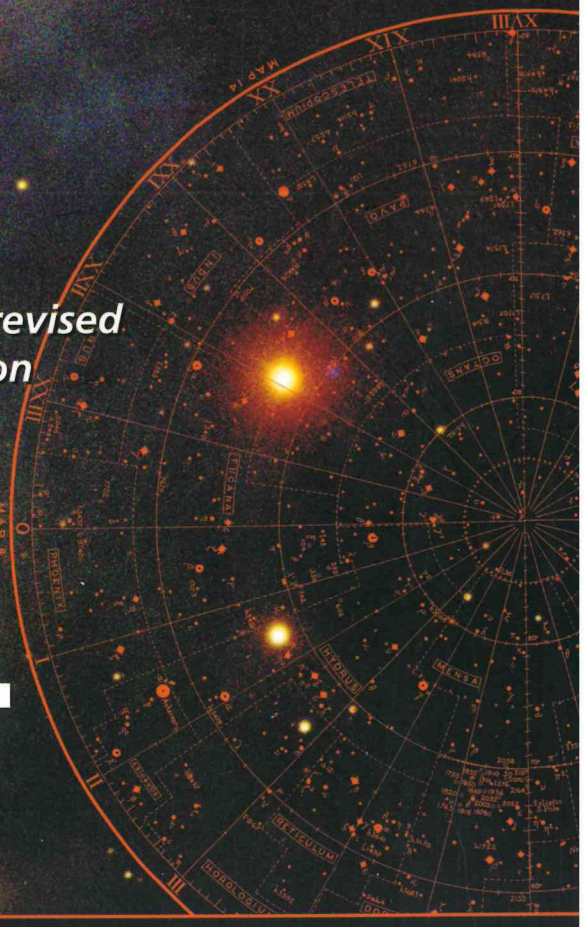
WESTERN AUSTRALIAN

ASTRONOMY ALMANAC

The really useful guide to the wonders of the night sky

Highlights:
May 5 – Total Eclipse of the Moon
June 8 – Transit of Venus

Over 100 pages of recently revised astronomical information



2004

PERTH OBSERVATORY

GOVERNMENT OF WESTERN AUSTRALIA

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

2004

JANUARY 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
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4	5	6	7 ○	8	9	10
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FEBRUARY 2004

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29						

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MAY 2004

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JUNE 2004

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AUGUST 2004

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29	30 ○	31				

SEPTEMBER 2004

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			1	2	3	4
5	6 ◐	7	8	9	10	11
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OCTOBER 2004

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24	25	26	27	28 ○	29	30

NOVEMBER 2004

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5 ◐	6
7	8	9	10	11	12 ●	13
14	15	16	17	18	19 ◑	20
21	22	23	24	25	26	27 ○
28	29	30				

DECEMBER 2004

Sun	Mon	Tue	Wed	Thu	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

WESTERN AUSTRALIAN

ASTRONOMY ALMANAC

2004

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Disclaimer: Perth Observatory has gone to a great deal of effort to ensure that all the details in this almanac are correct. However, the Perth Observatory cannot be held responsible for any eventuality arising out of the use of the data herein. It is advisable to contact Perth Observatory directly with your astronomical data requirements in order to maximise their quality. Please note that charges apply for such consultancies.

ACKNOWLEDGEMENTS

Thanks to Perth Observatory staff for proof reading and input, Peter Pieloor of Ali B Design for all the graphic design work, and the taxpayers of Western Australia who have supported Perth Observatory for over a century.

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'Astronomical Almanac for the Year 2004', (US Naval Observatory/H.M. Nautical Almanac Office, Rutherford Appleton Laboratory).

'Astronomical Tables of the Sun, Moon and Planets', 2nd ed., 1995, by Jean Meeus, Willmann-Bell Inc.

'The Cambridge Guide to the Constellations', 1995, by Michael E Bakich, Cambridge University Press

'Eclipse! The What, Where, When, Why and How Guide to Watching Solar and Lunar Eclipses', 1997, by Philip Harrington, John Wiley & Sons, Inc.

'Explanatory Supplement to the Astronomical Almanac', 1992, ed. by P. K. Seidelmann, University Science Books, Mill Valley, California, USA

'Mathematical Astronomy Morsels', 1997, by Jean Meeus, Willmann-Bell Inc.

'The Southern Sky Guide', 1993, by David Ellyard & Wil Tirion, Cambridge University Press

'Total Eclipses: Science, Observations, Myths and Legends', 1999, by Pierre Guillermier and Serge Koutchmy, Springer – Praxis Series in Astronomy.

'2004 Transit of Venus', 2004, by Fred Espenak, in the 'Observer's Handbook 2004', Royal Astronomical Society of Canada

Heavens Above website http://www.heavens-above.com

ICQ/CBAT/MPC World Wide Web pages http://cfa-www.harvard.edu/iau/

JPL Solar Systems Dynamics Group http://ssd.jpl.nasa.gov/

SIMBAD database, operated at CDS, Strasbourg, France http://simbad.u-strasbg.fr/sim-fid.pl

United States Naval Observatory http://www.usno.navy.mil

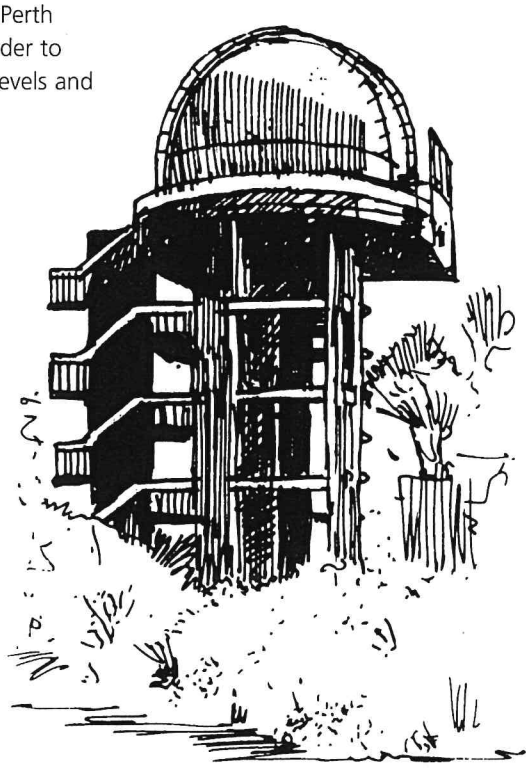
ICE version 0.51, US Naval Observatory, Nautical Almanac Office

Starry Night Pro, version 3.0.2, Sienna Software Inc.

***Front cover image**: Colour composite photo of the Chamaeleon I complex of bright nebulae and hot stars in the constellation of the same name, close to the southern celestial pole. (PR Photo 17c/99) © ESO, European Southern Observatory.*

INTRODUCTION

Once again the Earth has made another orbit around the Sun and it's time to consult the latest Western Australian Astronomy Almanac. This almanac is compiled and published by Perth Observatory, Australia's oldest continuously operating astronomical observatory, in order to assist the local community enjoy the night sky. It is designed to cater for a range of levels and interest – from the complete novice to the very keen amateur.



We hope you enjoy this updated and expanded Almanac. It now has an additional sixteen pages in order to accommodate monthly charts of Saturn's moons, lunar eclipse information, Solar System object naming information, Moon facts, comet ephemerides, a map showing the location of the nearest stars, how to tell the time using the Southern Cross, and a sub-section that will assist newcomers interpret any unusual sightings they may witness. Updated items include outer Solar System charts, close approaches by asteroids and comets, astronomy definitions and places of astronomical interest.

TOTAL ECLIPSE OF THE MOON ON MAY 5
Get up after midnight to view the Full Moon darken.

The first major event for 2004 is a total eclipse of the Moon in the early hours of May 5 (ie. after midnight on May 4). The Moon stays dark for quite a long duration – 74 minutes. But not completely dark – it may have a grey, orange, red or copper hue. To find out what colour it turns, get outside and observe it, no special instruments are required.

BRIGHT COMETS LATE MAY?

Dare we mention bright comets visible to the naked eye? Comets C/NEAT (2001 Q4) and C/LINEAR (2002 T7) may brighten to naked eye visibility from around the middle of the month. At that time they will be located low in the West and North-west sky after sunset. Please note that ***comet brightness is notoriously difficult to predict and naked-eye visibility is not guaranteed!***

TRANSIT OF VENUS ON JUNE 8 – this is a rare event, occurring about every 74 years.

Last year Mercury transited across the face of the Sun, this year it's Venus' turn to line up with the Sun and Earth and have a transit. Transits of Venus are more scientifically productive than those involving Mercury because Venus is physically larger and closer, and the effect of parallax greater. However, they are quite rare with an occurrence of only one about every 74 years. Two centuries ago, measuring the time of passage across the Sun's disc from various locations scattered across the globe facilitated accurate determination of the size of the Solar System, or rather, the size of the planetary orbits within the Solar System. This is an interesting result in itself, as it is the first rung on the ladder of determining the size of the Universe. Also, knowing the sizes of the orbits assisted the determination of the size and reflectivity of the planets and their moons. A word of caution: ***Do not risk your eyesight by looking at, or observing the Sun with optical instruments***. See section: *Eclipses, Transits & Occultations* for more details.

Transits of Venus have a special connection for Australians because it was after observing the 1769 transit in Tahiti that Captain Cook arrived on the East Coast of Australia and claimed it for Britain, thus setting in train its colonisation by Europeans.

FREE COMPETITION: The author of the most helpful feedback will receive a free copy of the Western Australian Astronomy Almanac for 2005.

Thankyou to all those who provided feedback regarding the 2003 edition. We hope we have been able to satisfy all your information needs. If we haven't - please contact us. Like last year, the author of the most helpful feedback will receive a free copy of the Western Australian Astronomy Almanac for 2005. Standard rules apply: All entries must be in writing, the judge's decision is final and no correspondence will be entered into. Final submission date for feedback is 2004 March 1.

What other sporadic and possibly spectacular astronomical events will occur this year? Some events just can't be predicted, but if you don't get outside and have a look at the night sky you will have no chance of enjoying them. And best of all - they're free!

James Biggs, BSc (hons) PhD
Government Astronomer for Western Australia,
Director of Perth Observatory,
and Adjunct Associate Professor, Curtin University of Technology.

***Competence** requires practice. So if you want to appreciate the night sky beyond the level of simple wonderment (which we might add is a reasonable thing in itself) then you have to practice – you have to get out and observe, and prepare yourself so that you know what you are observing.*

Here are some steps that you should take in order to gain a deeper appreciation of the night sky.

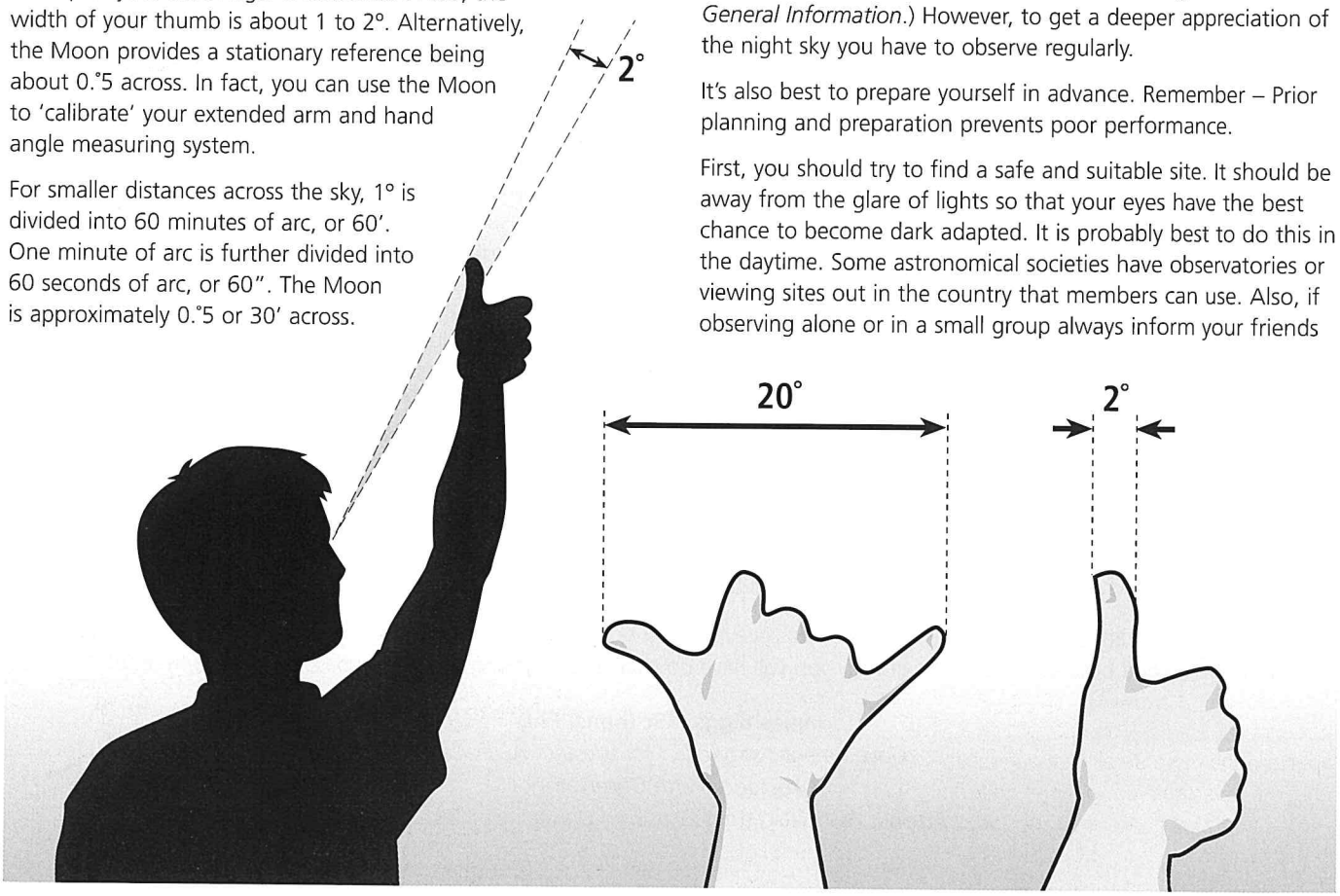
Read astronomy books and other media

It's best to be prepared before you step outside to observe. This means obtaining some reliable background information about what there is to view, in which direction, what time it's visible and so on. This Almanac is a great place to start. It's designed to assist star viewing. Even when you are more expert you can consult it for the information that will assist your nights observing. There are also many websites, magazines, books, CDs and videos that can assist you. We have listed some useful websites in section: *Background & General Information* that can get you started and they also have references to resources in other media.

A planisphere is a useful tool. It has a representation of the stars and constellations visible for any night of the year. Make sure you purchase the correct one for your latitude.

One important issue in becoming familiar with the sky is size. Astronomers measure distances across the sky in degrees. We all know that in a circle there are 360°. However this is rather large and not easily applicable to star viewing. There is an easy way to estimate smaller angles. Stretch out your arm in front of you. Open your hand and extend your fingers. With your arm outstretched, the angle between the tip of your thumb and tip of your little finger is about 20°. Also, the width of your thumb is about 1 to 2°. Alternatively, the Moon provides a stationary reference being about 0.°5 across. In fact, you can use the Moon to 'calibrate' your extended arm and hand angle measuring system.

For smaller distances across the sky, 1° is divided into 60 minutes of arc, or 60'. One minute of arc is further divided into 60 seconds of arc, or 60". The Moon is approximately 0.°5 or 30' across.



These detailed units are used in the tables of accurate positions of objects in the sky, for example, see section: *Solar System Information*. Also note the way that astronomers write decimal angles – the symbol is always placed after its integer part, eg $^1/_2{}^\circ$ = 30' = **0.°5**, not 0.5°. Another system to define angular positions on the sky uses time-based units: hours, minutes and seconds. This type of unit is convenient because the sky moves one rotation about every 24 hours, similar to the Sun. In this system, one complete rotation corresponds to 24 hours (denoted 24^h) and the hour is subdivided into minutes and seconds in the conventional way. Note: This system is used for positions on the sky, for example right ascension. In order to measure positional differences the system based on degrees, arc minutes and arc seconds should be used.

Join an astronomy society

At an astronomy society you will meet a diverse range of people who have in common a great appreciation for and fascination with astronomy. The more established members are a great source of knowledge not only about the sky, but also instruments and observing sites. These societies can also provide enjoyable learning opportunities with formal and semi-formal lectures on astronomical topics, viewing nights, camps for star viewing and the like. The viewing nights also present an opportunity to learn about telescopes from the people who already own one. Some local societies are listed in section: *Western Australian Places of Astronomical Interest*.

Basic Observing

A lot of star viewing occurs incidentally, while putting out the rubbish bin, driving home late from a trip to the country and so on. You can see some spectacular sights when you least expect it. (Some of these are discussed in section: B*ackground & General Information*.) However, to get a deeper appreciation of the night sky you have to observe regularly.

It's also best to prepare yourself in advance. Remember – Prior planning and preparation prevents poor performance.

First, you should try to find a safe and suitable site. It should be away from the glare of lights so that your eyes have the best chance to become dark adapted. It is probably best to do this in the daytime. Some astronomical societies have observatories or viewing sites out in the country that members can use. Also, if observing alone or in a small group always inform your friends

and family and have some form of mobile communication in case of an emergency.

Read your almanacs and reference books, or run your computer programs to find out what's where and when, then make a list of things to see and do, set up at your observing site and get some equipment to make yourself comfortable such as a chair and blanket well before it gets dark. Also, it's advisable to wear stout shoes to protect your feet.

It also pays to inquire about the weather beforehand. You may need to dress warmly – you will probably be exposed to the breeze and this may create a wind chill factor that can make conditions cool even in summer. Also, star viewing is a rather low energy activity. This has the benefit that star viewing presents little restriction with regard to physical fitness - but keeping your body warm is an issue. If the weather is warm or still, insect repellent may be required.

Whilst star viewing is not a strenuous activity muscle strains can occur if your body is contorted in order to view through a telescope eyepiece or the like. In your planning think about what you will be doing. A simple folding chair may be very useful to minimise the risk of strain injuries.

Bring some spares. Batteries for your torch (very low power, or lens covered with red cellophane), spare cables etc, and food and drink for the humans!

Being organised means that there will be less need to rush and less possibility of mistakes or accidents during star viewing.

Keep it simple

Don't rush out to buy a telescope! There are a lot of telescopes that have been used once then never used again.

Become familiar with what is visible to the unaided eye. In fact, the eye is the best 'instrument' to view large sections of the sky such as those of constellation size. This also gives you an appreciation of the location of stars and constellations and at what season and time they are visible.

Objects that are visible with the unaided eye are the Moon and the five brightest planets, shooting stars (meteors), satellites, and more rarely, meteor showers, bright comets and auroras.

Optical Instruments

Binoculars are a good instrument to start with. They are mass produced and this means that generally their optical quality is quite good, and cost relatively cheap.

They come in a variety of sizes. 7 x 50 binoculars are a cost effective choice. The 7 refers to their magnification and 50 is the width of the lens in millimetres.

Binoculars need to be held steady in order to minimise image shake. This can be done by leaning up against a tree, or wall, or mounting them on a tripod.

More detail is visible when using binoculars as compared to the unaided eye. This is a simple fact of physics – the wider the aperture the more detail that can be seen. Also, fainter objects become detectable using larger collecting areas; the pupil in the human eye has an aperture of about 7mm, compared to tens of millimetres for binoculars. Sights to see with binoculars include the craters of the Moon, the moons of Jupiter, bright comets (should any be around), star clusters and vistas rich in stars especially along the Milky Way.

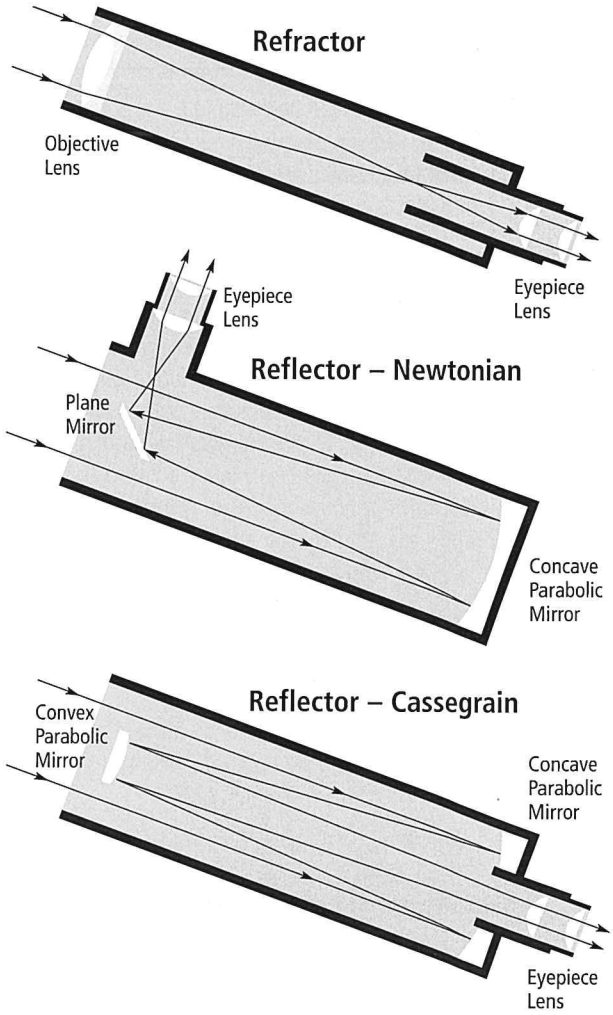
Buying a telescope

Eventually, if you've enjoyed doing all the things mentioned above you will probably want to buy your own telescope. Beware of any telescope that is advertised promoting its high magnification. These are probably built for a price, and not quality. It probably does have a high magnification, but what you will end up magnifying is the distortion in the telescope and atmosphere. Read widely about telescopes and purchase from a reputable business.

The subject of astronomical telescopes is quite large and only a very brief discussion is presented here. Telescopes come in three basic types:

- ***refractors*** – uses lenses,
- ***reflectors*** – uses a concave mirror to focus light, and
- ***catadioptrics*** – part reflecting telescope that has a correcting lens at the top to form the image. Most catadioptrics are of the Schmidt-Cassegrain design and these are quite a popular and useful design.

A sturdy mount is necessary in order to keep the image stable. A motor drive is also very useful as it allows your telescope to track celestial objects (assuming it is aligned correctly). This eliminates the tedious task of winding knobs in order to keep objects in the field of view and allows you to concentrate on astronomy.



HOW TO USE THIS ALMANAC

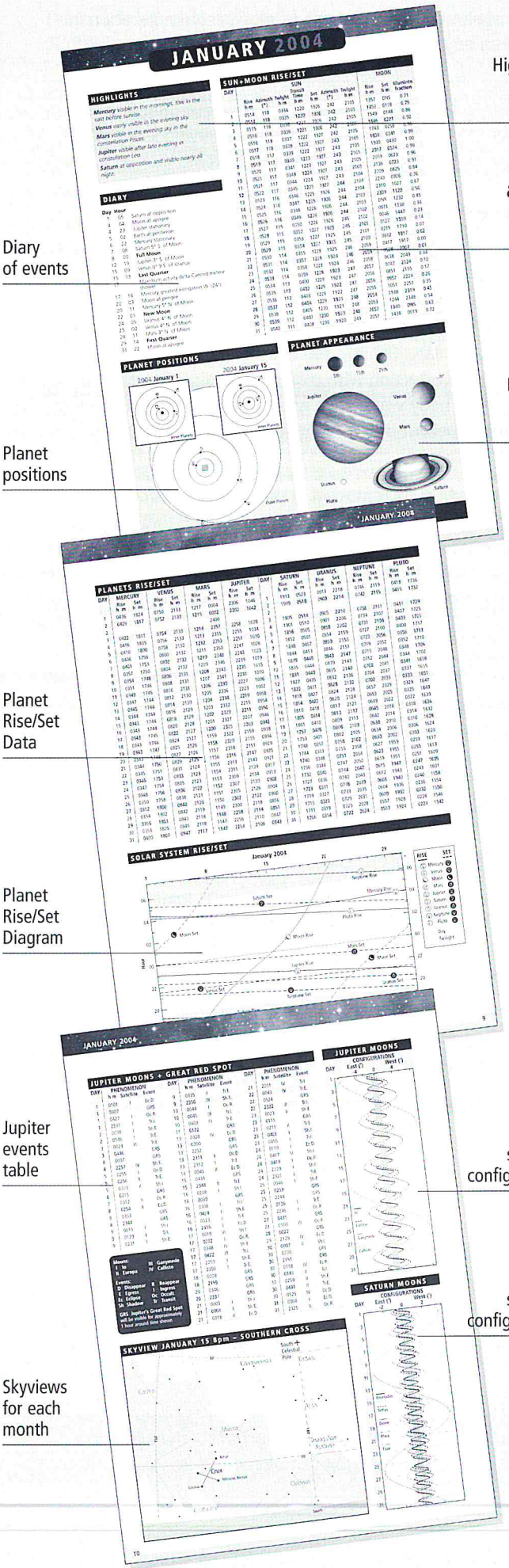
***The majority** of this almanac is dedicated to the provision of detailed information about what is to be seen and where it is located for each month. Following that is a section providing details about very rare and/or unusual events. Finally, the later sections provide background and reference information relevant for this year, as well as more general astronomical information.*

Monthly Sections

Highlights for each month and a more detailed diary of events are provided in the **monthly sections**. A chart of rise and set times is provided in order to assist determination of whether an object is visible. Also, the relative size of the planets (in seconds of arc) is illustrated graphically. In order to put the previous information in context a diagram of the inner Solar System is included for the beginning and middle of the month. Also, the planets in the outer Solar System do not move very fast and one plot for the middle of the month is provided for them. Detailed rise and set times for the major Solar System objects are tabulated along with other useful information such as twilight times, azimuth of sunrise and set, and the fraction of the Moon illuminated. In the table of Moon rise and set times, DNR indicates the Moon did not rise on that date, and DNS indicates the Moon did not set on that date. Note that all times are given in Western Australian Standard Times (WAST = Universal Time (formerly known as Greenwich Mean Time) + 8 hours) unless noted otherwise and twilight refers to astronomical twilight – the time when the Sun is 18° below the horizon and its glow is approximately equal to the background starlight. Sometimes the planets rise or set twice in one night and this is just a consequence of the planet's and Earth's orbital motions. All rise and set times are correct for observers in Perth, however graphs indicating the corrections required for observers elsewhere in WA are provided in section: *Background and General Information*.

