	02:02	III	Ec	R
	18:34	I	Oc	D
	22:01	I	Ec	R
5	00:45	II	Oc	D
	18:09	I	Tr	E
	19:20	I	Sh	E
6	19:00	II	Tr	I
	21:23	II	Sh	I
	21:47	II	Tr	E
7	00:11	II	Sh	E
8	19:19	II	Ec	R
9	19:54	IV	Oc	D
	23:01	IV	Oc	R
10	01:57	I	Oc	D
	21:49	III	Oc	D
	23:18	I	Tr	I
11	00:32	I	Sh	I
	00:59	III	Oc	R
	01:32	I	Tr	E
	20:25	I	Oc	D
	23:56	I	Ec	R
12	17:46	I	Tr	I
	19:00	I	Sh	I
	20:01	I	Tr	E
	21:15	I	Sh	E
13	18:25	I	Ec	R
	21:30	II	Tr	I
	23:59	II	Sh	I
14	00:16	II	Tr	E
	20:07	III	Sh	E
15	21:57	II	Ec	R
18	01:11	I	Tr	I
	01:38	III	Oc	D
	18:18	IV	Sh	E
	22:18	I	Oc	D
19	19:39	I	Tr	I
	20:56	I	Sh	I
	21:54	I	Tr	E
	23:11	I	Sh	E
20	20:20	I	Ec	R
21	00:02	II	Tr	I
	17:40	I	Sh	E
	18:50	III	Tr	E
	20:53	III	Sh	I
22	00:08	III	Sh	E
	19:05	II	Oc	D
23	00:34	II	Ec	R
24	18:42	II	Sh	E
26	00:12	I	Oc	D
	21:34	I	Tr	I
	22:51	I	Sh	I
	23:48	I	Tr	E
27	01:06	I	Sh	E
	01:21	IV	Ec	D
	18:41	I	Oc	D
	22:15	I	Ec	R
28	18:17	I	Tr	E
	19:35	I	Sh	E
	19:38	III	Tr	I
	22:48	III	Tr	E
29	00:54	III	Sh	I
	21:41	II	Oc	D

OCTOBER

1	18:29	II	Sh	I
	18:41	II	Tr	E
	21:18	II	Sh	E
2	18:05	III	Ec	R
3	23:29	I	Tr	I
4	00:47	I	Sh	I
	20:32	IV	Tr	I
	20:36	I	Oc	D
	23:44	IV	Tr	E
5	00:11	I	Ec	R
	17:58	I	Tr	I
	19:15	I	Sh	I
	20:12	I	Tr	E
	21:30	I	Sh	E
	23:39	III	Tr	I
6	18:39	I	Ec	R
7	00:19	II	Oc	D
8	18:31	II	Tr	I
	21:06	II	Sh	I
	21:18	II	Tr	E
	23:55	II	Sh	E
9	18:47	III	Ec	D
	22:07	III	Ec	R
10	19:06	II	Ec	R
11	22:32	I	Oc	D
12	19:54	I	Tr	I
	21:11	I	Sh	I
	22:09	I	Tr	E
	23:26	I	Sh	E
13	19:25	IV	Ec	D
	20:35	I	Ec	R
	23:17	IV	Ec	R
14	17:55	I	Sh	E
15	21:10	II	Tr	I
	23:43	II	Sh	I
	23:58	II	Tr	E
16	17:41	III	Oc	D
	20:54	III	Oc	R
	22:48	III	Ec	D
17	21:43	II	Ec	R
19	21:52	I	Tr	I
	23:06	I	Sh	I
20	18:58	I	Oc	D
	22:30	I	Ec	R
21	18:33	IV	Tr	E
	18:36	I	Tr	E
	19:50	I	Sh	E
23	21:51	III	Oc	D
24	19:00	II	Oc	D
26	18:29	II	Sh	E
27	20:13	III	Sh	E
	20:57	I	Oc	D
28	18:19	I	Tr	I
	19:30	I	Sh	I
	20:34	I	Tr	E
	21:45	I	Sh	E
29	18:55	I	Ec	R
31	21:43	II	Oc	D

NOVEMBER

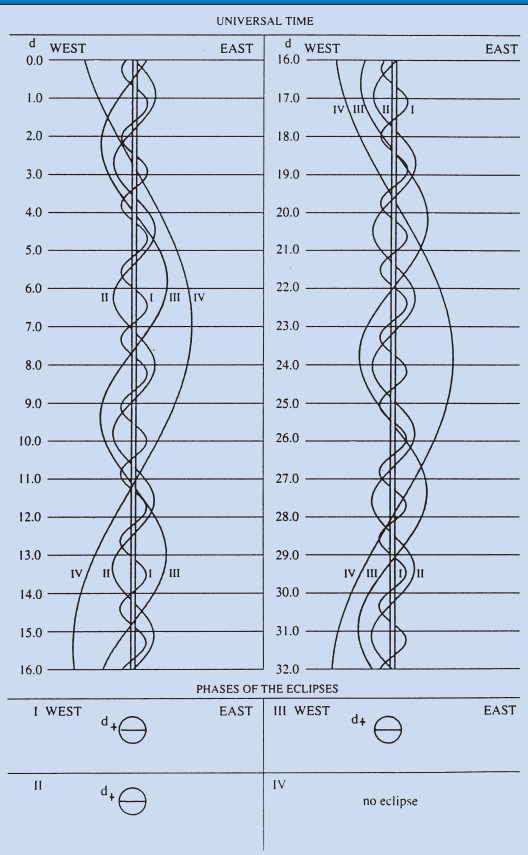
2	18:15	II	Sh	I
	18:46	II	Tr	E
	21:06	II	Sh	E
3	19:33	III	Tr	E
	20:55	III	Sh	I
	22:55	I	Oc	D
4	20:18	I	Tr	I
	21:25	I	Sh	I
	22:33	I	Tr	E
5	20:50	I	Ec	R
6	18:09	I	Sh	E
7	20:57	IV	Sh	I
9	18:42	II	Tr	I
	20:52	II	Sh	I
	21:31	II	Tr	E
10	20:36	III	Tr	I
11	18:50	II	Ec	R
	22:17	I	Tr	I
12	19:25	I	Oc	D
13	19:02	I	Tr	E
	20:04	I	Sh	E
14	18:11	III	Ec	R
15	22:09	IV	Oc	D
16	21:28	II	Tr	I
18	21:25	II	Ec	R
19	21:25	I	Oc	D
20	18:47	I	Tr	I
	19:44	I	Sh	I
	21:02	I	Tr	E
	22:00	I	Sh	E
21	18:18	III	Oc	R
	18:48	III	Ec	D
	19:10	I	Ec	R
24	19:09	IV	Sh	E
25	19:23	II	Oc	D
27	18:18	II	Sh	E
	20:48	I	Tr	I
	21:39	I	Sh	I
28	19:24	III	Oc	D
	21:05	I	Ec	R
29	18:23	I	Sh	E

DECEMBER

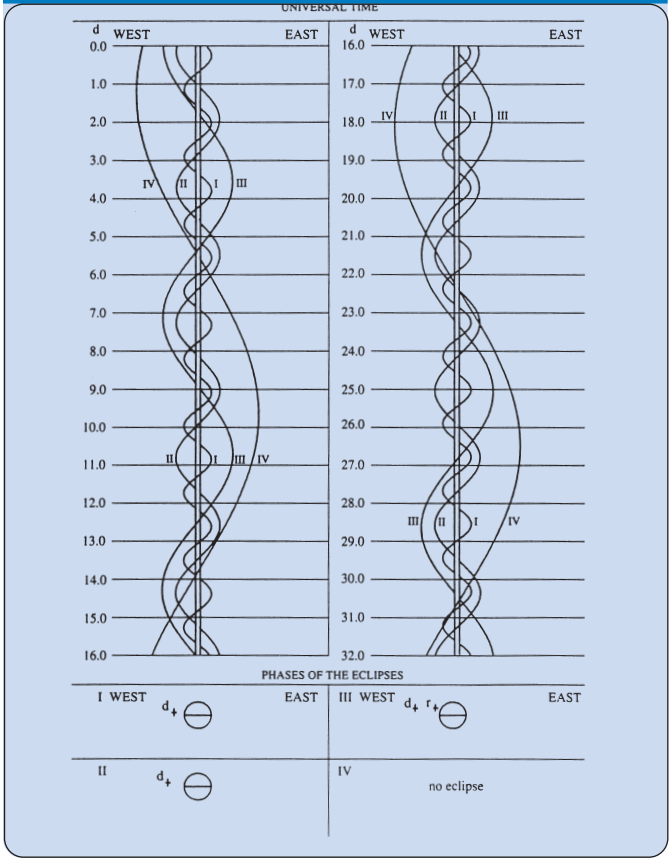
4	19:22	II	Tr	E
	20:56	II	Sh	E
5	19:58	I	Oc	D
6	19:34	I	Tr	E
	20:18	I	Sh	E
9	20:20	III	Sh	E
11	19:20	II	Tr	I
	20:41	II	Sh	I
13	19:20	I	Tr	I
	19:57	I	Sh	I
14	19:24	I	Ec	R
16	18:34	III	Tr	I
19	18:48	IV	Oc	R
	19:43	IV	Ec	D
22	18:36	I	Sh	E
27	20:01	II	Oc	D
29	20:09	I	Tr	E

JUPITER'S MOONS

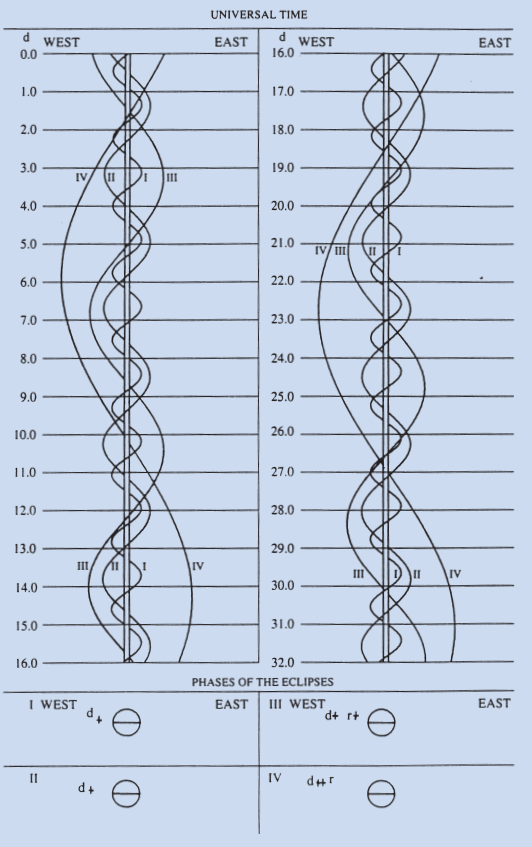
JANUARY



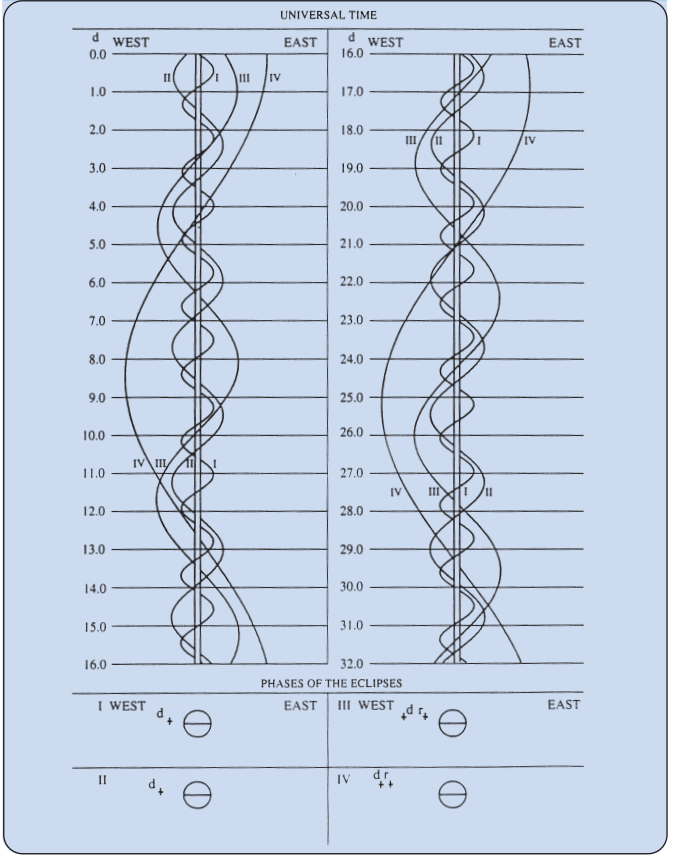
FEBRUARY



MARCH



APRIL



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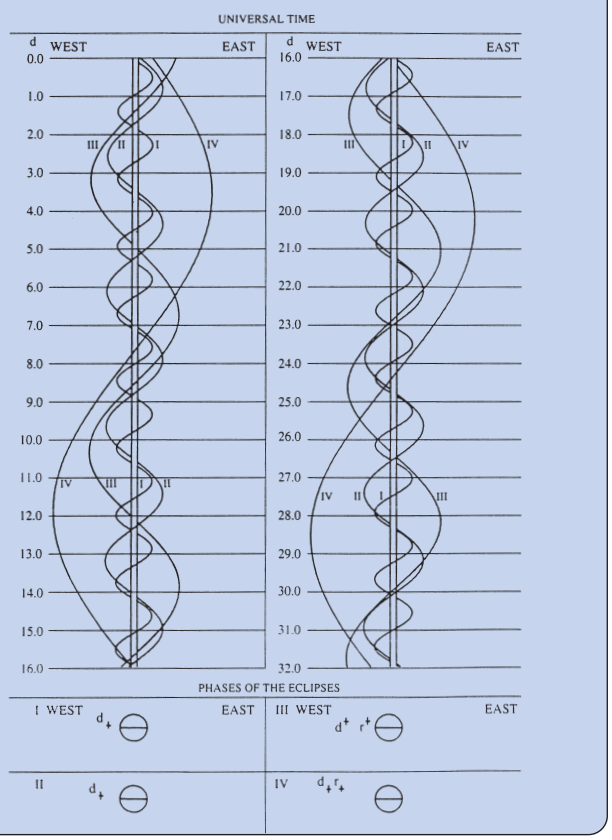
JUPITER'S MOONS

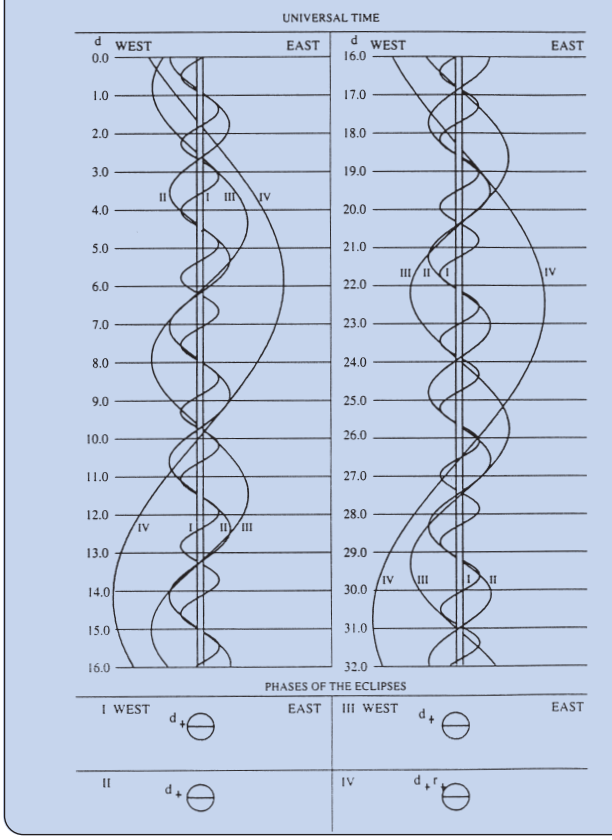
MAY

CONFIGURATIONS OF SATELLITES I–IV FOR MAY

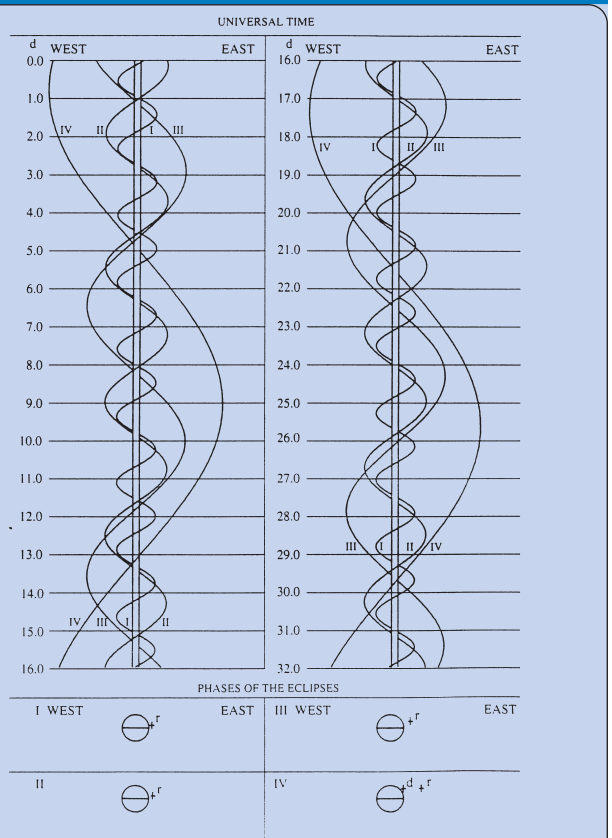


JUNE

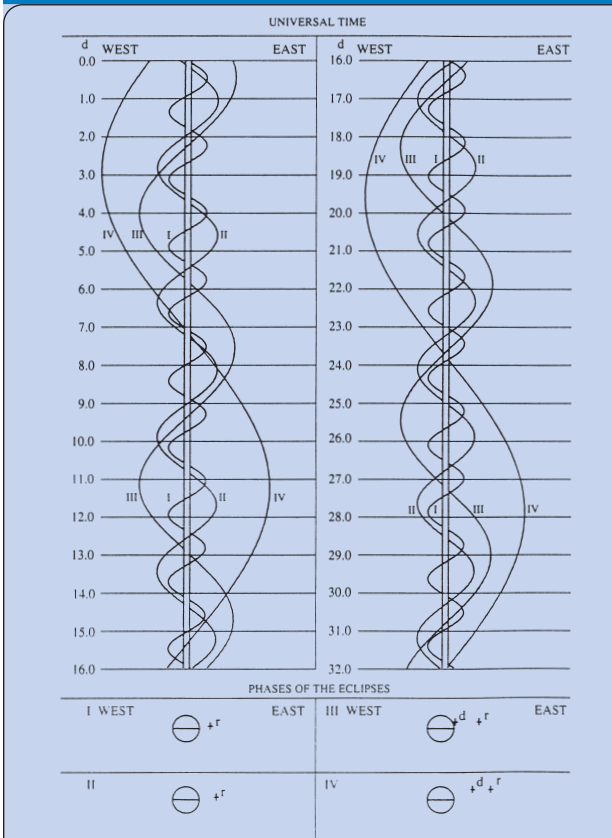
CONFIGURATIONS OF SATELLITES I–IV FOR JUNE



JULY



AUGUST



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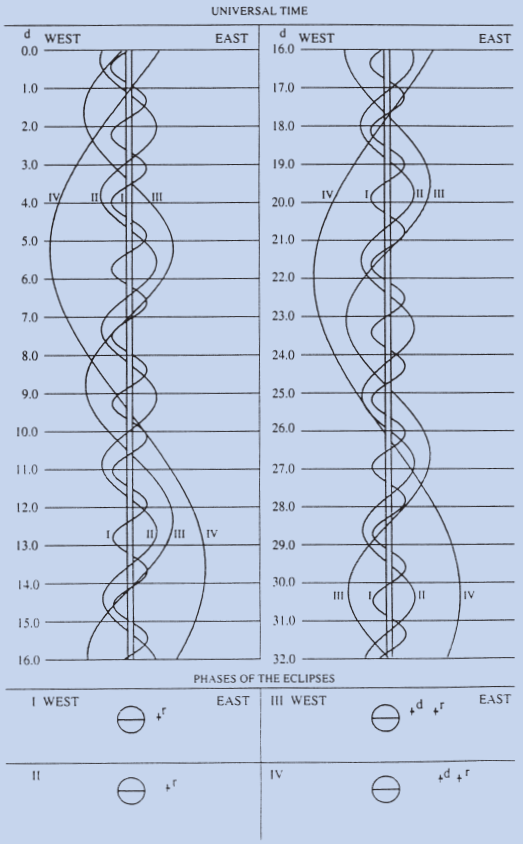
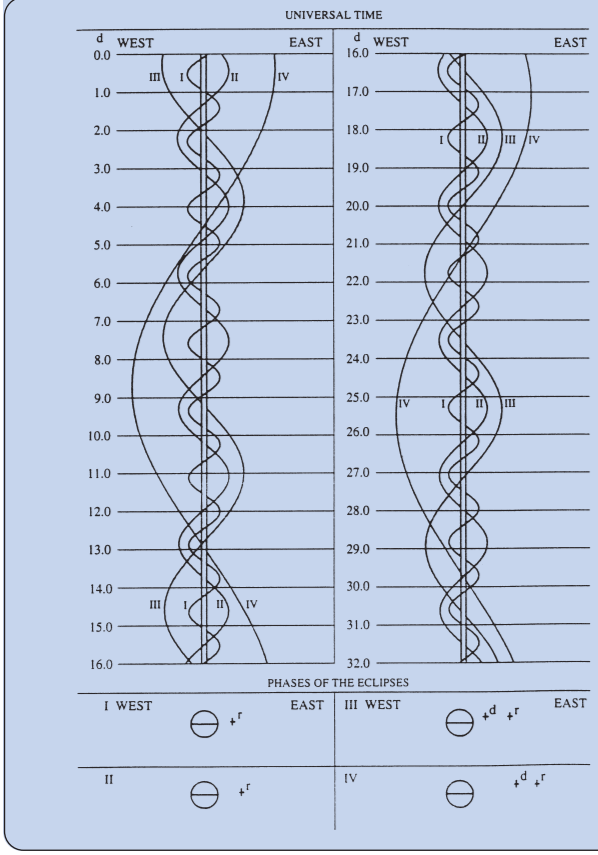
JUPITER'S MOONS