Jupiter is the next major focus of these sections. A table is provided that indicates the time of events involving its four brightest moons Io (I), Europa (II), Ganymede (III) and Callisto (IV). The events indicated are a transit (Tr, passage of moon across Jupiter), shadow (Sh, a moon's shadow crosses the disc of Jupiter), eclipse (Ec, a moon passes into Jupiter's shadow) and occultation (Oc, a moon passes behind Jupiter). The timings associated with these events are related to the disappearance (D) and reappearance (R) of a moon after an occultation, and, ingress (I) into, and egress (E) from, Jupiter's disc associated with a transit, shadow or eclipse event. Also, the times of visibility of Jupiter's Great Red Spot (GRS) are provided. In practise, it is only visible for around one hour centred on these times and is notoriously difficult to detect without stable atmospheric conditions and a decent telescope. The positions of the moons with respect to Jupiter are also illustrated graphically. Also, a chart indicating the positions of the moons of Saturn is included.

The last component of these sections is one of the most useful – the sky views – charts showing the planet or object of interest against the background of brighter stars. These are a great aid in assisting beginners find their way around the sky. Please note that the size of the Moon in these images is larger than it should be in order to aid clarity.



Additional Sections

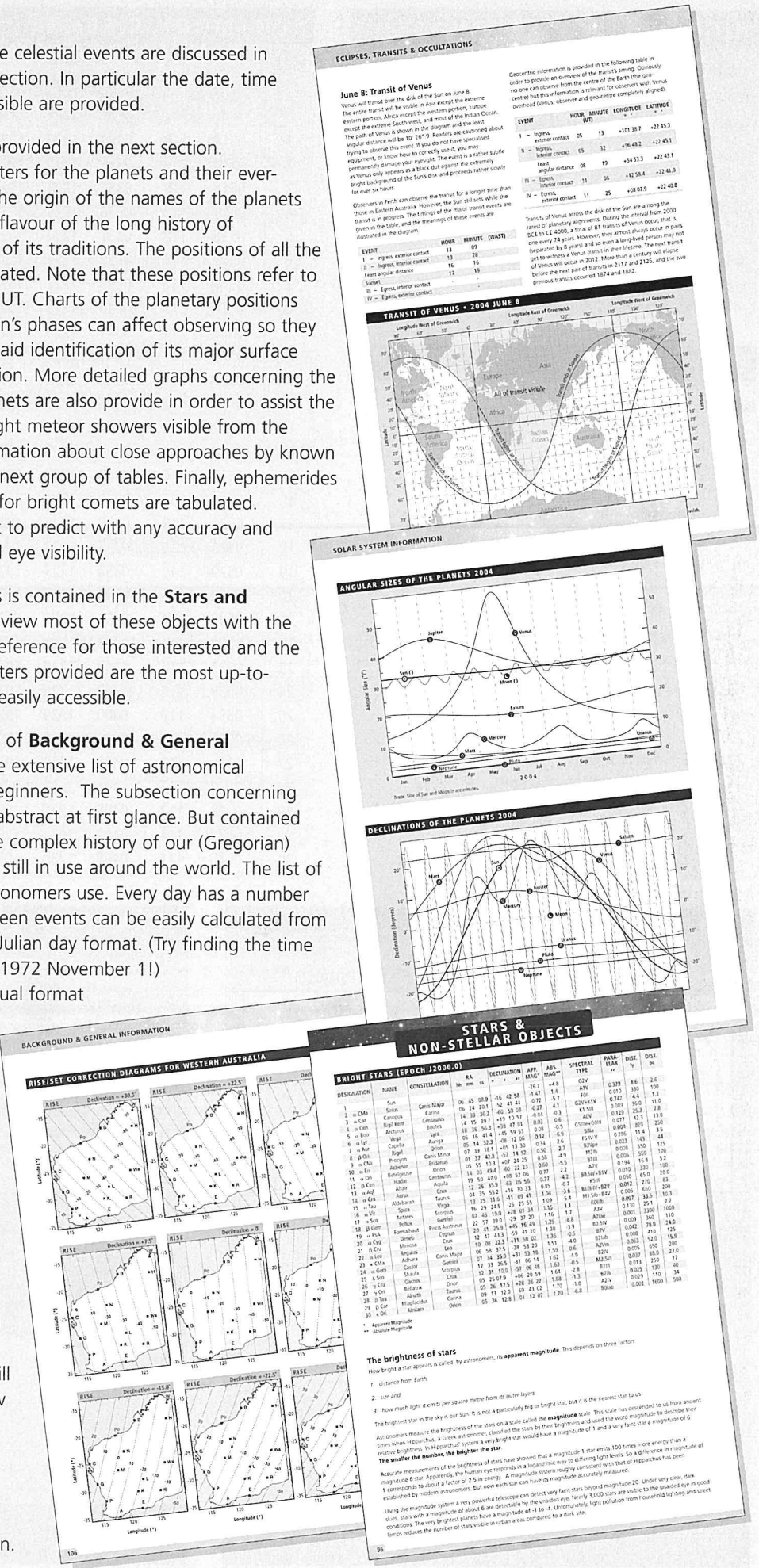
Some of the more spectacular and/or rare celestial events are discussed in the **Eclipses, Transits & Occultations** Section. In particular the date, time and region where the event is actually visible are provided.

Detailed **Solar System information** is provided in the next section. This includes up-to-date physical parameters for the planets and their ever-increasing number of moons. Notes on the origin of the names of the planets and moons are also provided and give a flavour of the long history of astronomy and the creative continuation of its traditions. The positions of all the major Solar System objects are also tabulated. Note that these positions refer to 0000 WAST, which corresponds to 1600 UT. Charts of the planetary positions over the year are also included. The Moon's phases can affect observing so they are provided, along with a map that will aid identification of its major surface features, and some basic Moon information. More detailed graphs concerning the positions, sizes, brightness etc of the planets are also provide in order to assist the more experienced observers. A list of bright meteor showers visible from the Southern Hemisphere is also given. Information about close approaches by known asteroids and comets is contained in the next group of tables. Finally, ephemerides (tables of position as a function of time) for bright comets are tabulated. Note: the brightness of comets is difficult to predict with any accuracy and the brighter objects may not reach naked eye visibility.

A detailed section with explanatory notes is contained in the **Stars and Non-Stellar Objects** sections. You can't view most of these objects with the unaided eye, but they are included as a reference for those interested and the more experienced observers. The parameters provided are the most up-to-date from recent observations that were easily accessible.

The penultimate section contains a range of **Background & General Information**. The list of websites and the extensive list of astronomical definitions will be particularly useful to beginners. The subsection concerning calendars and the like may appear quiet abstract at first glance. But contained within it is information that alludes to the complex history of our (Gregorian) calendar system, and the other calendars still in use around the world. The list of Julian day numbers is a calendar that astronomers use. Every day has a number assigned to it, and the time interval between events can be easily calculated from the difference between the two dates in Julian day format. (Try finding the time interval between, say, 1963 April 29 and 1972 November 1!)
Also note that astronomers have an unusual format for dates and times. Not only do they use a 24 hour clock, but also they always put the most significant part first, and the least last. For example, 2pm on the 6th of July, 1990 becomes CE 1990 July 6 1400 (CE means the Common Era, a modern variant of AD). This system is also the international standard. A new entry in this section will aid naked-eye observers interpret, what might appear at first sight to be, unusual observations. Readers are most welcome to use the observation form provided and submit recent observations that they cannot readily identify themselves. You will also find a section that will show you how to tell the time using the Southern Cross.

The final section, **Western Australian Places of Astronomical Interest**, lists a number of places you can visit for an astronomy experience, and societies to join.



JANUARY 2004

HIGHLIGHTS

Mercury *visible in the mornings, low in the east before sunrise.*

Venus *easily visible in the evening sky.*

Mars *visible in the evening sky in the constellation Pisces.*

Jupiter *visible after late evening in constellation Leo.*

Saturn *at opposition and visible nearly all night.*

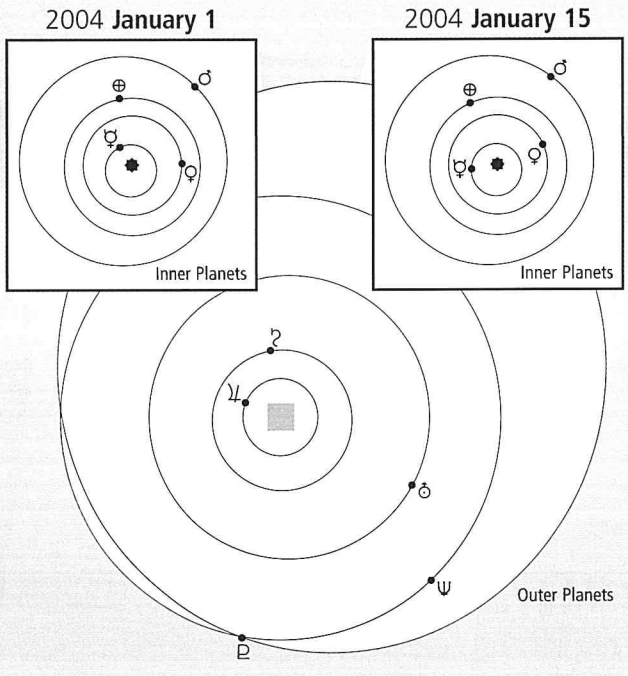
DIARY

Day	Hour	
1	05	Saturn at opposition
4	04	Moon at apogee
4	23	Jupiter stationary
5	02	Earth at perihelion
6	22	Mercury stationary
7	08	Saturn 5° S. of Moon
8	00	**Full Moon**
12	19	Jupiter 3° S. of Moon
15	09	Venus 0°.9 S. of Uranus
15	13	**Last Quarter**
17		Maximum activity delta-Cancrid meteor shower
17	18	Mercury greatest elongation W. (24°)
20	03	Moon at perigee
20	11	Mercury 5° N. of Moon
22	05	**New Moon**
24	05	Uranus 4° N. of Moon
25	00	Venus 4° N. of Moon
28	11	Mars 3° N. of Moon
29	14	**First Quarter**
31	22	Moon at apogee

SUN+MOON RISE/SET

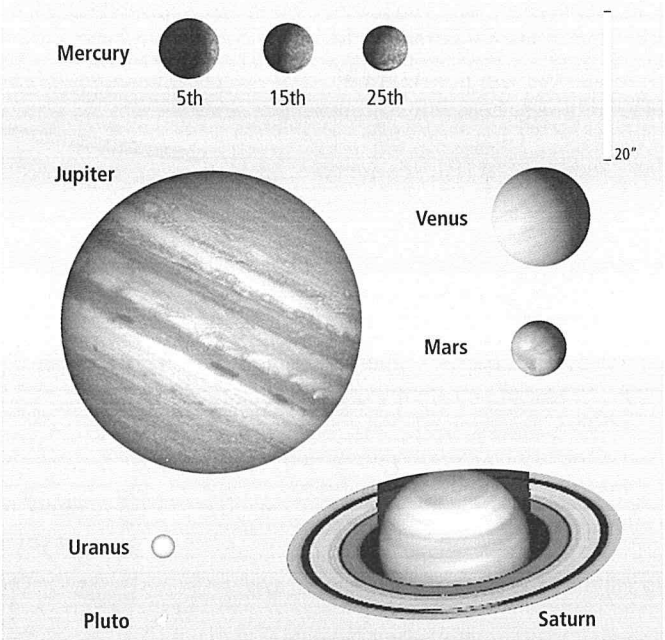
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0514	118	0334	1220	1926	242	2105	1357	DNS	0.71
2	0514	118	0335	1220	1926	242	2105	1453	0118	0.79
3	0515	118	0336	1221	1926	242	2105	1549	0148	0.86
4	0516	118	0336	1221	1926	242	2105	1646	0221	0.92
5	0516	118	0337	1222	1927	242	2105	1743	0258	0.96
6	0517	118	0338	1222	1927	243	2105	1838	0341	0.99
7	0518	117	0339	1222	1927	243	2105	1930	0430	1.00
8	0519	117	0340	1223	1927	243	2105	2017	0524	0.99
9	0520	117	0341	1223	1927	243	2105	2059	0623	0.96
10	0521	117	0343	1224	1927	243	2105	2136	0723	0.91
11	0521	117	0344	1224	1927	243	2104	2209	0825	0.84
12	0522	117	0345	1225	1927	244	2104	2240	0926	0.76
13	0523	116	0346	1225	1926	244	2104	2310	1027	0.67
14	0524	116	0347	1225	1926	244	2103	2339	1128	0.56
15	0525	116	0348	1226	1926	244	2103	DNR	1232	0.45
16	0526	116	0349	1226	1926	244	2102	0011	1338	0.34
17	0527	115	0350	1226	1926	245	2102	0046	1447	0.23
18	0528	115	0352	1227	1925	245	2101	0127	1559	0.14
19	0529	115	0353	1227	1925	245	2101	0215	1710	0.07
20	0529	115	0354	1227	1925	245	2100	0312	1817	0.02
21	0530	114	0355	1228	1925	246	2059	0417	1917	0.00
22	0531	114	0357	1228	1924	246	2059	0528	2007	0.01
23	0532	114	0358	1228	1924	246	2058	0638	2049	0.04
24	0533	114	0359	1228	1923	247	2057	0747	2124	0.10
25	0534	113	0400	1229	1923	247	2056	0851	2155	0.17
26	0535	113	0402	1229	1922	247	2056	0952	2224	0.26
27	0536	113	0403	1229	1922	247	2055	1051	2251	0.35
28	0537	112	0404	1229	1921	248	2054	1148	2319	0.45
29	0538	112	0405	1230	1921	248	2053	1244	2348	0.54
30	0539	112	0407	1230	1920	248	2052	1340	DNS	0.63
31	0540	111	0408	1230	1920	249	2051	1438	0019	0.72

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ♅ Uranus ♇ Pluto
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

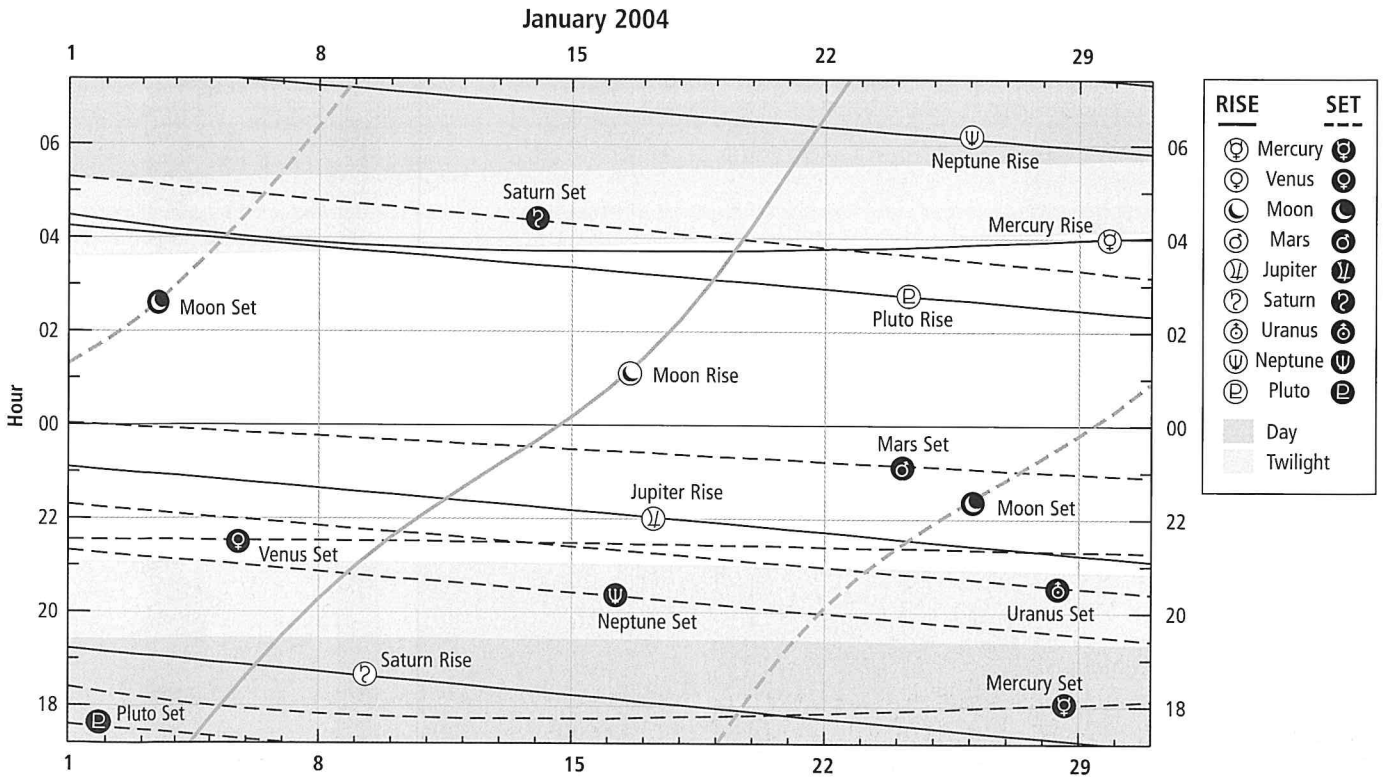


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0436	1824	0750	2133	1217	0004	2306	1046	1	1913	0523	0913	2218	0746	2119	0418	1736
2	0429	1817	0752	2133	1215	0002	2302	1042	2	1909	0518	0909	2214	0742	2115	0415	1732
2						2400			2								
3	0422	1811	0754	2133	1214	2357	2258	1038	3	1905	0514	0905	2210	0738	2111	0411	1729
4	0416	1805	0756	2133	1213	2355	2255	1034	4	1901	0510	0901	2206	0734	2107	0407	1725
5	0410	1800	0758	2132	1212	2353	2251	1030	5	1856	0505	0858	2202	0731	2104	0403	1721
6	0406	1756	0800	2132	1211	2350	2247	1026	6	1852	0501	0854	2159	0727	2100	0400	1717
7	0401	1753	0802	2132	1210	2348	2243	1023	7	1848	0457	0850	2155	0723	2056	0356	1713
8	0357	1750	0804	2132	1209	2346	2239	1019	8	1844	0453	0846	2151	0719	2052	0352	1710
9	0354	1748	0806	2131	1208	2343	2235	1015	9	1839	0448	0843	2147	0715	2048	0348	1706
10	0351	1746	0808	2131	1207	2341	2231	1010	10	1835	0444	0839	2143	0712	2044	0344	1702
11	0349	1745	0810	2131	1206	2339	2227	1006	11	1831	0440	0835	2140	0708	2041	0341	1658
12	0347	1744	0812	2130	1205	2336	2223	1002	12	1827	0435	0832	2136	0704	2037	0337	1655
13	0345	1744	0814	2130	1204	2334	2219	0958	13	1822	0431	0828	2132	0700	2033	0333	1651
14	0344	1744	0816	2129	1203	2332	2215	0954	14	1818	0427	0824	2128	0657	2029	0329	1647
15	0343	1744	0818	2129	1202	2329	2211	0950	15	1814	0422	0820	2124	0653	2025	0325	1643
16	0343	1744	0820	2128	1201	2327	2207	0946	16	1810	0418	0817	2121	0649	2022	0322	1639
17	0343	1745	0822	2127	1200	2325	2203	0942	17	1805	0414	0813	2117	0645	2018	0318	1636
18	0343	1746	0824	2127	1159	2322	2159	0938	18	1801	0410	0809	2113	0642	2014	0314	1632
19	0343	1747	0825	2126	1158	2320	2155	0934	19	1757	0405	0806	2109	0638	2010	0310	1628
20	0343	1748	0827	2126	1157	2318	2151	0929	20	1753	0401	0802	2105	0634	2006	0306	1624
21	0344	1750	0829	2125	1156	2316	2147	0925	21	1748	0357	0758	2102	0630	2002	0303	1620
22	0345	1751	0831	2124	1155	2313	2143	0921	22	1744	0353	0755	2058	0627	1959	0259	1617
23	0346	1753	0833	2123	1154	2311	2139	0917	23	1740	0348	0751	2054	0623	1955	0255	1613
24	0347	1754	0835	2123	1153	2309	2134	0913	24	1736	0344	0747	2050	0619	1951	0251	1609
25	0348	1756	0836	2122	1152	2307	2130	0908	25	1732	0340	0744	2047	0615	1947	0247	1605
26	0350	1758	0838	2121	1151	2305	2126	0904	26	1727	0336	0740	2043	0612	1943	0243	1601
27	0352	1800	0840	2120	1150	2302	2122	0900	27	1723	0331	0736	2039	0608	1940	0240	1558
28	0354	1802	0842	2119	1149	2300	2118	0856	28	1719	0327	0733	2035	0604	1936	0236	1554
29	0356	1803	0843	2118	1148	2258	2114	0851	29	1715	0323	0729	2031	0600	1932	0232	1550
30	0358	1805	0845	2118	1147	2256	2110	0847	30	1711	0319	0725	2028	0557	1928	0228	1546
31	0400	1807	0847	2117	1147	2254	2106	0843	31	1706	0314	0722	2024	0553	1924	0224	1542

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

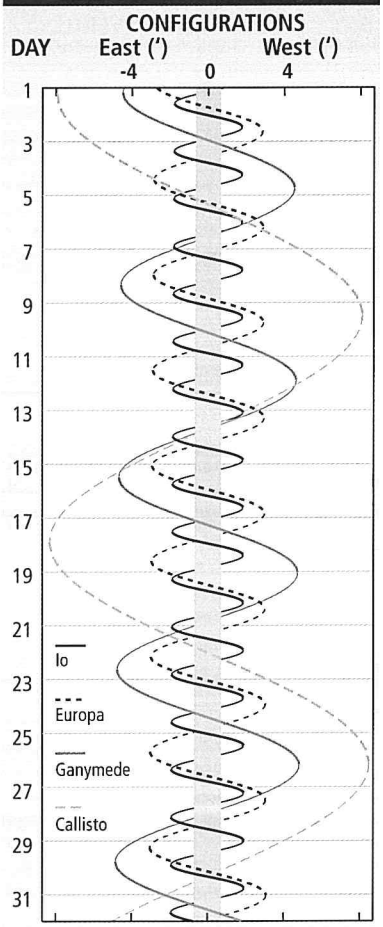
DAY	PHENOMENON h m	Satellite	Event	DAY	PHENOMENON h m	Satellite	Event	DAY	PHENOMENON h m	Satellite	Event
1	0101	I	Ec.D.	9	0335	I	Tr.E.	21	2201	IV	Tr.I.
1	0307		GRS	9	2350	III	Sh.E.	22	0043	IV	Tr.E.
1	0427	I	Oc.R.	10	0044	I	Oc.R.	22	0524		GRS
1	2331	I	Tr.I.	10	0045	III	Tr.I.	22	2322	II	Tr.I.
2	0038	I	Sh.E.	10	0403	III	Tr.E.	23	0023	II	Sh.E.
2	0146	I	Tr.E.	11	0122		GRS	23	0115		GRS
3	0024	III	Tr.E.	13	0328	IV	Ec.D.	23	0211	II	Tr.E.
3	0446		GRS	13	0300		GRS	23	0401	I	Sh.I.
4	0037		GRS	13	2252		GRS	23	0455	I	Tr.I.
4	2257	IV	Sh.E.	13	2311	I	Oc.D.	24	0110	I	Ec.D.
5	0255	I	Oc.D.	13	2312	I	Tr.E.	24	0417	III	Sh.I.
5	0256	I	Tr.E.	14	0045	II	Ec.D.	24	0419	I	Oc.R.
5	0303	II	Sh.I.	15	0438		GRS	24	2229	I	Sh.I.
6	0215		GRS	15	2348	II	Tr.E.	24	2321	I	Tr.I.
7	0312	II	Oc.R.	16	0208	I	Sh.I.	25	0046	I	Sh.E.
8	0254	I	Ec.D.	16	0030		GRS	25	0253		GRS
8	0353		GRS	16	0308	I	Tr.I.	25	2244		GRS
8	2344		GRS	16	0424	I	Sh.E.	25	0136	I	Tr.E.
9	0015	I	Sh.I.	16	0523	I	Tr.E.	25	2246	I	Oc.R.
9	0120	I	Tr.I.	16	2316	I	Ec.D.	27	0431		GRS
9	0231	I	Sh.E.	17	0019	III	Sh.I.	28	0100	III	Oc.R.
				17	0232	I	Oc.R.	28	0022		GRS
				17	0348	III	Sh.E.	29	2129	IV	Ec.D.
				17	0422	III	Tr.I.	30	0007	II	Sh.I.
				17	2253	I	Sh.E.	30	0200		GRS
				17	2350	I	Tr.E.	30	2151		GRS
				18	0208		GRS	30	0118	IV	Ec.R.
				18	2159		GRS	30	0143	II	Tr.I.
				20	0346		GRS	30	0259	II	Sh.E.
				20	2337		GRS	30	0431	II	Tr.E.
				21	0003	I	Sh.I.	30	0525	IV	Oc.D.
				21	0004	I	Sh.E.	31	0304	I	Ec.D.
				21	0318	II	Ec.D.	31	2325	II	Oc.R.

Moons:
I Io III Ganymede
II Europa IV Callisto

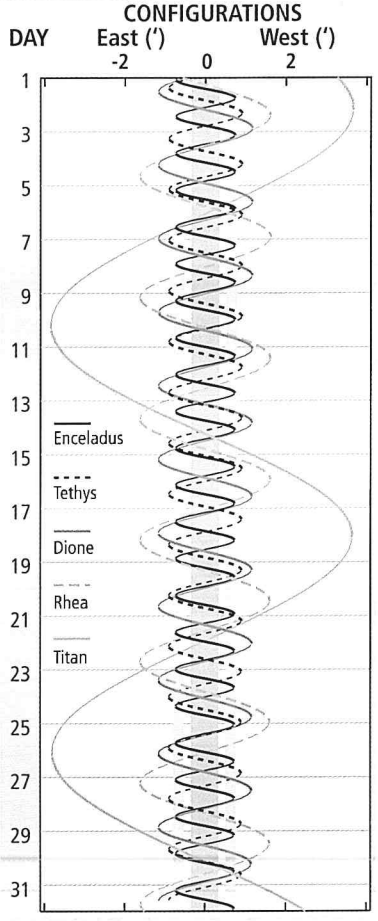
Events:
D Disappear R Reappear
E Egress I Ingress
Ec Eclipse Oc Occult
Sh Shadow Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

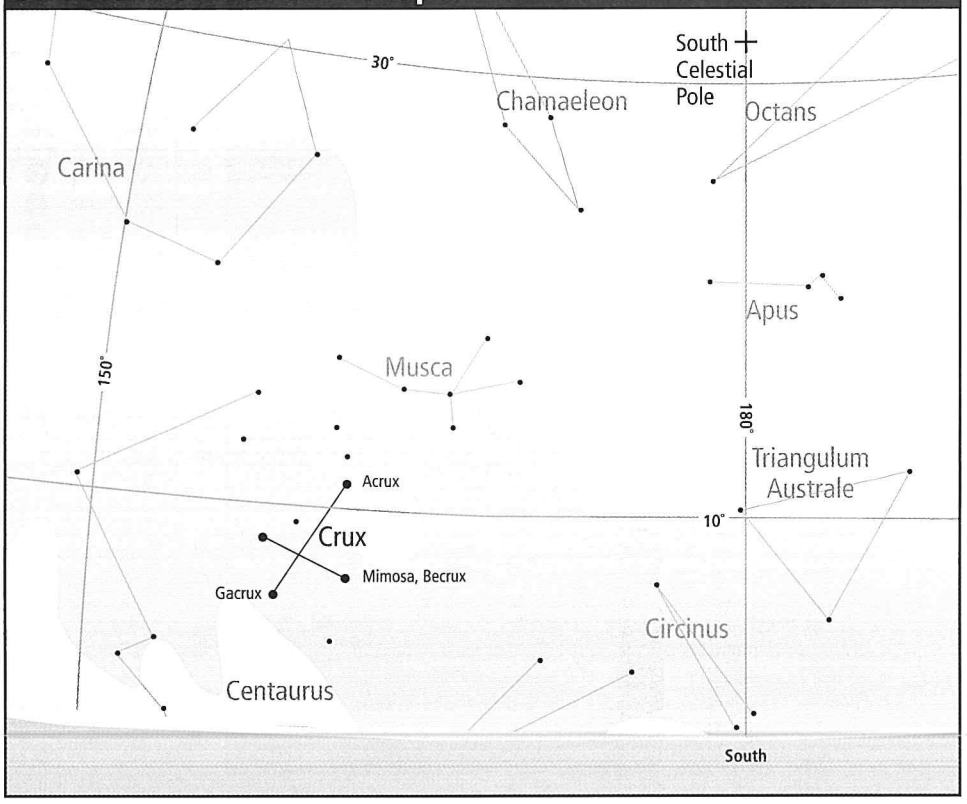
JUPITER MOONS



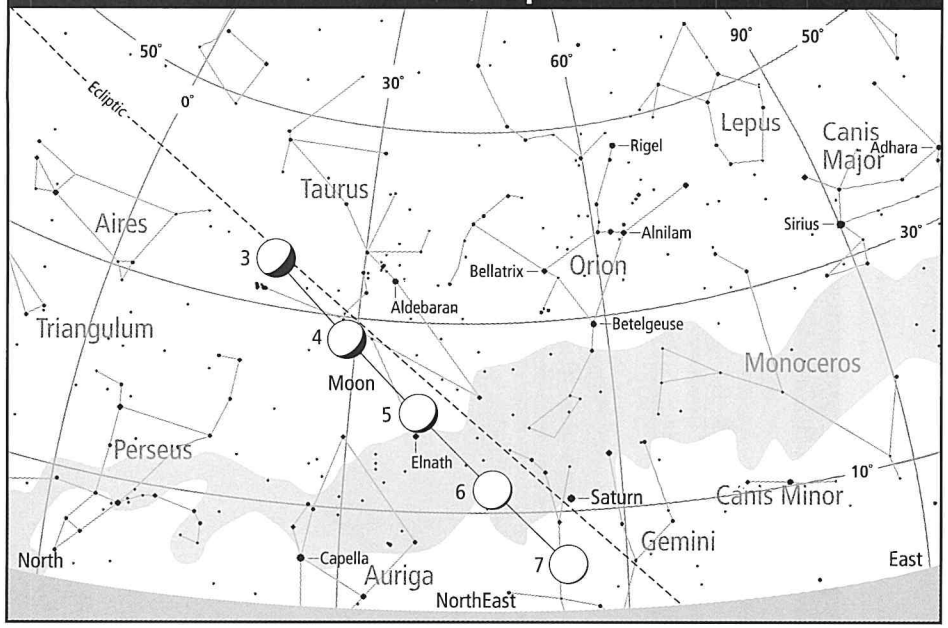
SATURN MOONS



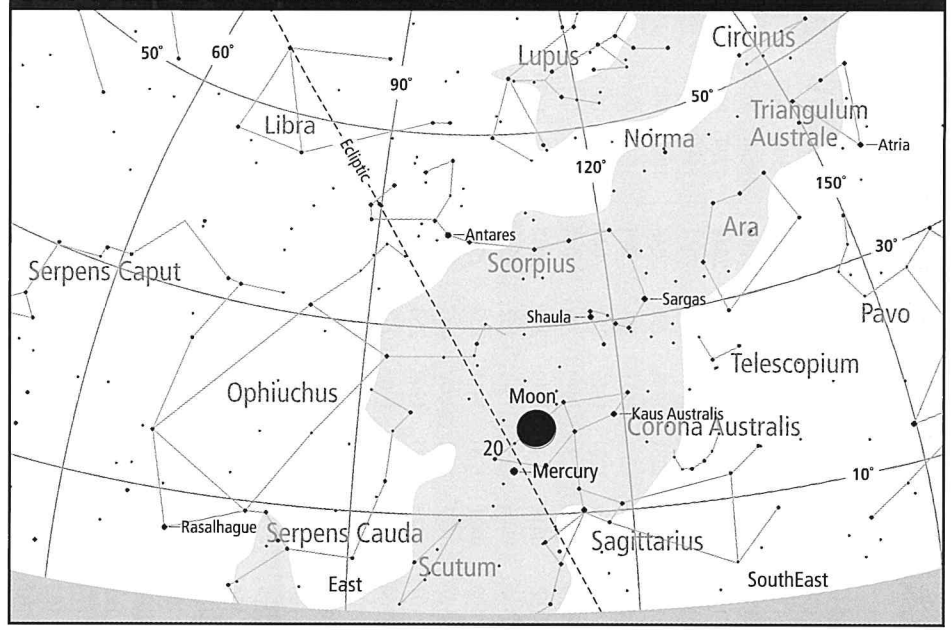
SKYVIEW JANUARY 15 8pm – SOUTHERN CROSS



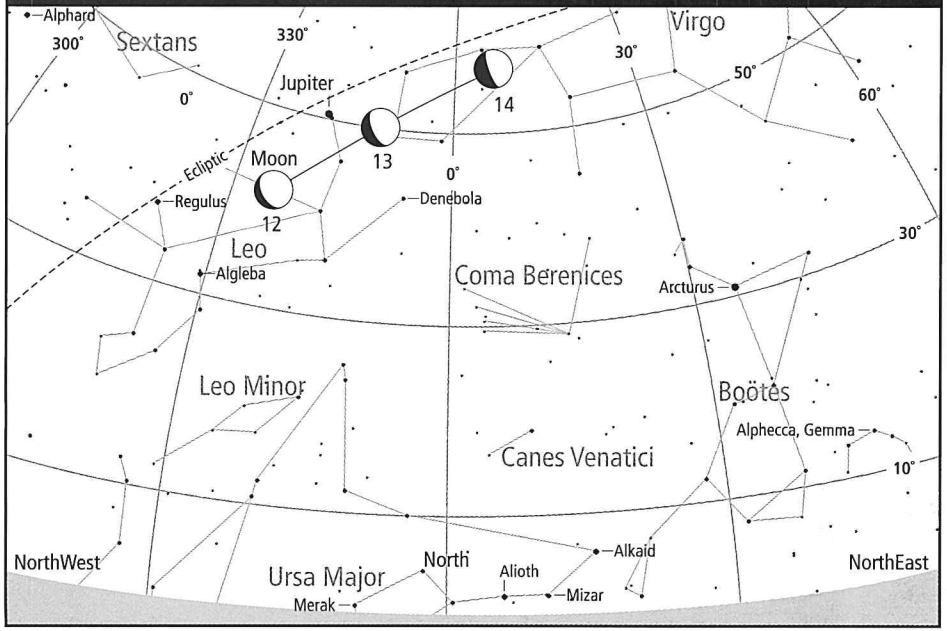
SKYVIEW 2004 JANUARY 3-7 8pm



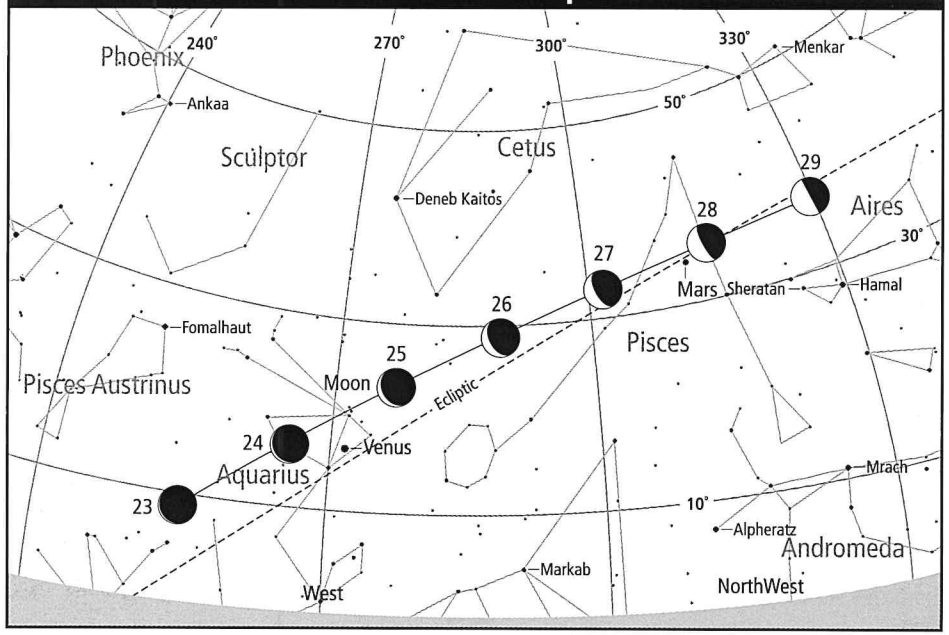
SKYVIEW 2004 JANUARY 20 5am



SKYVIEW 2004 JANUARY 12-14 5am



SKYVIEW 2004 JANUARY 23-29 8pm



FEBRUARY 2004

HIGHLIGHTS

Mercury *visible in the mornings, low in the east before sunrise, in the first half of the month.*

Venus *easily visible in the evening sky.*

Mars *visible in the evening sky in the constellation Aries.*

Jupiter *visible after early evening in constellation Leo.*

Saturn *visible in the evening in constellation Gemini. Decreasing visibility in the morning.*

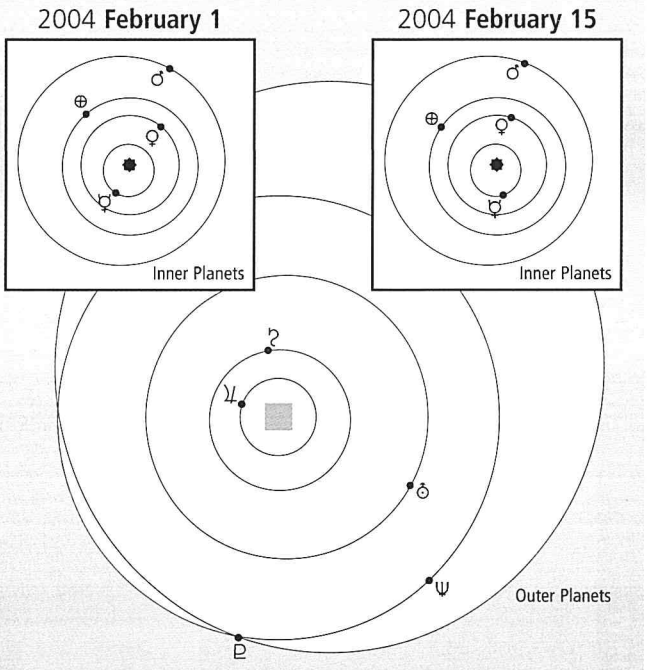
DIARY

Day	Hour	
2	17	Neptune in conjunction with Sun
3	12	Saturn 4° S. of Moon
6	17	**Full Moon**
7		Maximum activity alpha-Centaurid meteor shower
8	22	Jupiter 3° S. of Moon
13	22	**Last Quarter**
15	17	Mercury 2° S. of Neptune
16	16	Moon at perigee
19	09	Neptune 5° N. of Moon
20	17	**New Moon**
22	10	Uranus in conjunction with Sun
24	03	Venus 3° N. of Moon
25		Maximum activity delta-Leonid meteor shower
26	10	Mars 0°.9 N. of Moon – Occultation
28	11	**First Quarter**
28	19	Moon at apogee
29		**Leap Day**

SUN+MOON RISE/SET

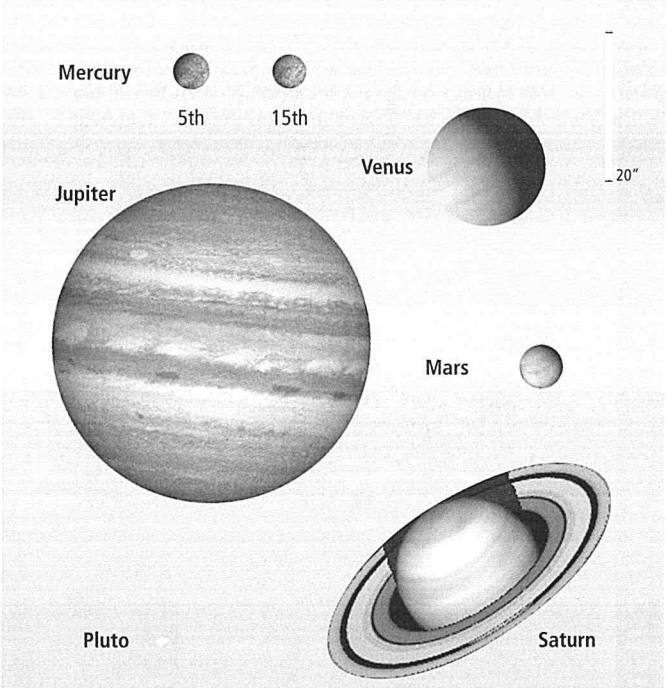
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0541	111	0409	1230	1919	249	2050	1535	0055	0.80
2	0542	111	0410	1230	1918	249	2049	1630	0136	0.87
3	0543	110	0412	1230	1918	250	2048	1724	0223	0.93
4	0544	110	0413	1230	1917	250	2047	1813	0315	0.97
5	0545	110	0414	1231	1916	250	2046	1857	0413	0.99
6	0545	109	0415	1231	1915	251	2045	1936	0514	1.00
7	0546	109	0416	1231	1915	251	2044	2011	0616	0.98
8	0547	109	0418	1231	1914	252	2043	2042	0718	0.94
9	0548	108	0419	1231	1913	252	2042	2112	0820	0.88
10	0549	108	0420	1231	1912	252	2041	2142	0922	0.80
11	0550	108	0421	1231	1911	253	2040	2213	1025	0.71
12	0551	107	0422	1231	1910	253	2038	2246	1130	0.60
13	0552	107	0424	1231	1909	253	2037	2324	1237	0.49
14	0553	106	0425	1231	1908	254	2036	DNR	1347	0.38
15	0554	106	0426	1231	1907	254	2035	0008	1457	0.27
16	0554	106	0427	1231	1906	255	2034	0100	1604	0.17
17	0555	105	0428	1231	1906	255	2032	0201	1704	0.10
18	0556	105	0429	1231	1905	256	2031	0307	1757	0.04
19	0557	104	0430	1231	1903	256	2030	0417	1841	0.01
20	0558	104	0432	1230	1902	256	2028	0526	1919	0.00
21	0559	103	0433	1230	1901	257	2027	0632	1952	0.02
22	0600	103	0434	1230	1900	257	2026	0735	2022	0.06
23	0600	103	0435	1230	1859	258	2025	0836	2050	0.12
24	0601	102	0436	1230	1858	258	2023	0934	2117	0.19
25	0602	102	0437	1230	1857	259	2022	1032	2146	0.27
26	0603	101	0438	1230	1856	259	2021	1129	2217	0.36
27	0604	101	0439	1229	1855	259	2019	1227	2251	0.46
28	0604	100	0440	1229	1854	260	2018	1324	2330	0.55
29	0605	100	0441	1229	1853	260	2017	1421	DNS	0.64

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ♅ Uranus ♇ Pluto
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

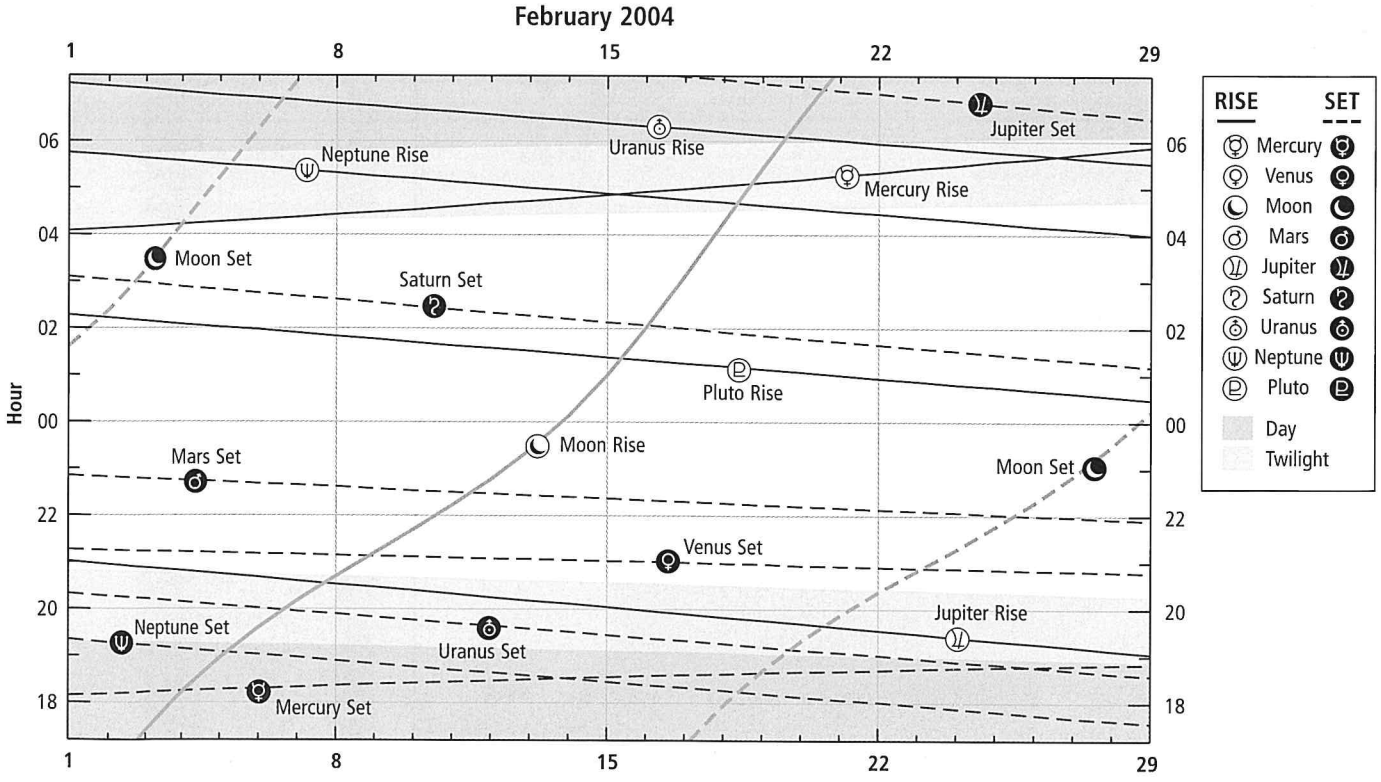


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0402	1809	0848	2116	1146	2251	2101	0838	1	1702	0310	0718	2020	0549	1921	0221	1538
2	0405	1811	0850	2115	1145	2249	2057	0834	2	1658	0306	0714	2016	0545	1917	0217	1535
3	0408	1813	0852	2114	1144	2247	2053	0830	3	1654	0302	0710	2013	0542	1913	0213	1531
4	0410	1815	0853	2113	1143	2245	2049	0825	4	1650	0258	0707	2009	0538	1909	0209	1527
5	0413	1817	0855	2112	1142	2243	2045	0821	5	1646	0253	0703	2005	0534	1905	0205	1523
6	0416	1818	0857	2111	1141	2241	2041	0817	6	1641	0249	0659	2001	0530	1902	0201	1519
7	0419	1820	0858	2110	1140	2239	2036	0812	7	1637	0245	0656	1957	0527	1858	0158	1515
8	0422	1822	0900	2109	1139	2237	2032	0808	8	1633	0241	0652	1954	0523	1854	0154	1512
9	0426	1824	0902	2108	1138	2234	2028	0803	9	1629	0237	0648	1950	0519	1850	0150	1508
10	0429	1825	0903	2107	1137	2232	2024	0759	10	1625	0233	0645	1946	0515	1846	0146	1504
11	0432	1827	0905	2106	1137	2230	2020	0755	11	1621	0228	0641	1942	0512	1842	0142	1500
12	0436	1828	0906	2105	1136	2228	2015	0750	12	1617	0224	0638	1939	0508	1839	0138	1456
13	0440	1830	0908	2104	1135	2226	2011	0746	13	1613	0220	0634	1935	0504	1835	0135	1452
14	0443	1832	0910	2103	1134	2224	2007	0741	14	1609	0216	0630	1931	0500	1831	0131	1449
15	0447	1833	0911	2102	1133	2222	2003	0737	15	1604	0212	0627	1927	0457	1827	0127	1445
16	0451	1835	0913	2101	1132	2220	1958	0732	16	1600	0208	0623	1923	0453	1823	0123	1441
17	0455	1836	0914	2100	1131	2218	1954	0728	17	1556	0204	0619	1920	0449	1820	0119	1437
18	0459	1837	0916	2059	1130	2216	1950	0723	18	1552	0200	0616	1916	0445	1816	0115	1433
19	0503	1839	0917	2058	1130	2214	1946	0719	19	1548	0155	0612	1912	0442	1812	0112	1429
20	0507	1840	0919	2056	1129	2212	1942	0714	20	1544	0151	0608	1908	0438	1808	0108	1425
21	0511	1841	0920	2055	1128	2210	1937	0710	21	1540	0147	0605	1905	0434	1804	0104	1422
22	0516	1842	0922	2054	1127	2208	1933	0705	22	1536	0143	0601	1901	0430	1801	0100	1418
23	0520	1844	0923	2053	1126	2206	1929	0701	23	1532	0139	0557	1857	0427	1757	0056	1414
24	0525	1845	0925	2052	1125	2204	1924	0656	24	1528	0135	0554	1853	0423	1753	0052	1410
25	0529	1846	0926	2051	1124	2202	1920	0652	25	1524	0131	0550	1850	0419	1749	0048	1406
26	0534	1847	0928	2050	1124	2200	1916	0647	26	1520	0127	0546	1846	0415	1745	0045	1402
27	0538	1848	0929	2049	1123	2158	1912	0643	27	1516	0123	0543	1842	0411	1741	0041	1358
28	0543	1849	0931	2048	1122	2156	1907	0638	28	1512	0119	0539	1838	0408	1738	0037	1354
29	0548	1850	0932	2047	1121	2154	1903	0634	29	1508	0115	0535	1835	0404	1734	0033	1351

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

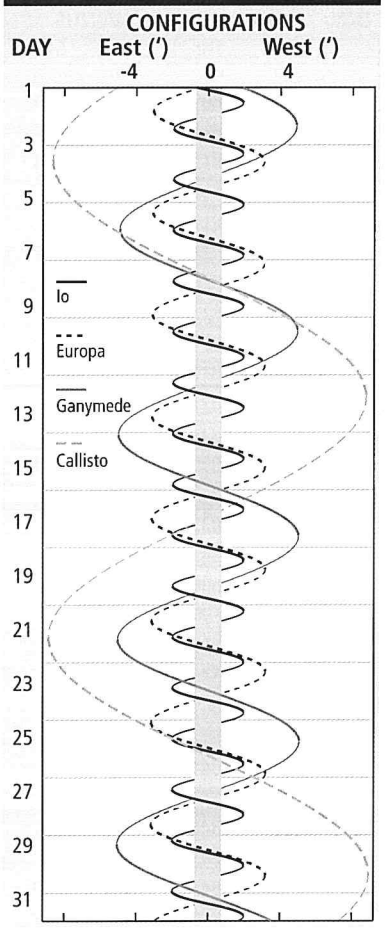
DAY	PHENOMENON h m	Sat.	Event
1	0023	I	Sh.I.
1	0338		GRS
1	2329		GRS
1	0107	I	Tr.I.
1	0239	I	Sh.E.
1	0322	I	Tr.E.
1	2132	I	Ec.D.
2	0032	I	Oc.R.
2	2107	I	Sh.E.
2	2148	I	Tr.E.
3	0516		GRS
3	2218	III	Ec.D.
4	0425	III	Oc.R.
4	0107		GRS
4	2058		GRS
6	0243	II	Sh.I.
6	0245		GRS
6	2236		GRS
6	0401	II	Tr.I.
6	0535	II	Sh.E.
7	0457	I	Ec.D.
7	2142	II	Ec.D.
8	0141	II	Oc.R.
8	0423		GRS
8	0216	I	Sh.I.
8	0252	I	Tr.I.
8	0432	I	Sh.E.
8	0507	I	Tr.E.
8	2326	I	Ec.D.
9	0217	I	Oc.R.
9	0014		GRS
9	2044	I	Sh.I.
9	2118	I	Tr.I.
9	2301	I	Sh.E.
9	2333	I	Tr.E.
10	2043	I	Oc.R.
11	0217	III	Ec.D.
11	0152		GRS
11	2143		GRS
13	0519	II	Sh.I.
13	0330		GRS
13	2321		GRS
13	2149	I	Tr.I.
13	2150	I	Oc.R.
14	2119	III	Tr.E.
15	0016	II	Ec.D.
15	0508		GRS
15	0356	II	Oc.R.
15	0410	I	Sh.I.
15	0436	I	Tr.I.
15	2004	IV	Oc.D.
15	2243	IV	Oc.R.
16	0120	I	Ec.D.
16	0059		GRS
16	2050		GRS
16	0402	I	Oc.R.
16	2128	II	Sh.E.
16	2216	II	Tr.E.
16	2238	I	Sh.I.
16	2302	I	Tr.I.
17	0054	I	Sh.E.
17	0117	I	Tr.E.
17	2228	I	Oc.R.
18	0237		GRS
18	2228		GRS
20	0415		GRS
21	0006		GRS
21	1957		GRS
21	2008	III	Sh.I.
21	2120	III	Tr.I.
21	2334	III	Sh.E.
22	0037	III	Tr.E.
22	0553		GRS
22	0250	II	Ec.D.
23	0314	I	Ec.D.
23	0144		GRS
23	2135		GRS
23	0546	I	Oc.R.
23	2113	II	Sh.I.
23	2142	II	Tr.I.
24	0004	II	Sh.E.
24	0031	II	Tr.E.
24	0031	I	Sh.I.
24	0046	I	Tr.I.
24	0057	IV	Sh.I.
24	0247	I	Sh.E.
24	0301	I	Tr.E.
24	0330	IV	Tr.I.
24	0433	IV	Sh.E.
24	2143	I	Ec.D.
25	0012	I	Oc.R.
25	0322		GRS
25	2313		GRS
25	2116	I	Sh.E.
25	2126	I	Tr.E.
27	0500		GRS
28	0051		GRS
28	2042		GRS
29	0006	III	Sh.I.
29	0036	III	Tr.I.
29	0331	III	Sh.E.
29	0353	III	Tr.E.
29	0523	II	Ec.D.
29	1937	I	Sh.I.
29	1938	I	Ec.R.