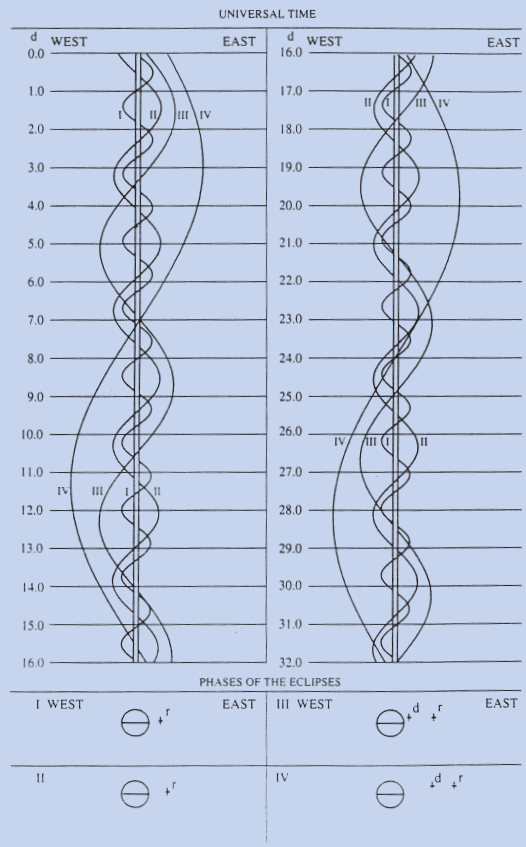
SEPTEMBER



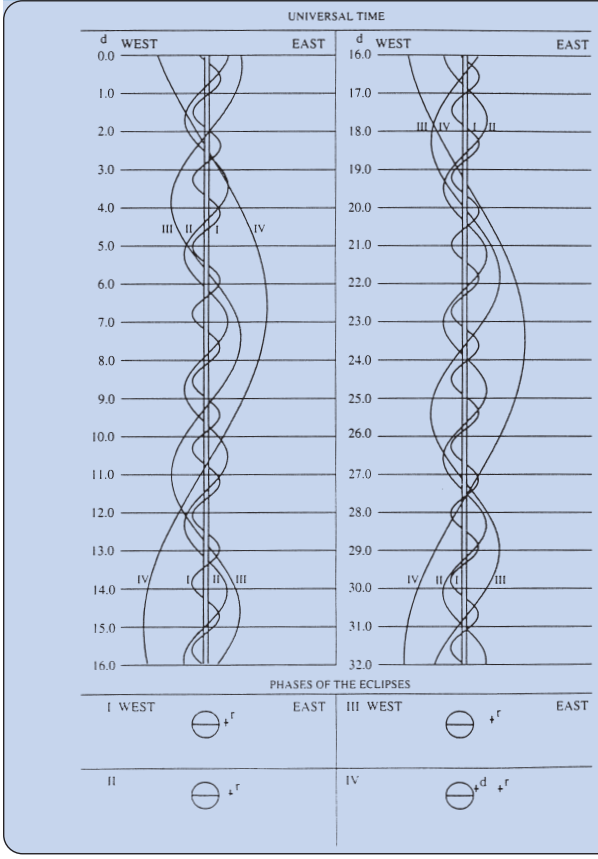
OCTOBER



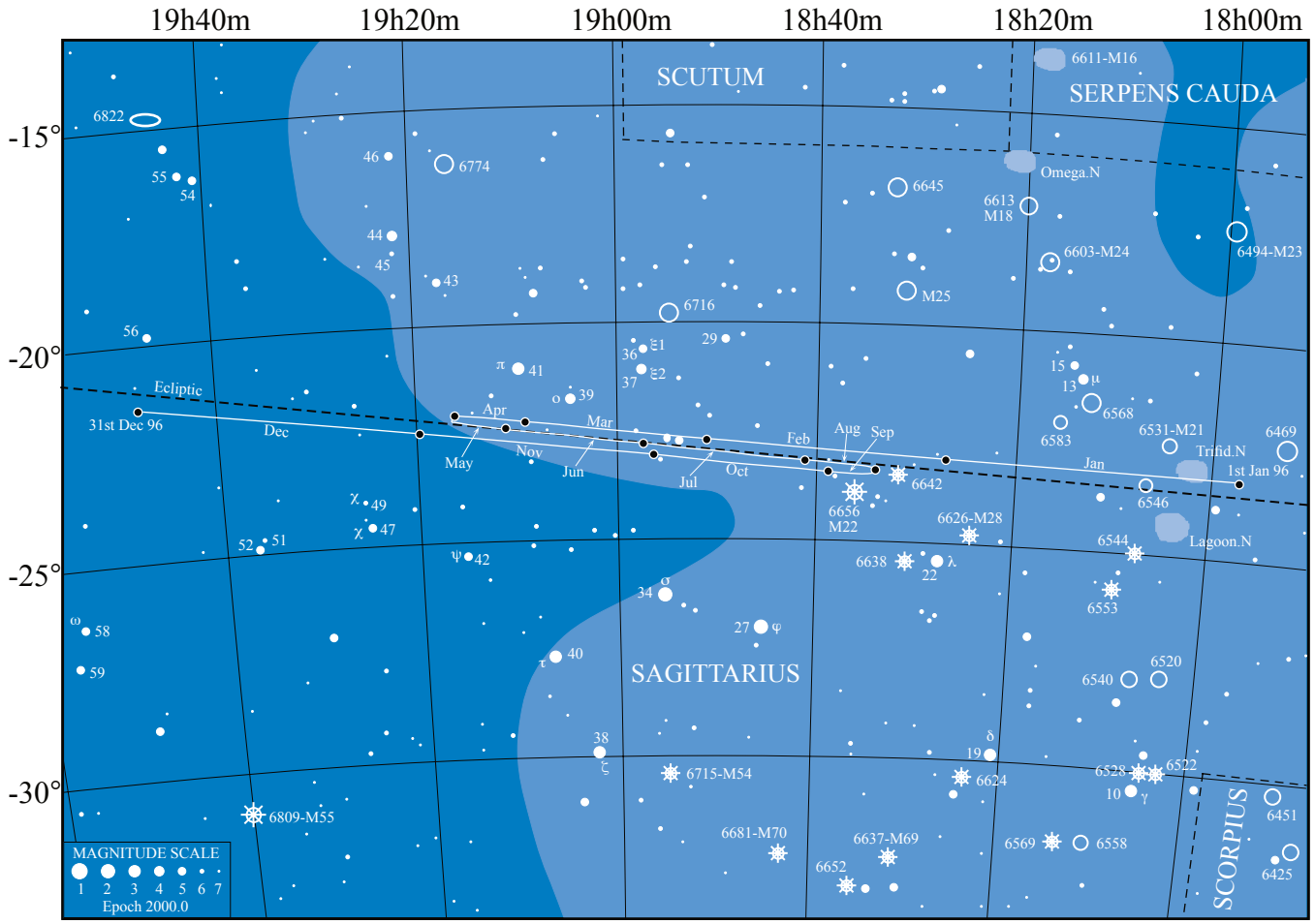
NOVEMBER

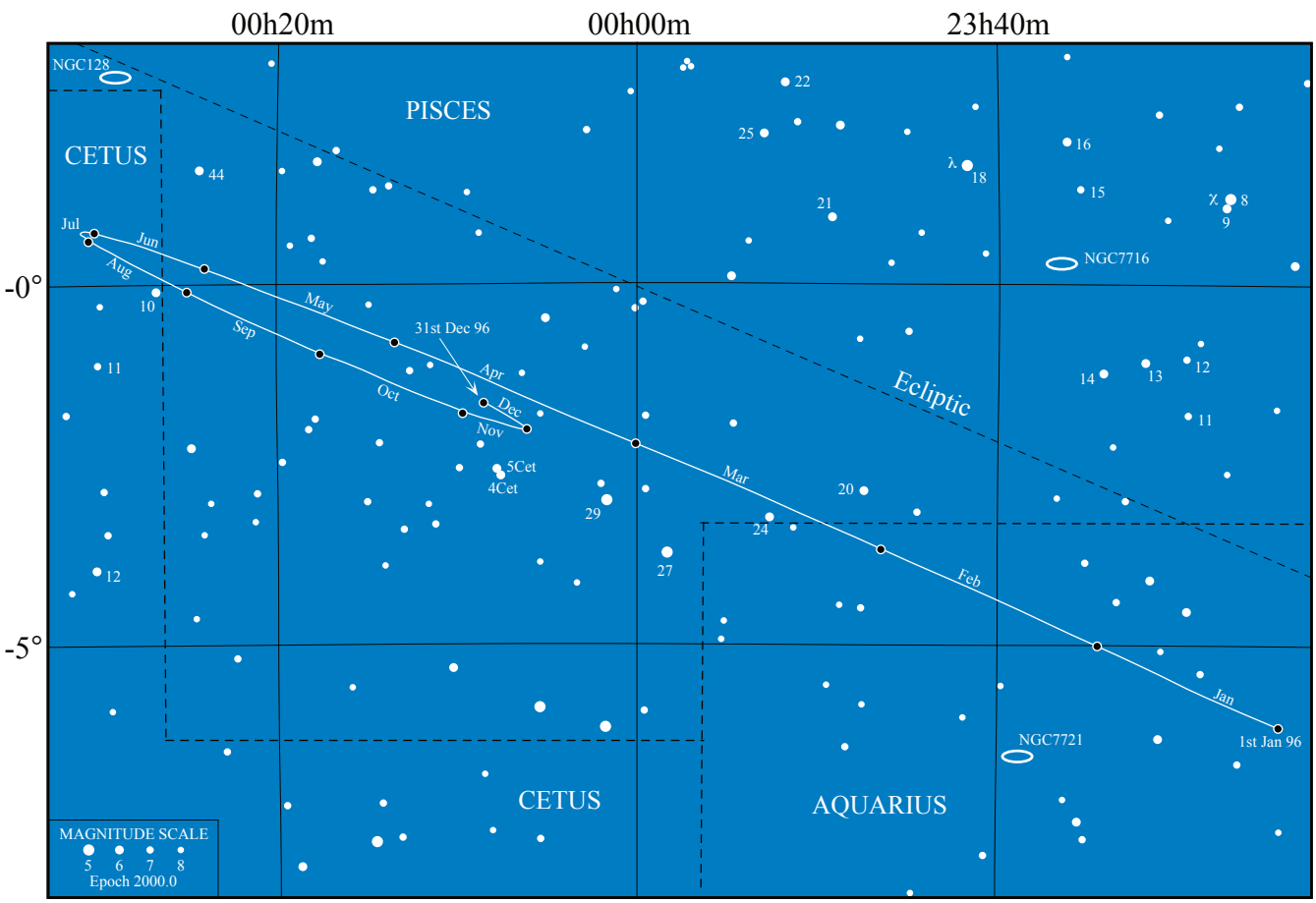


DECEMBER



105


19h40m
19h20m
19h00m
18h40m
18h20m
18h00m
-15°
-20°
-25°
-30°
SCUTUM
SERPENS CAUDA
SAGITTARIUS
SCORPIUS
Ecliptic
31st Dec 96
Dec
Nov
Oct
Sep
Aug
Jul
Jun
May
Apr
Mar
Feb
Jan
1st Jan 96
6822
6774
6645
6611-M16
Omega.N
6613
M18
6603-M24
6494-M23
M25
6716
6568
6583
6531-M21
Trifid.N
6469
6642
6656
M22
6626-M28
6546
6544
Lagoon.N
6638
6553
6520
6540
6715-M54
6624
6528
6522
6451
6425
6809-M55
6681-M70
6637-M69
6652
6569
6558
MAGNITUDE SCALE
1 2 3 4 5 6 7
Epoch 2000.0


00h20m
00h00m
23h40m
-0°
-5°
PISCES
CETUS
AQUARIUS
NGC128
NGC7716
NGC7721
Ecliptic
31st Dec 96
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
1st Jan 96
5Cet
4Cet
MAGNITUDE SCALE
5 6 7 8
Epoch 2000.0

SATURN

RISE AND SET TIMES

AEST (Adelaide & Darwin ACST)

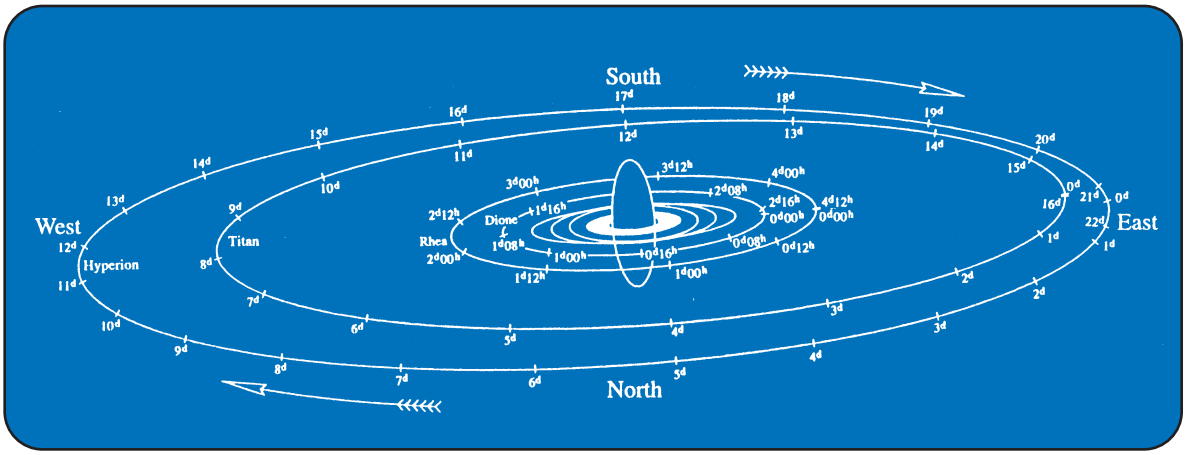
	Adelaide		Brisbane		Canberra		Darwin		Hobart		Melbourne		Sydney		Townsville	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
Jan 6	10:22	22:59	09:59	22:27	10:10	22:47	11:05	23:19	10:12	23:01	10:25	23:06	10:02	22:38	10:28	22:48
13	09:57	22:33	09:34	22:01	09:45	22:21	10:40	22:53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

POSITION

(0hrs UT Epoch 2000.0)

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

SATELLITES OF SATURN



Apparent Orbits Diagram (at date of opposition, September 26).

Saturn appears to be egg shaped on this diagram due to the need to exaggerate the scale in the direction of the minor axis. This makes seeing the orbits of the satellites easier, especially the inner moons while Saturn has a very small tilt with respect to the Earth.

	Satellite Name	Mean Synodic Period d hh.h		Satellite Name	Mean Synodic Period d hh.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			

TITAN (AEST) Mean Synodic Period 15d 23.3h

Greatest Eastern Elongation	Inferior Conjunction	Greatest Western Elongation	Superior Conjunction
		Jan 1 14.1	Jan 5 09.7
Jan 9 07.4	Jan 13 11.9	Jan 17 14.0	Jan 21 09.6
Jan 25 07.5	Jan 29 12.1	Feb 2 14.1	Feb 6 09.7
Feb 10 07.8	Feb 14 12.5	Feb 18 14.4	Feb 22 10.0
Feb 26 08.2	Mar 1 13.1	Mar 5 14.9	Mar 9 10.4
Mar 13 08.8	Mar 17 13.7	Mar 21 15.4	Mar 25 10.9
Mar 29 09.4	Apr 2 14.4	Apr 6 15.9	Apr 10 11.3
Apr 14 10.0	Apr 18 14.9	Apr 22 16.3	Apr 26 11.7
Apr 30 10.4	May 4 15.4	May 8 16.6	May 12 11.9
May 16 10.7	May 20 15.6	May 24 16.6	May 28 11.8
Jun 1 10.7	Jun 5 15.5	Jun 9 16.4	Jun 13 11.5
Jun 17 10.4	Jun 21 15.1	Jun 25 15.8	Jun 29 10.9
Jul 3 09.7	Jul 7 14.4	Jul 11 14.9	Jul 15 09.9
Jul 19 08.6	Jul 23 13.2	Jul 27 13.6	Jul 31 08.5
Aug 4 07.1	Aug 8 11.5	Aug 12 11.9	Aug 16 06.7
Aug 20 05.2	Aug 24 09.5	Aug 28 09.9	Sep 1 04.6
Sep 5 02.9	Sep 9 07.2	Sep 13 07.6	Sep 17 02.3
Sep 21 00.5	Sep 25 04.7	Sep 29 05.1	Oct 2 23.9
Oct 6 22.0	Oct 11 02.1	Oct 15 02.7	Oct 18 21.5
Oct 22 19.6	Oct 26 23.8	Oct 31 00.5	Nov 3 19.3
Nov 7 17.4	Nov 11 21.7	Nov 15 22.5	Nov 19 17.5
Nov 23 15.6	Nov 27 20.0	Dec 1 21.0	Dec 5 16.0
Dec 9 14.2	Dec 13 18.7	Dec 17 19.8	Dec 21 15.0
Dec 25 13.3	Dec 29 17.9		

For explanation. see page 70.

IAPETUS (AEST) Mean Synodic Period 79d 22.1h

Greatest Eastern Elongation	Inferior Conjunction	Greatest Western Elongation	Superior Conjunction
Jan 3 19.7	Jan 24 10.9	Feb 14 16.6	Mar 5 12.4
Mar 25 00.1	Apr 14 23.1	May 6 03.2	May 25 17.3
Jun 14 01.9	Jul 4 18.5	Jul 25 09.4	Aug 13 10.7
Sep 1 07.4	Sep 21 11.0	Oct 11 17.7	Oct 30 16.6
Nov 18 13.1	Dec 8 22.0	Dec 29 16.8	

HYPERION (AEST) Mean Synodic Period 21d 7.6h

Greatest Eastern Elongation	Inferior Conjunction	Greatest Western Elongation	Superior Conjunction
		Jan 6 22.5	Jan 12 16.1
Jan 17 05.1	Jan 22 02.0	Jan 28 05.7	Feb 2 22.4
Feb 7 11.1	Feb 12 08.9	Feb 18 13.8	Feb 24 05.5
Feb 28 17.7	Mar 4 16.7	Mar 10 22.5	Mar 16 13.1
Mar 21 00.8	Mar 26 01.0	Mar 31 19.4	Apr 6 20.9
Apr 11 08.1	Apr 16 09.5	Apr 22 17.1	Apr 28 05.1
May 2 15.9	May 7 18.5	May 14 02.7	May 19 13.5
May 23 23.8	May 29 03.4	Jun 4 12.2	Jun 9 21.7
Jun 14 07.6	Jun 19 12.1	Jun 25 21.2	Jul 1 05.8
Jul 5 15.4	Jul 10 20.5	Jul 17 05.8	Jul 22 13.7
Jul 26 22.9	Aug 1 04.3	Aug 7 13.7	Aug 12 21.1
Aug 17 06.1	Aug 22 11.4	Aug 28 21.0	Sep 3 04.3
Sep 7 12.9	Sep 12 18.2	Sep 19 04.0	Sep 24 11.6
Sep 28 20.0	Oct 4 01.0	Oct 10 11.1	Oct 15 18.7
Oct 20 03.1	Oct 25 08.0	Oct 31 18.5	Nov 6 02.5
Nov 10 10.8	Nov 15 16.0	Nov 22 02.9	Nov 27 11.1
Dec 1 19.5	Dec 7 01.1	Dec 13 12.4	Dec 18 20.2
Dec 23 04.8	Dec 28 11.1		

TIMES OF GREATEST EASTERN ELONGATION (AEST)

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
2 13.2	3 04.9	1 08.3	2 00.3	3 16.1	4 07.8	1 10.6	2 01.5	2 16.0	4 06.3	4 20.8	1 23.1
7 01.7	7 17.5	5 20.8	6 12.8	8 04.7	8 20.3	5 23.1	6 13.9	7 04.4	8 18.7	9 09.1	6 11.6
11 14.2	12 06.0	10 09.4	11 01.4	12 17.2	13 08.8	10 11.5	11 02.3	11 16.7	13 07.0	13 21.5	11 00.0
16 02.7	16 18.6	14 22.0	15 13.9	17 05.8	17 21.2	14 23.9	15 14.7	16 05.0	17 19.3	18 09.9	15 12.4
20 15.3	21 07.2	19 10.6	20 02.5	21 18.3	22 09.7	19 12.3	20 03.0	20 17.4	22 07.7	22 22.3	20 00.9
25 03.8	25 19.7	23 23.1	24 15.1	26 06.8	26 22.2	24 00.8	24 15.4	25 05.7	26 20.0	27 10.7	24 13.4
29 16.3		28 11.7	29 03.6	30 19.3		28 13.1	29 03.7	29 18.0	31 08.4		29 01.9

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
2 11.5	1 14.5	2 17.6	1 20.8	1 23.9	1 02.8	1 05.5	3 01.7	2 04.0	2 06.2	1 08.4	1 10.9
5 05.2	4 08.2	5 11.4	4 14.5	4 17.6	3 20.5	3 23.2	5 19.4	4 21.7	4 23.8	4 02.1	4 04.6
7 22.9	7 02.0	8 05.1	7 08.3	7 11.3	6 14.2	6 16.9	8 13.1	7 15.3	7 17.5	6 19.8	6 22.3
10 16.6	9 19.7	10 22.8	10 02.0	10 05.0	9 07.9	9 10.6	11 06.7	10 09.0	10 11.1	9 13.4	9 15.9
13 10.4	12 13.4	13 16.6	12 19.7	12 22.8	12 01.6	12 04.3	14 00.4	13 02.6	13 04.8	12 07.1	12 09.6
16 04.1	15 07.2	16 10.3	15 13.5	15 16.5	14 19.3	14 22.0	16 18.1	15 20.3	15 22.5	15 00.8	15 03.3
18 21.8	18 00.9	19 04.1	18 07.2	18 10.2	17 13.1	17 15.7	19 11.7	18 13.9	18 16.1	17 18.4	17 21.0
21 15.6	20 18.7	21 21.8	21 00.9	21 03.9	20 06.8	20 09.4	22 05.4	21 07.6	21 09.8	20 12.1	20 14.8
24 09.3	23 12.4	24 15.6	23 18.7	23 21.6	23 00.5	23 03.0	24 23.0	24 01.2	24 03.4	23 05.8	23 08.5
27 03.0	26 06.2	27 09.3	26 12.4	26 15.4	25 18.2	25 20.7	27 16.7	26 18.9	26 21.1	25 23.5	26 02.2
29 20.8	28 23.9	30 03.0	29 06.1	29 09.1	28 11.9	28 14.4	30 10.3	29 12.5	29 14.7	28 17.2	28 19.9
						31 08.1					31 13.6

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
2 11.2	1 16.4	1 00.4	2 03.1	2 08.4	1 13.5	1 18.6	2 20.7	2 01.5	2 06.1	1 10.8	1 15.7
4 08.5	3 13.8	2 21.8	4 00.4	4 05.7	3 10.9	3 15.9	4 18.0	3 22.8	4 03.4	3 08.1	3 13.0
6 05.8	5 11.1	4 19.1	5 21.8	6 03.0	5 08.2	5 13.2	6 15.3	5 20.0	6 00.7	5 05.4	5 10.3
8 03.1	7 08.4	6 16.4	7 19.1	8 00.4	7 05.5	7 10.5	8 12.6	7 17.3	7 22.0	7 02.7	7 07.6
10 00.5	9 05.8	8 13.8	9 16.4	9 21.7	9 02.8	9 07.8	10 09.9	9 14.6	9 19.3	9 00.0	9 04.9
11 21.8	11 03.1	10 11.1	11 13.8	11 19.0	11 00.1	11 05.1	12 07.2	11 11.9	11 16.6	10 21.3	11 02.3
13 19.1	13 00.4	12 08.4	13 11.1	13 16.3	12 21.5	13 02.4	14 04.5	13 09.2	13 13.9	12 18.6	12 23.6
15 16.5	14 21.8	14 05.8	15 08.4	15 13.7	14 18.8	14 23.7	16 01.8	15 06.5	15 11.2	14 15.9	14 20.9
17 13.8	16 19.1	16 03.1	17 05.7	17 11.0	16 16.1	16 21.0	17 23.1	17 03.8	17 08.5	16 13.2	16 18.2
19 11.1	18 16.4	18 00.4	19 03.1	19 08.3	18 13.4	18 18.3	19 20.4	19 01.1	19 05.8	18 10.5	18 15.5
21 08.5	20 13.8	19 21.8	21 00.4	21 05.6	20 10.7	20 15.6	21 17.7	20 22.4	21 03.0	20 07.8	20 12.8
23 05.8	22 11.1	21 19.1	22 21.7	23 02.9	22 08.0	22 12.9	23 15.0	22 19.7	23 00.3	22 05.1	22 10.2
25 03.1	24 08.4	23 16.4	24 19.1	25 00.3	24 05.3	24 10.2	25 12.3	24 16.9	24 21.6	24 02.5	24 07.5
27 00.4	26 05.8	25 13.8	26 16.4	26 21.6	26 02.6	26 07.5	27 09.6	26 14.2	26 18.9	25 23.8	26 04.8
28 21.8	28 03.1	27 11.1	28 13.7	28 18.9	28 00.0	28 04.8	29 06.9	28 11.5	28 16.2	27 21.1	28 02.1
30 19.1		29 08.4	30 11.1	30 16.2	29 21.3	30 02.1	31 04.2	30 08.8	30 13.5	29 18.4	29 23.4
		31 05.8				31 23.4					31 20.7

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 10.6	1 23.2	1 18.1	2 06.8	1 01.6	1 14.1	1 17.7	2 06.0	1 09.3	1 12.6	2 00.8	2 04.2
2 19.5	3 08.1	3 03.0	3 15.7	2 10.5	2 23.0	3 02.5	3 14.8	2 18.2	2 21.4	3 09.6	3 13.1
4 04.4	4 17.0	4 11.9	5 00.5	3 19.4	4 07.9	4 11.4	4 23.7	4 03.0	4 06.3	4 18.5	4 22.0
5 13.3	6 01.9	5 20.8	6 09.5	5 04.3	5 16.8	5 20.3	6 08.6	5 11.9	5 15.2	6 03.4	6 06.9
6 22.1	7 10.8	7 05.7	7 18.3	6 13.2	7 01.7	7 05.2	7 17.5	6 20.8	7 00.1	7 12.3	7 15.8
8 07.1	8 19.7	8 14.6	9 03.2	7 22.1	8 10.6	8 14.1	9 02.4	8 05.7	8 08.9	8 21.2	9 00.7
9 15.9	10 04.6	9 23.5	10 12.1	9 06.9	9 19.5	9 23.0	10 11.2	9 14.5	9 17.8	10 06.1	10 09.6
11 00.8	11 13.5	11 08.4	11 21.0	10 15.8	11 04.4	11 07.9	11 20.1	10 23.4	11 02.7	11 14.9	11 18.4
12 09.7	12 22.4	12 17.3	13 05.9	12 00.7	12 13.2	12 16.7	13 05.0	12 08.3	12 11.6	12 23.8	13 03.3
13 18.6	14 07.3	14 02.2	14 14.8	13 09.6	13 22.1	14 01.6	14 13.9	13 17.2	13 20.5	14 08.7	14 12.2
15 03.5	15 16.2	15 11.1	15 23.7	14 18.5	15 07.0	15 10.5	15 22.8	15 02.0	15 05.3	15 17.6	15 21.1
16 12.4	17 01.1	16 20.0	17 08.6	16 03.4	16 15.9	16 19.4	17 07.6	16 10.9	16 14.2	17 02.5	17 06.0
17 21.3	18 10.0	18 04.9	18 17.5	17 12.3	18 00.8	18 04.3	18 16.5	17 19.8	17 23.1	18 11.4	18 14.9
19 06.2	19 18.9	19 13.8	20 02.4	18 21.2	19 09.7	19 13.1	20 01.4	19 04.7	19 08.0	19 20.2	19 23.8
20 15.1	21 03.8	20 22.7	21 11.3	20 06.1	20 18.6	20 22.0	21 10.3	20 13.5	20 16.8	21 05.1	21 08.7
22 00.0	22 12.7	22 07.6	22 20.2	21 15.0	22 03.5	22 06.9	22 19.1	21 22.4	22 01.7	22 14.0	22 17.6
23 08.9	23 21.6	23 16.5	24 05.1	22 23.9	23 12.3	23 15.8	24 04.0	23 07.3	23 10.6	23 22.9	24 02.5
24 17.8	25 06.5	25 01.4	25 14.0	24 08.8	24 21.2	25 00.7	25 12.9	24 16.2	24 19.5	25 07.8	25 11.4
26 02.7	26 15.4	26 10.3	26 22.9	25 17.7	26 06.1	26 09.6	26 21.8	26 01.1	26 04.4	26 16.7	26 20.2
27 11.6	28 00.3	27 19.2	28 07.8	27 02.6	27 15.0	27 18.4	28 06.6	27 09.9	27 13.2	28 01.6	28 05.1
28 20.5	29 09.2	29 04.1	29 16.7	28 11.5	28 23.9	29 03.3	29 15.5	28 18.8	28 22.1	29 10.4	29 14.0
30 05.4		30 13.0		29 20.3	30 08.8	30 12.2	31 00.4	30 03.7	30 07.0	30 19.3	30 22.9
31 14.3		31 21.9		31 05.2		31 21.1			31 15.9		