Moons: I Io, II Europa, III Ganymede, IV Callisto

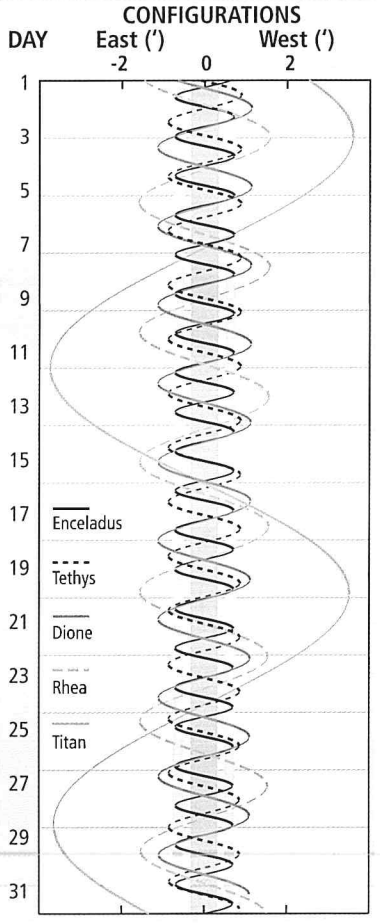
Events: D Disappear, E Egress, Ec Eclipse, Sh Shadow, R Reappear, I Ingress, Oc Occult, Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

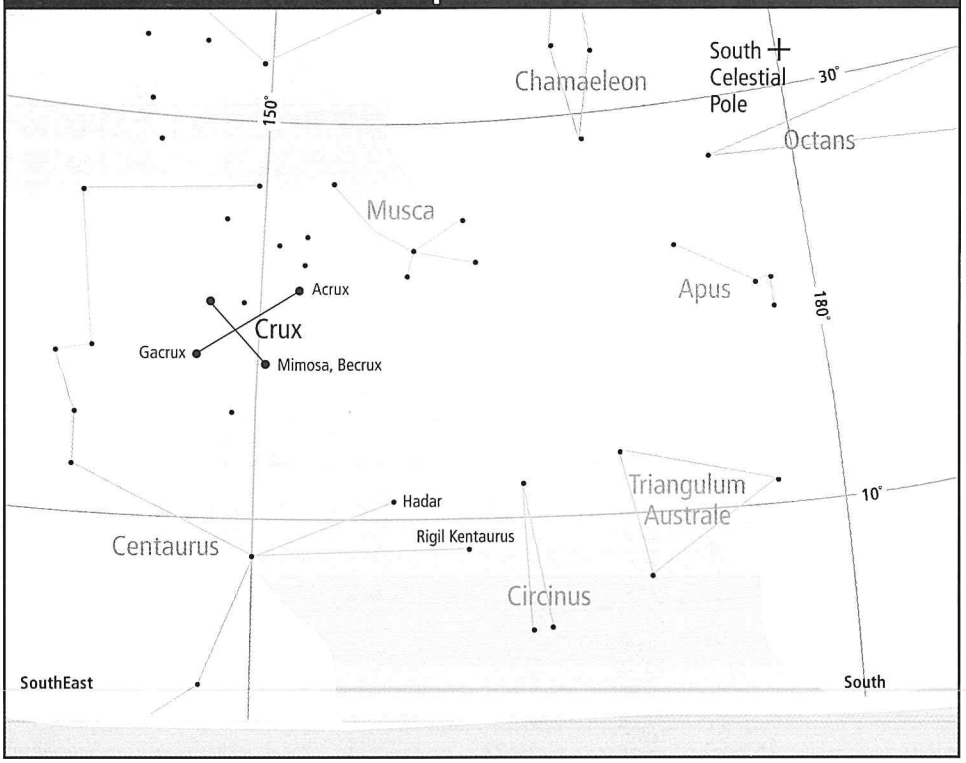
JUPITER MOONS

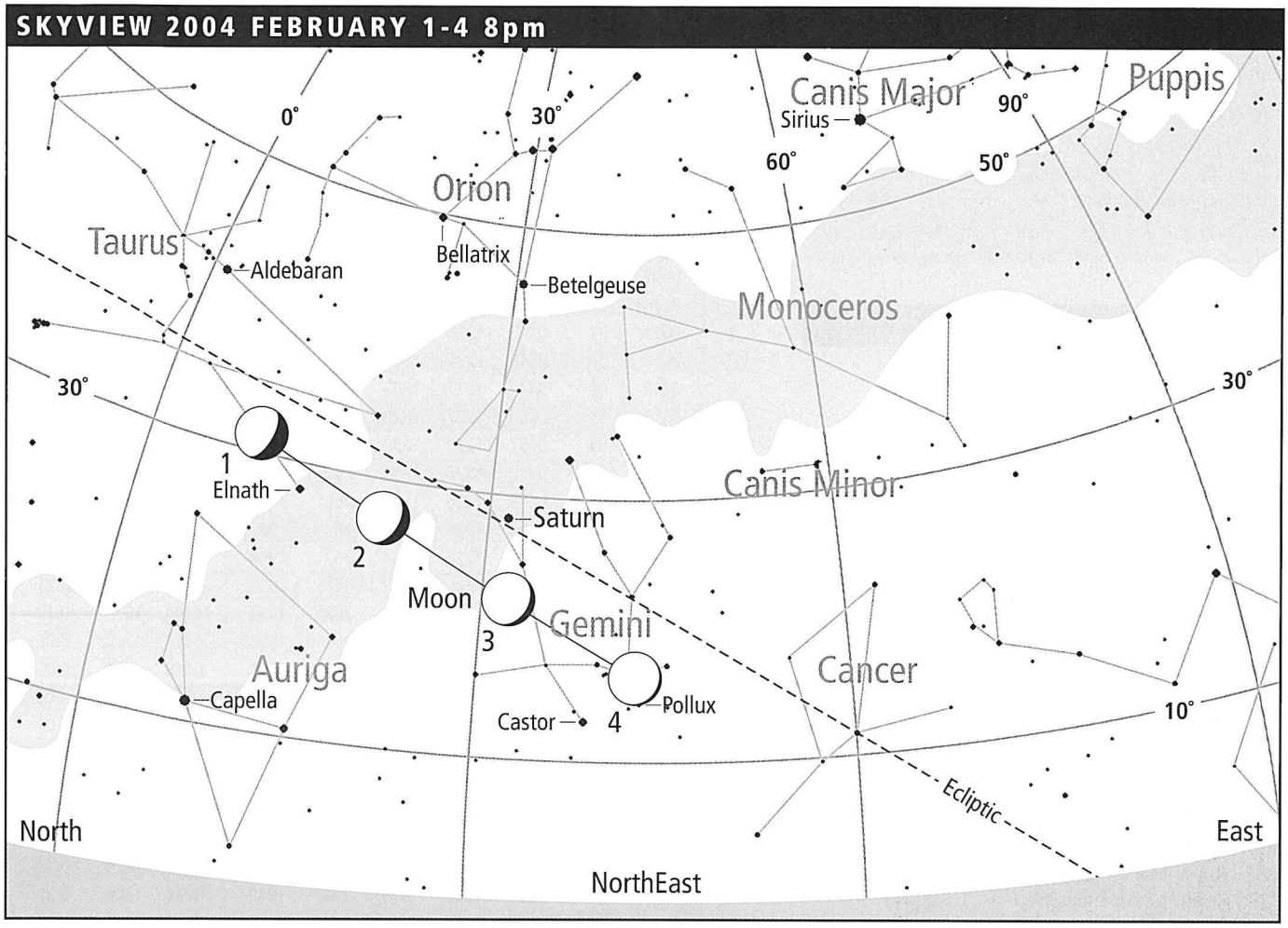


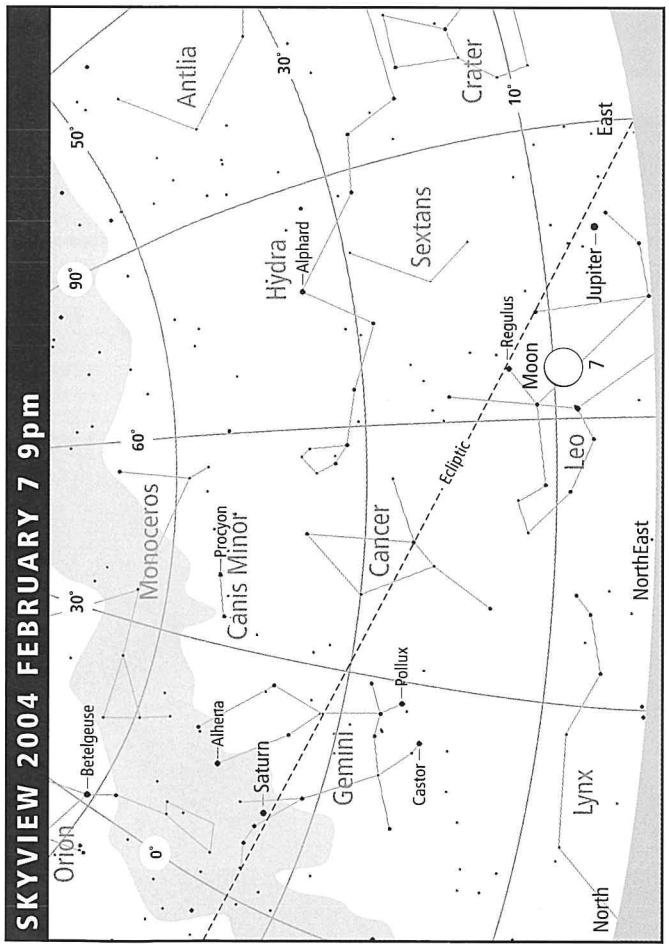
SATURN MOONS

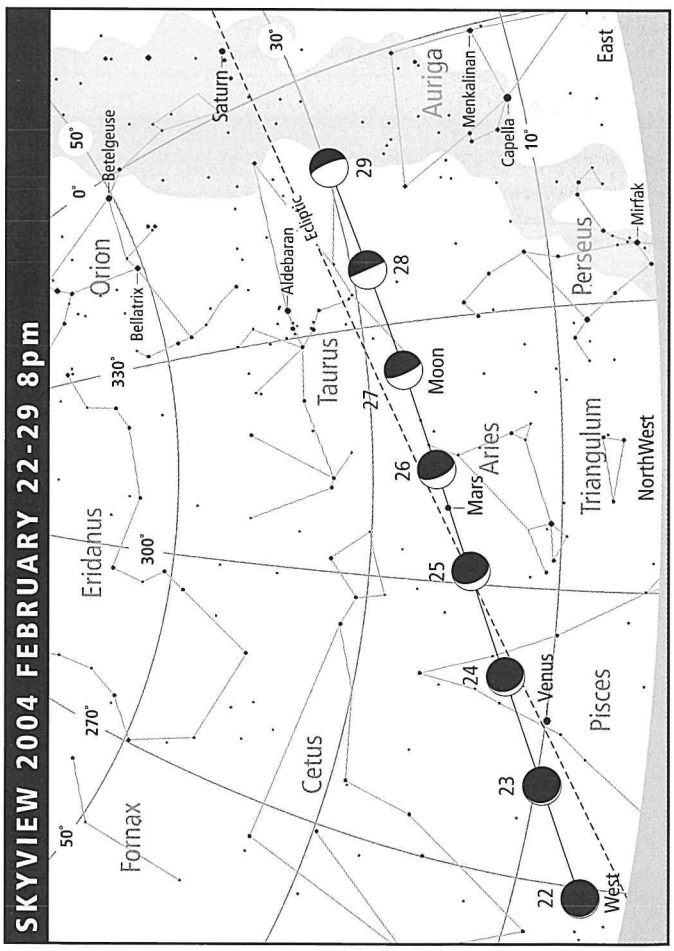


SKYVIEW FEBRUARY 15 8pm – SOUTHERN CROSS




SKYVIEW 2004 FEBRUARY 1-4 8pm
Canis Major
Puppis
Sirius
Orion
Taurus
Aldebaran
Bellatrix
Betelgeuse
Monoceros
Canis Minor
Elnath
Saturn
Moon
Gemini
Auriga
Capella
Cancer
Castor
Pollux
Ecliptic
North
East
NorthEast
0°
30°
50°
60°
90°
10°
1
2
3
4


SKYVIEW 2004 FEBRUARY 7 9pm
Antlia
Crater
Hydra
Alphard
Sextans
Jupiter
Regulus
Moon
Leo
Ecliptic
Monoceros
Procyon
Canis Minor
Cancer
Betelgeuse
Alhena
Saturn
Gemini
Pollux
Castor
Lynx
Orion
East
NorthEast
North
30°
50°
90°
60°
10°
0°
7


SKYVIEW 2004 FEBRUARY 22-29 8pm
Saturn
Auriga
Menkalinan
Capella
Betelgeuse
Aldebaran
Ecliptic
Perseus
Mirfak
Orion
Bellatrix
Taurus
Moon
Mars
Aries
Triangulum
Eridanus
Venus
Pisces
Cetus
Fornax
East
NorthWest
West
30°
50°
0°
10°
330°
300°
270°
29
28
27
26
25
24
23
22

MARCH 2004

HIGHLIGHTS

Venus *easily visible in the evening sky.*

Mars *visible in the evening sky in the constellation Aries then Taurus.*

Jupiter *at opposition, visible all night in constellation Leo.*

Saturn *visible in the evening in Gemini.*

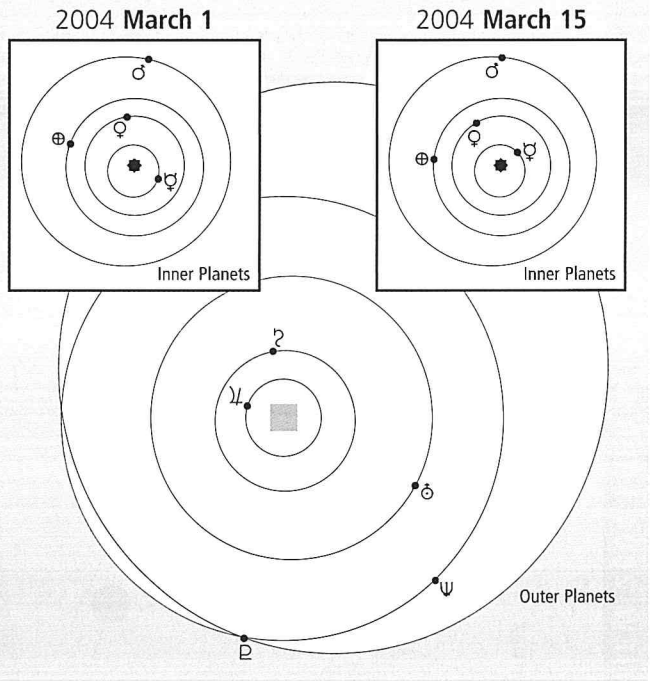
DIARY

Day	Hour	
1	18	Saturn 5° S. of Moon
4	10	Mercury in superior conjunction
4	13	Jupiter at opposition
7	00	Jupiter 3° S. of Moon
7	07	**Full Moon**
7	23	Saturn stationary
12	12	Moon at perigee
13		Maximum activity gamma-Normid meteor shower
14	05	**Last Quarter**
17	17	Neptune 5° N. of Moon
19	04	Uranus 4° N. of Moon
20	15	Equinox
21	07	**New Moon**
22	13	Mercury 4° N. of Moon
24		Maximum activity Virginid meteor shower
25	05	Venus 2° N. of Moon
25	07	Pluto stationary
26	08	Mars 0°.8 S. of Moon – Occultation
27	15	Moon at apogee
29	03	Saturn 5° S. of Moon
29	08	**First Quarter**
29	20	Mercury greatest elongation E. (19°)
30	01	Venus greatest elongation E. (46°)

SUN+MOON RISE/SET

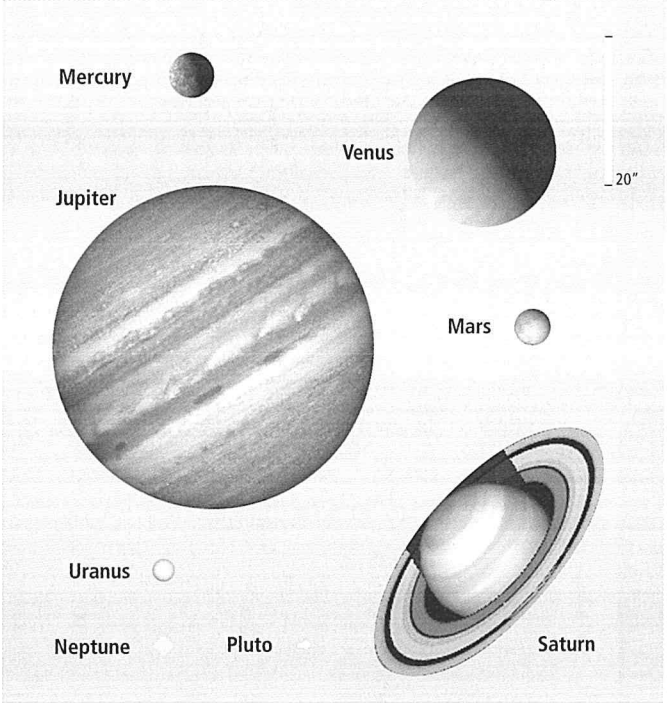
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0606	99	0442	1229	1851	261	2015	1515	0014	0.73
2	0607	99	0443	1229	1850	261	2014	1605	0104	0.81
3	0608	99	0444	1229	1849	262	2012	1651	0200	0.88
4	0608	98	0445	1228	1848	262	2011	1732	0259	0.94
5	0609	98	0446	1228	1847	263	2010	1809	0401	0.98
6	0610	97	0447	1228	1845	263	2008	1842	0504	1.00
7	0611	97	0447	1228	1844	264	2007	1913	0608	0.99
8	0611	96	0448	1227	1843	264	2006	1943	0711	0.96
9	0612	96	0449	1227	1842	264	2004	2014	0816	0.91
10	0613	95	0450	1227	1840	265	2003	2047	0921	0.84
11	0613	95	0451	1227	1839	265	2001	2124	1029	0.74
12	0614	94	0452	1226	1838	266	2000	2206	1139	0.64
13	0615	94	0453	1226	1837	266	1959	2255	1249	0.53
14	0616	93	0454	1226	1835	267	1957	2353	1357	0.41
15	0616	93	0454	1226	1834	267	1956	DNR	1459	0.30
16	0617	93	0455	1225	1833	268	1955	0056	1553	0.21
17	0618	92	0456	1225	1832	268	1953	0204	1638	0.12
18	0618	92	0457	1225	1830	269	1952	0312	1717	0.06
19	0619	91	0458	1224	1829	269	1951	0418	1751	0.02
20	0620	91	0458	1224	1828	270	1949	0521	1821	0.00
21	0621	90	0459	1224	1826	270	1948	0622	1849	0.01
22	0621	90	0500	1223	1825	270	1946	0721	1917	0.03
23	0622	89	0501	1223	1824	271	1945	0819	1945	0.08
24	0623	89	0501	1223	1823	271	1944	0917	2015	0.13
25	0623	88	0502	1223	1821	272	1942	1015	2048	0.21
26	0624	88	0503	1222	1820	272	1941	1113	2124	0.29
27	0625	87	0503	1222	1819	273	1940	1210	2206	0.38
28	0625	87	0504	1222	1818	273	1939	1306	2254	0.47
29	0626	87	0505	1221	1816	274	1937	1357	2347	0.57
30	0627	86	0506	1221	1815	274	1936	1445	DNS	0.66
31	0627	86	0506	1221	1814	275	1935	1527	0044	0.75

PLANET POSITIONS



☿ Mercury ♁ Earth ♃ Jupiter ♅ Uranus ♇ Pluto
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

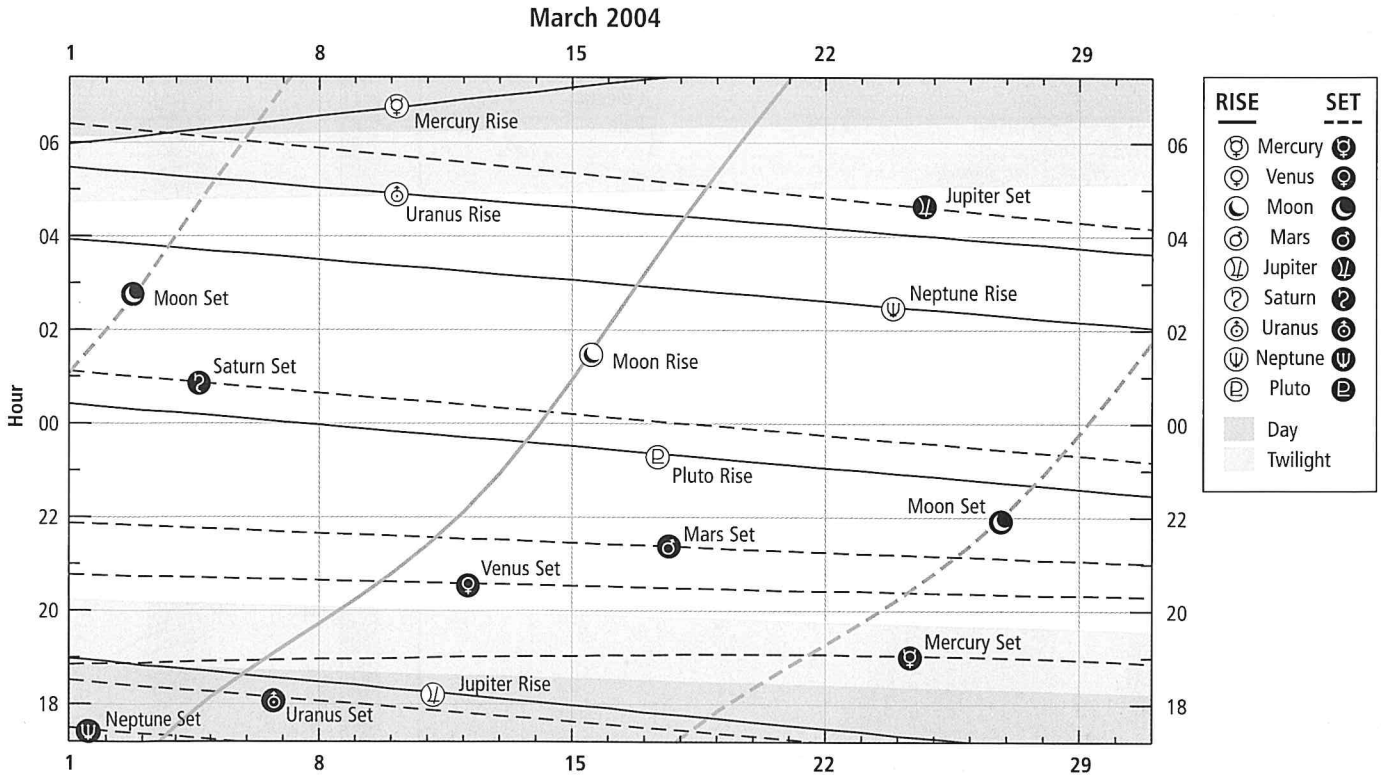


1 degree (1°) = 60 arc minutes (60') = 3600 arc seconds (3600")
Therefore 20" = 1/3' = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0553	1851	0934	2046	1120	2152	1859	0629	1	1504	0111	0532	1831	0400	1730	0029	1347
2	0558	1852	0935	2045	1119	2151	1855	0624	2	1500	0107	0528	1827	0356	1726	0025	1343
3	0603	1853	0937	2044	1119	2149	1850	0620	3	1456	0103	0524	1823	0353	1722	0021	1339
4	0608	1854	0938	2043	1118	2147	1846	0615	4	1452	0059	0521	1819	0349	1719	0017	1335
5	0613	1855	0940	2042	1117	2145	1842	0611	5	1448	0055	0517	1816	0345	1715	0014	1331
6	0618	1856	0941	2041	1116	2143	1837	0606	6	1444	0051	0513	1812	0341	1711	0010	1327
7	0623	1857	0942	2040	1115	2141	1833	0602	7	1440	0047	0510	1808	0338	1707	0006	1323
8	0628	1858	0944	2039	1114	2139	1829	0557	8	1436	0043	0506	1804	0334	1703	0002	1319
8									8							2358	
9	0634	1858	0945	2038	1114	2138	1825	0553	9	1432	0039	0502	1801	0330	1659	2354	1316
10	0639	1859	0947	2037	1113	2136	1820	0548	10	1429	0035	0459	1757	0326	1656	2350	1312
11	0644	1900	0948	2036	1112	2134	1816	0544	11	1425	0031	0455	1753	0322	1652	2346	1308
12	0649	1901	0949	2035	1111	2132	1812	0539	12	1421	0028	0451	1749	0319	1648	2342	1304
13	0655	1901	0951	2034	1110	2131	1807	0535	13	1417	0024	0448	1745	0315	1644	2339	1300
14	0700	1902	0952	2033	1109	2129	1803	0530	14	1413	0020	0444	1742	0311	1640	2335	1256
15	0705	1902	0954	2032	1109	2127	1759	0525	15	1409	0016	0440	1738	0307	1636	2331	1252
16	0711	1903	0955	2031	1108	2125	1755	0521	16	1405	0012	0437	1734	0304	1633	2327	1248
17	0716	1903	0956	2030	1107	2124	1750	0516	17	1401	0008	0433	1730	0300	1629	2323	1244
18	0721	1904	0957	2029	1106	2122	1746	0512	18	1358	0004	0429	1727	0256	1625	2319	1240
19	0725	1904	0959	2028	1105	2120	1742	0507	19	1354	0000	0426	1723	0252	1621	2315	1236
19									19		2357						
20	0730	1904	1000	2027	1104	2118	1737	0503	20	1350	2353	0422	1719	0248	1617	2311	1232
21	0735	1904	1001	2026	1103	2117	1733	0458	21	1346	2349	0418	1715	0245	1613	2307	1229
22	0739	1904	1003	2025	1103	2115	1729	0454	22	1342	2345	0415	1711	0241	1610	2303	1225
23	0743	1903	1004	2025	1102	2113	1725	0450	23	1338	2341	0411	1708	0237	1606	2300	1221
24	0746	1903	1005	2024	1101	2112	1720	0445	24	1335	2337	0407	1704	0233	1602	2256	1217
25	0749	1902	1006	2023	1100	2110	1716	0441	25	1331	2334	0403	1700	0229	1558	2252	1213
26	0752	1901	1007	2022	1059	2109	1712	0436	26	1327	2330	0400	1656	0226	1554	2248	1209
27	0754	1900	1008	2021	1058	2107	1708	0432	27	1323	2326	0356	1653	0222	1550	2244	1205
28	0756	1859	1009	2020	1058	2105	1704	0427	28	1320	2322	0352	1649	0218	1546	2240	1201
29	0757	1857	1010	2020	1057	2104	1659	0423	29	1316	2319	0349	1645	0214	1543	2236	1157
30	0758	1855	1012	2019	1056	2102	1655	0418	30	1312	2315	0345	1641	0210	1539	2232	1153
31	0759	1853	1013	2018	1055	2101	1651	0414	31	1308	2311	0341	1637	0207	1535	2228	1149

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

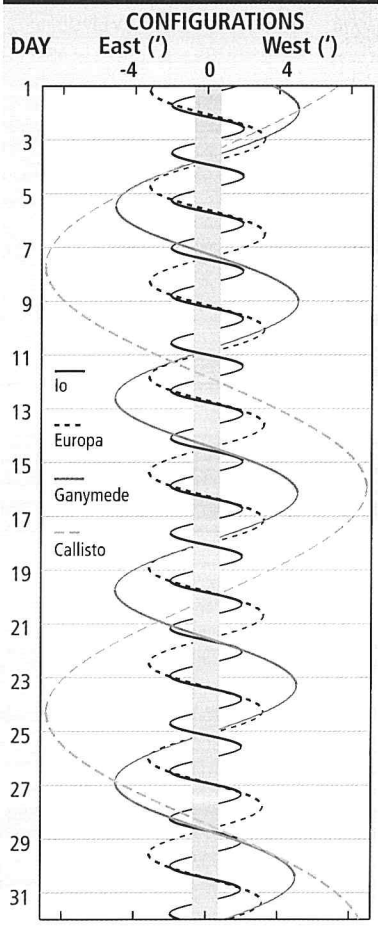
DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event
1	0508	I	Ec.D.	7	0352	III	Tr.I.	11	1857	IV	Sh.I.	20	2257		GRS
1	0229		GRS	7	0405	III	Sh.I.	11	1949	I	Oc.D.	20	0314	IV	Oc.R.
1	2220		GRS	7	2131	I	Ec.D.	11	2029	IV	Tr.E.	20	0336	IV	Ec.D.
1	2349	II	Sh.I.	7	2132	I	Ec.R.	11	2217	I	Ec.R.	20	1840	I	Ec.R.
1	2358	II	Tr.I.	8	0314		GRS	11	2225	IV	Sh.E.	21	1848		GRS
2	0225	I	Sh.I.	8	2305		GRS	12	1919	I	Tr.E.	22	0444		GRS
2	0229	I	Tr.I.	9	0213	II	Tr.I.	12	1932	I	Sh.E.	22	2214	I	Oc.D.
2	0241	II	Sh.E.	9	1856		GRS	13	0221		GRS	22	2215	I	Tr.E.
2	0247	II	Tr.E.	9	0226	II	Sh.I.	13	2212		GRS	23	0035		GRS
2	0441	I	Sh.E.	9	0412	I	Tr.I.	15	0359		GRS	23	2027		GRS
2	0444	I	Tr.E.	9	0419	I	Sh.I.	15	2350		GRS	23	1948	I	Sh.I.
2	2337	I	Ec.D.	9	0502	II	Tr.E.	15	2046	I	Ec.D.	25	0011	III	Oc.D.
3	0156	I	Oc.R.	9	0517	II	Sh.E.	15	2047	I	Sh.E.	25	0213		GRS
3	0407		GRS	10	0123	I	Oc.D.	16	0429	II	Tr.I.	25	2205		GRS
3	2358		GRS	10	0452		GRS	16	1941		GRS	25	0124	II	Oc.D.
3	2054	I	Sh.I.	10	0348	I	Ec.R.	16	0503	II	Sh.I.	25	0207	I	Tr.I.
3	2055	I	Tr.I.	10	2056	II	Oc.D.	17	2053	III	Oc.D.	25	0235	I	Sh.I.
3	2130	II	Oc.R.	10	2136	III	Ec.R.	17	2310	II	Oc.D.	25	0422	I	Tr.E.
3	2309	I	Sh.E.	10	2238	I	Tr.I.	18	0022	I	Tr.I.	25	2319	I	Oc.D.
3	2310	I	Tr.E.	10	2247	I	Sh.I.	18	0128		GRS	26	0206	I	Ec.R.
4	1949		GRS	11	0003	II	Ec.R.	18	2119		GRS	26	1954	II	Tr.I.
4	2022	I	Ec.R.	11	0043		GRS	18	0041	I	Sh.I.	26	2033	I	Tr.I.
5	0544		GRS	11	2034		GRS	18	0135	III	Ec.R.	26	2059	II	Sh.I.
6	0136		GRS	11	0053	I	Tr.E.	18	0236	II	Ec.R.	26	2104	I	Sh.I.
6	2127		GRS	11	0103	I	Sh.E.	18	0237	I	Tr.E.	26	2244	II	Tr.E.
								18	0257	I	Sh.E.	26	2248	I	Tr.E.
								18	2134	I	Oc.D.	26	2320	I	Sh.E.
								19	0011	I	Ec.R.	26	2350	II	Sh.E.
								19	1848	I	Tr.I.	27	0352		GRS
								19	1910	I	Sh.I.	27	2343		GRS
								19	2027	II	Tr.E.	27	2035	I	Ec.R.
								19	2103	I	Tr.E.	28	1934		GRS
								19	2113	II	Sh.E.	28	1827	II	Ec.R.
								19	2126	I	Sh.E.	28	1923	III	Sh.E.
								20	0013	IV	Oc.D.	30	0121		GRS
								20	0306		GRS	30	2112		GRS

Moons: I Io, II Europa, III Ganymede, IV Callisto

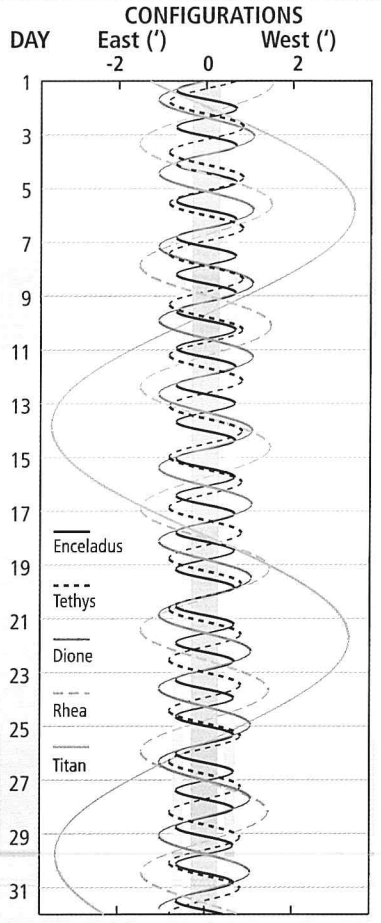
Events: D Disappear, E Egress, Ec Eclipse, Sh Shadow, R Reappear, I Ingress, Oc Occult, Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

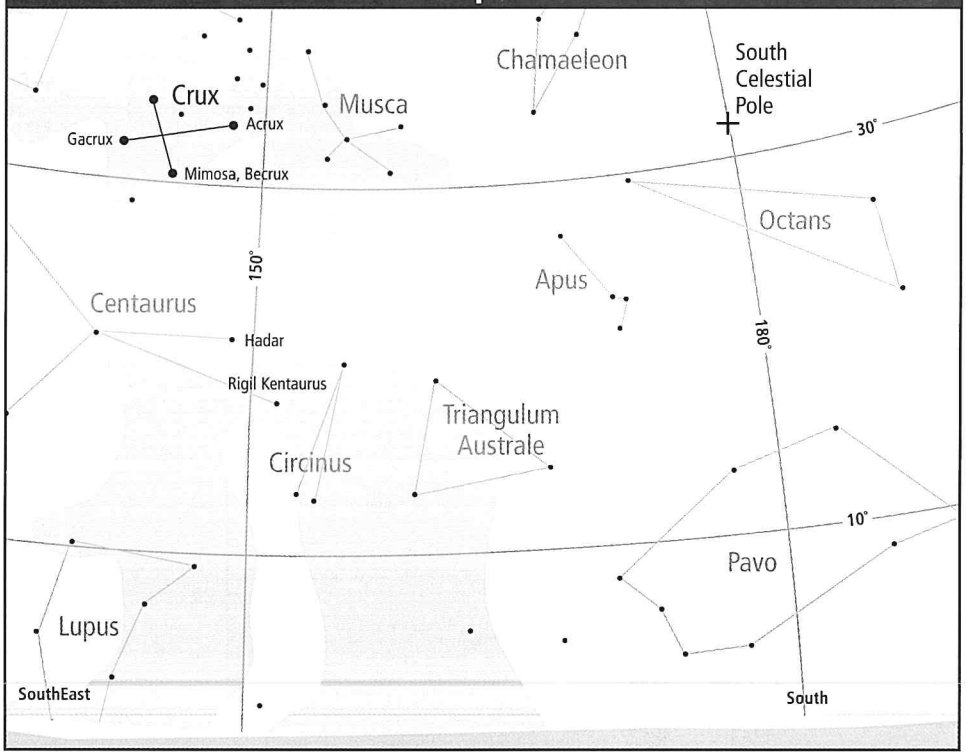
JUPITER MOONS



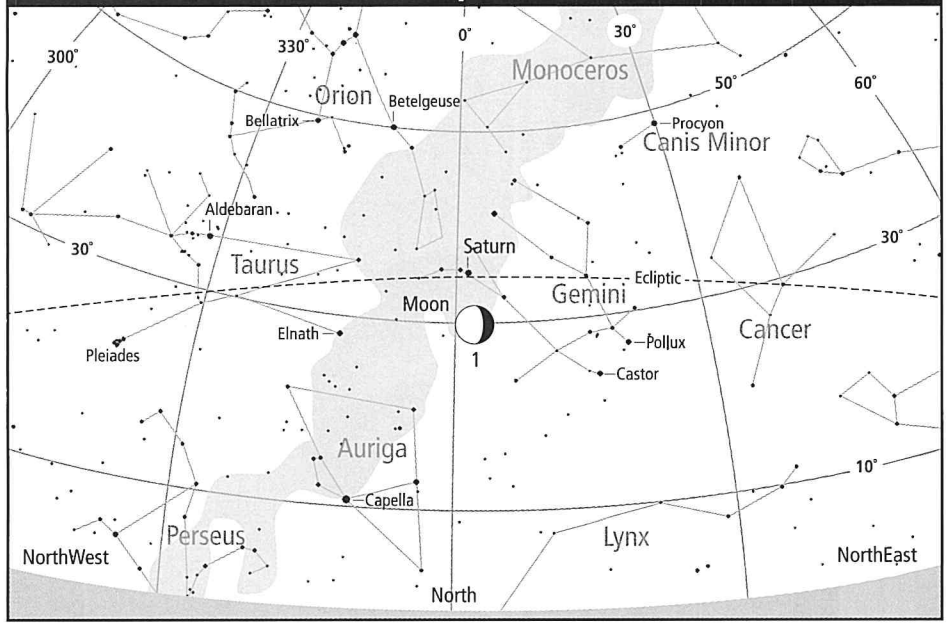
SATURN MOONS



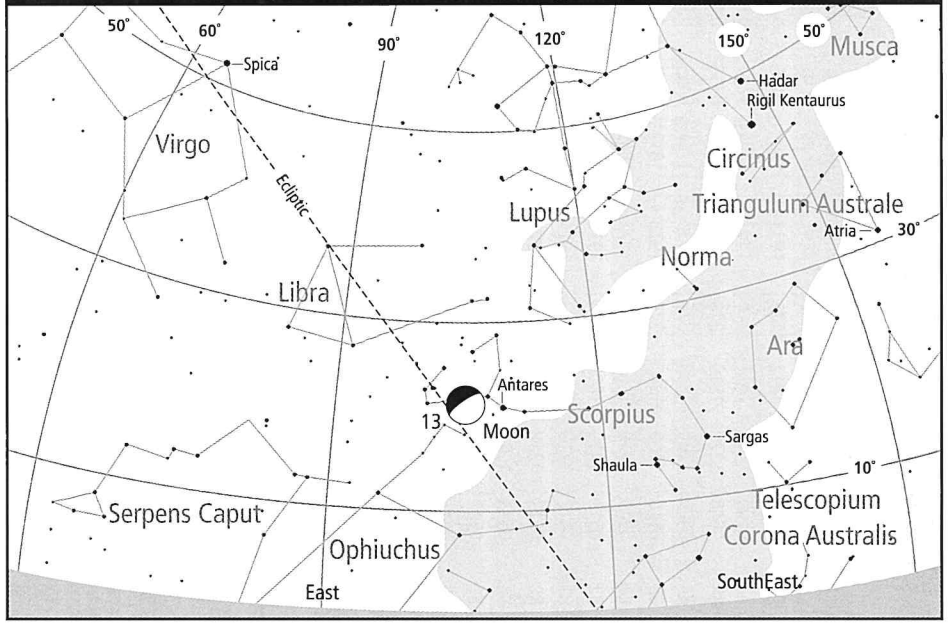
SKYVIEW 2003 MARCH 15 8pm – SOUTHERN CROSS



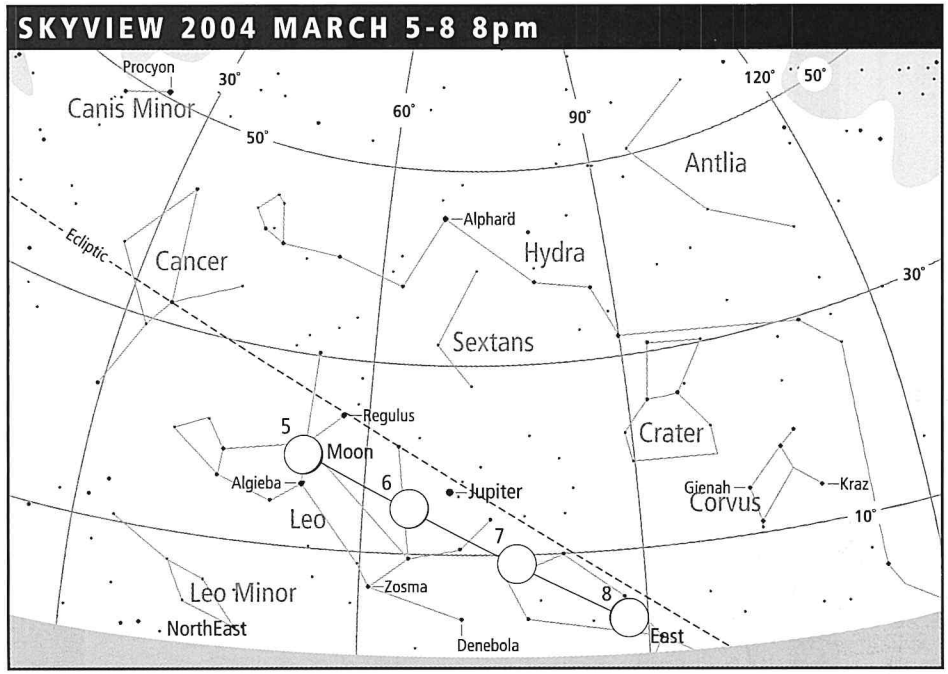
SKYVIEW 2004 MARCH 1 8pm



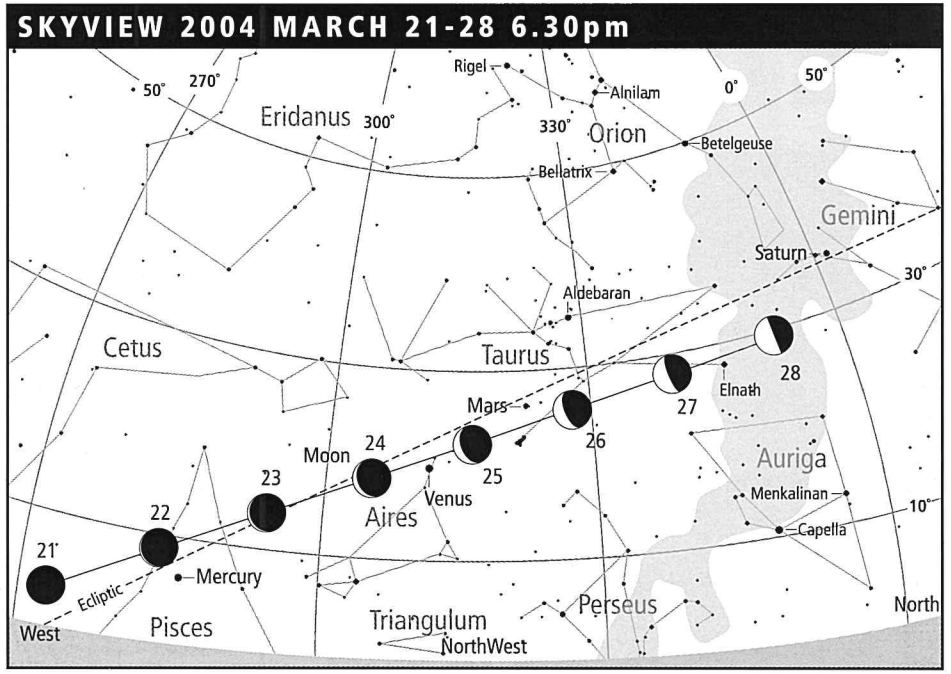
SKYVIEW 2004 MARCH 13 midnight



SKYVIEW 2004 MARCH 5-8 8pm



SKYVIEW 2004 MARCH 21-28 6.30pm



APRIL 2004

HIGHLIGHTS

Mercury *visible in the morning sky, low in the east before sunrise toward end of the month.*

Venus *easily visible in the evening sky.*

Mars *visible in the evening sky in the constellation Taurus. Passes 7° N of Aldebaran on April 7.*

Jupiter *visible until the morning in constellation Leo.*

Saturn *visible in the early evening in constellation Gemini.*

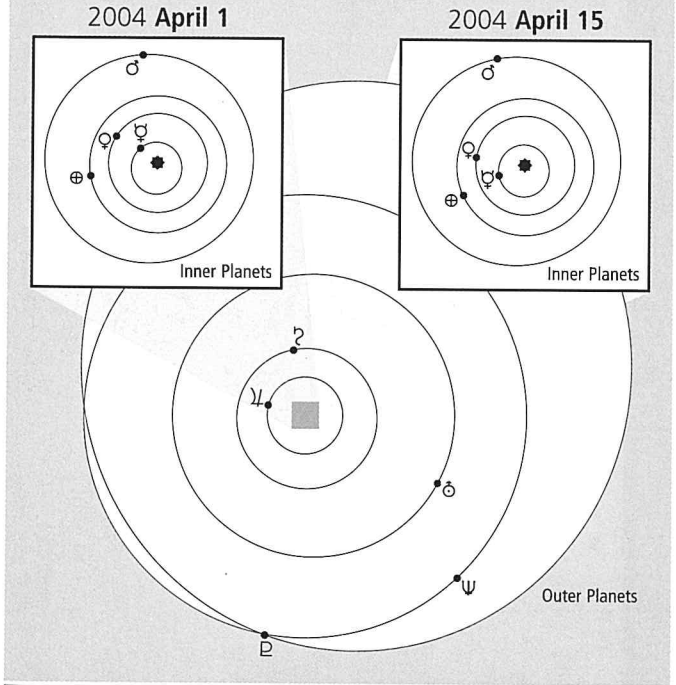
DIARY

Day	Hour	
2		Saturn at extreme north declination (+22° 49′)
3	03	Jupiter 3° S. of Moon
5	19	**Full Moon**
7	05	Mercury stationary
7	13	Mars 7° N. of Aldebaran
8	10	Moon at perigee
12	12	**Last Quarter**
14	00	Neptune 5° N. of Moon
15	12	Uranus 4° N. of Moon
16	18	Venus 10° N. of Aldebaran
17	09	Mercury in inferior conjunction
19	21	**New Moon – Eclipse**
23	18	Venus 1°.5 N. of Moon
24	05	Mars 2° S. of Moon
24	08	Moon at apogee
25	14	Saturn 5° S. of Moon
28	02	**First Quarter**
29	18	Mercury stationary
30	10	Jupiter 4° S. of Moon

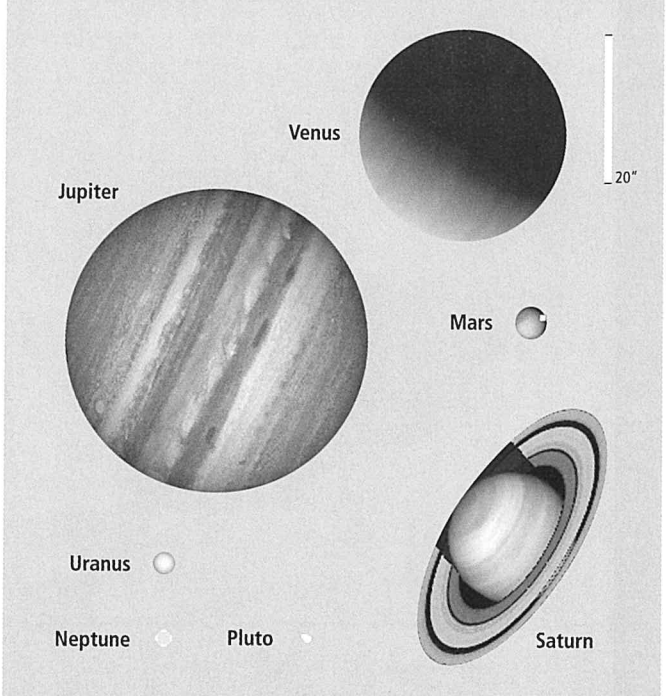
SUN+MOON RISE/SET

DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0628	85	0507	1220	1812	275	1933	1605	0145	0.83
2	0629	85	0508	1220	1811	276	1932	1639	0247	0.90
3	0629	84	0508	1220	1810	276	1931	1711	0350	0.96
4	0630	84	0509	1220	1809	276	1930	1741	0453	0.99
5	0631	83	0510	1219	1807	277	1928	1812	0558	1.00
6	0631	83	0510	1219	1806	277	1927	1845	0705	0.98
7	0632	82	0511	1219	1805	278	1926	1921	0814	0.93
8	0633	82	0512	1218	1804	278	1925	2002	0925	0.86
9	0633	82	0512	1218	1803	279	1924	2050	1038	0.77
10	0634	81	0513	1218	1801	279	1922	2146	1149	0.67
11	0635	81	0513	1218	1800	280	1921	2249	1254	0.56
12	0635	80	0514	1217	1759	280	1920	2356	1351	0.44
13	0636	80	0515	1217	1758	280	1919	DNR	1439	0.34
14	0637	79	0515	1217	1757	281	1918	0103	1519	0.24
15	0637	79	0516	1217	1755	281	1917	0209	1553	0.15
16	0638	79	0517	1216	1754	282	1916	0312	1624	0.09
17	0639	78	0517	1216	1753	282	1915	0413	1652	0.04
18	0639	78	0518	1216	1752	282	1914	0511	1719	0.01
19	0640	77	0518	1216	1751	283	1913	0609	1746	0.00
20	0641	77	0519	1215	1750	283	1912	0707	1815	0.01
21	0641	76	0520	1215	1749	284	1911	0805	1846	0.04
22	0642	76	0520	1215	1748	284	1910	0903	1922	0.09
23	0643	76	0521	1215	1747	284	1909	1001	2001	0.15
24	0644	75	0521	1215	1746	285	1908	1057	2047	0.22
25	0644	75	0522	1215	1744	285	1907	1150	2137	0.31
26	0645	75	0523	1214	1743	286	1906	1239	2232	0.40
27	0646	74	0523	1214	1742	286	1905	1323	2331	0.50
28	0646	74	0524	1214	1741	286	1904	1401	DNS	0.59
29	0647	73	0524	1214	1741	287	1903	1436	0031	0.69
30	0648	73	0525	1214	1740	287	1902	1508	0132	0.78