SATURN

LONGITUDE OF CENTRAL MERIDIAN (System I) 0 hrs UT

Date	JAN °	FEB °	MAR °	APR °	MAY °	JUN °
1	273.8	162.7	163.4	053.3	180.2	072.9
2	037.9	286.8	287.6	177.5	304.4	197.2
3	162.1	051.0	051.8	301.7	068.7	321.5
4	286.3	175.2	175.9	065.9	193.0	085.8
5	050.4	299.3	300.1	190.1	317.2	210.1
6	174.6	063.5	064.3	314.3	081.5	334.4
7	298.8	187.6	188.5	078.5	205.7	098.7
8	062.9	311.8	312.6	202.8	330.0	223.0
9	187.1	076.0	076.8	327.0	094.3	347.4
10	311.2	200.1	201.0	091.2	218.5	111.7
11	075.4	324.3	325.2	215.4	342.8	236.0
12	199.6	088.4	089.4	339.7	107.1	000.3
13	323.7	212.6	213.5	103.9	231.4	124.6
14	087.9	336.7	337.7	228.1	355.6	249.0
15	212.0	100.9	101.9	352.3	119.9	013.3
16	336.2	225.1	226.1	116.6	244.2	137.6
17	100.4	349.2	350.3	240.8	008.5	262.0
18	224.5	113.4	114.5	005.0	132.8	026.3
19	348.7	237.6	238.7	129.3	257.0	150.6
20	112.8	001.7	002.9	253.5	021.3	275.0
21	237.0	125.9	127.1	017.7	145.6	039.3
22	001.1	250.1	251.3	142.0	269.9	163.6
23	125.3	014.2	015.4	266.2	034.2	288.0
24	249.4	138.4	139.6	030.5	158.5	052.3
25	013.6	262.6	263.8	154.7	282.8	176.7
26	137.8	026.7	028.0	278.9	047.1	301.0
27	261.9	150.9	152.2	043.2	171.4	065.4
28	026.1	275.1	276.4	167.4	295.7	189.7
29	150.2	039.2	040.7	291.7	060.0	314.0
30	274.4		164.9	055.9	184.3	078.4
31	038.5		289.1		308.6	

Date	JUL °	AUG °	SEP °	OCT °	NOV °	DEC °
1	202.7	098.2	354.4	125.9	020.2	148.1
2	327.1	222.6	118.8	250.2	144.5	272.4
3	091.5	347.0	243.2	014.6	268.8	036.6
4	215.8	111.4	007.6	138.9	033.1	160.8
5	340.2	235.8	132.0	263.3	157.4	285.0
6	104.5	000.2	256.4	027.7	281.7	049.2
7	228.9	124.6	020.8	152.0	045.9	173.5
8	353.2	249.0	145.2	276.4	170.2	297.7
9	117.6	013.4	269.6	040.7	294.5	061.9
10	242.0	137.8	034.0	165.1	058.8	186.1
11	006.3	262.1	158.3	289.4	183.1	310.3
12	130.7	026.5	282.7	053.8	307.3	074.5
13	255.1	150.9	047.1	178.1	071.6	198.7
14	019.4	275.3	171.5	302.4	195.9	322.9
15	143.8	039.7	295.9	066.8	320.2	087.2
16	268.2	164.1	060.3	191.1	084.4	211.4
17	032.5	288.5	184.6	315.4	208.7	335.6
18	156.9	052.9	309.0	079.8	332.9	099.8
19	281.3	177.3	073.4	204.1	097.2	223.9
20	045.7	301.7	197.8	328.4	221.5	348.1
21	170.0	066.1	322.2	092.8	345.7	112.3
22	294.4	190.5	086.5	217.1	110.0	236.5
23	058.8	314.9	210.9	314.4	234.2	000.7
24	183.2	079.3	335.3	105.7	358.5	124.9
25	307.6	203.7	099.7	230.0	122.7	249.1
26	071.9	328.1	224.0	354.4	246.9	013.3
27	196.3	092.5	348.4	118.7	011.2	137.5
28	320.7	216.9	112.8	243.0	135.4	261.7
29	085.1	341.2	237.1	007.3	259.7	025.8
30	209.5	105.6	001.5	131.6	023.9	150.0
31	333.9	230.0		255.9		274.2

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

See part 2 Introduction (page 70) for explanation..

SATURN'S RINGS

Date	Major "	Minor "	U °	B °
Jan 02	38.13	1.24	221.009	+1.864
Jan 10	37.67	1.03	221.523	+1.566
Jan 18	37.26	0.80	222.111	+1.231
Jan 26	36.89	0.56	222.766	+0.863
Feb 03	36.57	0.30	223.479	+0.468
Feb 11	36.30	0.03	224.241	+0.050
Feb 19	36.08	0.24	225.044	-0.386
Feb 27	35.92	0.52	225.879	-0.835
Mar 06	35.81	0.81	226.737	-1.292
Mar 14	35.76	1.09	227.610	-1.752
Mar 22	35.76	1.38	228.490	-2.211
Mar 30	35.82	1.66	229.367	-2.664
Apr 07	35.93	1.95	230.233	-3.106
Apr 15	36.09	2.22	231.082	-3.533
Apr 23	36.31	2.50	231.904	-3.942
May 01	36.57	2.76	232.691	-4.327
May 09	36.89	3.01	233.435	-4.686
May 17	37.25	3.26	234.129	-5.014
May 25	37.66	3.48	234.765	-5.308
Jun 02	38.11	3.70	235.335	-5.565
Jun 10	38.59	3.89	235.833	-5.782
Jun 18	39.11	4.06	236.251	-5.955
Jun 26	39.65	4.20	236.584	-6.083
Jul 04	40.21	4.32	236.826	-6.165
Jul 12	40.78	4.40	236.974	-6.198
Jul 20	41.35	4.45	237.025	-6.182
Jul 28	41.91	4.47	236.978	-6.118
Aug 05	42.44	4.44	236.836	-6.008
Aug 13	42.93	4.38	236.601	-5.854
Aug 21	43.38	4.28	236.281	-5.659
Aug 29	43.75	4.14	235.885	-5.430
Sep 06	44.05	3.97	235.425	-5.174
Sep 14	44.26	3.78	234.917	-4.897
Sep 22	44.37	3.57	234.376	-4.610
Sep 30	44.38	3.34	233.821	-4.322
Oct 08	44.29	3.12	233.272	-4.042
Oct 16	44.10	2.91	232.747	-3.780
Oct 24	43.81	2.71	232.265	-3.546
Nov 01	43.45	2.54	231.842	-3.348
Nov 09	43.01	2.40	231.492	-3.192
Nov 17	42.52	2.29	231.227	-3.084
Nov 25	41.99	2.22	231.056	-3.027
Dec 03	41.43	2.19	230.984	-3.024
Dec 11	40.85	2.19	231.013	-3.075
Dec 19	40.28	2.23	231.145	-3.180
Dec 27	39.72	2.31	231.378	-3.336

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.

URANUS

RISE AND SET TIMES

AEST (Adelaide & Darwin ACST)

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

POSITION

(0hrs UT Epoch 2000.0)

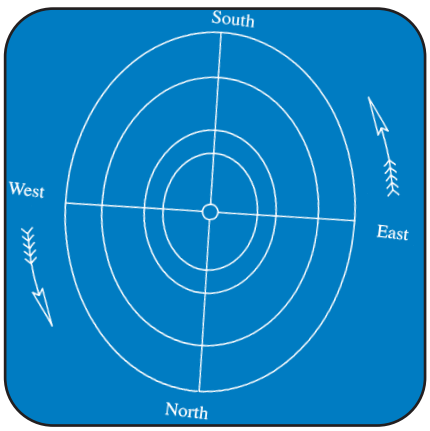
RA	DEC
h m s	° ' "
20 07 56	- 20 44 12
20 09 38	- 20 39 03
20 11 21	- 20 33 47
20 13 04	- 20 28 28
20 14 46	- 20 23 10
20 16 26	- 20 17 55
20 18 03	- 20 12 48
20 19 35	- 20 07 52
20 21 03	- 20 03 11
20 22 25	- 19 58 47
20 23 41	- 19 54 45
20 24 48	- 19 51 07
20 25 48	- 19 47 56
20 26 39	- 19 45 15
20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

SATELLITES OF URANUS — GREATEST NORTHERN ELONGATION (AEST)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
					ARIEL						
3 01.1	2 06.9	1 00.1	2 18.4	3 00.2	2 06.0	2 11.9	1 17.8	3 12.2	1 05.7	3 00.1	3 06.0
5 13.6	4 19.4	3 12.6	5 06.9	5 12.7	4 18.5	5 00.3	4 06.3	6 00.7	3 18.2	5 12.6	5 18.5
8 02.1	7 07.8	6 01.1	7 19.4	8 01.1	7 07.0	7 12.8	6 18.8	8 13.2	6 06.6	8 01.1	8 07.0
10 14.5	9 20.3	8 13.6	10 07.9	10 13.6	9 19.5	10 01.3	9 07.3	11 01.7	8 19.2	10 13.6	10 19.4
13 03.0	12 08.8	11 02.1	12 20.3	13 02.1	12 07.9	12 13.8	11 19.7	13 14.2	11 07.6	13 02.1	13 07.9
15 15.5	14 21.3	13 14.5	15 08.8	15 14.6	14 20.4	15 02.3	14 08.2	16 02.7	13 20.1	15 14.6	15 20.4
18 04.0	17 09.7	16 03.0	17 21.3	18 03.1	17 08.9	17 14.8	16 20.7	18 15.2	16 08.6	18 03.1	18 08.9
20 16.5	19 22.2	18 15.5	20 09.8	20 15.6	19 21.4	20 03.3	19 09.2	21 03.7	18 21.1	20 15.6	20 21.4
23 05.0	22 10.7	21 04.0	22 22.2	23 04.1	22 09.9	22 15.8	21 21.7	23 16.2	21 09.6	23 04.0	23 09.9
25 17.4	24 23.2	23 16.5	25 10.7	25 16.6	24 22.4	25 04.3	24 10.2	26 04.7	23 22.1	25 16.5	25 22.4
28 05.9	27 11.6	26 05.0	27 23.2	28 05.1	27 10.9	27 16.8	26 22.7	28 17.2	26 10.6	28 05.0	28 10.9
30 18.4		28 17.4	30 11.7	30 17.5	29 23.3	30 05.3	29 11.2		28 23.1	30 17.5	30 23.4
		31 06.0					31 23.7		31 11.6		
					UMBRIEL						
2 14.3	4 17.9	4 17.8	2 17.8	1 18.1	3 21.8	2 21.9	5 01.7	3 02.1	2 02.4	4 06.0	3 06.3
6 17.7	8 21.3	8 21.2	6 21.3	5 21.6	8 01.2	7 01.3	9 05.2	7 05.6	6 05.9	8 09.5	7 09.8
10 21.2	13 00.7	13 00.6	11 00.8	10 01.1	12 04.6	11 04.8	13 08.7	11 09.0	10 09.3	12 13.0	11 13.1
15 00.7	17 04.1	17 04.0	15 04.3	14 04.5	16 08.0	15 08.3	17 12.2	15 12.5	14 12.9	16 16.4	15 16.6
19 04.1	21 07.5	21 07.5	19 07.8	18 07.9	20 11.5	19 11.8	21 15.5	19 16.0	18 16.3	20 19.8	19 20.1
23 07.5	25 10.9	25 11.0	23 11.3	22 11.4	24 15.1	23 15.2	25 19.0	23 19.5	22 19.7	24 23.3	23 23.6
27 10.9	29 14.4	29 14.3	27 14.6	26 14.8	28 18.5	27 18.7	29 22.6	27 23.0	26 23.2	29 02.8	28 03.1
31 14.4				30 18.3		31 22.2			31 02.6		
					TITANIA						
4 21.0	8 16.3	5 18.8	9 14.3	5 17.1	9 12.9	5 15.8	9 11.8	4 14.8	9 10.7	4 13.5	9 09.3
13 13.8	17 09.1	14 11.6	18 07.2	14 10.1	18 06.0	14 08.9	18 04.8	13 07.7	18 03.7	13 06.5	18 02.1
22 06.6	26 01.9	23 04.5	27 00.2	23 03.0	26 22.9	23 01.8	26 21.8	22 00.7	26 20.6	21 23.4	26 19.0
30 23.5		31 21.4		31 20.0		31 18.8		30 17.7		30 16.3	
					OBERON						
13 04.2	9 02.1	7 00.2	2 22.0	13 07.2	9 05.4	6 03.7	2 02.5	11 12.2	8 10.7	4 08.8	1 06.7
26 15.1	22 13.0	20 11.2	16 09.0	26 18.2	22 16.6	19 15.0	15 13.7	24 23.3	21 21.7	17 19.9	14 17.7
			29 19.9				29 01.0				28 04.8

SATELLITES OF URANUS

Apparent orbit of Satellites I-IV at date of opposition, July 25.

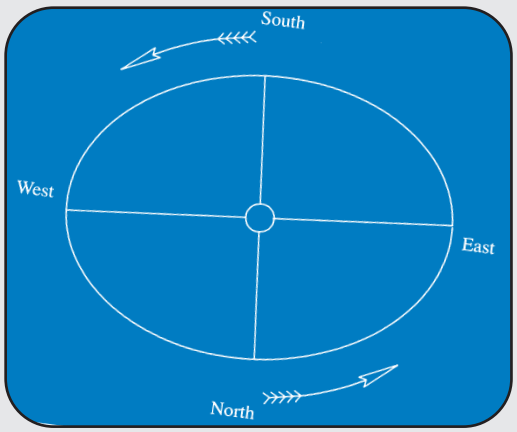


Name		Sidereal Period d	h
V	Miranda	1.4	
I	Ariel	2	12.489
II	Umbriel	4	03.460
III	Titania	8	16.941
IV	Oberon	13	11.118

See introduction to part 2 (page 70) for explanation.

SATELLITE OF NEPTUNE

Apparent orbit of Triton at date of opposition, July 18.



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

See introduction to Part II (p. 66) for explanation.

SATELLITE OF NEPTUNE — GREATEST EASTERN ELONGATION (AEST)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
					TRITON						
1 18.1	5 23.6	6 08.2	4 17.0	4 02.1	2 11.4	1 21.0	6 03.8	4 13.4	3 22.9	2 08.1	1 17.0
7 15.0	11 20.5	12 05.2	10 14.0	9 23.1	8 08.5	7 18.1	12 00.9	10 10.6	9 20.0	8 05.1	7 14.0
13 12.0	17 17.4	18 02.1	16 11.0	15 20.2	14 05.6	13 15.3	17 22.1	16 07.7	15 17.0	14 02.1	13 10.9
19 08.9	23 14.3	23 23.1	22 08.0	21 17.3	20 02.7	19 12.4	23 19.2	22 04.7	21 14.1	19 23.1	19 07.9
25 05.8	29 11.3	29 20.0	28 05.1	27 14.3	25 23.9	25 09.5	29 16.3	28 01.8	27 11.1	25 20.0	25 04.8
31 02.7						31 06.7					31 01.7

NEPTUNE

RISE AND SET TIMES

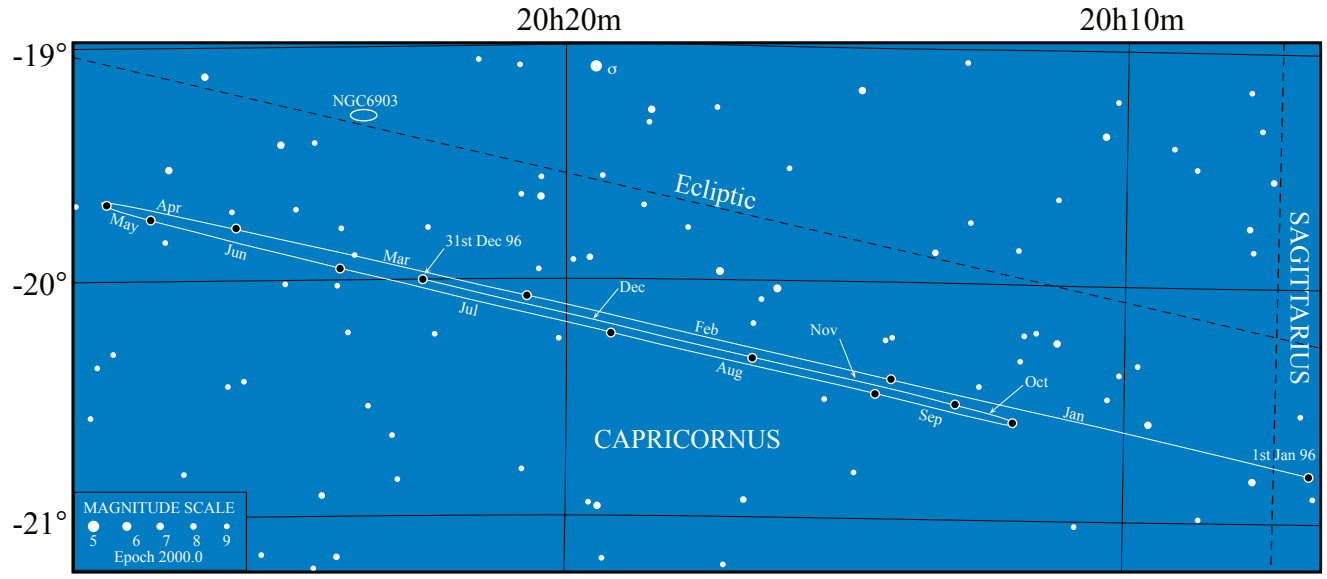
AEST (Adelaide & Darwin ACST)

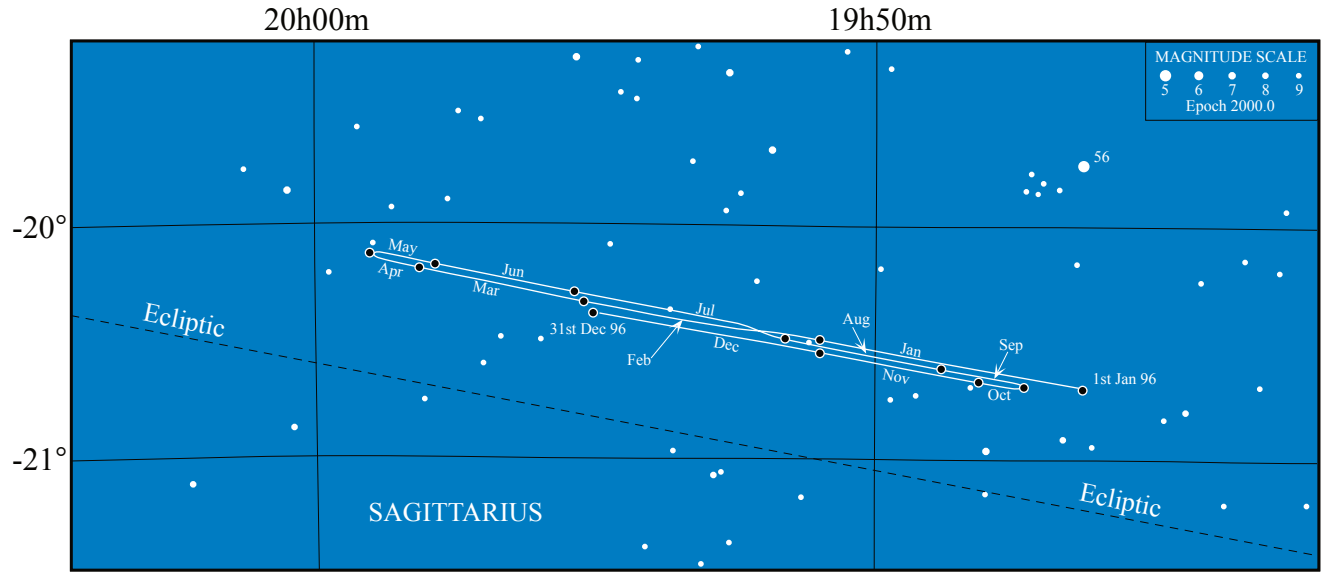
	Adelaide		Brisbane		Canberra		Darwin		Hobart		Melbourne		Sydney		Townsville	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
Jan 6	05:59	20:05	05:48	19:22	05:47	19:54	07:13	19:54	05:34	20:22	05:57	20:17	05:41	19:43	06:28	19:32
13	05:33	19:39	05:22	18:55	05:20	19:28	06:47	19:28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

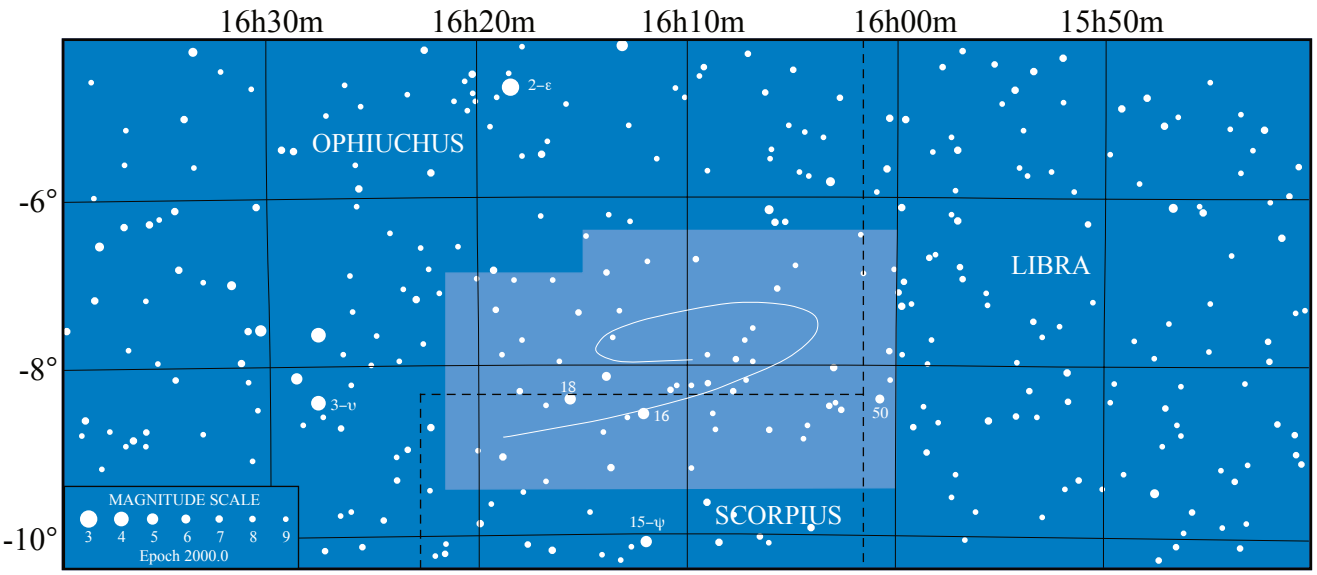
POSITION

(0hrs UT Epoch 2000.0)

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

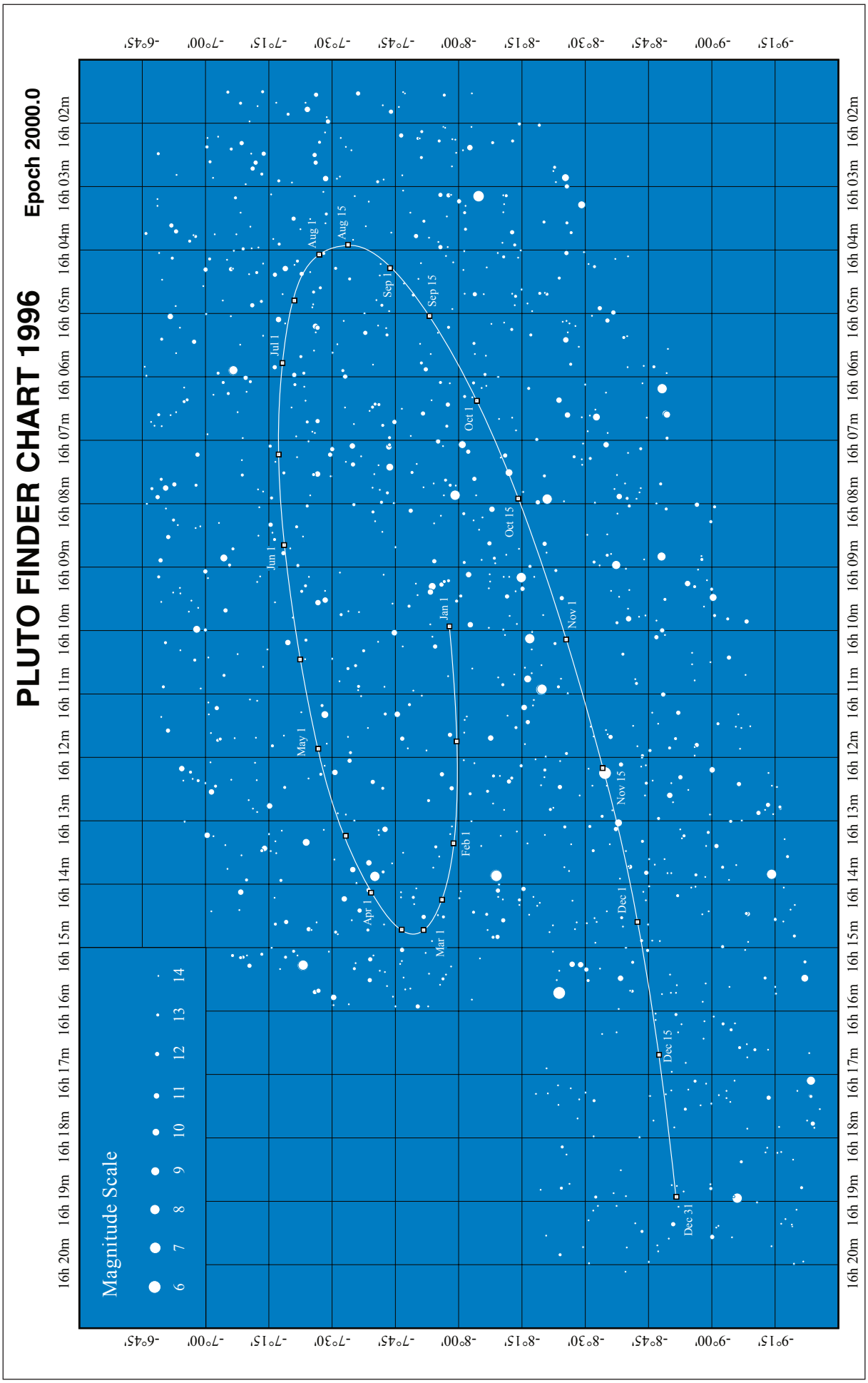






See introduction to part 2 (page 71) for explanation.