PLANET POSITIONS



PLANET APPEARANCE

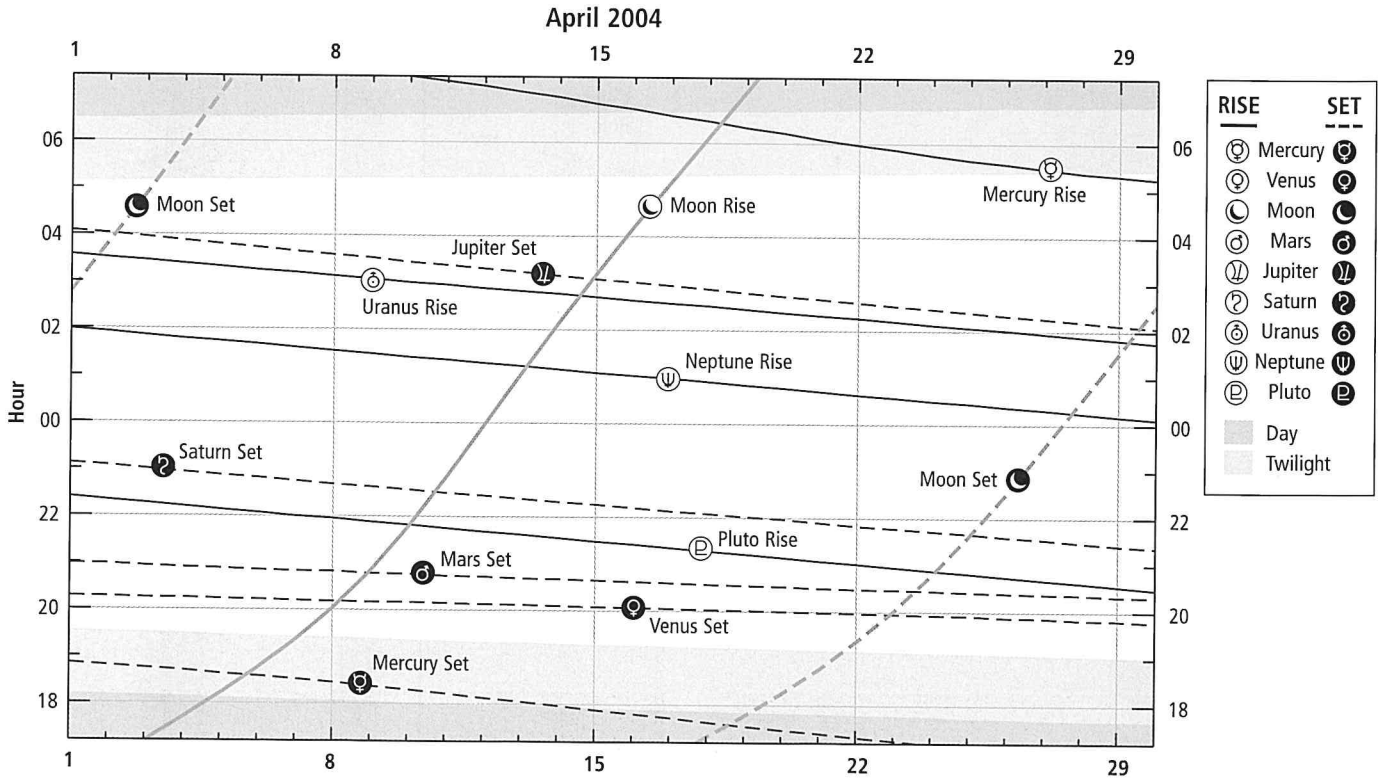


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0758	1851	1013	2017	1054	2059	1647	0410	1	1305	2307	0338	1634	0203	1531	2224	1145
2	0758	1848	1014	2016	1053	2058	1642	0405	2	1301	2304	0334	1630	0159	1527	2220	1141
3	0756	1845	1015	2015	1052	2056	1638	0401	3	1257	2300	0330	1626	0155	1523	2216	1137
4	0754	1842	1016	2015	1051	2054	1634	0357	4	1253	2256	0327	1622	0151	1519	2212	1133
5	0752	1838	1017	2014	1050	2053	1630	0352	5	1250	2252	0323	1618	0147	1516	2208	1129
6	0748	1835	1018	2013	1050	2051	1626	0348	6	1246	2249	0319	1615	0144	1512	2204	1125
7	0745	1831	1018	2012	1049	2050	1622	0344	7	1242	2245	0315	1611	0140	1508	2200	1121
8	0740	1827	1019	2011	1048	2049	1617	0339	8	1239	2241	0312	1607	0136	1504	2157	1117
9	0736	1822	1020	2010	1047	2047	1613	0335	9	1235	2238	0308	1603	0132	1500	2153	1113
10	0730	1818	1020	2010	1046	2046	1609	0331	10	1231	2234	0304	1559	0128	1456	2149	1109
11	0724	1813	1021	2009	1045	2044	1605	0326	11	1227	2230	0300	1556	0124	1452	2145	1105
12	0718	1808	1021	2008	1044	2043	1601	0322	12	1224	2227	0257	1552	0121	1449	2141	1101
13	0712	1803	1021	2007	1043	2041	1557	0318	13	1220	2223	0253	1548	0117	1445	2137	1058
14	0705	1758	1022	2006	1042	2040	1553	0314	14	1216	2219	0249	1544	0113	1441	2133	1054
15	0658	1753	1022	2005	1041	2039	1548	0309	15	1213	2216	0246	1540	0109	1437	2129	1050
16	0650	1748	1022	2004	1040	2037	1544	0305	16	1209	2212	0242	1537	0105	1433	2125	1046
17	0643	1743	1022	2003	1039	2036	1540	0301	17	1206	2208	0238	1533	0101	1429	2121	1042
18	0635	1738	1022	2002	1038	2034	1536	0257	18	1202	2205	0234	1529	0058	1425	2117	1038
19	0628	1733	1022	2001	1037	2033	1532	0253	19	1158	2201	0231	1525	0054	1421	2113	1034
20	0620	1728	1022	2000	1036	2032	1528	0248	20	1155	2158	0227	1521	0050	1418	2109	1030
21	0613	1724	1021	1959	1035	2030	1524	0244	21	1151	2154	0223	1517	0046	1414	2105	1026
22	0605	1719	1021	1958	1034	2029	1520	0240	22	1147	2150	0219	1514	0042	1410	2101	1022
23	0558	1715	1021	1957	1033	2028	1516	0236	23	1144	2147	0216	1510	0038	1406	2057	1018
24	0552	1710	1020	1956	1032	2027	1512	0232	24	1140	2143	0212	1506	0034	1402	2053	1014
25	0545	1706	1019	1955	1031	2025	1508	0228	25	1137	2140	0208	1502	0030	1358	2049	1010
26	0539	1702	1019	1953	1030	2024	1504	0224	26	1133	2136	0204	1458	0027	1354	2045	1006
27	0534	1659	1018	1952	1029	2023	1500	0220	27	1129	2133	0201	1454	0023	1350	2041	1002
28	0528	1655	1017	1950	1028	2022	1456	0216	28	1126	2129	0157	1451	0019	1346	2037	0958
29	0523	1652	1016	1949	1027	2020	1452	0212	29	1122	2125	0153	1447	0015	1342	2033	0954
30	0519	1648	1015	1947	1026	2019	1448	0208	30	1119	2122	0149	1443	0011	1339	2029	0950

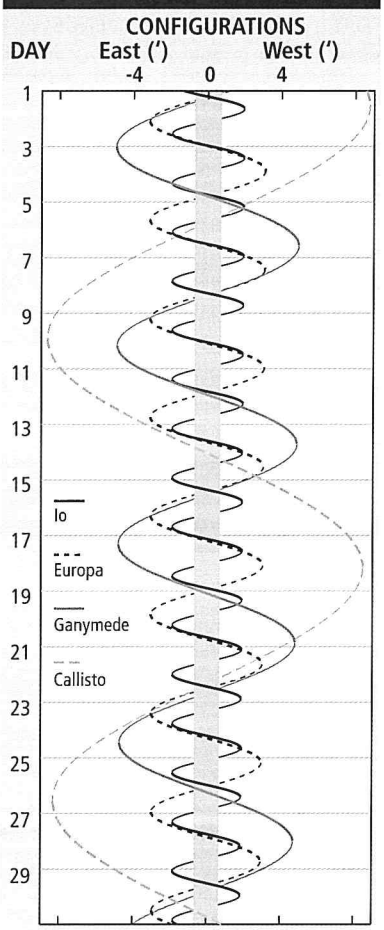
SOLAR SYSTEM RISE/SET



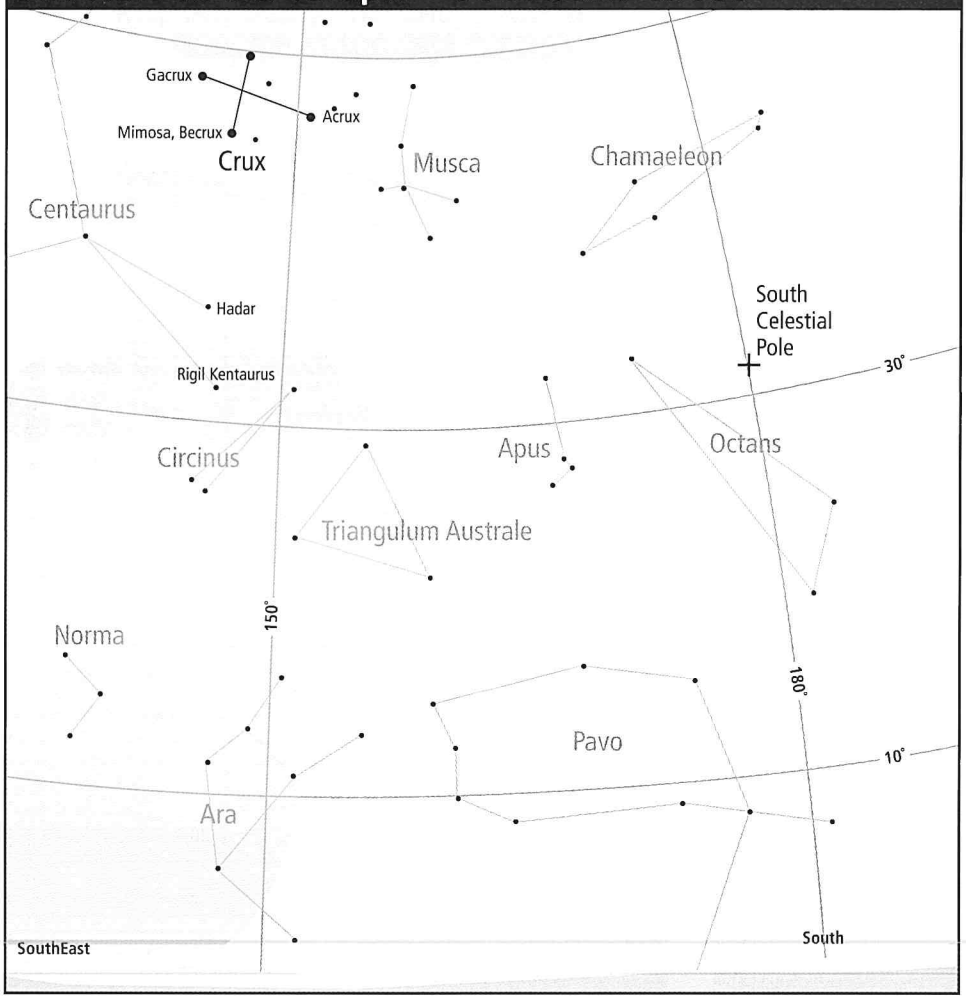
JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event
1	0333	III	Oc.D.	8	2336		GRS	14	1836		GRS	22	2128	III	Ec.R.
1	0259		GRS	9	0251	I	Oc.D.	14	0040	I	Oc.R.	23	0109		GRS
1	2250		GRS	9	1928		GRS	14	0204	IV	Tr.E.	23	2101		GRS
1	0340	II	Oc.D.	10	0004	I	Tr.I.	15	1906	I	Oc.D.	23	1916	I	Sh.I.
1	0352	I	Tr.I.	10	0034	II	Tr.I.	15	1907	I	Oc.R.	23	1917	I	Sh.E.
2	0104	I	Oc.D.	10	0052	I	Sh.I.	16	0023		GRS	25	0055	I	Oc.D.
2	1842		GRS	10	0213	II	Sh.I.	16	2014		GRS	25	2239		GRS
2	0401	I	Ec.R.	10	0220	I	Tr.E.	17	0152	I	Tr.I.	25	2207	I	Tr.I.
2	2213	II	Tr.I.	10	0308	I	Sh.E.	17	0247	I	Sh.I.	25	2310	I	Sh.I.
2	2218	I	Tr.I.	10	0324	II	Tr.E.	17	0256	II	Tr.I.	25	2351	II	Oc.D.
2	2258	I	Sh.I.	10	2118	I	Oc.D.	17	2306	I	Oc.D.	26	0023	I	Tr.E.
2	2336	II	Sh.I.	11	0025	I	Ec.R.	18	0220	I	Ec.R.	26	1831		GRS
3	0033	I	Tr.E.	11	0115		GRS	18	0201		GRS	26	0125	I	Sh.E.
3	0103	II	Tr.E.	11	2106		GRS	18	2153		GRS	26	1922	I	Oc.D.
3	0114	I	Sh.E.	11	1831	I	Tr.I.	18	2019	I	Tr.I.	26	2243	I	Ec.R.
3	0227	II	Sh.E.	11	1907	II	Oc.D.	18	2116	I	Sh.I.	27	1834	II	Tr.I.
3	1931	I	Oc.D.	11	1921	I	Sh.I.	18	2128	II	Oc.D.	27	1850	I	Tr.E.
3	2230	I	Ec.R.	11	2033	III	Tr.I.	18	2234	I	Tr.E.	27	1954	I	Sh.E.
4	0029		GRS	11	2047	I	Tr.E.	18	2331	I	Sh.E.	27	2046	II	Sh.I.
4	2020		GRS	11	2137	I	Sh.E.	19	0003	III	Tr.I.	27	2125	II	Tr.E.
4	1900	I	Tr.E.	11	2335	II	Ec.R.	19	0209	II	Ec.R.	27	2336	II	Sh.E.
4	1942	I	Sh.E.	11	2356	III	Tr.E.	19	2048	I	Ec.R.	28	0018		GRS
4	1959	III	Sh.I.	11	2357	III	Sh.I.	20	2331		GRS	28	2009		GRS
4	2029	III	Tr.E.	12	0319	III	Sh.E.	20	1800	I	Sh.E.	29	1801	II	Ec.R.
4	2101	II	Ec.R.	12	1853	I	Ec.R.	20	1808	II	Sh.I.	29	2102	III	Oc.R.
4	2321	III	Sh.E.	13	0253		GRS	20	1859	II	Tr.E.	29	2206	III	Ec.D.
5	2140	IV	Ec.D.	13	2244		GRS	20	2059	II	Sh.E.	30	0127	III	Ec.R.
6	0057	IV	Ec.R.	13	1822	II	Sh.E.	21	1922		GRS	30	0156		GRS
6	0207		GRS	13	2244	IV	Tr.I.	22	1806	III	Ec.D.	30	2148		GRS
6	2158		GRS	14	0039	I	Tr.I.	22	1853	IV	Ec.R.	30	1800	IV	Tr.E.

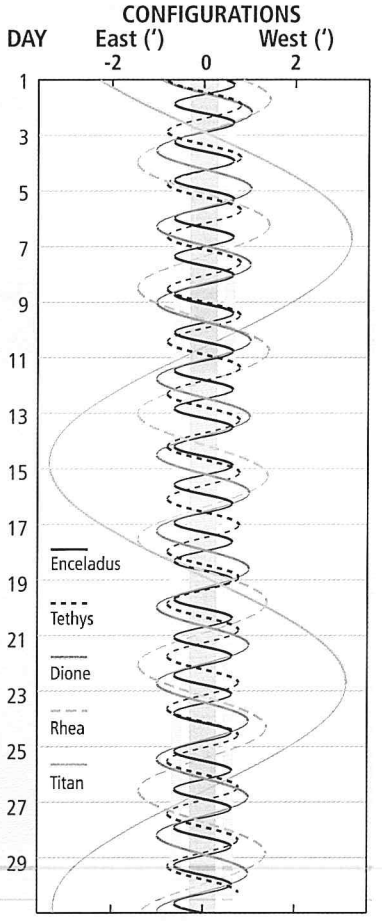
JUPITER MOONS

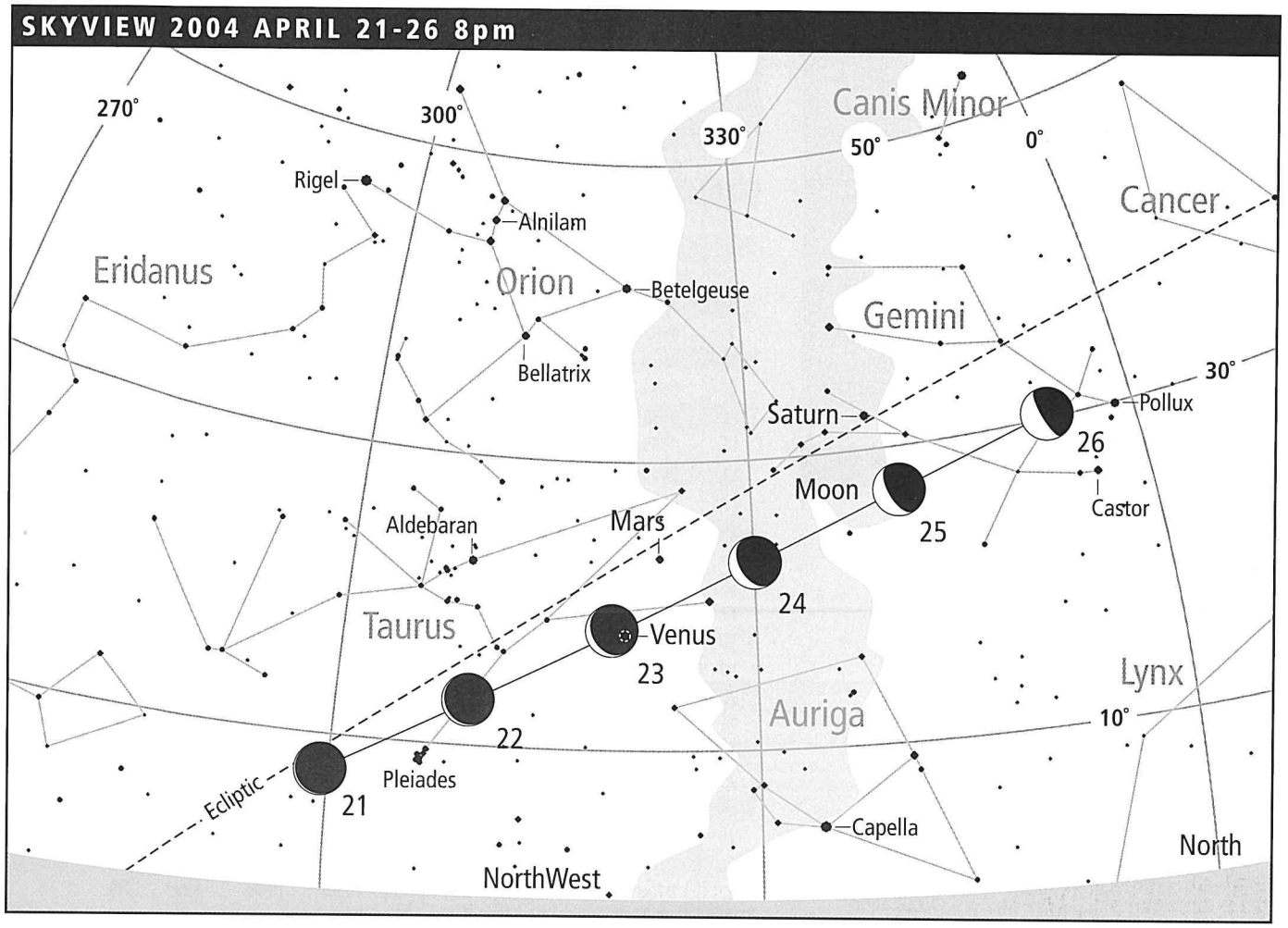


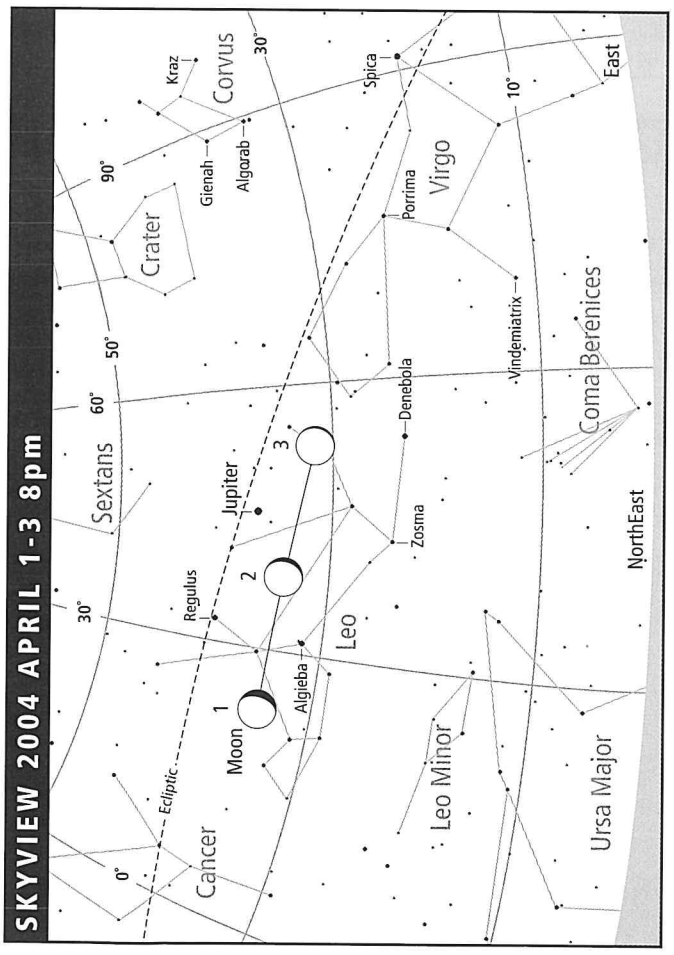
SKYVIEW APRIL 15 8pm – SOUTHERN CROSS

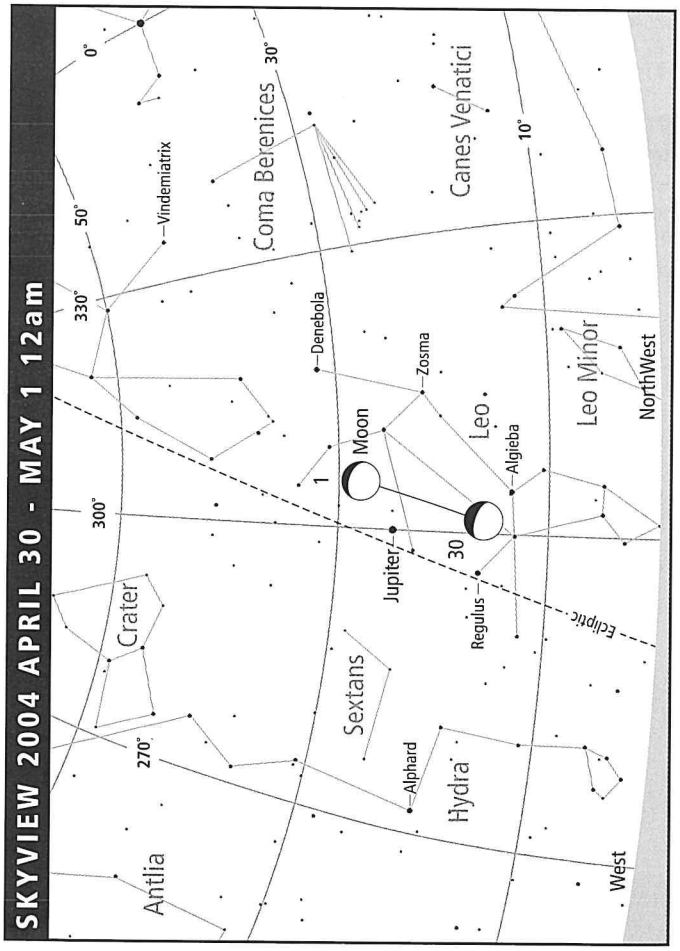


SATURN MOONS




SKYVIEW 2004 APRIL 21-26 8pm
270°
300°
330°
50°
0°
30°
10°
Canis Minor
Cancer
Gemini
Eridanus
Orion
Rigel
Alnilam
Betelgeuse
Bellatrix
Pollux
Saturn
Moon
Castor
Aldebaran
Mars
Taurus
Venus
Lynx
Auriga
Pleiades
Capella
Ecliptic
21
22
23
24
25
26
North
NorthWest


SKYVIEW 2004 APRIL 1-3 8pm
Corvus
Kraz
Spica
Gienah
Algorab
Crater
Virgo
Porrima
Sextans
Jupiter
Regulus
Denebola
Vindemiatrix
Coma Berenices
Zosma
Leo
Algieba
Moon
Ecliptic
Cancer
Leo Minor
Ursa Major
East
NorthEast
1
2
3


SKYVIEW 2004 APRIL 30 - MAY 1 12am
Vindemiatrix
Coma Berenices
Canes Venatici
Denebola
Zosma
Leo Minor
Moon
Leo
Algieba
Jupiter
Regulus
Ecliptic
Crater
Sextans
Alphard
Hydra
Antlia
West
NorthWest
1
30

MAY 2004

HIGHLIGHTS

Total Eclipse of the Moon *– morning of 5th*

Mercury *visible mornings, low in east before sunrise. Best morning visibility mid month.*

Venus *easily visible in the evening sky.*

Mars *visible in the evening sky in Taurus then Gemini. Conjunction with Saturn on the 24th.*

Jupiter *visible in the evening in Leo.*

Saturn *visible in the early evening in Gemini.*

Comets C/NEAT *(2001 Q4) and* ***C/LINEAR*** *(2002 T7) may brighten to naked eye visibility low in the West and North-west sky after sunset from around the middle of the month.*

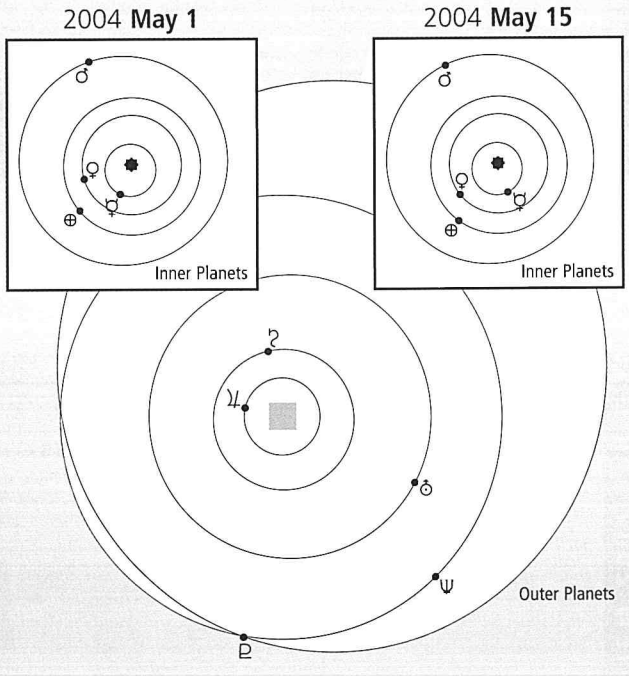
DIARY

2	16	Venus greatest brilliancy
4		Max activity eta-Aquarids meteor shower
5		Venus at extreme value of Declination (+27° 49′)
5	05	**Full Moon – Eclipse**
5	21	Jupiter stationary
6	13	Moon at perigee
11	06	Neptune 5° N. of Moon
11	19	**Last Quarter**
12	20	Uranus 4° N. of Moon
15	05	Mercury greatest elongation W. (26°)
17	07	Mercury 3° S. of Moon
17	23	Neptune stationary
18	08	Venus stationary
19		Max activity Sagittarid meteor shower
19	13	**New Moon**
21	20	Moon at apogee
21	20	Venus 0°.3 S. of Moon – Occultation
23	00	Mars 3° S. of Moon
23	02	Saturn 5° S. of Moon
25	07	Mars 1°.6 N. of Saturn
27	16	**First Quarter**
27	20	Jupiter 4° S. of Moon

SUN+MOON RISE/SET

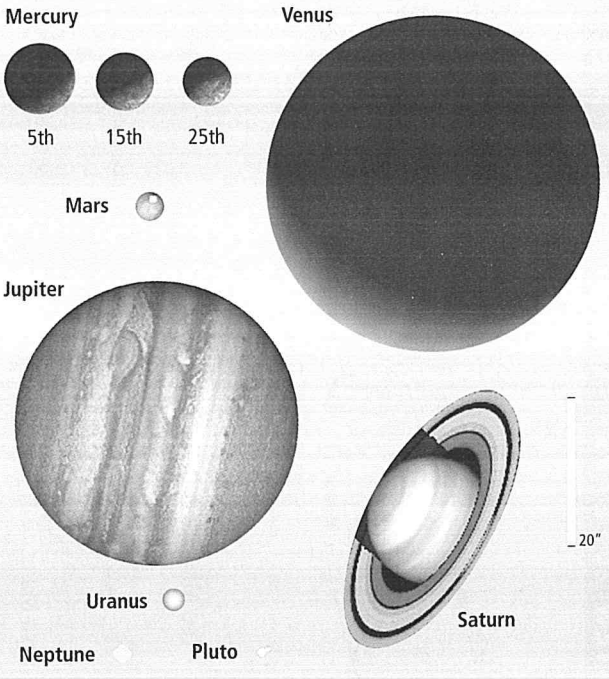
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0648	73	0525	1214	1739	288	1902	1538	0234	0.87
2	0649	72	0526	1214	1738	288	1901	1608	0338	0.93
3	0650	72	0527	1213	1737	288	1900	1640	0443	0.98
4	0650	72	0527	1213	1736	289	1859	1714	0551	1.00
5	0651	71	0528	1213	1735	289	1858	1754	0702	0.99
6	0652	71	0528	1213	1734	289	1858	1840	0817	0.95
7	0652	71	0529	1213	1733	290	1857	1934	0931	0.89
8	0653	70	0529	1213	1733	290	1856	2037	1042	0.80
9	0654	70	0530	1213	1732	290	1856	2145	1144	0.70
10	0655	70	0531	1213	1731	291	1855	2254	1236	0.59
11	0655	69	0531	1213	1730	291	1854	DNR	1320	0.48
12	0656	69	0532	1213	1730	291	1854	0002	1356	0.37
13	0657	69	0532	1213	1729	291	1853	0106	1427	0.27
14	0657	68	0533	1213	1728	292	1853	0207	1456	0.19
15	0658	68	0533	1213	1728	292	1852	0306	1523	0.12
16	0659	68	0534	1213	1727	292	1852	0403	1550	0.06
17	0659	68	0534	1213	1726	293	1851	0500	1618	0.02
18	0700	67	0535	1213	1726	293	1851	0557	1648	0.00
19	0701	67	0536	1213	1725	293	1850	0655	1721	0.00
20	0701	67	0536	1213	1725	293	1850	0753	1759	0.02
21	0702	67	0537	1213	1724	294	1849	0850	1843	0.06
22	0703	66	0537	1213	1724	294	1849	0944	1931	0.11
23	0703	66	0538	1213	1723	294	1849	1034	2025	0.17
24	0704	66	0538	1213	1723	294	1848	1120	2122	0.25
25	0705	66	0539	1214	1722	294	1848	1200	2221	0.34
26	0705	65	0539	1214	1722	295	1848	1235	2320	0.43
27	0706	65	0540	1214	1722	295	1848	1307	DNS	0.54
28	0706	65	0540	1214	1721	295	1847	1337	0020	0.64
29	0707	65	0541	1214	1721	295	1847	1406	0121	0.74
30	0707	65	0541	1214	1721	295	1847	1436	0223	0.83
31	0708	64	0542	1214	1720	296	1847	1508	0328	0.91

PLANET POSITIONS



☿ Mercury ♁ Earth ♃ Jupiter ♅ Uranus ♇ Pluto
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

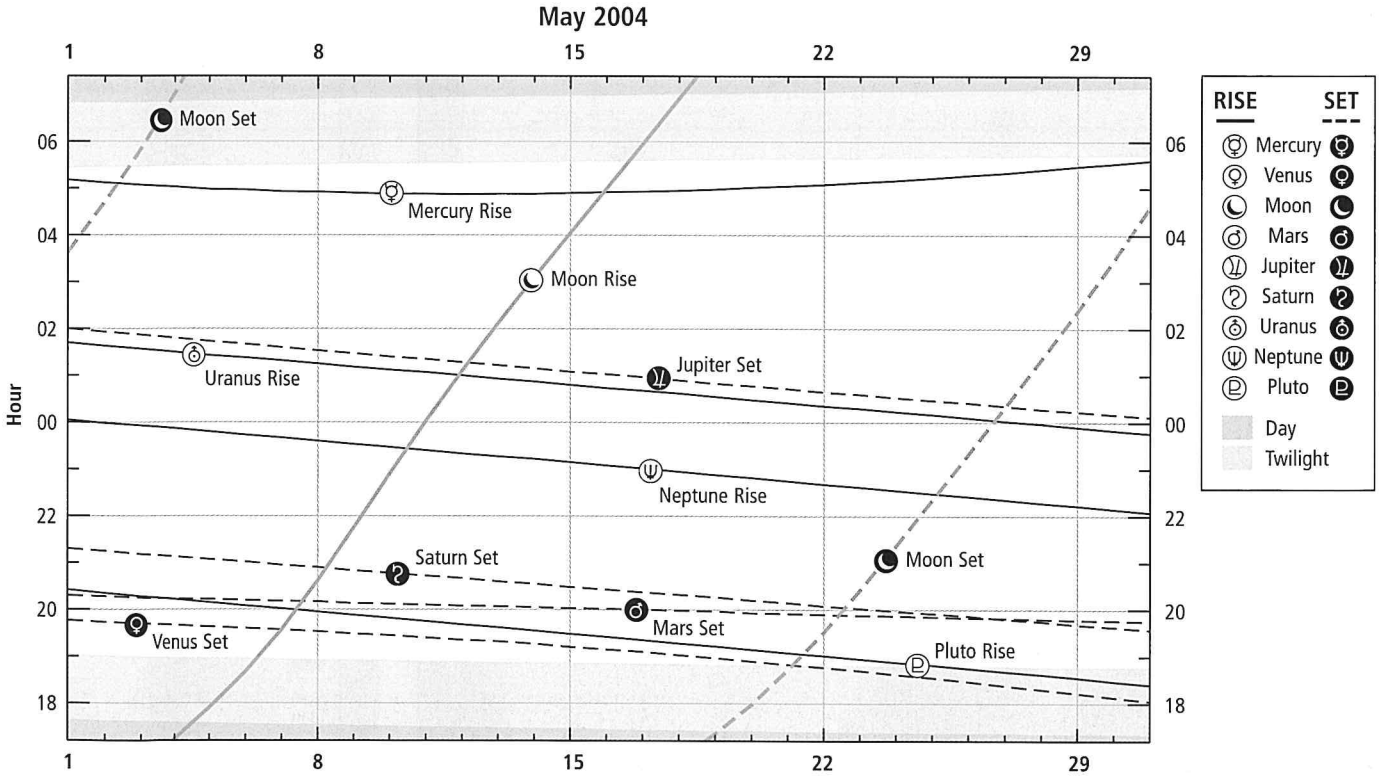


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0515	1645	1013	1946	1025	2018	1444	0204	1	1115	2118	0145	1439	0007	1335	2025	0946
2	0511	1643	1012	1944	1024	2017	1440	0200	2	1112	2115	0142	1435	0003	1331	2021	0942
2									2					2359			
3	0507	1640	1010	1942	1023	2015	1436	0156	3	1108	2111	0138	1431	2356	1327	2017	0938
4	0504	1637	1008	1940	1022	2014	1432	0152	4	1105	2108	0134	1428	2352	1323	2013	0934
5	0502	1635	1006	1938	1021	2013	1428	0148	5	1101	2104	0130	1424	2348	1319	2009	0929
6	0459	1633	1004	1936	1019	2012	1424	0144	6	1057	2101	0126	1420	2344	1315	2005	0925
7	0458	1630	1002	1934	1018	2011	1420	0140	7	1054	2057	0123	1416	2340	1311	2001	0921
8	0456	1628	1000	1932	1017	2010	1416	0136	8	1050	2054	0119	1412	2336	1307	1957	0917
9	0455	1627	0957	1929	1016	2008	1412	0132	9	1047	2050	0115	1408	2332	1303	1953	0913
10	0454	1625	0955	1927	1015	2007	1408	0128	10	1043	2047	0111	1404	2328	1259	1949	0909
11	0453	1623	0952	1924	1014	2006	1404	0124	11	1040	2043	0107	1401	2324	1256	1945	0905
12	0453	1622	0949	1921	1012	2005	1401	0121	12	1036	2040	0104	1357	2320	1252	1941	0901
13	0452	1620	0945	1919	1011	2004	1357	0117	13	1033	2036	0100	1353	2316	1248	1937	0857
14	0453	1619	0942	1916	1010	2003	1353	0113	14	1029	2033	0056	1349	2313	1244	1933	0853
15	0453	1618	0938	1912	1009	2002	1349	0109	15	1026	2029	0052	1345	2309	1240	1929	0849
16	0454	1617	0935	1909	1008	2001	1345	0105	16	1022	2026	0048	1341	2305	1236	1925	0845
17	0455	1616	0931	1906	1006	2000	1341	0102	17	1019	2022	0044	1337	2301	1232	1921	0841
18	0456	1616	0926	1902	1005	1959	1337	0058	18	1015	2019	0041	1334	2257	1228	1917	0837
19	0457	1615	0922	1858	1004	1958	1334	0054	19	1012	2016	0037	1330	2253	1224	1913	0833
20	0459	1614	0917	1854	1003	1956	1330	0050	20	1008	2012	0033	1326	2249	1220	1909	0829
21	0501	1614	0913	1850	1001	1955	1326	0047	21	1005	2009	0029	1322	2245	1216	1905	0825
22	0503	1614	0908	1846	1000	1954	1322	0043	22	1001	2005	0025	1318	2241	1212	1901	0821
23	0505	1614	0902	1842	0959	1953	1318	0039	23	0958	2002	0021	1314	2237	1208	1857	0817
24	0508	1613	0857	1837	0957	1952	1315	0036	24	0954	1958	0018	1310	2233	1204	1853	0813
25	0510	1614	0851	1833	0956	1951	1311	0032	25	0951	1955	0014	1306	2229	1201	1849	0809
26	0513	1614	0846	1828	0955	1950	1307	0028	26	0947	1952	0010	1302	2225	1157	1845	0805
27	0517	1614	0840	1823	0953	1949	1303	0025	27	0944	1948	0006	1259	2221	1153	1841	0801
28	0520	1615	0833	1818	0952	1948	1259	0021	28	0940	1945	0002	1255	2217	1149	1837	0757
28									28			2358					
29	0524	1615	0827	1813	0950	1947	1256	0017	29	0937	1941	2354	1251	2213	1145	1833	0753
30	0528	1616	0820	1808	0949	1946	1252	0014	30	0934	1938	2350	1247	2209	1141	1828	0749
31	0532	1617	0814	1803	0948	1945	1248	0010	31	0930	1934	2346	1243	2205	1137	1824	0745

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

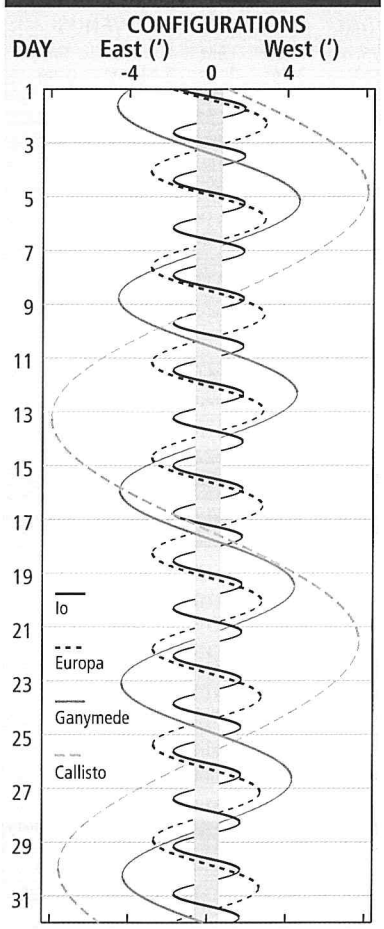
DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event
1	0103	IV	Sh.I.	8	1827		GRS	14	2347	I	Oc.D.	25	1733		GRS
1	1739		GRS	8	1903	I	Tr.I.	14	2348	I	Tr.E.	25	1903	IV	Oc.R.
2	2326		GRS	8	1904	I	Oc.R.	15	1914		GRS	26	0002	I	Tr.I.
2	2357	I	Tr.I.	8	2210	IV	Oc.D.	15	1809	II	Sh.E.	26	2320		GRS
3	0105	I	Sh.I.	10	0014		GRS	17	2053		GRS	26	2120	I	Oc.D.
3	1918		GRS	10	2005		GRS	17	1817	III	Tr.E.	27	1911		GRS
3	2113	I	Oc.D.	10	1914	III	Sh.E.	17	1906	IV	Sh.I.	27	1830	I	Tr.I.
4	0039	I	Ec.R.	10	2305	I	Oc.D.	17	1954	III	Sh.I.	27	1946	I	Sh.I.
4	1825	I	Tr.I.	11	2016	I	Tr.I.	17	2158	IV	Sh.E.	27	2046	I	Tr.E.
4	1933	I	Sh.I.	11	2128	I	Sh.I.	17	2312	III	Sh.E.	27	2201	I	Sh.E.
4	2041	I	Tr.E.	11	2232	I	Tr.E.	18	0057	I	Oc.D.	27	2300	II	Oc.D.
4	2102	II	Tr.I.	11	2332	II	Tr.I.	18	2208	I	Tr.I.	28	1723	III	Ec.R.
4	2149	I	Sh.E.	11	2343	I	Sh.E.	18	2323	I	Sh.I.	28	1922	I	Ec.R.
4	2323	II	Sh.I.	12	2144		GRS	19	0024	I	Tr.E.	29	2050		GRS
4	2353	II	Tr.E.	12	1733	I	Oc.D.	19	2232		GRS	29	1758	II	Tr.I.
5	0105		GRS	12	2103	I	Ec.R.	19	1926	I	Oc.D.	29	2033	II	Sh.I.
5	2057		GRS	13	1736		GRS	19	2258	I	Ec.R.	29	2049	II	Tr.E.
5	1907	I	Ec.R.	13	1757	II	Oc.D.	20	1823		GRS	29	2323	II	Sh.E.
6	2035	II	Ec.R.	13	1812	I	Sh.E.	20	1751	I	Sh.I.	31	2229		GRS
6	2118	III	Oc.D.	13	2310	II	Ec.R.	20	1853	I	Tr.E.	31	1737	II	Ec.R.
7	0045	III	Oc.R.	14	0104	III	Oc.D.	20	2007	I	Sh.E.	31	2239	III	Tr.I.
7	2235		GRS	14	2323		GRS	20	2028	II	Oc.D.				
								21	1726	I	Ec.R.				
								22	0011		GRS				
								22	2002		GRS				
								22	1756	II	Sh.I.				
								22	1813	II	Tr.E.				
								22	2046	II	Sh.E.				
								24	2141		GRS				
								24	1842	III	Tr.I.				
								24	2209	III	Tr.E.				
								24	2353	III	Sh.I.				

Moons: I Io, II Europa, III Ganymede, IV Callisto

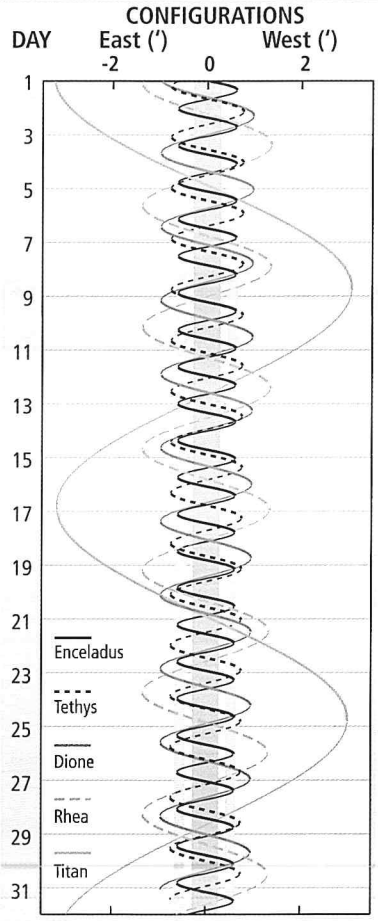
Events: D Disappear, E Egress, Ec Eclipse, Sh Shadow, R Reappear, I Ingress, Oc Occult, Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