Stars range in magnitude from 5.5 to 14.5



See introduction to part 2 (page 71) for explanation.

PLUTO

RISE AND SET TIMES

AEST (Adelaide & Darwin ACST)

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

POSITION

(0hrs UT Epoch 2000.0)

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

METEOR SHOWERS

The table of Meteor Showers has been complied from the '1996 Meteor Shower Calendar' produced by the International Meteor Organisation (IMO). Regular meteor observers will notice that the table has been condensed from that provided in previous editions of this book, by the omission of about 25 showers. This new listing has been completely revised by the IMO, and questionable showers or any that have not been observed in recent times have been deleted. All listed showers now have been brought up to date, with amendments made where necessary to each shower's parameters.

In addition to the showers catalogued, an average of about 5 to 10 sporadic meteors (originating from random points in the sky) are visible per hour under dark sky conditions. More meteors are seen in the morning sky than in the evening; as the morning sky is facing the Earth's motion in space we tend to 'run into' and 'sweep up' meteors, whereas evening meteors must have sufficient velocity to catch up to the speeding Earth.

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 or after a bright star near the radiant.

SHOWER NAME	MOON PHASE	ACTIVITY DURATION	MAX ACT	RADIANT		DIA	VEL km/s	ZHR
				R.A.	Dec			
Quadrantids	FM	Jan 01-Jan 05	Jan 04	230˚	+49˚	5˚	41	120
delta-Cancrids	LQ	Jan 01-Jan 24	Jan 16	130˚	+20˚	10˚-5˚	28	4
alpha-Centaurids	FM	Feb 01-Feb 21	Feb 07	210˚	-59˚	4˚	56	6
delta-Leonids	FQ	Feb 15-Mar 10	Feb 25	168˚	+16˚	5˚	23	3
gamma-Normids	LQ	Feb 25-Mar 22	Mar 14	249˚	-51˚	5˚	56	8
Virginids	FQ	Jan 25-Apr 15	Mar 25	195˚	-04˚	15˚-10˚	30	5
Lyrids	FQ	Apr 16-Apr 25	Apr 22	271˚	+34˚	5˚	49	15
pi-Puppids*	FQ	Apr 15 - Apr 28	Apr 24	110˚	-45˚	5˚	18	*
eta-Aquarids	FM	Apr 19-May 28	May 06	339˚	-01˚	4˚	66	60
Sagittariids	NM	Apr 15-Jul 15	May 20	247˚	-22˚	15˚-10˚	30	5
Pegasids (Jul)	NM	Jul 07-Jul 13	Jul 11	340˚	+15˚	5˚	70	3
Phoenicids (July)*	NM	Jul 10 - Jul 16	Jul 14	032˚	-48˚	7˚	47	*
Pisces Austrinids	FM	Jul 15-Aug 10	Jul 28	341˚	-30˚	15˚-10˚	41	5
Southern delta-Aquarids	FM	Jul 08-Aug 19	Jul 28	339˚	-16˚	5˚	41	20
alpha-Capricornids	FM	Jul 03-Aug 15	Jul 30	307˚	-10˚	8˚	25	4
Southern iota-Aquarids	LQ	Jul 25-Aug 15	Aug 05	334˚	-15˚	5˚	34	2
Northern delta-Aquarids	LQ	Jul 15-Aug 25	Aug 09	335˚	-05˚	5˚	42	4
Perseids	NM	Jul 17-Aug 24	Aug 12	046˚	+58˚	5˚	59	100
kappa-Cygnids	FQ	Aug 03-Aug 25	Aug 18	286˚	+59˚	6˚	25	3
Northern iota-Aquarids	FQ	Aug 11-Aug 31	Aug 20	327˚	-06˚	5˚	31	3
alpha-Aurigids	LQ	Aug 25-Sep 05	Sep 01	084˚	+42˚	5˚	66	10
delta-Aurigids	NM	Sep 05-Oct 10	Sep 09	060˚	+47˚	5˚	64	6
Piscids	FQ	Sep 01-Sep 30	Sep 20	005˚	+01˚	5˚	26	3
Draconids*	NM	Oct 06 - Oct 10	Oct 10	262˚	+54˚	2˚	20	*
Epsilon Geminids	FQ	Oct 14-Oct 27	Oct 20	102˚	+27˚	5˚	71	3
Orionids	FQ	Oct 02-Nov 07	Oct 21	095˚	+16˚	10˚	66	25
Southern Taurids	LQ	Oct 01-Nov 25	Nov 03	050˚	+13˚	10˚-5˚	27	5
Northern Taurids	NM	Oct 01-Nov 25	Nov 13	058˚	+22˚	10˚-5˚	29	5
Leonids	FQ	Nov 14-Nov 21	Nov 18	153˚	+22˚	5˚	71	Var
alpha-Monocerotids	FQ	Nov 15-Nov 25	Nov 20	117˚	-06˚	5˚	60	5
chi-Orionids	LQ	Nov 26-Dec 15	Dec 02	082˚	+23˚	8˚	28	3
Phoenicids (Dec)	LQ	Nov 28-Dec 09	Dec 05	018˚	-53˚	5˚	22	Var
Puppid-Velids	LQ	Dec 01-Dec 15	Dec 06	123˚	-45˚	10˚	40	10
Monocerotids (Dec)	NM	Nov 27-Dec 17	Dec 10	102˚	+08˚	5˚	42	3
sigma-Hydrids	NM	Dec 03-Dec 15	Dec 11	127˚	+02˚	5˚	58	2
Geminids	FQ	Dec 07-Dec 17	Dec 14	112˚	+33˚	5˚	35	110
Coma Berenicids	FQ	Dec 12-Jan 23	Dec 19	175˚	+25˚	5˚	65	5
Ursids	FM	Dec 17-Dec 26	Dec 22	217˚	+76˚	5˚	33	10

NOTES ON THE TABLE ABOVE

SHOWER NAME
The shower is named after the constellation that the radiant appears in or a bright star near that point. A shower marked with an asterisk (*) is periodic or only occasionally active.

MOON PHASE
The phase of the Moon nearest the date of maximum activity. If a Full Moon occurs near a shower's maximum period, only the very brightest of meteors will be seen.

ACTIVITY DURATION
The approximate dates when the shower is active.

MAX ACT
The date when maximum activity can be expected.

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

DIA
The radiant diameter. When two figures are given, the first is the spread in R.A. and the second the spread in Dec.

VEL km/s
The apparent velocity through the atmosphere in kilometres per second. The range can be from about 11 kms (very slow) to 71 kms (very fast), medium speed is about 40 kms.

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).

COMETS FOR 1996

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 5 to 10 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). There are also other designations given to comets (you will see examples on the following pages). The prefix 'P/' refers to the fact the comet is periodic. The number before the 'P' indicates the number of the periodic comet. For example comet 65P/Gunn indicates Gunn was the 65th comet found to be periodic. Interestingly, Halley's Comet's prefix is 1P/ because it was the first comet shown to be periodic. In fact Halley did not find the comet. It was named after him after he successfully predicted its return. You will also see references to a new preliminary designation system. It is best to explain this with an example. You will notice Comet Hale-Bopp is also referred to as '1995 O1'. 1995 refers to the year, O refers to the 14th half month period ('O' is the 15th letter but 'I' is not used) during the year and 1 shows it was the first discovery in this half month. Therefore Hale-Bopp was the first discovery in the last half of July 1995.

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

This section is devoted to the 'periodic' comets that are expected to be observable during 1996. The table (opposite) lists these objects as well as their orbital elements (the data required to calculate their locations in the sky). This is followed by 'ephemerides' (a list of expected positions in the sky and magnitude estimates for different dates) for some of the brighter comets. These tables of positions and magnitudes are only approximate, for few of these comets (as of early September 95) had been found yet on this return. Hence the orbital elements and magnitude parameters, used to generate the ephemerides, have been based on their behaviour on previous returns. There are also non gravitational effects, associated with comets, which can render predicted ephemerides inaccurate.

Many of the comets expected in 1996 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 1996

C/1995 01 (Hale-Bopp)

Comet Hale-Bopp, discovered in July 1995 by two American amateurs, is currently holding the attention of astronomers around the world. The best predictions at present see it being brighter than 6th magnitude from July 1996 till November 1997, reaching a peak magnitude of -1.7 in March/April 1997 for Northern Hemisphere observers. Though it is early days, astronomers are more confident about Hale-Bopp than they were about recent 'under performers' such as Austin and Kohoutek. This is because Hale-Bopp is not a 'new' comet from the Oort cloud, having a period in the order of 3000 to 4000 years. This means that its surface has been heated by the Sun before.

Despite the Northern Hemisphere being able to view Hale-Bopp at its most brilliant, Australian observers will be able to watch it while still quite bright. November 1995 sees Hale-Bopp at around 10th magnitude in Sagittarius, heading towards solar conjunction. In February 1996, Hale-Bopp will become visible again in the morning sky, still in Sagittarius, at about 9th magnitude. Hale-Bopp will remain in Sagittarius until mid-June, when it crosses over into Scutum at magnitude 6.5. Reaching 6th magnitude in mid-July, around the time it enters Serpens Cauda, observers in dark skies should be able to see it with the naked eye, and it will be visible all night. By August, Hale-Bopp will be in Ophiuchus. Towards the end of the month, at magnitude 5.5, it passes within 4 degrees of M14 and should be visible until around 1am. Hale-Bopp remains in Ophiuchus until the end of the year, returning to an even closer encounter with M14 in late October, this time at around magnitude 4.5. Australian observers will lose sight of Hale-Bopp in November, when it might be on the verge of 4th magnitude.

As for 1997, we won't see it again until the end of April (though it might be worth keeping an eye on the horizon in the early months for the possibility of a long tail poking above the horizon) when it could still be at magnitude –1 in our early evening twilight skies. By July 1997, Hale-Bopp will be a morning object, perhaps still at 3rd magnitude, and visible with the naked eye until near the end of the year.

45P/Honda-Mrkos-Pajdusakova

First sighted in 1948, Honda-Mrkos-Pajdusakova is making its 9th observed appearance as it approaches perihelion on 25th December 1995. The comet will become visible in large telescopes during November 1995 as it moves through Sagittarius. Honda-Mrkos-Pajdusakova is characterised by rapid brightening and fading, and so it should peak at 7th magnitude during late December in the evening sky. It then passes between us and the Sun, reemerging in late January's morning skies at around 8th magnitude in Scutum, moving into Ophiuchus. On 4th February 1996, still in Ophiuchus, it passes only 0.1702 AU from Earth, so despite being 9th magnitude, its large apparent size will make it harder to observe. Incidentally, in August 2011, it will pass Earth at a distance of only 0.06 AU. During February, Honda-Mrkos-Pajdusakova passes quickly through Serpens Caput, Virgo, and Bootes before ending the month in Coma Berenices. Around 20th February, observers will be challenged to find the comet at 12th magnitude in the midst of the Coma Berenices / Virgo galaxy cluster.

67P/Churyumov-Gerasimenko

Periodic comet Churyumov-Gerasimenko, discovered in 1969, is making an average return this time around. By early November 1995 it will already be 11th magnitude in Aquarius, well placed in the evening sky and not setting until after midnight. Between early November and mid-February, Churyumov-Gerasimenko will not vary much in brightness. A peak of magnitude 10.8 is predicted from late December, as it enters Pisces, until late January. At the beginning of February, as it moves into Aries, it will pass within 2 degrees of the galaxy M74. Late February sees the comet move into Taurus, with a very close approach to the Pleiades in the first week of March at around magnitude 11.5. Large telescope owners should be able to follow Churyumov-Gerasimenko until the end of April, when it will be 13th magnitude in Gemini, setting a few hours after evening twilight ends.

96P/Machholz 1

This enigmatic comet was discovered by American amateur Donald Machholz, who has discovered 9 comets during the last 20 years. Machholz 1 was discovered in 1986 and amazed astronomers with its short period (5 years). It should first become visible in the south west evening sky in Crux, moving into Centaurus in early September at 13th magnitude. By the end of September, Machholz will be crossing into Hydra at 10th magnitude, but the viewing window will be becoming very short, having now become a morning sky object. In early October, Machholz 1 brightens quickly as it approaches perihelion on 14th. However, observations will be confined to the first few days of October. While Machholz 1 will be brighter than 6th magnitude from October 10 through to 20, with a peak of 2nd magnitude on October 15, its proximity to the Sun will prevent observations. After perihelion, the comet will remain out of sight until it fades beyond the range of amateurs.

22P/Kopff

This year's return of comet Kopff, first seen in 1906 and making its 14th appearance, is about as good as they get, making it 1996's best periodic comet, visible for virtually the whole year. Large telescope observers should first sight it on the border of Libra and Scorpius, in the morning skies of early February, at around 13th magnitude. In late February, Kopff will move into Ophiuchus at about 12th magnitude, passing within 2 degrees of the globular cluster M9 around March 20, before entering Sagittarius in mid-April at 10th

magnitude. Kopff will remain in Sagittarius until mid-September, during which time it will peak in brightness at 7th magnitude in early July, visible all night. In mid-September, as it passes into Capricornus (at 9th magnitude), Kopff will be within 2.5 degrees of the globular M75. Now primarily an evening object, Kopff will fade slowly, moving into Aquarius in late November, at around 13th magnitude, when we should obtain our last views.

P/1983 M1 (IRAS)

This is the first return of periodic comet IRAS since its discovery by the orbiting Infra-Red Astronomical Satellite (IRAS) in 1983, hence the designation, and thus there are no guarantees on its visual performance. Nevertheless, we should expect to first sight IRAS in Tucana in July at about 13th magnitude. In early September, IRAS crosses the border into Grus, crossing the meridian mid-evening (perhaps at 11th magnitude). In late September, it will be within 2 degrees of Alpha Gruis. A peak of slightly better than 11th magnitude is expected in early October. Following this it will fade slowly, moving through Capricornus, Aquarius, before ending the year in Pegasus, still at about magnitude 12.5.

65P/Gunn

Like comet Kopff, this comet, discovered in 1954, will be within range of amateur telescopes for most of the year. It should first become visible in mid-February, rising around midnight at 13th magnitude in Scorpius, near the border with Libra. At the beginning of March Gunn moves into Ophiuchus where it remains until early June. It then enters Scorpius (again) at its peak brightness of magnitude 11.8. In mid-June, Gunn passes very close to the globular M80 and is visible for virtually the whole night. Another close globular encounter occurs in mid-August, this time with M4, still in Scorpius. In September Gunn returns to Ophiuchus at 13th magnitude, passing near M62. In mid-October it enters Sagittarius near the Galactic Centre at 13th magnitude.

EXPLANATION OF COMET ELEMENTS TABLE

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 of the Sun.

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 10 am AEST (9:30 am ACST) 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 .

Elg Elongation; angular distance of the comet from the Sun.

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:

$$\text{Mag.} = H1 + 5 \log (\Delta) + K1 \log R.$$

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

COMETS FOR 1996 — ORBITAL ELEMENTS (EQUINOX 2000.0)

Comet Name	Perihelion Date			q	e	Period	ω	Ω	i	H1	K1
	yy	mm	d.dd	A.U.		years	deg	deg	deg		
45P/Honda-Mrkos-Pajdusakova	95	Dec	25.92969	0.5319294	0.8243020	5.27	326.06051	089.16686	004.25050	13.5	20.0
19P/Pons-Winnecke	96	Jan	02.45304	1.2558917	0.6344237	6.37	172.31269	093.42808	022.30145	10.0	15.0
67P/Churyumov-Gerasimenko	96	Jan	17.66177	1.3000348	0.6301925	6.59	011.38678	051.00616	007.11334	9.5	10.0
95P/(2060) Chiron	96	Feb	14.75558	8.4539470	0.3831117		339.55289	209.38537	006.92992		
57P/du Toit-Neujmin-Delporte	96	Mar	05.61071	1.7196280	0.5007697	6.39	115.19196	188.99017	002.84531	12.5	15.0
120P/Mueller 1	96	Apr	24.66607	2.7394822	0.3373782		029.92075	004.56134	008.79562	12.0	10.0
P/1989 E3 (West-Hartley)	96	May	12.04044	2.1331077	0.4476300	7.59	102.97888	046.66673	015.34603	11.5	10.0
72P/Denning-Fujikawa	96	May	29.77633	0.7901853	0.8177978	9.03	337.57579	036.38922	009.12711	15.5	25.0
32P/Comas Sola	96	Jun	10.46545	1.8463676	0.5677900	8.83	045.76778	060.86986	012.91681	6.5	20.0
119P/Parker-Hartley	96	Jun	24.80740	3.0452197	0.2905960	8.89	181.10162	244.22354	005.18580	9.0	8.0
22P/Kopff	96	Jul	02.19980	1.5795617	0.5440739	6.45	162.83487	120.91329	004.72143	3.0	26.0
P/1991 R2 (Spacewatch)	96	Jul	16.87019	1.5388820	0.5097504	5.56	087.26782	153.37076	009.97056	13.5	15.0
65P/Gunn	96	Jul	24.40090	2.4619268	0.3163130	6.83	196.81730	068.51903	010.37993	5.0	15.0
P/1989 E2 (Shoemaker-Holt 2)	96	Aug	20.21103	2.6626291	0.3372233	8.05	005.99753	099.73070	017.69839	4.5	15.0
116P/Wild 4	96	Aug	31.24129	1.9890562	0.4077818	6.16	170.75263	022.06535	003.71964	5.0	20.0
96P/Machholz 1	96	Oct	15.06962	0.1247178	0.9586366	5.24	014.58608	094.53200	060.07415	13.0	12.0
P/1983 M1 (IRAS)	96	Oct	31.65110	1.7027555	0.6966502	13.30	356.88664	357.70152	045.96289	6.0	20.0
111P/Helin-Roman-Crockett	96	Oct	31.82656	3.4897068	0.1386941	8.16	010.13740	091.98593	004.23072	5.0	20.0
D/1978 C2 (Tritton)	96	Nov	05.01256	1.4363618	0.5806117	6.34	147.58521	300.71391	007.04914	13.0	20.0
P/1991 F1 (Mrkos)	96	Nov	08.97645	1.4128926	0.5542363	5.64	180.52271	001.65272	031.47030	12.5	20.0
46P/Wirtanen	97	Mar	14.17400	1.0637203	0.6567441		356.34322	082.19830	011.72300	9.0	15.0
C/1995 O1 (Hale-Bopp)	97	Mar	31.95962	0.9143839	0.9952982		130.56797	282.47058	089.43088	-2.0	10.0
81P/Wild 2	97	May	06.64136	1.5826159	0.5402257		041.77405	136.15134	003.24386	7.0	15.0

COMETS

Comet C/1995 O1 (Hale-Bopp)

Date	R.A. h m	Dec ° '	Δ AU	R AU	Elg	Mag
1995 Nov 4	18 22.66	-27 44.1	6.778	6.246	54.0	10.1
1995 Nov 11	18 25.32	-27 25.7	6.808	6.184	47.6	10.1
1995 Nov 18	18 28.34	-27 07.3	6.830	6.121	41.2	10.0
1995 Nov 25	18 31.70	-26 48.8	6.841	6.058	34.9	10.0
1995 Dec 2	18 35.36	-26 30.2	6.841	5.995	28.7	10.0
1995 Dec 9	18 39.26	-26 11.4	6.829	5.931	22.5	9.9
1995 Dec 16	18 43.38	-25 52.2	6.805	5.867	16.4	9.8
1995 Dec 23	18 47.67	-25 32.5	6.768	5.803	10.3	9.8
1995 Dec 30	18 52.09	-25 12.4	6.718	5.739	4.5	9.7
1996 Jan 6	18 56.60	-24 51.7	6.656	5.674	3.0	9.7
1996 Jan 13	19 01.16	-24 30.3	6.580	5.609	8.4	9.6
1996 Jan 20	19 05.73	-24 08.2	6.491	5.543	14.4	9.5
1996 Jan 27	19 10.26	-23 45.4	6.390	5.478	20.4	9.4
1996 Feb 3	19 14.72	-23 21.8	6.277	5.412	26.4	9.3
1996 Feb 10	19 19.06	-22 57.5	6.152	5.345	32.4	9.2
1996 Feb 17	19 23.24	-22 32.3	6.016	5.279	38.5	9.1
1996 Feb 24	19 27.21	-22 06.3	5.870	5.212	44.6	9.0
1996 Mar 2	19 30.93	-21 39.6	5.714	5.144	50.7	8.9
1996 Mar 9	19 34.33	-21 12.1	5.551	5.076	56.9	8.8
1996 Mar 16	19 37.38	-20 43.9	5.380	5.008	63.1	8.7
1996 Mar 23	19 40.01	-20 14.9	5.203	4.940	69.3	8.5
1996 Mar 30	19 42.17	-19 45.2	5.021	4.871	75.7	8.4
1996 Apr 6	19 43.78	-19 14.8	4.835	4.802	82.1	8.2
1996 Apr 13	19 44.78	-18 43.8	4.648	4.732	88.7	8.1
1996 Apr 20	19 45.10	-18 12.0	4.460	4.662	95.3	7.9
1996 Apr 27	19 44.66	-17 39.4	4.273	4.592	102.2	7.8
1996 May 4	19 43.39	-17 06.2	4.089	4.521	109.1	7.6
1996 May 11	19 41.22	-16 32.0	3.910	4.450	116.3	7.4
1996 May 18	19 38.07	-15 57.0	3.736	4.378	123.6	7.3
1996 May 25	19 33.88	-15 21.0	3.572	4.306	131.1	7.1
1996 Jun 1	19 28.63	-14 43.8	3.417	4.233	138.8	6.9
1996 Jun 8	19 22.30	-14 05.6	3.275	4.160	146.6	6.8
1996 Jun 15	19 14.93	-13 26.2	3.147	4.087	154.3	6.6
1996 Jun 22	19 06.61	-12 45.7	3.035	4.013	161.7	6.4
1996 Jun 29	18 57.47	-12 04.4	2.940	3.938	167.4	6.3
1996 Jul 6	18 47.72	-11 22.5	2.862	3.863	168.2	6.2
1996 Jul 13	18 37.61	-10 40.7	2.803	3.788	163.1	6.0
1996 Jul 20	18 27.43	-09 59.5	2.763	3.712	155.6	5.9
1996 Jul 27	18 17.48	-09 19.6	2.739	3.635	147.3	5.8
1996 Aug 3	18 08.04	-08 41.6	2.731	3.558	138.8	5.7
1996 Aug 10	17 59.36	-08 06.0	2.738	3.480	130.3	5.6
1996 Aug 17	17 51.64	-07 33.2	2.756	3.402	122.0	5.5
1996 Aug 24	17 45.01	-07 03.3	2.783	3.323	113.9	5.4
1996 Aug 31	17 39.56	-06 36.1	2.817	3.244	106.0	5.4
1996 Sep 7	17 35.31	-06 11.4	2.854	3.164	98.5	5.3
1996 Sep 14	17 32.27	-05 48.8	2.894	3.083	91.2	5.2
1996 Sep 21	17 30.39	-05 27.6	2.932	3.002	84.2	5.1
1996 Sep 28	17 29.64	-05 07.3	2.968	2.920	77.5	5.0
1996 Oct 5	17 29.93	-04 47.1	3.000	2.838	71.1	4.9
1996 Oct 12	17 31.21	-04 26.5	3.025	2.755	64.9	4.8
1996 Oct 19	17 33.41	-04 04.6	3.042	2.671	59.1	4.7
1996 Oct 26	17 36.48	-03 40.7	3.051	2.587	53.5	4.5
1996 Nov 2	17 40.35	-03 14.0	3.049	2.501	48.3	4.4
1996 Nov 9	17 44.98	-02 43.8	3.037	2.416	43.4	4.2
1996 Nov 16	17 50.33	-02 09.1	3.014	2.329	39.0	4.1
1996 Nov 23	17 56.37	-01 29.0	2.978	2.243	35.0	3.9
1996 Nov 30	18 03.07	-00 42.5	2.931	2.155	31.7	3.7
1996 Dec 7	18 10.43	+00 11.6	2.871	2.067	29.2	3.4
1996 Dec 14	18 18.47	+01 14.5	2.799	1.979	27.5	3.2
1996 Dec 21	18 27.20	+02 27.8	2.715	1.890	26.9	2.9
1996 Dec 28	18 36.69	+03 53.3	2.619	1.802	27.2	2.6

Comet 65P/Gunn

Date	R.A. h m	Dec ° '	Δ AU	R AU	Elg	Mag
1996 Jan 6	15 11.38	-12 07.7	3.157	2.738	56.4	14.1
1996 Jan 13	15 21.78	-12 53.8	3.061	2.721	60.8	13.9
1996 Jan 20	15 31.98	-13 36.9	2.962	2.704	65.4	13.8
1996 Jan 27	15 41.93	-14 17.1	2.862	2.688	69.9	13.7
1996 Feb 3	15 51.56	-14 54.3	2.759	2.672	74.6	13.6
1996 Feb 10	16 00.81	-15 28.8	2.655	2.657	79.4	13.5
1996 Feb 17	16 09.60	-16 00.6	2.551	2.642	84.2	13.4
1996 Feb 24	16 17.85	-16 30.1	2.447	2.627	89.2	13.2
1996 Mar 2	16 25.46	-16 57.4	2.344	2.613	94.4	13.1
1996 Mar 9	16 32.34	-17 22.9	2.242	2.600	99.7	13.0
1996 Mar 16	16 38.38	-17 47.0	2.142	2.587	105.1	12.8
1996 Mar 23	16 43.46	-18 10.2	2.045	2.574	110.8	12.7
1996 Mar 30	16 47.48	-18 32.8	1.952	2.562	116.8	12.6
1996 Apr 6	16 50.34	-18 55.3	1.865	2.551	122.9	12.5
1996 Apr 13	16 51.93	-19 18.1	1.783	2.540	129.4	12.3
1996 Apr 20	16 52.19	-19 41.4	1.708	2.530	136.1	12.2
1996 Apr 27	16 51.09	-20 05.5	1.642	2.521	143.2	12.1
1996 May 4	16 48.66	-20 30.3	1.585	2.512	150.5	12.0
1996 May 11	16 45.02	-20 55.6	1.538	2.504	158.1	11.9
1996 May 18	16 40.34	-21 21.1	1.503	2.497	165.9	11.8
1996 May 25	16 34.90	-21 46.4	1.480	2.490	173.8	11.8
1996 Jun 1	16 29.09	-22 11.3	1.470	2.484	178.2	11.8
1996 Jun 8	16 23.28	-22 35.4	1.472	2.478	170.2	11.8
1996 Jun 15	16 17.86	-22 58.9	1.487	2.474	162.3	11.8
1996 Jun 22	16 13.21	-23 21.9	1.513	2.470	154.6	11.8
1996 Jun 29	16 09.64	-23 44.8	1.550	2.467	147.2	11.8
1996 Jul 6	16 07.33	-24 08.0	1.597	2.465	140.1	11.9
1996 Jul 13	16 06.41	-24 31.9	1.652	2.463	133.3	12.0
1996 Jul 20	16 06.94	-24 56.5	1.715	2.462	126.8	12.0
1996 Jul 27	16 08.91	-25 22.1	1.784	2.462	120.6	12.1
1996 Aug 3	16 12.26	-25 48.5	1.859	2.463	114.8	12.2
1996 Aug 10	16 16.91	-26 15.4	1.937	2.464	109.2	12.3
1996 Aug 17	16 22.78	-26 42.4	2.019	2.466	103.9	12.4
1996 Aug 24	16 29.79	-27 09.3	2.104	2.469	98.8	12.5
1996 Aug 31	16 37.83	-27 35.5	2.190	2.473	93.9	12.6
1996 Sep 7	16 46.79	-28 00.4	2.278	2.477	89.1	12.7
1996 Sep 14	16 56.60	-28 23.6	2.367	2.482	84.5	12.8
1996 Sep 21	17 07.18	-28 44.6	2.456	2.488	80.1	12.9
1996 Sep 28	17 18.44	-29 03.0	2.544	2.495	75.8	13.0
1996 Oct 5	17 30.30	-29 18.1	2.632	2.502	71.5	13.1
1996 Oct 12	17 42.68	-29 29.7	2.719	2.510	67.4	13.2
1996 Oct 19	17 55.53	-29 37.5	2.804	2.518	63.3	13.3
1996 Oct 26	18 08.76	-29 41.0	2.888	2.528	59.2	13.3
1996 Nov 2	18 22.31	-29 40.1	2.969	2.538	55.2	13.4
1996 Nov 9	18 36.12	-29 34.6	3.048	2.548	51.3	13.5
1996 Nov 16	18 50.13	-29 24.5	3.124	2.559	47.3	13.6
1996 Nov 23	19 04.27	-29 09.5	3.197	2.571	43.4	13.7
1996 Nov 30	19 18.49	-28 49.8	3.266	2.583	39.6	13.8
1996 Dec 7	19 32.74	-28 25.5	3.331	2.596	35.7	13.8
1996 Dec 14	19 46.98	-27 56.6	3.393	2.609	31.9	13.9
1996 Dec 21	20 01.16	-27 23.5	3.450	2.623	28.1	14.0
1996 Dec 28	20 15.24	-26 46.2	3.502	2.638	24.4	14.0

Comet 45P/Honda-Mrkos-Pajdusakova

Date	R.A. h m	Dec ° '	Δ AU	R AU	Elg	Mag
1995 Nov 11	18 25.85	-25 48.5	1.379	1.021	47.7	14.4
1995 Nov 18	18 43.64	-25 39.3	1.307	0.921	44.7	13.4
1995 Nov 25	19 03.12	-25 19.6	1.221	0.821	42.0	12.2
1995 Dec 2	19 24.02	-24 46.8	1.119	0.726	39.7	11.0
1995 Dec 9	19 45.59	-23 58.6	0.999	0.640	37.6	9.6
1995 Dec 16	20 06.16	-22 54.9	0.864	0.572	35.3	8.3
1995 Dec 23	20 22.48	-21 40.5	0.718	0.536	32.1	7.4
1995 Dec 30	20 29.81	-20 24.5	0.573	0.539	26.9	6.9
1996 Jan 6	20 23.35	-19 11.1	0.442	0.581	18.6	7.0
1996 Jan 13	19 59.40	-17 44.4	0.334	0.653	6.8	7.4
1996 Jan 20	19 14.30	-15 18.5	0.252	0.741	13.2	7.9
1996 Jan 27	18 03.88	-10 33.1	0.196	0.837	37.4	8.4
1996 Feb 3	16 29.71	-02 31.5	0.171	0.937	68.7	9.1
1996 Feb 10	14 51.00	+06 26.4	0.180	1.038	101.5	10.1
1996 Feb 17	13 30.99	+12 41.8	0.220	1.138	128.4	11.3
1996 Feb 24	12 34.73	+15 57.5	0.280	1.236	148.1	12.6
1996 Mar 2	11 56.82	+17 24.1	0.355	1.332	161.3	13.7

COMETS

Comet 22P/Kopff

Date	R.A. h m	Dec ° '	Δ AU	R AU	Elg	Mag
1996 Jan 6	14 45.87	-11 41.5	2.579	2.296	62.4	14.4
1996 Jan 13	14 58.99	-12 31.1	2.463	2.255	66.2	14.1
1996 Jan 20	15 12.31	-13 17.4	2.347	2.213	70.0	13.8
1996 Jan 27	15 25.80	-13 59.8	2.231	2.172	73.8	13.5
1996 Feb 3	15 39.45	-14 38.2	2.115	2.132	77.5	13.2
1996 Feb 10	15 53.25	-15 12.2	2.001	2.091	81.2	12.8
1996 Feb 17	16 07.16	-15 41.7	1.889	2.052	84.9	12.5
1996 Feb 24	16 21.16	-16 06.2	1.779	2.013	88.5	12.1
1996 Mar 2	16 35.19	-16 25.8	1.671	1.975	92.1	11.8
1996 Mar 9	16 49.22	-16 40.4	1.567	1.937	95.7	11.4
1996 Mar 16	17 03.21	-16 49.8	1.466	1.901	99.3	11.1
1996 Mar 23	17 17.06	-16 54.4	1.369	1.866	103.0	10.7
1996 Mar 30	17 30.72	-16 54.3	1.277	1.832	106.6	10.4
1996 Apr 6	17 44.10	-16 50.0	1.189	1.799	110.2	10.0
1996 Apr 13	17 57.12	-16 42.2	1.105	1.768	113.9	9.7
1996 Apr 20	18 09.64	-16 31.6	1.027	1.739	117.7	9.3
1996 Apr 27	18 21.55	-16 19.4	0.954	1.712	121.6	9.0
1996 May 4	18 32.73	-16 07.0	0.887	1.687	125.6	8.6
1996 May 11	18 43.05	-15 56.0	0.825	1.664	129.8	8.3
1996 May 18	18 52.34	-15 48.3	0.769	1.643	134.3	8.0
1996 May 25	19 00.46	-15 45.8	0.719	1.626	139.0	7.8
1996 Jun 1	19 07.31	-15 50.6	0.676	1.610	144.0	7.5
1996 Jun 8	19 12.81	-16 04.4	0.639	1.598	149.4	7.3
1996 Jun 15	19 16.93	-16 28.5	0.609	1.589	155.1	7.2
1996 Jun 22	19 19.75	-17 03.3	0.587	1.583	161.1	7.0
1996 Jun 29	19 21.49	-17 48.1	0.572	1.580	167.4	7.0
1996 Jul 6	19 22.49	-18 40.7	0.565	1.580	173.7	6.9
1996 Jul 13	19 23.11	-19 38.2	0.567	1.583	177.2	7.0
1996 Jul 20	19 23.85	-20 36.9	0.577	1.590	171.8	7.0
1996 Jul 27	19 25.20	-21 33.0	0.596	1.599	165.4	7.2
1996 Aug 3	19 27.51	-22 23.2	0.622	1.612	159.2	7.4
1996 Aug 10	19 31.01	-23 05.3	0.657	1.627	153.1	7.6
1996 Aug 17	19 35.85	-23 37.7	0.699	1.645	147.4	7.8
1996 Aug 24	19 42.05	-23 59.6	0.749	1.666	142.0	8.1
1996 Aug 31	19 49.53	-24 10.9	0.805	1.689	136.8	8.4
1996 Sep 7	19 58.13	-24 12.0	0.868	1.714	132.0	8.8
1996 Sep 14	20 07.70	-24 03.3	0.937	1.741	127.3	9.1
1996 Sep 21	20 18.09	-23 45.4	1.012	1.771	122.9	9.5
1996 Sep 28	20 29.12	-23 19.1	1.093	1.802	118.6	9.8
1996 Oct 5	20 40.63	-22 45.2	1.179	1.834	114.5	10.2
1996 Oct 12	20 52.50	-22 04.4	1.270	1.868	110.4	10.6
1996 Oct 19	21 04.64	-21 17.3	1.366	1.904	106.4	10.9
1996 Oct 26	21 16.95	-20 24.7	1.466	1.940	102.5	11.3
1996 Nov 2	21 29.34	-19 27.3	1.570	1.978	98.6	11.7
1996 Nov 9	21 41.77	-18 25.7	1.677	2.016	94.7	12.0
1996 Nov 16	21 54.19	-17 20.4	1.788	2.055	90.8	12.4
1996 Nov 23	22 06.57	-16 11.9	1.901	2.095	86.9	12.7
1996 Nov 30	22 18.88	-15 00.9	2.017	2.135	83.0	13.1
1996 Dec 7	22 31.10	-13 47.8	2.134	2.176	79.2	13.4
1996 Dec 14	22 43.23	-12 32.9	2.252	2.217	75.3	13.8
1996 Dec 21	22 55.26	-11 16.6	2.371	2.258	71.4	14.1
1996 Dec 28	23 07.17	-09 59.5	2.490	2.300	67.4	14.4

Comet 96P/Machholz 1

Date	R.A. h m	Dec ° '	Δ AU	R AU	Elg	Mag
1996 Aug 24	12 23.80	-70 07.5	0.984	1.338	84.3	14.5
1996 Aug 31	12 25.66	-64 05.9	0.972	1.213	75.5	13.9
1996 Sep 7	12 28.11	-58 13.5	0.961	1.080	66.5	13.3
1996 Sep 14	12 30.31	-52 19.6	0.948	0.936	57.2	12.5
1996 Sep 21	12 31.71	-46 02.9	0.930	0.781	47.4	11.6
1996 Sep 28	12 32.01	-38 43.0	0.908	0.609	36.8	10.2
1996 Oct 5	12 31.69	-28 57.2	0.888	0.413	24.4	8.1
1996 Oct 12	12 37.62	-13 26.1	0.910	0.188	10.0	4.1
1996 Oct 19	13 46.86	-00 49.8	1.120	0.215	9.6	5.2
1996 Oct 26	14 49.55	-03 22.7	1.320	0.439	14.7	9.3
1996 Nov 2	15 31.39	-06 27.8	1.506	0.631	17.2	11.5
1996 Nov 9	16 02.90	-08 59.5	1.685	0.801	17.7	13.0
1996 Nov 16	16 28.29	-10 59.2	1.857	0.954	16.9	14.1

Comet 67P/Churyumov-Gerasimenko

Date	R.A. h m	Dec ° '	Δ AU	R AU	Elg	Mag
1995 Nov 4	22 19.94	-19 18.7	0.936	1.564	108.4	11.3
1995 Nov 11	22 25.98	-17 42.9	0.949	1.522	103.4	11.2
1995 Nov 18	22 34.10	-15 54.0	0.962	1.483	99.0	11.1
1995 Nov 25	22 44.16	-13 52.5	0.975	1.446	94.9	11.0
1995 Dec 2	22 55.99	-11 38.8	0.988	1.413	91.4	11.0
1995 Dec 9	23 09.44	-09 13.3	1.000	1.383	88.3	10.9
1995 Dec 16	23 24.37	-06 37.0	1.012	1.357	85.6	10.9
1995 Dec 23	23 40.69	-03 50.5	1.025	1.336	83.3	10.8
1995 Dec 30	23 58.31	-00 55.3	1.039	1.319	81.4	10.8
1996 Jan 6	00 17.17	+02 06.7	1.054	1.308	79.8	10.8
1996 Jan 13	00 37.19	+05 13.0	1.071	1.301	78.5	10.8
1996 Jan 20	00 58.34	+08 20.9	1.091	1.300	77.4	10.8
1996 Jan 27	01 20.59	+11 27.0	1.116	1.305	76.5	10.9
1996 Feb 3	01 43.86	+14 27.6	1.144	1.315	75.8	11.0
1996 Feb 10	02 08.07	+17 19.1	1.178	1.330	75.2	11.1
1996 Feb 17	02 33.11	+19 57.8	1.217	1.349	74.6	11.2
1996 Feb 24	02 58.84	+22 20.8	1.263	1.374	74.0	11.4
1996 Mar 2	03 25.07	+24 25.4	1.314	1.402	73.4	11.6
1996 Mar 9	03 51.58	+26 10.1	1.372	1.434	72.7	11.8
1996 Mar 16	04 18.13	+27 33.8	1.436	1.470	71.8	12.0
1996 Mar 23	04 44.50	+28 36.6	1.506	1.509	70.8	12.2
1996 Mar 30	05 10.44	+29 19.3	1.582	1.550	69.7	12.4
1996 Apr 6	05 35.75	+29 43.1	1.663	1.593	68.3	12.6
1996 Apr 13	06 00.27	+29 49.7	1.750	1.639	66.8	12.9
1996 Apr 20	06 23.90	+29 41.0	1.840	1.685	65.1	13.1
1996 Apr 27	06 46.56	+29 19.0	1.935	1.734	63.3	13.3
1996 May 4	07 08.21	+28 45.5	2.032	1.783	61.3	13.6
1996 May 11	07 28.85	+28 02.5	2.133	1.833	59.2	13.8
1996 May 18	07 48.51	+27 11.5	2.235	1.884	56.9	14.0
1996 May 25	08 07.24	+26 13.9	2.339	1.935	54.5	14.2

Comet P/1983 M1 (IRAS)

Date	R.A. h m	Dec ° '	Δ AU	R AU	Elg	Mag
1996 Jun 8	00 30.45	-61 12.4	1.880	2.292	100.4	14.6
1996 Jun 15	00 42.84	-61 07.5	1.796	2.247	102.5	14.3
1996 Jun 22	00 53.31	-61 09.2	1.713	2.202	104.7	14.0
1996 Jun 29	01 01.57	-61 18.0	1.631	2.159	106.9	13.7
1996 Jul 6	01 07.28	-61 34.3	1.551	2.116	109.2	13.5
1996 Jul 13	01 09.94	-61 57.7	1.473	2.075	111.5	13.2
1996 Jul 20	01 08.92	-62 26.7	1.398	2.035	113.9	12.9
1996 Jul 27	01 03.45	-62 58.0	1.325	1.996	116.4	12.6
1996 Aug 3	00 52.79	-63 25.8	1.255	1.959	118.9	12.3
1996 Aug 10	00 36.28	-63 41.3	1.190	1.924	121.4	12.1
1996 Aug 17	00 13.87	-63 31.7	1.131	1.891	123.7	11.8
1996 Aug 24	23 46.72	-62 41.2	1.078	1.859	125.7	11.6
1996 Aug 31	23 17.40	-60 55.2	1.035	1.831	127.2	11.3
1996 Sep 7	22 49.12	-58 05.3	1.001	1.804	127.9	11.1
1996 Sep 14	22 24.59	-54 12.1	0.980	1.781	127.5	11.0
1996 Sep 21	22 05.25	-49 25.5	0.972	1.760	126.0	10.8
1996 Sep 28	21 51.26	-44 01.8	0.978	1.742	123.3	10.8
1996 Oct 5	21 42.01	-38 19.1	0.998	1.728	119.7	10.7
1996 Oct 12	21 36.72	-32 33.3	1.032	1.716	115.4	10.8
1996 Oct 19	21 34.64	-26 57.0	1.079	1.708	110.8	10.8
1996 Oct 26	21 35.10	-21 38.2	1.136	1.704	106.0	10.9
1996 Nov 2	21 37.58	-16 40.9	1.203	1.703	101.3	11.0
1996 Nov 9	21 41.68	-12 05.7	1.277	1.705	96.7	11.2
1996 Nov 16	21 47.10	-07 51.8	1.357	1.711	92.3	11.3
1996 Nov 23	21 53.61	-03 56.9	1.441	1.720	88.2	11.5
1996 Nov 30	22 01.02	-00 18.9	1.528	1.733	84.2	11.7
1996 Dec 7	22 09.21	+03 04.9	1.617	1.749	80.5	11.9
1996 Dec 14	22 18.09	+06 16.8	1.707	1.768	77.0	12.1
1996 Dec 21	22 27.57	+09 18.8	1.798	1.790	73.6	12.3
1996 Dec 28	22 37.60	+12 12.5	1.889	1.814	70.4	12.6

MINOR PLANET POSITIONS (0hr UT, Epoch 2000.0)

	1 CERES			2 PALLAS			3 JUNO			4 VESTA			8 FLORA		
	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 6	15 32.4	- 12 46	8.9	14 01.4	- 03 29	9.1	19 51.4	- 13 30	10.8	14 17.6	- 06 37	7.8	14 11.3	- 07 22	11.5
13	15 42.8	- 13 24	8.9	14 10.9	- 02 49	9.1	20 02.9	- 13 09	10.7	14 28.6	- 07 17	7.7	14 19.8	- 07 52	11.4
20	15 52.8	- 13 59	8.9	14 19.8	- 02 00	9.0	20 14.6	- 12 43	10.7	14 39.1	- 07 52	7.6	14 27.6	- 08 16	11.4
27	16 02.5	- 14 30	8.8	14 27.9	+ 00 58	9.0	20 26.3	- 12 14	10.6	14 49.2	- 08 22	7.5	14 34.8	- 08 35	11.3
Feb 3	16 11.7	- 14 57	8.8	14 35.1	+ 00 14	8.9	20 38.0	- 11 41	10.6	14 58.7	- 08 46	7.4	14 41.2	- 08 49	11.2
10	16 20.4	- 15 21	8.8	14 41.4	+ 01 39	8.8	20 49.7	- 11 05	10.6	15 07.5	- 09 04	7.3	14 46.7	- 08 57	11.1
17	16 28.5	- 15 43	8.7	14 46.6	+ 03 15	8.7	21 01.5	- 10 25	10.7	15 15.6	- 09 17	7.2	14 51.2	- 08 58	11.0
24	16 35.9	- 16 01	8.7	14 50.7	+ 05 03	8.6	21 13.2	- 09 43	10.7	15 22.7	- 09 24	7.1	14 54.5	- 08 54	10.9
Mar 2	16 42.5	- 16 17	8.6	14 53.5	+ 07 01	8.5	21 24.8	- 08 58	10.7	15 28.8	- 09 26	7.0	14 56.7	- 08 43	10.8
9	16 48.3	- 16 30	8.5	14 54.9	+ 09 07	8.5	21 36.4	- 08 10	10.7	15 33.8	- 09 22	6.8	14 57.5	- 08 26	10.7
16	16 53.2	- 16 42	8.4	14 55.0	+ 11 19	8.4	21 48.0	- 07 20	10.7	15 37.4	- 09 13	6.7	14 57.0	- 08 04	10.5
23	16 56.9	- 16 52	8.3	14 53.7	+ 13 34	8.3	21 59.4	- 06 29	10.7	15 39.6	- 08 59	6.5	14 55.0	- 07 36	10.4
30	16 59.5	- 17 02	8.2	14 51.2	+ 15 47	8.2	22 10.8	- 05 36	10.6	15 40.3	- 08 41	6.4	14 51.6	- 07 04	10.2
Apr 6	17 00.9	- 17 11	8.1	14 47.4	+ 17 53	8.2	22 22.1	- 04 42	10.6	15 39.3	- 08 21	6.2	14 46.9	- 06 29	10.1
13	17 00.9	- 17 19	8.0	14 42.8	+ 19 49	8.2	22 33.2	- 03 47	10.6	15 36.8	- 07 58	6.0	14 41.1	- 05 52	10.0
20	16 59.6	- 17 28	7.8	14 37.4	+ 21 31	8.2	22 44.3	- 02 52	10.5	15 32.7	- 07 35	5.9	14 34.5	- 05 16	9.8
27	16 57.0	- 17 36	7.7	14 31.8	+ 22 55	8.3	22 55.2	- 01 57	10.5	15 27.4	- 07 14	5.7	14 27.5	- 04 42	9.8
May 4	16 53.1	- 17 46	7.6	14 26.2	+ 23 59	8.4	23 05.9	- 01 02	10.4	15 21.1	- 06 56	5.6	14 20.3	- 04 12	9.8
11	16 48.1	- 17 55	7.4	14 20.9	+ 24 44	8.5	23 16.6	+ 00 08	10.4	15 14.3	- 06 43	5.6	14 13.5	- 03 49	10.0
18	16 42.2	- 18 05	7.2	14 16.3	+ 25 10	8.7	23 27.0	+ 00 44	10.3	15 07.5	- 06 37	5.6	14 07.4	- 03 33	10.1
25	16 35.8	- 18 15	7.1	14 12.5	+ 25 18	8.8	23 37.2	+ 01 34	10.2	15 01.2	- 06 40	5.8	14 02.3	- 03 25	10.3
Jun 1	16 29.0	- 18 26	7.0	14 09.7	+ 25 10	8.9	23 47.3	+ 02 22	10.2	14 55.7	- 06 51	5.9	13 58.3	- 03 27	10.4
8	16 22.4	- 18 38	7.2	14 08.0	+ 24 49	9.0	23 57.0	+ 03 07	10.1	14 51.4	- 07 10	6.0	13 55.6	- 03 36	10.5
15	16 16.2	- 18 50	7.4	14 07.4	+ 24 16	9.2	00 06.5	+ 03 48	10.0	14 48.5	- 07 38	6.2	13 54.2	- 03 54	10.7
22	16 10.8	- 19 04	7.5	14 07.9	+ 23 35	9.3	00 15.7	+ 04 24	9.9	14 47.2	- 08 14	6.3	13 54.1	- 04 18	10.8
29	16 06.4	- 19 19	7.7	14 09.4	+ 22 46	9.4	00 24.4	+ 04 56	9.8	14 47.3	- 08 56	6.5	13 55.2	- 04 49	10.9
Jul 6	16 03.1	- 19 36	7.9	14 11.9	+ 21 51	9.5	00 32.7	+ 05 22	9.6	14 49.0	- 09 44	6.6	13 57.5	- 05 26	11.0
13	16 01.0	- 19 55	8.0	14 15.3	+ 20 52	9.6	00 40.5	+ 05 40	9.5	14 52.1	- 10 36	6.8	14 00.9	- 06 07	11.1
20	16 00.3	- 20 16	8.2	14 19.5	+ 19 50	9.7	00 47.6	+ 05 51	9.4	14 56.6	- 11 31	6.9	14 05.3	- 06 52	11.2
27	16 00.8	- 20 39	8.3	14 24.4	+ 18 45	9.7	00 54.0	+ 05 54	9.2	15 02.2	- 12 29	7.0	14 10.6	- 07 41	11.3
Aug 3	16 02.5	- 21 04	8.4	14 30.0	+ 17 40	9.8	00 59.6	+ 05 46	9.1	15 09.0	- 13 29	7.1	14 16.7	- 08 32	11.3
10	16 05.3	- 21 30	8.5	14 36.2	+ 16 33	9.9	01 04.3	+ 05 28	8.9	15 16.8	- 14 29	7.2	14 23.6	- 09 25	11.4
17	16 09.2	- 21 57	8.6	14 43.0	+ 15 27	9.9	01 07.9	+ 04 57	8.7	15 25.5	- 15 29	7.3	14 31.2	- 10 19	11.5
24	16 14.1	- 22 25	8.7	14 50.2	+ 14 22	10.0	01 10.2	+ 04 14	8.5	15 35.1	- 16 29	7.4	14 39.5	- 11 14	11.5
31	16 19.9	- 22 54	8.8	14 57.9	+ 13 18	10.0	01 11.4	+ 03 19	8.4	15 45.4	- 17 27	7.4	14 48.3	- 12 09	11.5
Sep 7	16 26.5	- 23 22	8.9	15 06.0	+ 12 15	10.1	01 11.1	+ 02 10	8.2	15 56.5	- 18 23	7.5	14 57.7	- 13 05	11.6
14	16 33.9	- 23 50	9.0	15 14.5	+ 11 15	10.1	01 09.6	+ 00 51	8.0	16 08.2	- 19 17	7.6	15 07.6	- 13 59	11.6
21	16 42.0	- 24 16	9.0	15 23.3	+ 10 17	10.1	01 06.9	+ 00 38	7.8	16 20.6	- 20 07	7.6	15 18.1	- 14 53	11.6
28	16 50.7	- 24 42	9.1	15 32.4	+ 09 21	10.2	01 03.2	- 02 12	7.6	16 33.4	- 20 53	7.7	15 28.9	- 15 45	11.6
Oct 5	16 59.9	- 25 06	9.1	15 41.8	+ 08 29	10.2	00 58.9	- 03 47	7.5	16 46.8	- 21 35	7.7	15 40.2	- 16 36	11.6
12	17 09.7	- 25 28	9.1	15 51.5	+ 07 40	10.2	00 54.3	- 05 18	7.6	17 00.7	- 22 13	7.8	15 52.0	- 17 24	11.6
19	17 19.9	- 25 48	9.2	16 01.3	+ 06 55	10.2	00 49.8	- 06 40	7.7	17 15.0	- 22 46	7.8	16 04.1	- 18 09	11.6
26	17 30.5	- 26 06	9.2	16 11.3	+ 06 14	10.2	00 46.0	- 07 48	7.8	17 29.6	- 23 13	7.8	16 16.6	- 18 52	11.6
Nov 2	17 41.5	- 26 20	9.2	16 21.5	+ 05 37	10.2	00 43.1	- 08 41	7.9	17 44.5	- 23 34	7.9	16 29.4	- 19 31	11.6
9	17 52.9	- 26 32	9.2	16 31.9	+ 05 05	10.2	00 41.5	- 09 16	8.1	17 59.7	- 23 50	7.9	16 42.6	- 20 06	11.5
16	18 04.4	- 26 40	9.2	16 42.3	+ 04 37	10.2	00 41.2	- 09 34	8.2	18 15.1	- 23 59	7.9	16 56.0	- 20 38	11.5
23	18 16.3	- 26 46	9.2	16 52.8	+ 04 14	10.2	00 42.5	- 09 36	8.3	18 30.7	- 24 03	7.9	17 09.8	- 21 05	11.4
30	18 28.3	- 26 47	9.2	17 03.3	+ 03 55	10.2	00 45.2	- 09 23	8.5	18 46.4	- 24 00	7.9	17 23.7	- 21 28	11.4
Dec 7	18 40.4	- 26 46	9.1	17 13.9	+ 03 42	10.2	00 49.3	- 08 56	8.6	19 02.2	- 23 50	7.9	17 37.9	- 21 45	11.3
14	18 52.7	- 26 41	9.1	17 24.5	+ 03 34	10.2	00 54.7	- 08 18	8.7	19 18.0	- 23 35	7.9	17 52.3	- 21 58	11.2
21	19 05.0	- 26 32	9.0	17 35.0	+ 03 31	10.3	01 01.3	- 07 29	8.8	19 33.8	- 23 13	7.9	18 06.9	- 22 06	11.1
28	19 17.4	- 26 20	9.0	17 45.4	+ 03 33	10.3	01 09.0	- 06 33	8.9	19 49.5	- 22 46	7.8	18 21.5	- 22 09	11.1

	9 METIS			11 PARTHENOPE			12 VICTORIA			14 IRENE			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 6	16 42.7	- 21 36	11.8	14 55.6	- 12 33	11.9	15 52.4	- 21 48	12.0	08 28.0	+ 26 42	9.5	12 40.9	- 16 26	10.8
13	16 54.7	- 22 03	11.8	15 06.0	- 13 09	11.8	16 07.6	- 22 17	11.9	08 21.8	+ 27 39	9.3	12 44.2	- 17 21	10.8
20	17 06.5	- 22 26	11.8	15 16.2	- 13 42	11.8	16 22.9	- 22 41	11.9	08 14.8	+ 28 34	9.1	12 46.6	- 18 11	10.7
27	17 18.1	- 22 46	11.8	15 26.0	- 14 10	11.7	16 38.2	- 22 58	11.9	08 07.5	+ 29 23	9.2	12 47.9	- 18 57	10.6
Feb 3	17 29.4	- 23 02	11.8	15 35.4	- 14 33	11.6	16 53.5	- 23 09	11.8	08 00.4	+ 30 04	9.4	12 48.2	- 19 37	10.5
10	17 40.5	- 23 16	11.8	15 44.2	- 14 52	11.5	17 08.8	- 23 13	11.7	07 54.1	+ 30 36	9.5	12 47.4	- 20 10	10.4
17	17 51.2	- 23 27	11.8	15 52.4	- 15 07	11.5	17 23.9	- 23 10	11.7	07 49.0	+ 30 58	9.7	12 45.4	- 20 37	10.3
24	18 01.5	- 23 36	11.7	15 59.9	- 15 17	11.4	17 38.9	- 23 00	11.6	07 45.4	+ 31 10	9.8	12 42.3	- 20 54	10.2
Mar 2	18 11.3	- 23 43	11.7	16 06.6	- 15 23	11.2	17 53.6	- 22 43	11.5	07 43.6	+ 31 14	10.0	12 38.1	- 21 03	10.1
9	18 20.5	- 23 48	11.6	16 12.4	- 15 25	11.1	18 08.0	- 22 19	11.4	07 43.6	+ 31 11	10.1	12 33.0	- 21 02	10.0
16	18 29.2	- 23 53	11.6	16 17.1	- 15 23	11.0	18 22.0	- 21 48	11.3	07 45.4	+ 31 01	10.2	12 27.3	- 20 50	9.9
23	18 37.2	- 23 57	11.5	16 20.6	- 15 17	10.9	18 35.5	- 21 11	11.2	07 48.8	+ 30 45	10.3	12 21.1	- 20 29	9.8
30	18 44.4	- 24 00	11.4	16 22.8	- 15 08	10.7	18 48.4	- 20 27	11.1	07 53.8	+ 30 23	10.4	12 14.7	- 20 00	9.8
Apr 6	18 50.7	- 24 05	11.3	16 23.7	- 14 56	10.6	19 00.7	- 19 37	11.0	08 00.2	+ 29 57	10.5	12 08.6	- 19 23	9.8
13	18 56.1	- 24 11	11.3	16 23.1	- 14 40	10.4	19 12.3	- 18 41	10.9	08 07.8	+ 29 26	10.6	12 03.0	- 18 41	9.9
20	19 00.5	- 24 19	11.1	16 21.0	- 14 23	10.2	19 23.1	- 17 40	10.7	08 16.4	+ 28 51	10.7	11 58.0	- 17 57	10.0
27	19 03.7	- 24 29	11.0	16 17.5	- 14 04	10.0	19 32.9	- 16 35	10.6	08 25.9	+ 28 11	10.8	11 54.0	- 17 12	10.1
May 4	19 05.6	- 24 41	10.9	16 12.7	- 13 45	9.8	19 41.6	- 15 26	10.4	08 36.1	+ 27 27	10.9	11 51.0	- 16 29	10.2
11	19 06.2	- 24 57	10.8	16 07.0	- 13 25	9.6	19 49.2	- 14 13	10.3	08 47.0	+ 26 37	10.9	11 49.2	- 15 49	10.3
18	19 05.4	- 25 16	10.6	16 00.4	- 13 07	9.5	19 55.5	- 12 59	10.1	08 58.5	+ 25 44	11.0	11 48.4	- 15 15	10.4
25	19 03.1	- 25 37	10.5	15 53.6	- 12 52	9.5	20 00.3	- 11 43	9.9	09 10.3	+ 24 46	11.0	11 48.7	- 14 46	10.6
Jun 1	18 59.4	- 26 00	10.3	15 47.0	- 12 41	9.6	20 03.5	- 10 28	9.7	09 22.5	+ 23 43	11.0	11 50.0	- 14 23	10.7
8	18 54.4	- 26 25	10.2	15 40.9	- 12 35	9.8	20 05.1	- 09 16	9.6	09 35.0	+ 22 37	11.1	11 52.3	- 14 07	10.8
15	18 48.2	- 26 49	10.0	15 35.6	- 12 34	9.9	20 05.0	- 08 07	9.4	09 47.7	+ 21 26	11.1	11 55.5	- 13 57	10.8
22	18 41.1	- 27 12	9.8	15 31.6	- 12 40	10.1	20 03.2	- 07 04	9.2	10 00.6	+ 20 12	11.1	11 59.5	- 13 54	10.9
29	18 33.6	- 27 33	9.7	15 28.9	- 12 52	10.2	19 59.8	- 06 09	9.0	10 13.6	+ 18 53	11.1	12 04.2	- 13 57	11.0
Jul 6	18 25.9	- 27 50	9.8	15 27.7	- 13 10	10.4	19 55.2	- 05 25	8.8	10 26.7	+ 17 32	11.1	12 09.6	- 14 05	11.1
13	18 18.6	- 28 03	10.0	15 27.9	- 13 33	10.5	19 49.6	- 04 53	8.7	10 39.9	+ 16 08	11.2	12 15.5	- 14 19	11.1
20	18 12.1	- 28 11	10.1	15 29.6	- 14 01	10.6	19 43.7	- 04 35	8.7	10 53.2	+ 14 40	11.2	12 22.0	- 14 37	11.2
27	18 06.7	- 28 17	10.3	15 32.6	- 14 34	10.7	19 38.0	- 04 29	8.7	11 06.5	+ 13 11	11.2	12 29.0	- 15 00	11.2
Aug 3	18 02.5	- 28 19	10.4	15 36.9	- 15 09	10.8	19 33.1	- 04 35	8.9	11 19.8	+ 11 39	11.1	12 36.4	- 15 26	11.3
10	17 59.9	- 28 19	10.6	15 42.5	- 15 47	10.9	19 29.3	- 04 52	9.0	11 33.2	+ 10 06	11.1	12 44.1	- 15 56	11.3
17	17 58.8	- 28 18	10.7	15 49.1	- 16 27	11.0	19 27.2	- 05 16	9.2	11 46.6	+ 08 32	11.1	12 52.3	- 16 30	11.3
24	17 59.2	- 28 16	10.8	15 56.7	- 17 08	11.1	19 26.8	- 05 45	9.4	12 00.0	+ 06 56	11.1	13 00.8	- 17 06	11.3
31	18 01.0	- 28 13	10.9	16 05.2	- 17 49	11.2	19 28.2	- 06 16	9.5	12 13.5	+ 05 21	11.1	13 09.6	- 17 44	11.3
Sep 7	18 04.2	- 28 09	11.0	16 14.6	- 18 29	11.2	19 31.4	- 06 47	9.7	12 27.0	+ 03 45	11.0	13 18.6	- 18 24	11.3
14	18 08.7	- 28 05	11.1	16 24.8	- 19 08	11.3	19 36.3	- 07 17	9.9	12 40.5	+ 02 09	11.0	13 28.0	- 19 05	11.3
21	18 14.3	- 27 59	11.2	16 35.7	- 19 45	11.4	19 42.7	- 07 42	10.0	12 54.1	+ 00 34	11.0	13 37.5	- 19 48	11.3
28	18 21.0	- 27 53	11.3	16 47.3	- 20 20	11.4	19 50.5	- 08 03	10.2	13 07.8	+ 00 59	10.9	13 47.4	- 20 31	11.3
Oct 5	18 28.7	- 27 45	11.4	16 59.5	- 20 51	11.4	19 59.5	- 08 19	10.3	13 21.5	- 02 32	10.9	13 57.4	- 21 15	11.3
12	18 37.1	- 27 35	11.4	17 12.2	- 21 19	11.5	20 09.6	- 08 28	10.5	13 35.3	- 04 02	10.8	14 07.6	- 22 00	11.2
19	18 46.4	- 27 22	11.5	17 25.4	- 21 43	11.5	20 20.5	- 08 30	10.6	13 49.2	- 05 30	10.8	14 18.0	- 22 44	11.2
26	18 56.2	- 27 07	11.5	17 39.0	- 22 02	11.5	20 32.2	- 08 25	10.7	14 03.1	- 06 55	10.8	14 28.6	- 23 27	11.1
Nov 2	19 06.7	- 26 49	11.5	17 53.1	- 22 17	11.5	20 44.5	- 08 13	10.9	14 17.1	- 08 18	10.8	14 39.3	- 24 10	11.1
9	19 17.7	- 26 28	11.6	18 07.5	- 22 26	11.5	20 57.3	- 07 54	11.0	14 31.2	- 09 37	10.9	14 50.1	- 24 52	11.1
16	19 29.1	- 26 04	11.6	18 22.2	- 22 30	11.5	21 10.5	- 07 28	11.1	14 45.3	- 10 52	11.0	15 01.1	- 25 33	11.1
23	19 40.8	- 25 35	11.6	18 37.1	- 22 28	11.5	21 24.0	- 06 55	11.2	14 59.5	- 12 04	11.0	15 12.2	- 26 13	11.1
30	19 52.9	- 25 03	11.6	18 52.3	- 22 20	11.5	21 37.8	- 06 17	11.3	15 13.7	- 13 11	11.1	15 23.3	- 26 50	11.1
Dec 7	20 05.2	- 24 28	11.6	19 07.5	- 22 06	11.4	21 51.7	- 05 32	11.4	15 27.9	- 14 14	11.2	15 34.5	- 27 26	11.2
14	20 17.8	- 23 48	11.6	19 22.9	- 21 47	11.4	22 05.8	- 04 43	11.4	15 42.1	- 15 12	11.2	15 45.7	- 28 00	11.2
21	20 30.5	- 23 04	11.6	19 38.3	- 21 21	11.4	22 19.9	- 03 48	11.5	15 56.3	- 16 05	11.2	15 56.9	- 28 31	11.2
28	20 43.3	- 22 17	11.5	19 53.8	- 20 50	11.3	22 34.1	- 02 49	11.6	16 10.4	- 16 53	11.3	16 08.1	- 29 01	11.2

MINOR PLANET POSITIONS (0hr UT, Epoch 2000.0)

	20 MASSALIA			21 LUTETIA			22 KALLIOPE			39 LAETITIA			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 6	11 35.7	+01 45	10.2	17 17.7	-22 39	12.4	23 08.7	-17 29	12.0	18 30.5	-16 26	11.5	13 18.8	-03 31	11.8
13	11 38.9	+01 22	10.1	17 32.8	-22 56	12.4	23 17.7	-16 08	12.0	18 43.1	-16 18	11.5	13 26.3	-04 02	11.7
20	11 40.8	+01 09	9.9	17 47.9	-23 08	12.4	23 27.0	-14 45	12.0	18 55.6	-16 07	11.6	13 33.0	-04 27	11.6
27	11 41.1	+01 06	9.8	18 03.0	-23 14	12.4	23 36.6	-13 22	12.0	19 08.0	-15 51	11.6	13 38.8	-04 46	11.5
Feb 3	11 39.9	+01 14	9.6	18 18.1	-23 15	12.4	23 46.3	-11 58	12.0	19 20.3	-15 32	11.6	13 43.5	-04 58	11.4
10	11 37.1	+01 32	9.5	18 33.1	-23 11	12.4	23 56.3	-10 33	12.0	19 32.5	-15 09	11.6	13 47.2	-05 02	11.2
17	11 32.9	+01 59	9.3	18 48.0	-23 02	12.3	00 06.4	-09 08	12.0	19 44.5	-14 42	11.7	13 49.6	-04 59	11.1
24	11 27.6	+02 34	9.2	19 02.7	-22 49	12.3	00 16.7	-07 43	12.0	19 56.4	-14 12	11.7	13 50.6	-04 48	10.9
Mar 2	11 21.5	+03 15	9.0	19 17.3	-22 30	12.3	00 27.2	-06 18	11.9	20 08.0	-13 39	11.7	13 50.1	-04 29	10.8
9	11 15.0	+03 59	8.8	19 31.6	-22 08	12.2	00 37.7	-04 53	11.9	20 19.5	-13 04	11.6	13 48.2	-04 04	10.6
16	11 08.7	+04 42	9.1	19 45.7	-21 42	12.2	00 48.4	-03 29	11.8	20 30.6	-12 26	11.6	13 44.9	-03 32	10.4
23	11 02.9	+05 21	9.3	19 59.4	-21 12	12.1	00 59.1	-02 06	11.8	20 41.4	-11 47	11.6	13 40.3	-02 55	10.3
30	10 58.1	+05 54	9.5	20 12.8	-20 40	12.1	01 09.9	+00 44	11.7	20 52.0	-11 06	11.6	13 34.5	-02 15	10.1
Apr 6	10 54.5	+06 20	9.7	20 25.8	-20 06	12.0	01 20.9	+00 37	11.7	21 02.1	-10 24	11.5	13 28.0	-01 35	9.9
13	10 52.3	+06 37	9.9	20 38.3	-19 31	12.0	01 31.8	+01 56	11.7	21 11.9	-09 42	11.5	13 21.2	+00 57	9.9
20	10 51.5	+06 46	10.0	20 50.4	-18 54	11.9	01 42.9	+03 14	11.7	21 21.3	-09 00	11.4	13 14.4	+00 23	10.1
27	10 52.2	+06 45	10.2	21 01.9	-18 17	11.8	01 54.0	+04 30	11.7	21 30.1	-08 19	11.4	13 08.2	+00 03	10.2
May 4	10 54.2	+06 36	10.4	21 12.9	-17 41	11.7	02 05.1	+05 44	11.8	21 38.5	-07 39	11.3	13 02.8	+00 20	10.4
11	10 57.3	+06 20	10.5	21 23.2	-17 07	11.6	02 16.3	+06 55	11.8	21 46.4	-07 02	11.2	12 58.6	+00 29	10.6
18	11 01.6	+05 56	10.7	21 32.8	-16 35	11.5	02 27.6	+08 05	11.9	21 53.6	-06 26	11.2	12 55.6	+00 27	10.7
25	11 06.8	+05 26	10.8	21 41.5	-16 06	11.3	02 38.8	+09 11	11.9	22 00.1	-05 55	11.1	12 54.0	+00 16	10.9
Jun 1	11 12.9	+04 50	10.9	21 49.4	-15 42	11.2	02 50.0	+10 16	11.9	22 05.9	-05 27	11.0	12 53.8	+00 04	11.0
8	11 19.7	+04 09	11.0	21 56.2	-15 23	11.1	03 01.2	+11 17	11.9	22 10.9	-05 05	10.9	12 55.0	+00 32	11.2
15	11 27.2	+03 23	11.1	22 02.0	-15 11	10.9	03 12.4	+12 15	11.9	22 15.0	-04 49	10.7	12 57.3	-01 07	11.3
22	11 35.2	+02 34	11.2	22 06.4	-15 06	10.8	03 23.6	+13 11	11.9	22 18.2	-04 40	10.6	13 00.9	-01 48	11.4
29	11 43.7	+01 41	11.3	22 09.5	-15 09	10.6	03 34.6	+14 03	11.9	22 20.3	-04 39	10.5	13 05.4	-02 35	11.5
Jul 6	11 52.6	+00 44	11.4	22 11.2	-15 21	10.4	03 45.5	+14 52	11.9	22 21.2	-04 46	10.3	13 10.9	-03 26	11.6
13	12 01.8	+00 14	11.5	22 11.3	-15 41	10.2	03 56.3	+15 39	11.9	22 21.0	-05 03	10.2	13 17.3	-04 21	11.7
20	12 11.4	-01 16	11.5	22 09.8	-16 09	10.0	04 06.9	+16 22	11.9	22 19.7	-05 30	10.0	13 24.5	-05 20	11.8
27	12 21.3	-02 18	11.6	22 06.8	-16 44	9.8	04 17.3	+17 03	11.8	22 17.2	-06 07	9.8	13 32.4	-06 20	11.8
Aug 3	12 31.5	-03 23	11.6	22 02.5	-17 24	9.6	04 27.4	+17 41	11.8	22 13.7	-06 52	9.7	13 40.9	-07 23	11.9
10	12 41.9	-04 28	11.7	21 57.2	-18 05	9.4	04 37.2	+18 17	11.8	22 09.4	-07 46	9.5	13 50.0	-08 27	11.9
17	12 52.5	-05 34	11.7	21 51.3	-18 45	9.3	04 46.5	+18 50	11.7	22 04.4	-08 45	9.3	13 59.6	-09 32	12.0
24	13 03.3	-06 40	11.7	21 45.3	-19 20	9.4	04 55.4	+19 21	11.7	21 59.2	-09 48	9.2	14 09.8	-10 38	12.0
31	13 14.3	-07 46	11.7	21 39.7	-19 48	9.6	05 03.8	+19 51	11.6	21 54.2	-10 51	9.4	14 20.4	-11 43	12.0
Sep 7	13 25.5	-08 52	11.8	21 35.1	-20 08	9.9	05 11.5	+20 20	11.5	21 49.5	-11 51	9.5	14 31.5	-12 48	12.1
14	13 36.8	-09 58	11.8	21 31.7	-20 17	10.1	05 18.5	+20 48	11.4	21 45.6	-12 46	9.7	14 43.1	-13 51	12.1
21	13 48.4	-11 02	11.8	21 29.9	-20 16	10.2	05 24.6	+21 15	11.3	21 42.8	-13 35	9.9	14 55.0	-14 54	12.1
28	14 00.0	-12 05	11.8	21 29.7	-20 06	10.4	05 29.8	+21 43	11.3	21 41.1	-14 15	10.0	15 07.3	-15 54	12.1
Oct 5	14 11.9	-13 07	11.7	21 31.1	-19 47	10.6	05 34.0	+22 12	11.1	21 40.7	-14 47	10.2	15 20.0	-16 52	12.1
12	14 23.8	-14 06	11.7	21 34.1	-19 19	10.8	05 36.9	+22 42	11.0	21 41.6	-15 10	10.3	15 33.1	-17 48	12.1
19	14 35.9	-15 04	11.7	21 38.5	-18 45	10.9	05 38.5	+23 14	10.9	21 43.8	-15 23	10.4	15 46.5	-18 40	12.0
26	14 48.2	-15 59	11.7	21 44.3	-18 03	11.1	05 38.7	+23 48	10.8	21 47.3	-15 28	10.6	16 00.3	-19 29	12.0
Nov 2	15 00.5	-16 52	11.6	21 51.2	-17 16	11.2	05 37.4	+24 23	10.6	21 51.9	-15 25	10.7	16 14.3	-20 14	12.0
9	15 12.9	-17 42	11.5	21 59.0	-16 22	11.3	05 34.6	+25 00	10.5	21 57.5	-15 14	10.8	16 28.6	-20 54	11.9
16	15 25.4	-18 28	11.4	22 07.8	-15 24	11.5	05 30.3	+25 37	10.3	22 04.0	-14 56	10.9	16 43.2	-21 30	11.9
23	15 38.0	-19 12	11.6	22 17.2	-14 20	11.6	05 24.7	+26 13	10.2	22 11.4	-14 32	11.0	16 58.1	-22 01	11.8
30	15 50.6	-19 51	11.7	22 27.2	-13 13	11.7	05 18.1	+26 48	10.0	22 19.5	-14 01	11.0	17 13.1	-22 27	11.8
Dec 7	16 03.2	-20 27	11.7	22 37.8	-12 01	11.8	05 10.8	+27 20	9.9	22 28.2	-13 24	11.1	17 28.3	-22 48	11.7
14	16 15.8	-21 00	11.8	22 48.8	-10 46	11.8	05 03.2	+27 48	9.9	22 37.4	-12 42	11.2	17 43.6	-23 03	11.6
21	16 28.4	-21 28	11.8	23 00.1	-09 27	11.9	04 55.9	+28 12	10.1	22 47.1	-11 56	11.2	17 59.1	-23 13	11.4
28	16 40.9	-21 53	11.9	23 11.7	-08 06	12.0	04 49.4	+28 33	10.2	22 57.2	-11 05	11.3	18 14.6	-23 16	11.5

	44 NYSA			192 NAUSIKAA			349 DEMBOWSKA			354 ELEONORA			532 HERCULINA		
	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 6	11 09.7	+06 25	10.2	17 23.1	-28 16	12.6	18 36.7	-28 43	11.5	09 08.1	+08 03	10.0	10 48.0	+20 17	9.6
13	11 12.2	+06 27	10.0	17 37.0	-28 29	12.6	18 49.4	-28 36	11.5	09 04.3	+09 02	9.8	10 49.6	+21 28	9.5
20	11 13.2	+06 41	9.9	17 51.0	-28 38	12.6	19 02.1	-28 25	11.5	08 59.6	+10 11	9.7	10 49.8	+22 48	9.3
27	11 12.5	+07 06	9.8	18 05.0	-28 42	12.6	19 14.7	-28 12	11.6	08 54.1	+11 29	9.5	10 48.5	+24 16	9.2
Feb 3	11 10.3	+07 41	9.6	18 18.9	-28 42	12.6	19 27.1	-27 55	11.6	08 48.3	+12 51	9.5	10 45.8	+25 48	9.0
10	11 06.6	+08 25	9.5	18 32.8	-28 39	12.6	19 39.4	-27 36	11.6	08 42.6	+14 16	9.6	10 41.8	+27 20	8.9
17	11 01.7	+09 16	9.3	18 46.6	-28 31	12.6	19 51.6	-27 15	11.6	08 37.4	+15 38	9.7	10 36.9	+28 49	8.8
24	10 55.9	+10 10	9.2	19 00.2	-28 20	12.5	20 03.5	-26 52	11.6	08 33.0	+16 56	9.9	10 31.3	+30 08	8.9
Mar 2	10 49.7	+11 03	9.2	19 13.6	-28 05	12.5	20 15.1	-26 27	11.6	08 29.8	+18 08	10.0	10 25.6	+31 13	8.9
9	10 43.6	+11 53	9.3	19 26.8	-27 47	12.4	20 26.5	-26 00	11.6	08 27.8	+19 11	10.2	10 20.2	+32 04	9.0
16	10 38.1	+12 35	9.5	19 39.7	-27 26	12.4	20 37.5	-25 33	11.5	08 27.4	+20 05	10.3	10 15.5	+32 37	9.2
23	10 33.6	+13 09	9.7	19 52.3	-27 03	12.3	20 48.2	-25 06	11.5	08 28.3	+20 49	10.4	10 12.0	+32 53	9.3
30	10 30.4	+13 32	9.8	20 04.6	-26 37	12.2	20 58.6	-24 38	11.5	08 30.7	+21 25	10.6	10 09.9	+32 54	9.4
Apr 6	10 28.6	+13 44	10.0	20 16.4	-26 10	12.2	21 08.5	-24 11	11.4	08 34.3	+21 52	10.7	10 09.2	+32 40	9.5
13	10 28.3	+13 45	10.2	20 27.8	-25 41	12.1	21 18.0	-23 44	11.4	08 39.2	+22 10	10.8	10 10.1	+32 14	9.7
20	10 29.5	+13 37	10.3	20 38.7	-25 12	12.0	21 27.0	-23 20	11.3	08 45.2	+22 21	10.9	10 12.4	+31 37	9.8
27	10 32.0	+13 20	10.5	20 49.1	-24 43	11.9	21 35.4	-22 57	11.3	08 52.1	+22 24	11.0	10 16.1	+30 51	9.9
May 4	10 35.7	+12 55	10.6	20 58.8	-24 15	11.7	21 43.3	-22 37	11.2	08 59.8	+22 20	11.1	10 21.0	+29 57	10.0
11	10 40.6	+12 23	10.8	21 07.8	-23 47	11.6	21 50.6	-22 20	11.1	09 08.3	+22 10	11.2	10 27.0	+28 56	10.1
18	10 46.4	+11 44	10.9	21 15.9	-23 22	11.5	21 57.1	-22 07	11.0	09 17.4	+21 54	11.2	10 34.0	+27 50	10.2
25	10 53.1	+10 59	11.0	21 23.2	-22 59	11.3	22 02.9	-21 58	10.9	09 27.0	+21 32	11.3	10 41.7	+26 38	10.2
Jun 1	11 00.5	+10 10	11.1	21 29.5	-22 40	11.2	22 07.8	-21 55	10.8	09 37.1	+21 05	11.3	10 50.2	+25 22	10.3
8	11 08.5	+09 16	11.3	21 34.7	-22 24	11.0	22 11.9	-21 56	10.7	09 47.6	+20 33	11.4	10 59.3	+24 02	10.4
15	11 17.1	+08 18	11.4	21 38.5	-22 13	10.8	22 14.9	-22 03	10.6	09 58.3	+19 56	11.4	11 08.8	+22 39	10.4
22	11 26.1	+07 17	11.4	21 41.0	-22 07	10.6	22 16.8	-22 16	10.5	10 09.4	+19 15	11.5	11 18.8	+21 12	10.5
29	11 35.5	+06 13	11.5	21 41.9	-22 05	10.4	22 17.5	-22 35	10.4	10 20.6	+18 30	11.5	11 29.2	+19 43	10.6
Jul 6	11 45.2	+05 07	11.6	21 41.1	-22 09	10.1	22 17.1	-22 58	10.3	10 32.0	+17 42	11.5	11 39.8	+18 12	10.6
13	11 55.2	+03 59	11.7	21 38.7	-22 15	9.9	22 15.3	-23 27	10.1	10 43.5	+16 50	11.6	11 50.7	+16 39	10.6
20	12 05.5	+02 48	11.7	21 34.5	-22 25	9.6	22 12.4	-23 58	10.0	10 55.2	+15 56	11.6	12 01.9	+15 05	10.7
27	12 16.0	+01 37	11.8	21 28.9	-22 34	9.3	22 08.4	-24 31	9.9	11 06.9	+14 59	11.6	12 13.3	+13 30	10.7
Aug 3	12 26.7	+00 24	11.8	21 22.1	-22 41	9.1	22 03.3	-25 04	9.8	11 18.8	+14 00	11.6	12 24.8	+11 54	10.7
10	12 37.6	+00 49	11.9	21 14.6	-22 44	9.0	21 57.6	-25 33	9.7	11 30.7	+12 59	11.6	12 36.5	+10 18	10.8
17	12 48.7	-02 02	11.9	21 07.0	-22 39	9.1	21 51.4	-25 58	9.7	11 42.6	+11 57	11.6	12 48.4	+08 42	10.8
24	12 59.9	-03 15	12.0	21 00.0	-22 27	9.3	21 45.2	-26 16	9.7	11 54.6	+10 54	11.6	13 00.4	+07 06	10.8
31	13 11.3	-04 28	12.0	20 54.0	-22 07	9.5	21 39.2	-26 26	9.8	12 06.6	+09 51	11.6	13 12.5	+05 31	10.8
Sep 7	13 22.8	-05 40	12.0	20 49.6	-21 39	9.7	21 33.9	-26 27	9.9	12 18.7	+08 47	11.6	13 24.8	+03 58	10.8
14	13 34.5	-06 51	12.0	20 47.1	-21 03	9.9	21 29.5	-26 20	10.0	12 30.7	+07 43	11.5	13 37.1	+02 26	10.8
21	13 46.3	-08 01	12.0	20 46.4	-20 22	10.0	21 26.3	-26 05	10.2	12 42.8	+06 39	11.5	13 49.7	+00 55	10.8
28	13 58.3	-09 09	12.0	20 47.8	-19 35	10.2	21 24.3	-25 43	10.3	12 55.0	+05 37	11.5	14 02.3	+00 33	10.8
Oct 5	14 10.3	-10 15	12.0	20 51.0	-18 44	10.3	21 23.6	-25 14	10.4	13 07.1	+04 35	11.5	14 15.0	-01 58	10.8
12	14 22.5	-11 20	12.0	20 56.0	-17 48	10.5	21 24.2	-24 39	10.5	13 19.3	+03 35	11.5	14 27.9	-03 20	10.8
19	14 34.8	-12 21	12.0	21 02.4	-16 48	10.6	21 26.1	-24 00	10.6	13 31.5	+02 37	11.6	14 40.9	-04 40	10.7
26	14 47.2	-13 20	12.0	21 10.3	-15 43	10.7	21 29.1	-23 15	10.7	13 43.6	+01 42	11.6	14 53.9	-05 56	10.7
Nov 2	14 59.7	-14 16	12.0	21 19.3	-14 34	10.8	21 33.2	-22 27	10.8	13 55.8	+00 49	11.6	15 07.1	-07 08	10.7
9	15 12.3	-15 09	11.9	21 29.4	-13 21	10.9	21 38.2	-21 36	10.9	14 07.9	+00 01	11.6	15 20.3	-08 16	10.7
16	15 24.9	-15 58	11.9	21 40.3	-12 04	11.0	21 44.1	-20 41	10.9	14 20.0	+00 48	11.7	15 33.6	-09 19	10.7
23	15 37.6	-16 44	12.0	21 52.0	-10 43	11.1	21 50.8	-19 43	11.0	14 32.0	-01 30	11.7	15 46.9	-10 18	10.7
30	15 50.3	-17 26	12.0	22 04.3	-09 17	11.1	21 58.1	-18 42	11.1	14 44.0	-02 09	11.7	16 00.2	-11 13	10.7
Dec 7	16 03.0	-18 04	12.1	22 17.1	-07 48	11.2	22 05.9	-17 38	11.1	14 55.8	-02 44	11.7	16 13.5	-12 03	10.8
14	16 15.6	-18 38	12.1	22 30.4	-06 14	11.3	22 14.3	-16 32	11.2	15 07.5	-03 13	11.7	16 26.9	-12 48	10.8
21	16 28.2	-19 07	12.2	22 44.1	-04 38	11.3	22 23.1	-15 24	11.2	15 19.1	-03 38	11.7	16 40.1	-13 28	10.9
28	16 40.8	-19 33	12.2	22 58.1	-02 58	11.4	22 32.3	-14 13	11.2	15 30.4	-03 58	11.7	16 53.3	-14 04	10.9

THE BRIGHTEST STARS

See introduction to part 3 (page 71) 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

THE NEARER STARS

No	Star Name		Constellation	R.A. 2000 hh mm.m	Dec ° '	Magnitude Apparent	Magnitude Absolute	Spect Type	Parallax ' "	Proper Motion	Distance ly	Distance pc
1	Sun					-26.70	4.80	G2				
2	Proxima Centauri		Centaurus	14 29.7	-62 41	11.09	15.50	M5	0.772	3"82	4.23	1.30
3	Alpha Centauri	A	Centaurus	14 39.6	-60 50	0.01	4.40	G2	0.750	3"70	4.35	1.33
		B				1.34	5.70	K0				
4	Barnard's Star		Ophiuchus	17 57.8	+04 42	9.55	13.20	M4	0.545	10"37	5.98	1.83
5	Wolf 359		Leo	10 56.5	+07 01	13.45	16.60	M6	0.418	4"69	7.80	2.39
6	Lalande 21185		Ursa Major	11 03.4	+35 58	7.47	10.50	M2	0.395	4"82	8.23	2.52
7	UV Ceti (L726-8)	A	Cetus	01 39.0	-17 57	12.41	15.30	M6	0.381	3"37	8.57	2.63
		B				13.20	16.10	M6				
8	Sirius	A	Canis Major	06 45.2	-16 43	-1.43	1.50	A1	0.380	1"33	8.57	2.63
		B				8.40	11.30	DA2				
9	Ross 154		Sagittarius	18 49.8	-23 50	10.47	13.10	M4	0.341	0"72	9.56	2.93
10	Ross 248		Andromeda	23 41.9	+44 11	12.29	14.80	M6	0.316	1"63	10.33	3.17
11	Epsilon Eridani		Eridanus	03 32.9	-09 28	3.73	6.20	K2	0.306	0"98	10.67	3.27
12	Ross 128		Virgo	11 47.8	+00 48	11.12	13.50	M4	0.301	1"35	10.83	3.32
13	L 789-6	ABC	Aquarius	22 38.5	-15 18	12.33	14.70	M5	0.294	3"26	11.08	3.40
14	BD +43°44	A	Andromeda	00 18.4	+44 01	8.08	10.40	M1	0.290	2"91	11.27	3.46
	(Groombridge 34)	B				11.07	13.40	M4				
15	Epsilon Indi		Indus	22 03.4	-56 47	4.68	7.00	K5	0.289	4"71	11.29	3.46
16	61 Cygni	A	Cygnus	21 06.9	+38 45	5.22	7.50	K5	0.289	5"23	11.30	3.47
		B				6.03	8.30	K7				
17	BD +59°1915	A	Draco	18 42.9	+59 38	8.90	11.20	M3	0.286	2"27	11.40	3.50
		B				9.68	12.00	M4				
18	Tau Ceti		Cetus	01 44.1	-15 56	3.50	5.80	G8	0.286	1"92	11.40	3.50
19	Procyon	A	Canis Minor	07 39.3	+05 14	0.38	2.70	F5	0.286	1"24	11.41	3.50
		B				10.70	13.00	F5				
20	Lacaille 9352		Piscis Austrinus	23 05.9	-35 51	7.34	9.60	M2	0.284	6"90	11.47	3.52
21	GJ 1111		Cancer	08 29.8	+26 47	14.79	17.00	M7	0.276	1"29	11.83	3.63
22	GJ 1061		Horologium	03 36.0	-44 31	13.03	15.20	M6	0.270	0"84	12.06	3.70
23	YZ Ceti (L725-32)		Cetus	01 12.5	-17 00	12.05	14.20	M5	0.267	1"35	12.20	3.74
24	Luyten (BD + 5°1668)		Canis Minor	07 27.4	+05 14	9.86	12.00	M4	0.264	3"76	12.34	3.79
25	Lacaille 8760		Microscopium	21 17.3	-38 52	6.67	8.70	M0	0.259	3"45	12.61	3.87
26	Kapteyn's Star		Pictor	05 11.6	-45 01	8.84	10.90	M0	0.258	8"65	12.63	3.87

NON STELLAR OBJECTS (Epoch 2000.0)

CAT	NUM	R.A.	DEC	SIZE	CON	TYPE	MAG	DESCRIPTION
NGC	55	00 14.9	-39° 11'	30'x6.3'	Scl	Spiral galaxy.	8.1	Brightest galaxy in Sculptor Group
NGC	104	00 24.1	-72° 05'	30.9'	Tuc	Globular cluster	3.8	47 Tucanae, one of the finest globulars
NGC	224	00 42.7	+41° 16'	185'x75'	And	Spiral galaxy	3.4	M31, The 'Andromeda Galaxy'
NGC	253	00 47.6	-25° 17'	30'x6.9'	Scl	Spiral galaxy	7.6	'Silver Coin' galaxy. Large, bright edge-on spiral
	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
NGC	3132	10 07.1	-40° 26'	30"	Vel	Planetary nebula	9.7	The 'Eight Burst Nebula', ring and disk, 10th magnitude central star
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	4945	13 05.4	-49° 28'	23'x5.9'	Cen	Spiral galaxy	9.0	Large edge on spiral, good field, another small galaxy in same field
NGC	5128	13 25.5	-43° 01'	31'x23'	Cen	Galaxy	6.7	'Centaurus A', bright sphere crossed by dark lane, radio source
NGC	5139	13 26.8	-47° 29'	36'	Cen	Globular cluster	3.5	Omega Centauri, perhaps the finest example of a globular cluster
NGC	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
NGC	7009	21 04.2	-11° 22'	25"	Aqr	Planetary nebula	8.5	The 'Saturn Nebula', ring structure in a larger and fainter halo
NGC	7078	21 30.0	+12° 10'	12.3'	Peg	Globular cluster	6.0	M15, bright, irregularly round, well resolved into faint stars
NGC	7293	22 29.6	-20° 48'	12'	Aqr	Planetary nebula	7.3	The 'Helix Nebula', ring structure involved in larger and fainter disk

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, when using these tables.

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 20 for Albury (36° 05'S, 146° 55'E)

	Rise	Set
From p.77 the rise/set values for Sydney are:-	5:03	19:08
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. = -20°18' p.78)	- :05	+ :05
Rise/Set times for Albury are :-	5:15	19:30

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

JULIAN DATE — 1996

To calculate Julian Date (JD), first convert local time to Universal Time (UT); subtract 10 hrs from AEST, 9.5 hrs from ACST 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 0 hrs 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 AEST on July 17th. Subtract 10 hours to get UT.

23 - 10 = 13:00 hrs UT

From the table the JD for July is 2450264.5
Add the day of month, 17 gives us 2450281.5

Now add the hours as a fraction of a day from the 2nd table. 13 hr is 0.542. Thus JD at 23:00 hr 17 Jul 1996 AEST is 2450282.042

JULIAN DATE at 0 hrs UT		
Month		Julian Date
Jan	0	245 0082.5
Feb	0	245 0113.5
Mar	0	245 0142.5
Apr	0	245 0173.5
May	0	245 0203.5
Jun	0	245 0234.5
Jul	0	245 0264.5
Aug	0	245 0295.5
Sep	0	245 0326.5
Oct	0	245 0356.5
Nov	0	245 0387.5
Dec	0	245 0417.5

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

SIDEREAL TIME — 1996

Greenwich mean sidereal time at 0 hrs UT

Jan	0	06.5968	Jul	0	18.5559
Feb	0	08.6338	Aug	0	20.5929
Mar	0	10.5393	Sep	0	22.6300
Apr	0	12.5764	Oct	0	00.6012
May	0	14.5476	Nov	0	02.6383
Jun	0	16.5846	Dec	0	04.6095

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 (AEST) on 17th July 1996.

23:00 AEST = 13:00 UT. GMST for July 0 is 18.5559 hrs.

GMST = 18.5559 + (0.06571 × 17) + (1.00274 × 13) = 32.7068

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

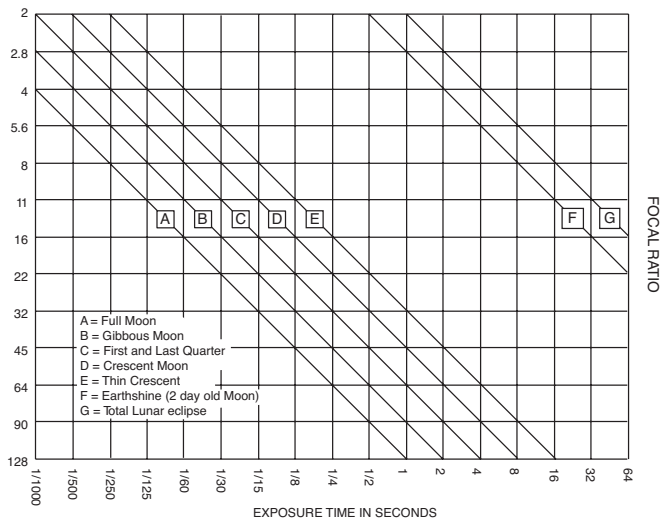
LMST = 32.7068 + 10.0833 = 42.7919

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

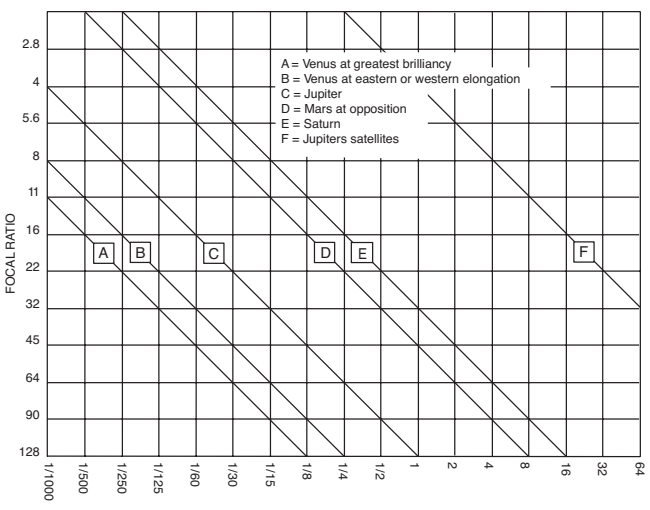
42.7919 - 24 = 18.7919 hrs or 18h 47m 31s

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.

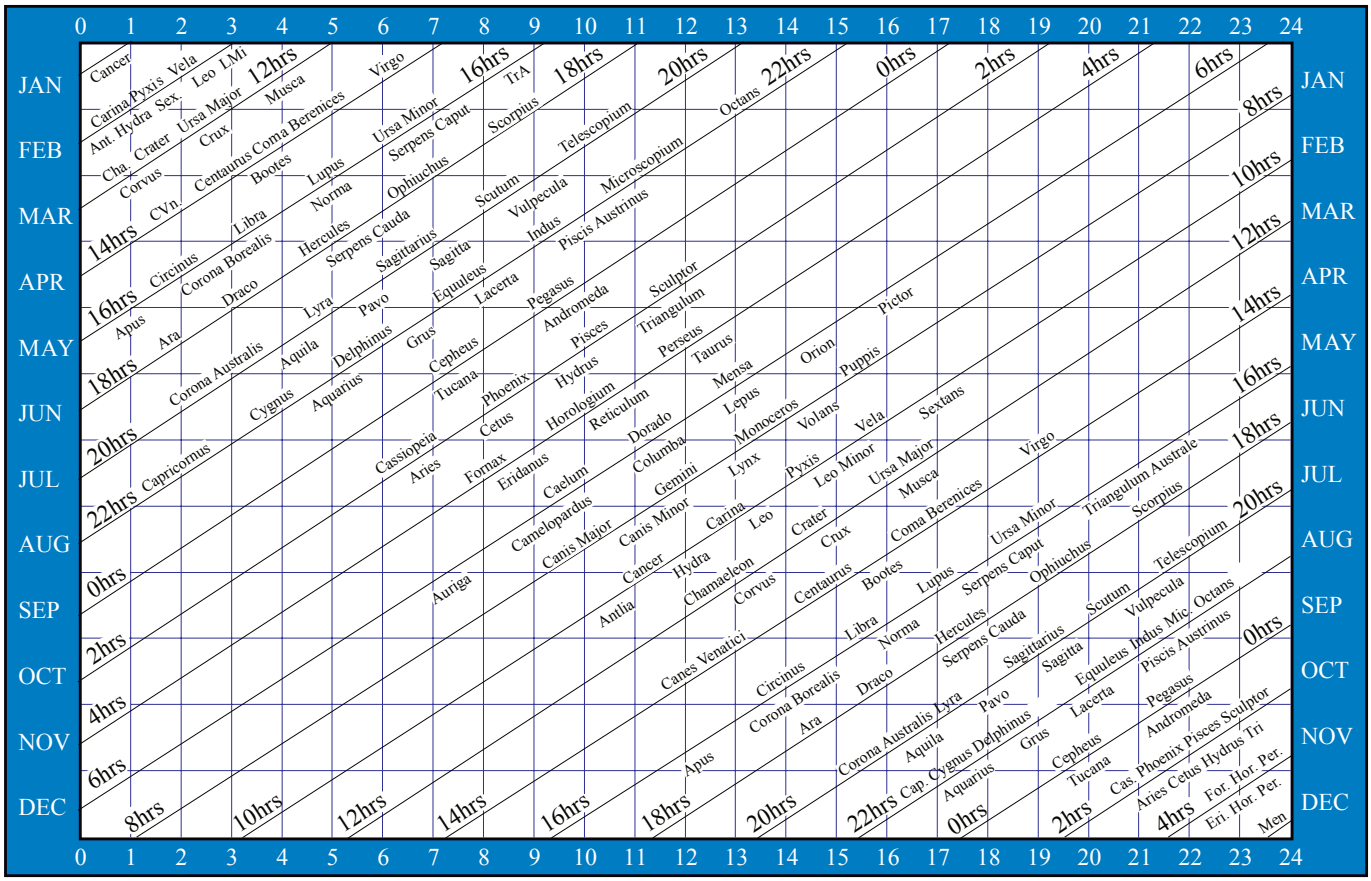
Follow a horizontal line nearest to your systems focal ratio to the oblique line that represents the Moon aspect or planet required, then follow the intersecting vertical line down to find the correct exposure.

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.

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

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

HOURS of RIGHT ASCENSION / CONSTELLATIONS on the MERIDIAN



CONSTELLATIONS - Abbreviations and Culmination at 9pm.

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

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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. Costs are subject to change.

NEW SOUTH WALES

THE AUSTRALIA TELESCOPE - NARRABRI ARRAY

The Australia Telescope operates in the radio region of the spectrum. It essentially uses high technology to combine the signals from a number of dishes, or elements, to obtain the performance of a single theoretical dish a number of kilometres in diameter. The 'compact array', located at the CSIRO's Paul Wild Observatory near Narrabri, is the heart of the telescope. It consists of six 22m dishes which are spaced along a 3km track. A 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 visitor's centre at Narrabri is well located. Being adjacent to the array's track good views of the dishes are available. There is an excellent display and video tape presentation which explains the concepts behind the telescope and Radio Astronomy in general.

Hours: 8am to 4pm daily (not staffed weekends, except school holidays).
Cost: No charge to visit the centre. Bus tours cost $60 (depending on numbers). No charge for school groups.
Contact: (067) 90-4070.

BOWEN MOUNTAIN OBSERVATORY

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

Contact: Adrian Saw (045) 72-1568

(ACT) THE CANBERRA OBSERVATORY

This professional quality astronomy complex is located at the Downer Club in Canberra. The address is Hawdon Place, Dickson (off Antill Street). There is no charge for admission to the centre for it is sponsored by the Canberra Tradesmen's Union Club. The telescopes of the observatory are world class and include a 41cm Newtonian-cassegrain IK6 with 17.8 cm Astro-Physics Starfire refractor (in a 5.2 metre dome) and a Celestron 14 (in a 4.2 metre dome). The astronomers staffing the observatory are members of the Canberra Astronomical Society. The observatory will be a opening a planetarium during 1996. Being located at a club there is also a coffee shop (open 10am - 10pm) and a bistro (hours 12.00 - 2.30pm, 6.00 - 9.00pm).

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

DARBY FALLS OBSERVATORY

The observatory is located on Observatory Road (off the road to Mt. McDonald) Darby Falls, Cowra. The observatory offers one of the largest telescopes accessible to the public ie. a 500mm Newtonian. Also available are 400mm, 300mm and 200mm instruments. Times: Winter viewing, 7 to 10pm, Summer viewing, 8.30pm to 11pm, other times by appointment.

Cost: Adults $5, Children $3, coaches and schools welcome.
Contact: Mark Monk (063) 45-1900

GREEN POINT OBSERVATORY

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

GROVE CREEK OBSERVATORY

This observatory is a non-profit organisation located 60km south of Bathurst. The facility caters for amateur astronomers and groups who are looking to use large aperture telescopes under very dark skies. The facility boasts a Celestron C-14, 12.5" Newtonian, Meade 10" LX-200 including full astrophotography and CCD equipment, located in two observatory buildings at the site. Grove Creek Observatory has modern on-site accommodation sleeping up to 12 people with full facilities available. The cost, including accommodation and full use of the facility, is $70 per person. Conditions apply, please contact 'Grove Creek' for further information.

Phone: (02)428-4334 (Jim Lynch)
Internet: astro@gco.apana.org.au Web - http://gco.apana.org.au

KOOLANG ASTRONOMY AND SCIENCE CENTRE.

This centre is located 50 km from Gosford (on the way to Wollombi) The observatory has a 0.5 metre telescope, in a roll-off building. There is also a display building. In the longer term, the centre will consist of a number of large buildings which will house various astronomy and space science displays. Contact: (049) 98-8216

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 many 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 visitor's 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 visitor's 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

NEPEAN ASTRONOMY CENTRE

This observatory is located at the University of Western Sydney, Werrington Campus (near Penrith, Sydney). The heart of the centre is a professional 60cm telescope housed in a 6.5m dome. It is the largest public access telescope in the Sydney region. As well as being a university facility, the observatory considers public education to be important and is open to the public on Tuesday and Friday evenings (bookings required). Evenings consist of a brief talk on some aspect of astronomy, followed by viewing of the sky (weather permitting).

Cost: $6 adults, $3 Children and $12 family.
Contact: (02) 678-7338

PARKES RADIO TELESCOPE

The observatory is located on the western plains of NSW, a few kilometres north of Parkes (just off the Newell Highway). The Parkes Telescope was indeed a pioneer in Radio Astronomy. It is still a 'work horse' and functions as part of the Australia Telescope. At the observatory, public education has a high priority, hence their impressive visitor's 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. The latest addition is an impressive public picnic area, consisting of a large shelter and gas barbecue facility.

Hours: 8:30am to 4:15pm - every day of the year, except for Christmas Day, Boxing Day, Good Friday and Anzac Day.
Cost: Admission to visitor's centre is free. A modest charge is made for the Audio/Visual presentation.
Contact: (068) 61-1777

SIDING SPRING OBSERVATORY

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

Hours: 9:30am to 4:00pm daily except Christmas Day.
Cost: $5:00 Adults, $3:00 Children/concession and $12:00 Family.
Contact (068) 42-6211.

PORT MACQUARIE OBSERVATORY

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

SCIENCE CENTRE/ PLANETARIUM

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

SKYWATCH NIGHT'N'DAY OBSERVATORY

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

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

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

SYDNEY OBSERVATORY

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

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

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

Contact: (02) 217-0485.

TIDBINBILLA TRACKING STATION

The station is located 40km southwest of Canberra, further along the same road you would take to visit Mt. Stromlo. In fact, Stromlo and Tidbinbilla would make a fascinating day trip if you were visiting or living in the ACT. The Tidbinbilla complex is a major link in NASA's Deep Space Tracking network. It has played a large role in nearly all of NASA's lunar and planetary probes. The Tracking Station, in the past, has also teamed up with the Parkes Radio Telescope to jointly monitor the faint signals from the distant Voyager spacecrafts as they made their historic flybys of the outer planets.

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

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

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

Contact: (06) 201-7800

QUEENSLAND

THE SIR THOMAS BRISBANE PLANETARIUM

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

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

Cost: 7:50 Adults, $4 Children (under 15 years) and concessions of $6.00 for Students / Pensioners.

Bookings and Enquires - (07) 3403-2578 - Wednesday to Sunday ONLY (noon to 7pm).

ALLOWAY OBSERVATORY

Operated by the Bundaberg Astronomical Society, this observatory is open to the public by appointment. The 48cm Newtonian reflector telescope is housed in a geodesic dome and is one of the largest telescopes in Queensland open to the public.

Cost: Over 10 persons - $3 adults, $2 children
Under 10 persons - $5 adults, $3 children

SOUTH AUSTRALIA

UNIVERSITY OF SOUTH AUSTRALIA PLANETARIUM

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

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

TASMANIA

LAUNCESTON PLANETARIUM

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

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

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

Contact: (003) 31-6777

VICTORIA

H.V. MCKAY MELBOURNE PLANETARIUM

Contact: as for Melbourne Observatory (see below), for costs and programme/timetable details for 1996.

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 1996 bookings will open in January and the year is normally booked out by mid March. The dates vary and are usually set around first quarter moon. Times are 8:00pm to 10:00pm and occasionally day time demonstrations are organised. There are open days (no booking is required) on the last Sunday of each month (2-4pm) and first Saturday (8-10pm)

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

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 - bookings necessary.

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

Contact: (09) 293-8255 or fax (09) 293-8138. There is also a recorded Information Line (09) 293-8109.

ASTRONOMICAL COURSES, SOURCES OF INFORMATION

The following lists astronomy courses, events, magazine, newsletter and radio programs known to the authors for 1996. This list is by no means intended to be exhaustive. Across the country there are no doubt many other evening courses held at various Universities and Colleges. Enquires from the general public are most welcome. A number of the amateur astronomical societies also provide an invaluable service to public education by their lectures and open nights. You will need to contact the societies for further details. Costs given are subject to change.

SKY AND SPACE MAGAZINE 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.

COMET TALES: This new bi-monthly newsletter, edited by the former Southern Sky magazine comet columnist Greg Bryant, is designed to keep readers up-to-date on comets that are observable by amateurs. It is especially useful for the upcoming apparition in 1996/97 of comet Hale-Bopp. The newsletter includes positions, observing guides and updates on their visual performance. Prominent meteor showers are also included. The annual cost is only $8 (payable to G. Bryant). For further information, write to 2/100-104 Kissing Point Rd, Dundas. NSW. 2117.

ASSOCIATION AGAINST OBTRUSIVE LIGHTING

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

SKY AND TELESCOPE ASTRONOMY HOTLINE 'SKYLINE'.

Telephone 0011-1-617-497-4168.

Internet address, Sky On-Line Home Page http://www.skypub.com/

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 1996. Contact WEA (02) 264-2781 or Sydney Observatory (02) 217-0485 for cost, timetable details.

SOUTH PACIFIC STAR PARTY.

A national gathering of amateurs for a week of observing under country skies. This is held at the Astronomical Society of NSW's (ASNSW) property at Ilford, NSW. It is normally held during May each year and usually attracts some 200 amateurs from all over the country. Contact the ASNSW for details (see society appendix).

PRACTICAL ASTRONOMY (SASPAC)

A practical astronomy course for beginners and interested amateurs. This is an 8 week course conducted by Sutherland Astronomical Society (SAS) during spring/autumn. Each 1 hour lecture is followed by observations with the society's equipment. Cost is $70.

Venue: Green Point Observatory (Sutherland).

Contact: write to the Education Officer c/o of the SAS address (see under society section)

INTRODUCTION TO ASTRONOMY

Course conducted by A. James (Answering Service (02) 819-6896)

Venue: Strathfield Evening College, 8 weeks, Monday evenings (total 18 hrs), 4 courses per year.
Cost: $64, Bookings (02) 419-4190
Venue: Chatswood Evening College, 11 weeks, Tuesday evenings (total 22 hrs), 3 courses per year.
Cost: $80, Bookings (02) 764-1499

COSMOLOGY - 'A Brief History of Time'

Course conducted by A. James

Venue: Strathfield Evening College, 4 weeks, Saturdays (total 12 hrs), 4 courses per year.
Cost: $64, Bookings (02) 419-4190
Venue: Chatswood Evening College, 10 weeks, Thursday evenings (total 20 hrs), 3 courses per year.
Cost: $76, Bookings (02) 764-1499

STELLAR EVOLUTION

Course conducted by A. James

Venue: Chatswood Evening College, 11 weeks, Wednesday evenings (total 22 hrs), 1 course per year in October to December.
Cost: $84, Bookings (02) 764-1499

VICTORIA

SKYLINE

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

THE SPACE SHOW

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

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

AMATEUR ASTRONOMY SHORTWAVE STATION (VK3 EKH).

This service is run by members of the Astronomical Society of Victoria. The station broadcasts to Australia on Fridays (from 10pm) on 3.543MHz (LSB).

QUEENSLAND

XVIITH NATIONAL AUSTRALIAN CONVENTION OF AMATEUR ASTRONOMERS

(Celebrating 100 years of Queensland Amateur Astronomy)

To be held in Brisbane over Easter 1996 (April 5 - 8).

Hosted by Combined South East Queensland Astronomical Societies.

The convention is held bi-annually and brings together amateur astronomers from all over Australia. The Venue for the convention will be the Hawken Building Theatre 2, The University of Queensland, St Lucia, Brisbane. The venue has ample parking within easy walking distance. Accommodation is currently being negotiated with residential colleges on campus. Current estimates for accommodation are in the order of approximately $45 - $50 per person per night. The accommodation being looked into is within easy walking distance of the convention venue. There will also be an Astronomy Expo, where equipment and other items of astronomical interest will be on display. Registrations are needed now.

Contact: The Convener, 17th NACAA, 124 B Kenmore Road, Kenmore, Qld 4069.

WEEKEND ASTRONOMY COURSES.

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

INTRODUCTION TO THE NIGHT SKY COURSE

Held by the Bundaberg Astronomical Society in conjunction with the Adult Education section of TAFE. These are conducted 3-4 times per year at the Alloway Observatory.

Contact Karlene Galway (071) 59-9674

SOUTHERN STAR EDUCATION

This is a planetarium service which travels throughout South East Queensland (inc. Toowoomba and Warwick). The organisation caters mainly for schools and community groups. Enquires are welcome.

Contact: Lot 25 Doncaster Drive, Beechmont, 4211, phone (075) 33-3610.

TASMANIA

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

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. Enquires from anyone with an interest in astronomy are most welcome. Where given, annual fees are subject to change. The authors of this publication are keen to keep the information in this section "evergreen'. It would be appreciated if any significant change occurs (especially new organisations) that the society contact Quasar Publishing (see page 2). The deadline for ASTRONOMY 1997 will be 1st Sep. 96.

Please note that a few of the societies now have internet addresses. They are the ANSW, SAS (Qld) and the ASV. These can be an excellent source of information such as latest astronomical discoveries, society events and connections to other astronomy sites on the Web.

NEW SOUTH WALES

ASTRONOMICAL SOCIETY OF COONABARABRAN

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

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

ASTRONOMICAL SOCIETY OF THE HUNTER

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

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

ASTRONOMICAL SOCIETY OF NSW

The society holds meetings twice per month at the 'Catholic College of Education', 179 Albert St, Strathfield. 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 newsletter '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: GPO Box 1123, Sydney, NSW, 2001.
Contact: Max Gardner (02) 337 3371.
Internet Site: ASNSWI Home Page, http://www.st.nepean.uws.edu.au/~Imacdona/asnswi.html

BRITISH ASTRONOMICAL ASSOCIATION - NSW BRANCH

The BAA meets at Sydney Observatory. The Association meets on the third Wednesday of each month, 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'.

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

(ACT) CANBERRA ASTRONOMICAL SOCIETY

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

Fees: $25 adult, $15 student/ pensioner and $20 country.
Address: PO Box 1338, Woden ACT 2606
Contact: Susan Ring (06) 288-5162

HAWKESBURY ASTRONOMICAL ASSOCIATION

Meetings are held once a month on the 2nd Wednesday, commencing 7.45pm, in the 'Tebbutt rooms' at the Windsor Library (Dight St. Windsor). They also observe as a club on the third quarter and new moon weekends. The club organises several public field nights per year and presents a basic introduction to astronomy. The HAA prides itself on being family orientated and aims to cater for the newcomer at a basic level.

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

ILLAWARRA ASTRONOMICAL SOCIETY

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

NORTHERN DISTRICTS SOCIETY OF AMATEUR ASTRONOMERS

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

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

PARKES ASTRONOMY CLUB

The club has infrequent meetings but holds regular observing nights.

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

PORT MACQUARIE ASTRONOMICAL ASSOCIATION

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

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

SHOALHAVEN ASTRONOMERS

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

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

SUTHERLAND ASTRONOMICAL SOCIETY

The society operates from Green Point Observatory near Sutherland. This houses a 42cm 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 and 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

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

WESTERN SYDNEY AMATEUR ASTRONOMICAL SOCIETY

The society meets 3rd Wednesday of the month at the Nepean Astronomy Centre, Uni. of Western Sydney, Werrington Campus. There are also regular observing nights and a monthly newsletter.

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

QUEENSLAND

ASTRONOMICAL ASSOCIATION OF QUEENSLAND (AAQ)

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

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

BRISBANE ASTRONOMICAL SOCIETY

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

Fees: $25 adult, $30 family and $15 student and pensioner (plus $5 joining fee).
Address: PO Box 204, Morningside QLD 4170
Contact: Darryl Mitchell (07) 349-8393

BUNDABERG ASTRONOMICAL SOCIETY

Meetings are held at Alloway Observatory on every Friday of each month at 7:30pm (except Jan.). The first Fri. are general meetings. The society publishes a bi-monthly journal and ephemeris. Field nights are generally held once a month.

Fees: $30 adult and $15 junior and $20 country (also joining fee for full members).
Address: PO Box 586, Bundaberg QLD 4670
Contact: Karlene Galway (071) 59-9674

CAIRNS ASTRONOMY GROUP

Hold monthly meeting at Bob's place (see below)

Fees: $12
Address: 18 Yurongi St., Caravonica QLD 4878
Contact: Bob Dollery (070) 58-1180

MT. ISA ASTRONOMY GROUP

The society meets at their dark sky observing site at the Lions Youth Camp on Lake Moondarra (17km outside of Mount Isa). Meetings are held monthly, usually on the nearest Sunday before new moon. An observatory is currently under construction at this location. Public star parties are held annually.

Fees: $35 ordinary (plus senior membership rate)
Address: PO Box 1556, Mount Isa, 4825
Contact: (077) 43-2955

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

SOUTHERN ASTRONOMICAL SOCIETY

Meetings are held at Pimpama State School 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 867, Beenleigh QLD 4207
Contact: Ray Suckling (075) 78-3795
Internet Site: SAS Home Page:
http://www.odyssey.com.au/infosphe/astro/home.html

SUN COAST ASTRONOMICAL SOCIETY

Monthly meetings are held at Caloundra State High (except Dec/Jan.) at 7:30pm. There is a bi-monthly newsletter.

Address: PO Box 166, Kenilworth QLD 4574
Contact: Col Blumson (074) 46-7449 or Ron Knight (074) 46 0908

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

SOUTH AUSTRALIA

ASTRONOMICAL SOCIETY OF FLINDERS UNIVERSITY

Contact: (08) 201-2954

BOWMAN PARK ASTRONOMICAL SOCIETY

The society meets twice monthly. It also runs an observatory with a 400mm telescope.

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

ELEANORA CENTRE ASTRONOMY GROUP

Noarlunga Downs : Contact (08) 382-1490

ASTRONOMICAL SOCIETY OF SOUTH AUSTRALIA

Meetings are held on the 1st Wednesday of each month (except Jan.) at the Uni. of South Australia, Levels Campus. The society maintains two observatories. The Heights Observatory at Heights School, Modbury, houses a 300mm telescope. T he society's country 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

TASMANIA

ASTRONOMICAL SOCIETY OF TASMANIA (AST)

Meetings are held at the Hutchins School, Sandy Bay, on the last Tuesday of each month (except December). The September meeting is held at Launceston Planetarium. In line with the society's aim of promoting interest in astronomy, public field nights are held twice a year in Hobart and once a year in Launceston. Presentations are made to school and community groups. The society also offers an observatory at Sandy Bay and a library.

Fees: $29 family, $27 full, $24 country (joining fee $5) and $17 concession (joining fee $2).
Address: c/o Norwood Ave. PO, Launceston TAS 7250
Contact: Karen Barnes (003) 44-7100

VICTORIA

ALBURY WODONGA ASTRONOMICAL SOCIETY

The society has occasional meetings at Wodonga High and holds regular viewing nights at the observatory at the school.

Fees: $12 adult, $15 family
Address: 1 Poplar St., Wodonga VIC 3690
Contact: John Hawkin (060) 24-5535

ASTRONOMICAL SOCIETY OF FRANKSTON

Meets at the Peninsula Church of England School, Wooralla Drive, Mt Eliza, on the 3rd Wednesday of each month at 8pm. Membership currently stands at around 100 and they are very active in many fields. They have a bimonthly newsletter and hold regular member's viewing nights at the society's dark sky site on the Mornington Peninsula (1.5 hours drive south of Melbourne). An observatory is currently under development at this location. The society conducts numerous public, school and community group viewing nights and presentations. Each year a Winter lecture series in Astronomy is held for the public.

Fees: $20 adult, $15 concession/ junior, $30 family and $10 newsletter only. (Rates may increase Nov. 95)
Address: PO Box 596, Frankston VIC 3199
Contact: Don Leggett (059) 85-4927

ASTRONOMICAL SOCIETY OF GEELONG

Holds a general meeting the last Friday of each month, plus meetings every other Friday. The venue is the Belmont Common (Breakwater Rd., Breakwater). The society publishes a quarterly newsletter and holds regular viewing nights for schools and community groups as required.

Fees: $30 adult, $45 family and $15 junior and concession.
Address: PO Box 1799, Geelong VIC 3220
Contact: Miles Charlesworth (Pres.) (052) 21-7484 or Robert Cowdell (Sec.) (052) 55-2702.

ASTRONOMICAL SOCIETY OF VICTORIA (ASV)

Meetings are held on the 2nd Wednesday of each month (except Jan.) at the Herbarium, Botanic Gardens in Melbourne (Birdwood Avenue, South Yarra). The ASV is probably the largest society in Australia with numerous specialist sections catering to a wide range of astronomical tastes. 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 north of Melbourne) The Heathcote site will soon have toilets and concrete pads.

Fees: $35 ordinary members, $24 country member (there is also $20 joining fee) and $24 junior (under 19) - No joining fee.
Address: GPO Box 1059J, Melbourne VIC 3001
Contact: Ms. Linda Mockridge (Pub. Rel.) (03) 9596-5884 (evenings)
Internet site ASTROVIC (ASV Home Page):
http://www.vicnet.net.au/~astrovic/asv.htm

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

THE BENDIGO DISTRICT ASTRONOMICAL SOCIETY

The society meets at the London Campus, TAFE (Bendigo) on the 4th Wednesday of each month (excluding December). A monthly newsletter is published and regular field nights are held around Bendigo.

Fees: $28 adult, $15 junior and $40 family.
Address: PO Box 123, Golden Square, Bendigo VIC 3555
Contact: Lisa Hewitt (054) 74-8220

LATROBE VALLEY ASTRONOMICAL SOCIETY

Meets at Monash Uni. College, Churchill, on the 2nd Tuesday of each month at 7:30pm. 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

NORTHERN TERRITORY

ASTRONOMICAL SOCIETY OF ALICE SPRINGS

The society holds meetings on the 2nd Monday of each month at the Motor Registry Office 'Metal Centre'.

Fees: $20 full, $25 family
Address: Box 739, Alice Springs NT 0871
Contact: Karl Kramer (Pres.) (089) 52-6426

DARWIN ASTRONOMY GROUP

Observing nights are held during the dry season. There are occasional meetings.

Address: GPO Box 3043, Darwin NT 0801
Contact: Robert Lang (089) 81-1985

WESTERN AUSTRALIA

ASTRONOMICAL SOCIETY OF WA

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. Meetings are conducted each month at the University and usually consisting of observation reports, slide shows, informal talks and occasional guest speakers. Regular viewing at the university's observatory as well as field and deep sky observing, at various places outside of Perth, are all part of the society's activities. The society owns a 30cm (suitable for astrophotography) and 15cm telescopes. The society has also been active in taking astronomy to the public via public viewing nights. Annual astro camps, for members. are also conducted at Meline sheep station near Mt. Magnet. There is also a small library of magazines and slides available to members.

Fees: Murdoch students $ 6, non students $15
Address: c/- Murdoch University, School of Mathematical and Physical Sciences, Murdoch WA 6150
Contact: Physics office, (09) 360-2433

ASTRONOMICAL SOCIETY OF THE SOUTH WEST

Conducts monthly meetings. The main aim of the ASSW is to increase public awareness in astronomy.

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

NEWMAN ASTRONOMICAL SOCIETY

Newman Contact: (091) 75-2660

PILBARA ASTRONOMICAL SOCIETY

Sth Hedland Contact: (091) 40-1512

GLOSSARY

AEST Australian Eastern Standard Time.

ACST Australian Central Standard Time.

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.

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.

Open star cluster A loose association of stars numbering from a few dozen to hundreds.

Opposition When a celestial body is opposite the Sun in the sky.

Orbit The path followed by one body as it moves around another.

Parallax An apparent shift in the positions of nearby stars (relative to more distant ones) from the changing position of the Earth in its orbit around the Sun. The size of the shift can be used to measure the distances to the nearer stars.

Parsec A unit of distance used by astronomers which is equal to 3.26 ***light years***. A parsec is defined as the distance to a celestial body whose ***parallax*** is one arc second.

Penumbra Area of partial illumination in the shadow of a planet surrounding the Umbra. Also zone of intermediate brightness between a sunspot and the solar photosphere.

Perigee The point at which a body in orbit around the Earth most closely approaches the Earth.

Perihelion The point in an orbit closest to the Sun, of a comet, planet or minor planet. It is opposite to ***aphelion***.

Perturbation Small changes in the motion of a body caused by the gravitational effects of another body.

Planetary nebula An expanding shell of gas ejected from a star. Thought to be the outer layers of a red giant during its latter stages of evolution, the core of which becomes a white dwarf.

Planisphere A handheld aid used to identify which constellations are visible to an observer on any particular date and time.

Polar axis The axis around which a celestial body rotates.

Proper motion The small change in position of nearby stars due to motion across the line of sight (measured in seconds of arc per year).

Quadrature A configuration that two celestial bodies have apparent longitudes that differ by 90° as viewed from a third body.

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 (24 hrs = 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 23 hrs 56 m 4 s 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 Australian Eastern Standard Time (AEST).

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

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