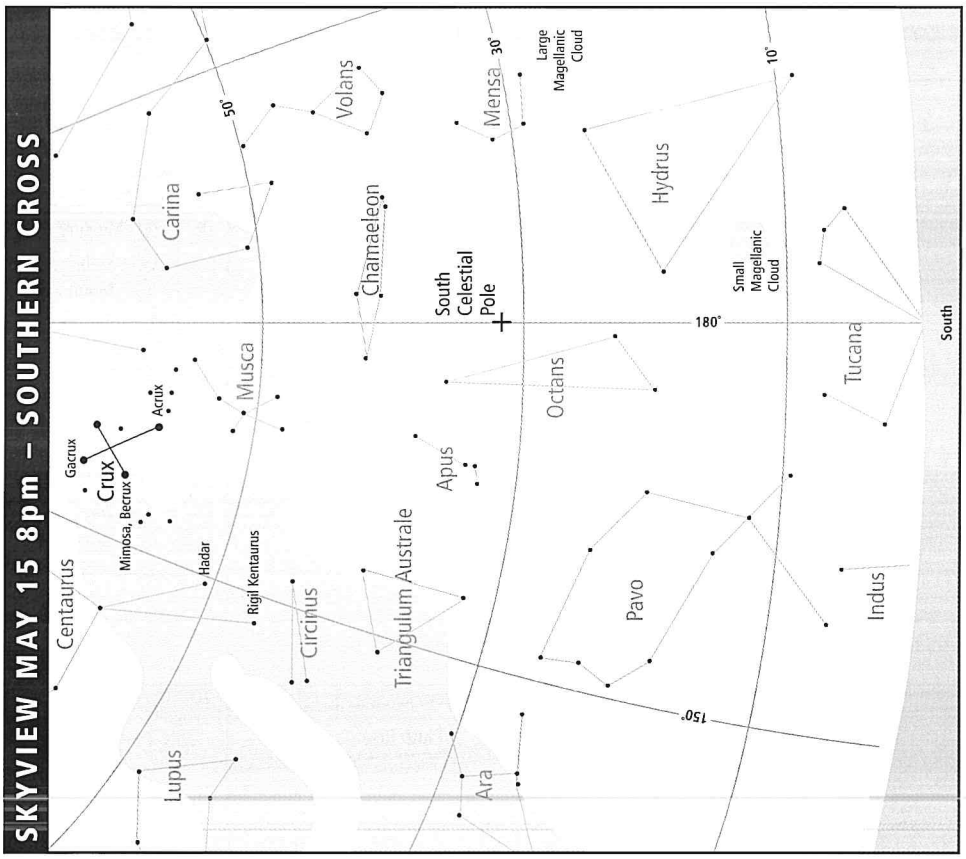
JUPITER MOONS

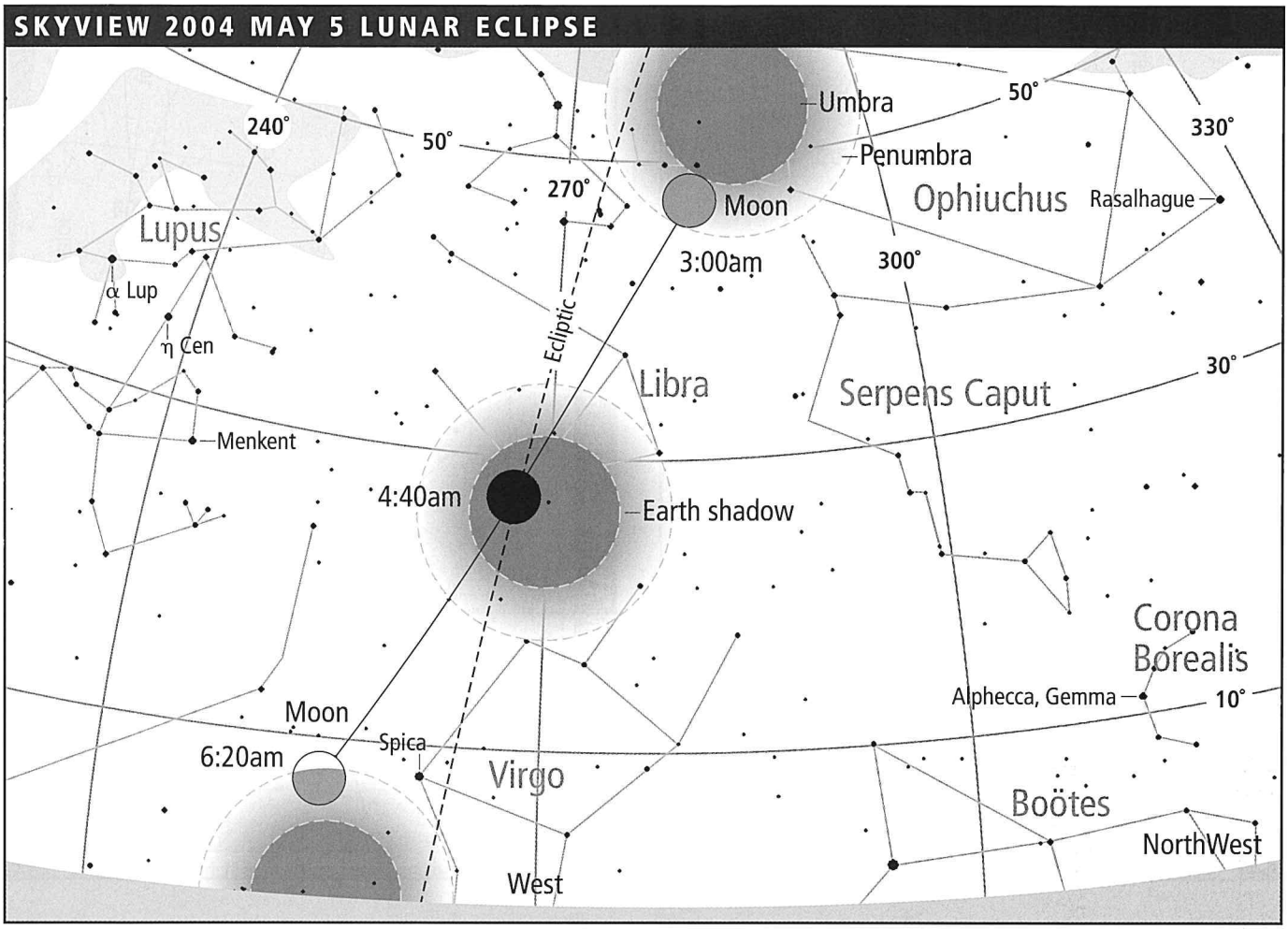


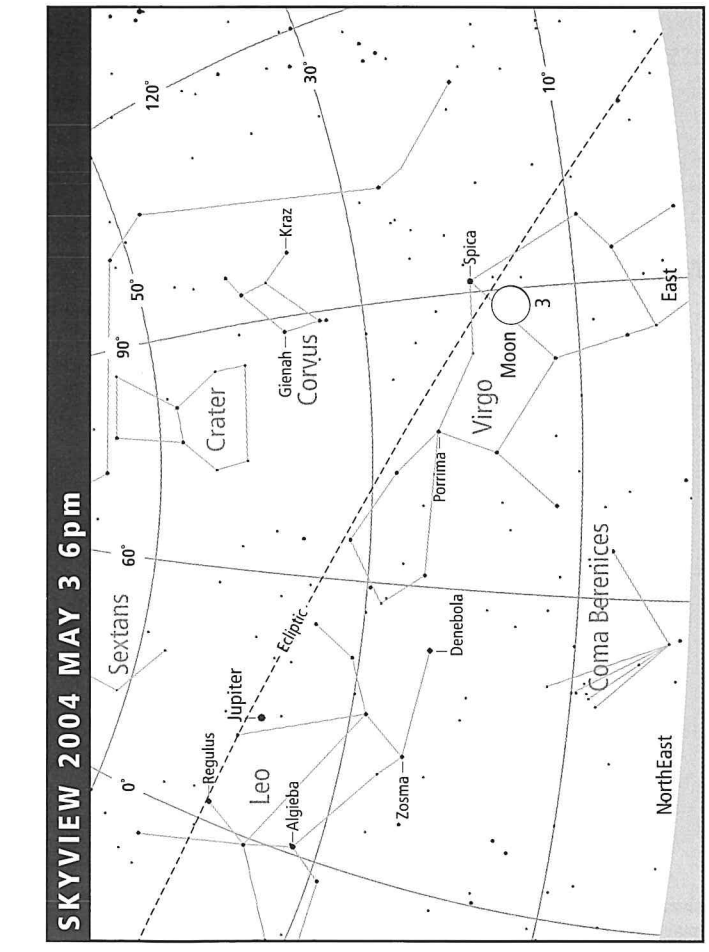
SATURN MOONS

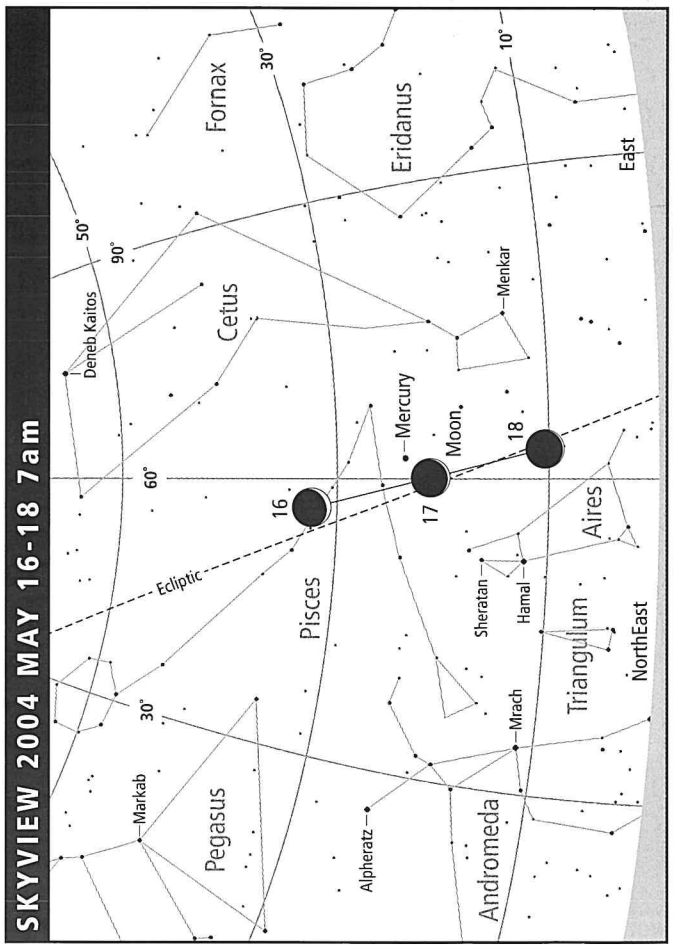


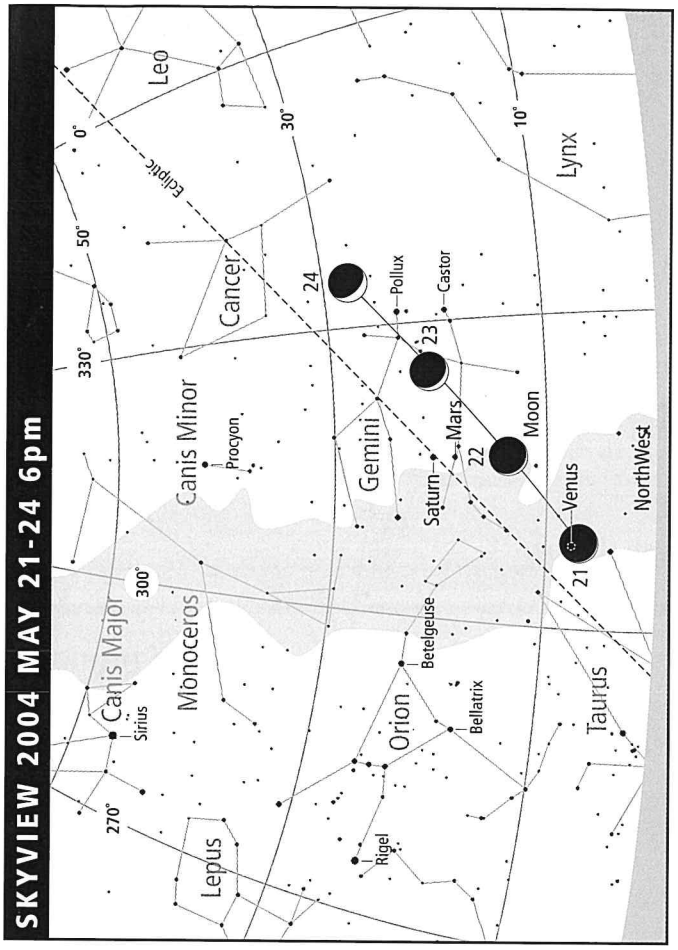
SKYVIEW MAY 15 8pm – SOUTHERN CROSS

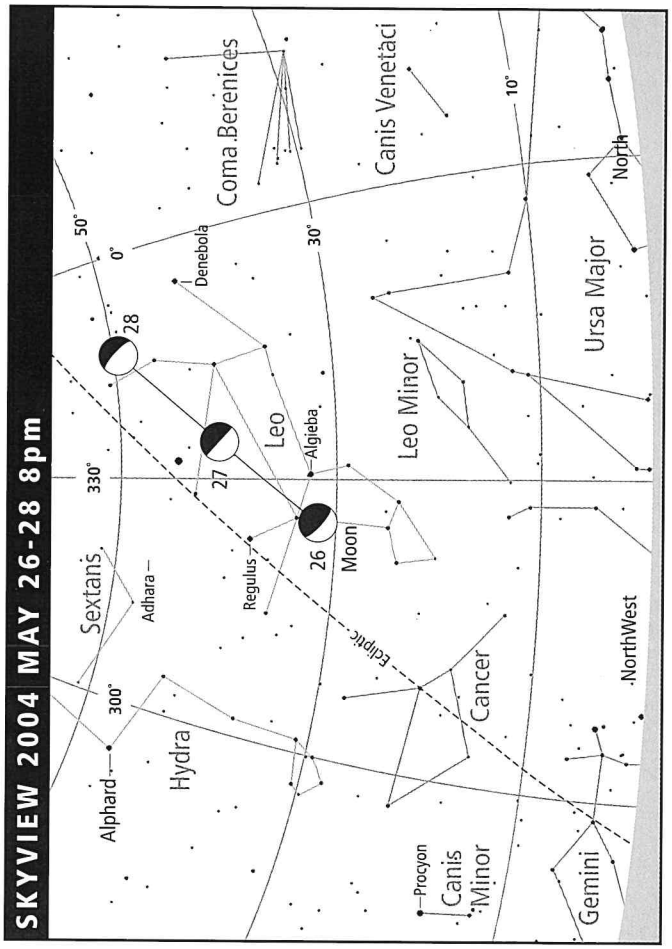


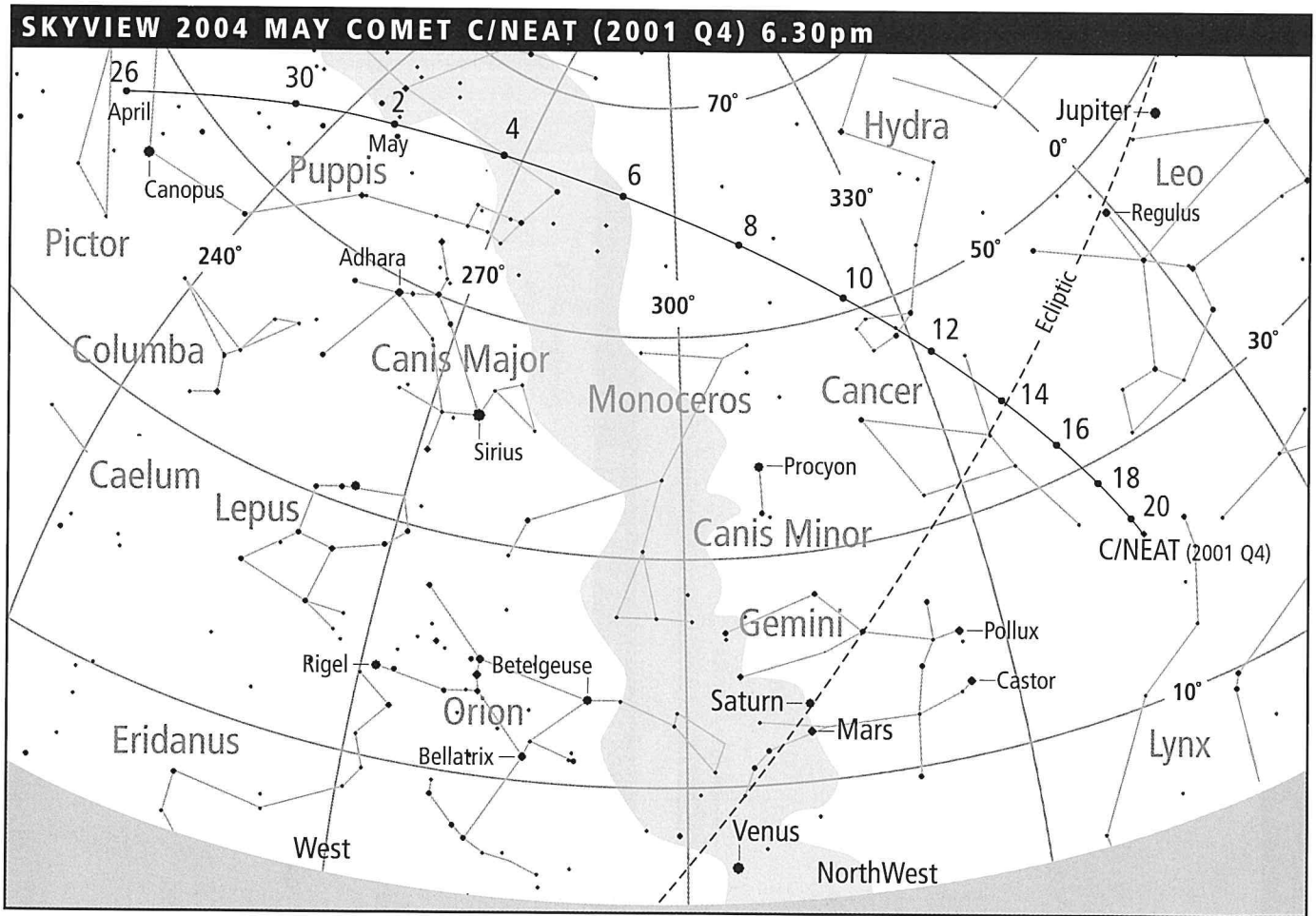

SKYVIEW 2004 MAY 5 LUNAR ECLIPSE
Umbra
Penumbra
Moon
3:00am
4:40am
Earth shadow
6:20am
Moon
Ecliptic
Lupus
α Lup
η Cen
Menkent
Libra
Serpens Caput
Ophiuchus
Rasalhague
Corona Borealis
Alphecca, Gemma
Spica
Virgo
Boötes
West
NorthWest
240°
50°
270°
300°
330°
30°
10°


SKYVIEW 2004 MAY 3 6pm
Kraz
Spica
Moon
3
East
Gienah
Corvus
Crater
Virgo
Porrima
Sextans
Ecliptic
Jupiter
Regulus
Leo
Algieba
Zosma
Denebola
Coma Berenices
NorthEast
120°
90°
60°
30°
0°
50°
10°


SKYVIEW 2004 MAY 16-18 7am
Fornax
Eridanus
East
Cetus
Deneb Kaitos
Menkar
Mercury
Moon
16
17
18
Ecliptic
Pisces
Aires
Sheratan
Hamal
Triangulum
Mrach
NorthEast
Markab
Pegasus
Alpheratz
Andromeda
90°
60°
50°
30°
10°

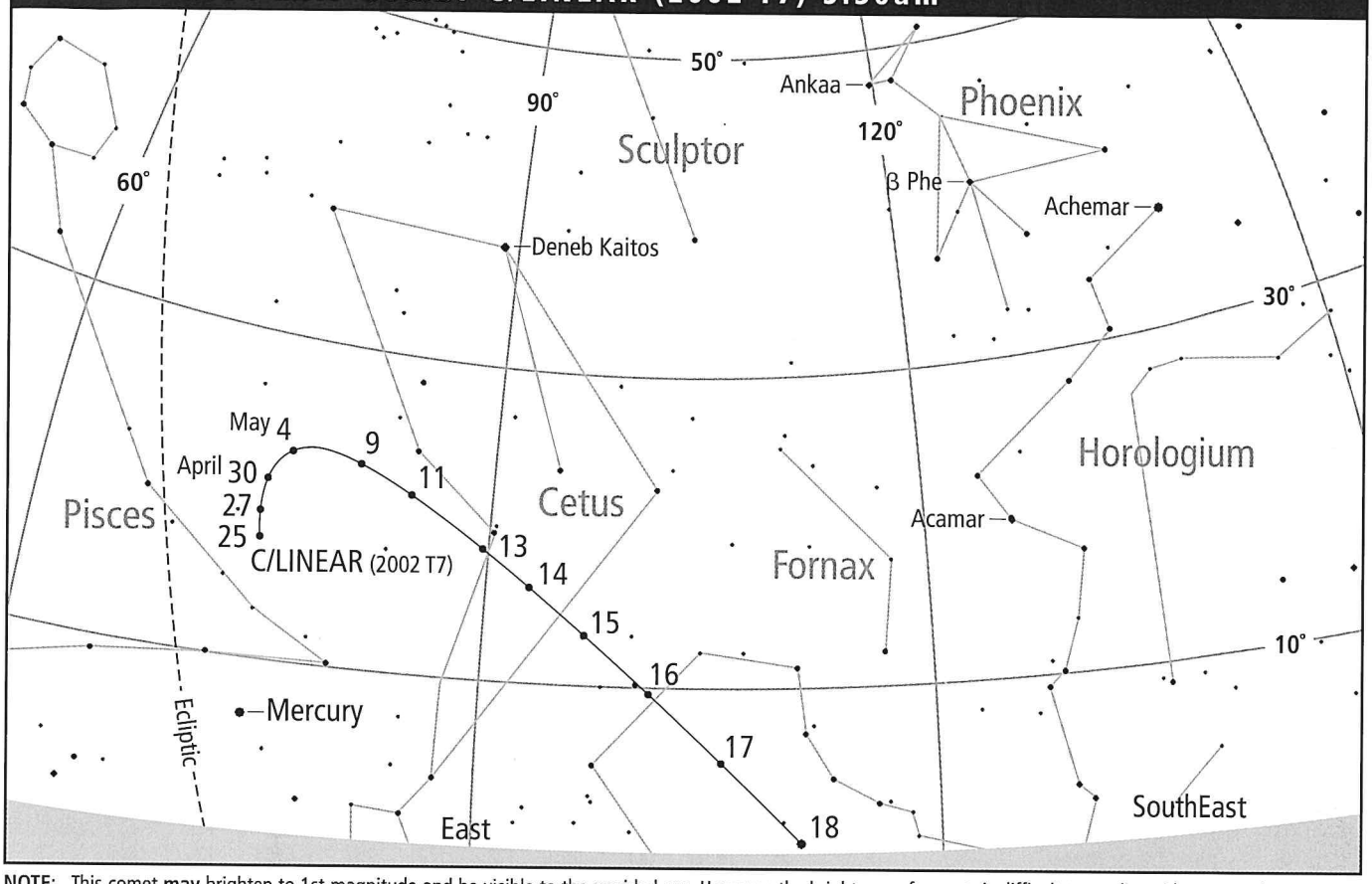






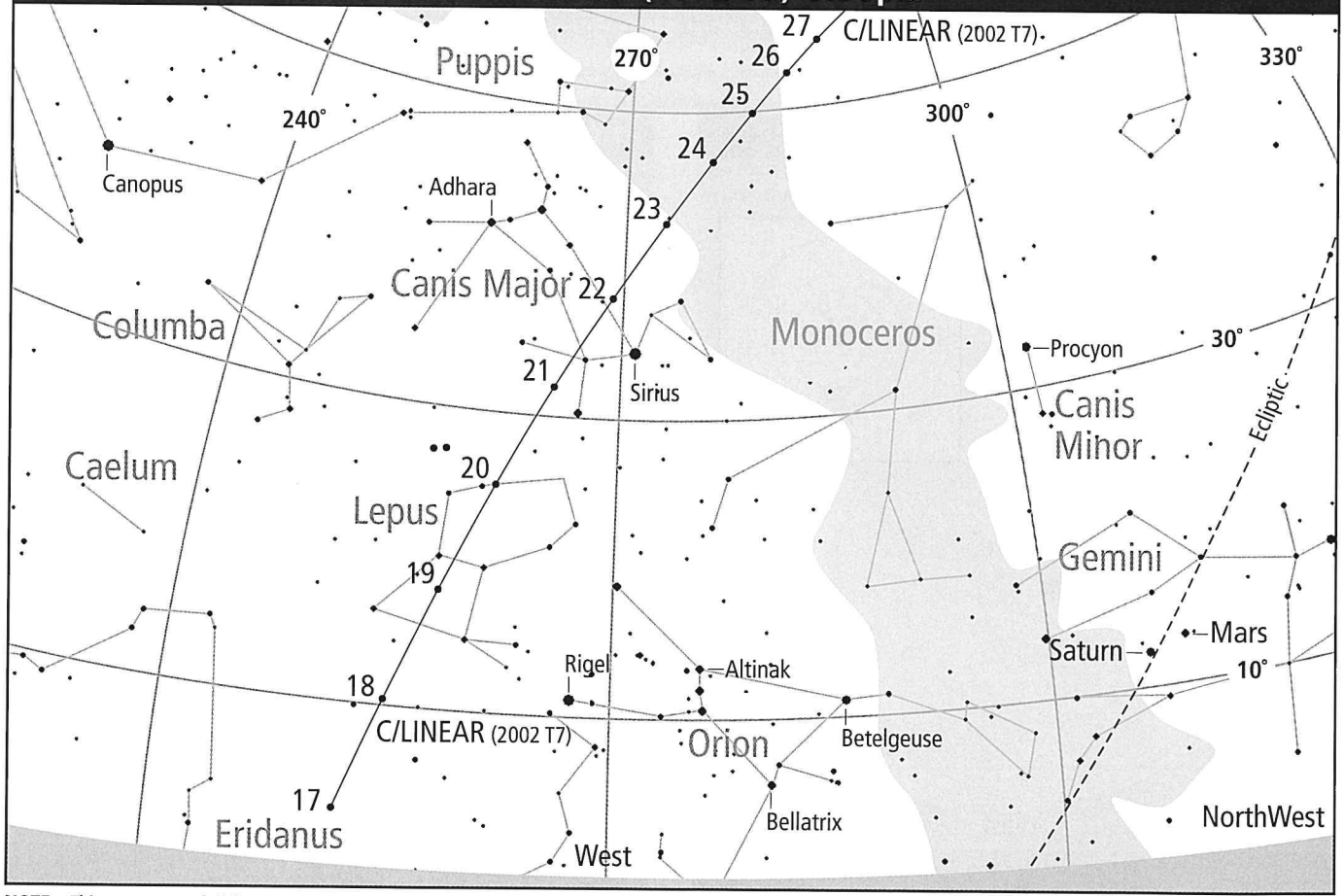
NOTE: This comet **may** brighten to 1st magnitude and be visible to the unaided eye. However, the brightness of comets is difficult to predict with any certainty.

SKYVIEW 2004 MAY COMET C/LINEAR (2002 T7) 5.30am



NOTE: This comet **may** brighten to 1st magnitude and be visible to the unaided eye. However, the brightness of comets is difficult to predict with any certainty.

SKYVIEW 2004 MAY COMET C/LINEAR (2002 T7) 6.30pm



NOTE: This comet **may** brighten to 1st magnitude and be visible to the unaided eye. However, the brightness of comets is difficult to predict with any certainty.

JUNE 2004

HIGHLIGHTS

Transit – ***Venus*** *transits the Sun's disk on afternoon of the 8th.*

Mercury *visible mornings, low in east before sunrise. Best visibility in first week.*

Venus *visible mornings second half of month.*

Mars *visible low in the evening sky in Gemini then Cancer. Passes 6° S of Pollux on the 14th.*

Jupiter *visible in the evening in Leo.*

Saturn *visible only early in the month, in the early evening in constellation Gemini.*

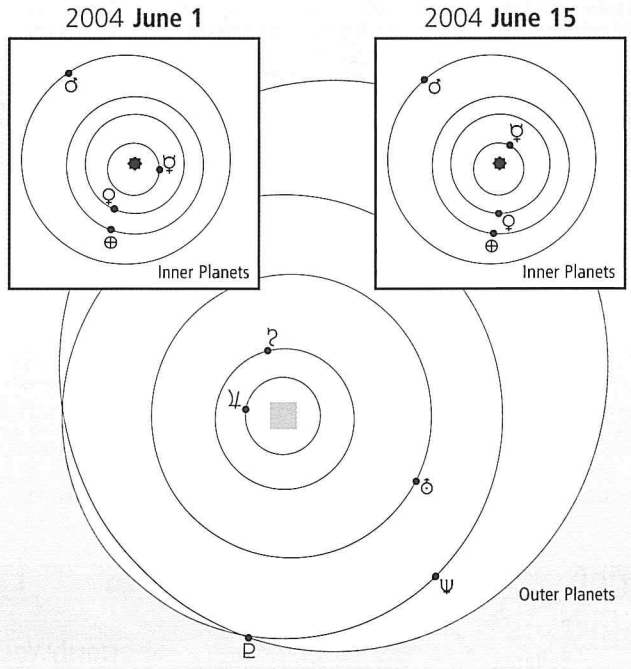
DIARY

Day	Hour	
3	12	**Full Moon**
3	21	Moon at perigee
7	14	Neptune 5° N. of Moon
8	17	Venus in inferior conjunction, transit over Sun
9	03	Uranus 4° N. of Moon
10	04	**Last Quarter**
11	08	Uranus stationary
11	20	Pluto at opposition
15	02	Mars 6° S. of Pollux
18	00	Moon at apogee
18	04	**New Moon**
19	05	Mercury in superior conjunction
19	15	Saturn 5° S. of Moon
20	17	Mars 4° S. of Moon
21	09	Solstice
24	07	Jupiter 3° S. of Moon
25	05	Venus 2° N. of Aldebaran
26	03	**First Quarter**
29	22	Venus stationary

SUN+MOON RISE/SET

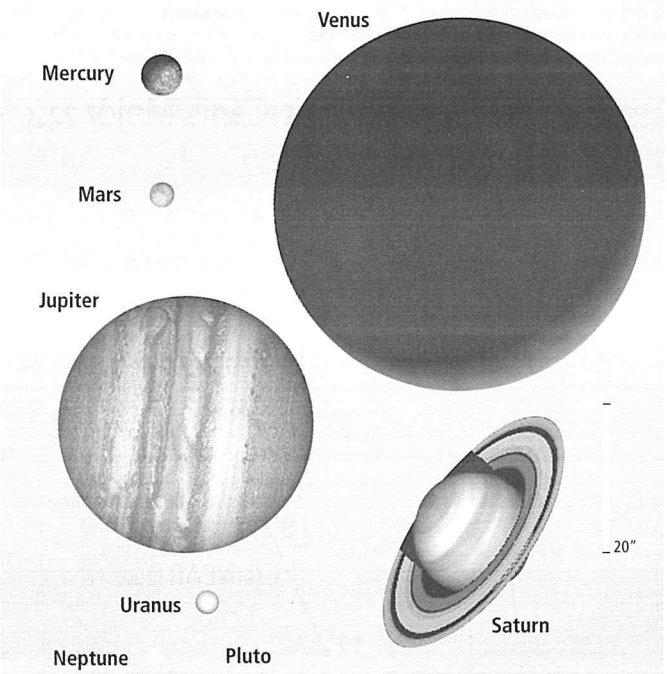
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0709	64	0542	1214	1720	296	1847	1544	0437	0.97
2	0709	64	0543	1215	1720	296	1846	1627	0549	1.00
3	0710	64	0543	1215	1720	296	1846	1718	0705	1.00
4	0710	64	0543	1215	1719	296	1846	1818	0819	0.97
5	0711	64	0544	1215	1719	296	1846	1926	0928	0.91
6	0711	64	0544	1215	1719	296	1846	2038	1027	0.83
7	0712	63	0545	1215	1719	297	1846	2149	1115	0.73
8	0712	63	0545	1216	1719	297	1846	2256	1155	0.63
9	0713	63	0546	1216	1719	297	1846	2400	1229	0.52
10	0713	63	0546	1216	1719	297	1846	DNR	1259	0.42
11	0713	63	0546	1216	1719	297	1846	0100	1327	0.32
12	0714	63	0547	1216	1719	297	1846	0158	1354	0.23
13	0714	63	0547	1217	1719	297	1846	0255	1421	0.15
14	0715	63	0547	1217	1719	297	1846	0352	1450	0.09
15	0715	63	0548	1217	1719	297	1846	0449	1522	0.04
16	0715	63	0548	1217	1719	297	1847	0547	1559	0.01
17	0716	63	0548	1217	1719	297	1847	0644	1641	0.00
18	0716	63	0548	1218	1719	297	1847	0739	1728	0.01
19	0716	63	0549	1218	1720	297	1847	0831	1820	0.03
20	0716	63	0549	1218	1720	297	1847	0918	1916	0.07
21	0717	63	0549	1218	1720	297	1848	0959	2014	0.13
22	0717	63	0549	1219	1720	297	1848	1036	2113	0.20
23	0717	63	0550	1219	1721	297	1848	1108	2212	0.29
24	0717	63	0550	1219	1721	297	1848	1138	2311	0.38
25	0717	63	0550	1219	1721	297	1849	1207	DNS	0.49
26	0717	63	0550	1219	1721	297	1849	1235	0011	0.60
27	0718	63	0550	1220	1722	297	1849	1305	0112	0.70
28	0718	63	0550	1220	1722	297	1849	1338	0217	0.80
29	0718	63	0550	1220	1722	297	1850	1416	0326	0.89
30	0718	63	0550	1220	1723	297	1850	1502	0438	0.95

PLANET POSITIONS



☿ Mercury ♀ Venus ⊕ Earth ♂ Mars ♃ Jupiter ♄ Saturn ♅ Uranus ♆ Neptune ♇ Pluto

PLANET APPEARANCE

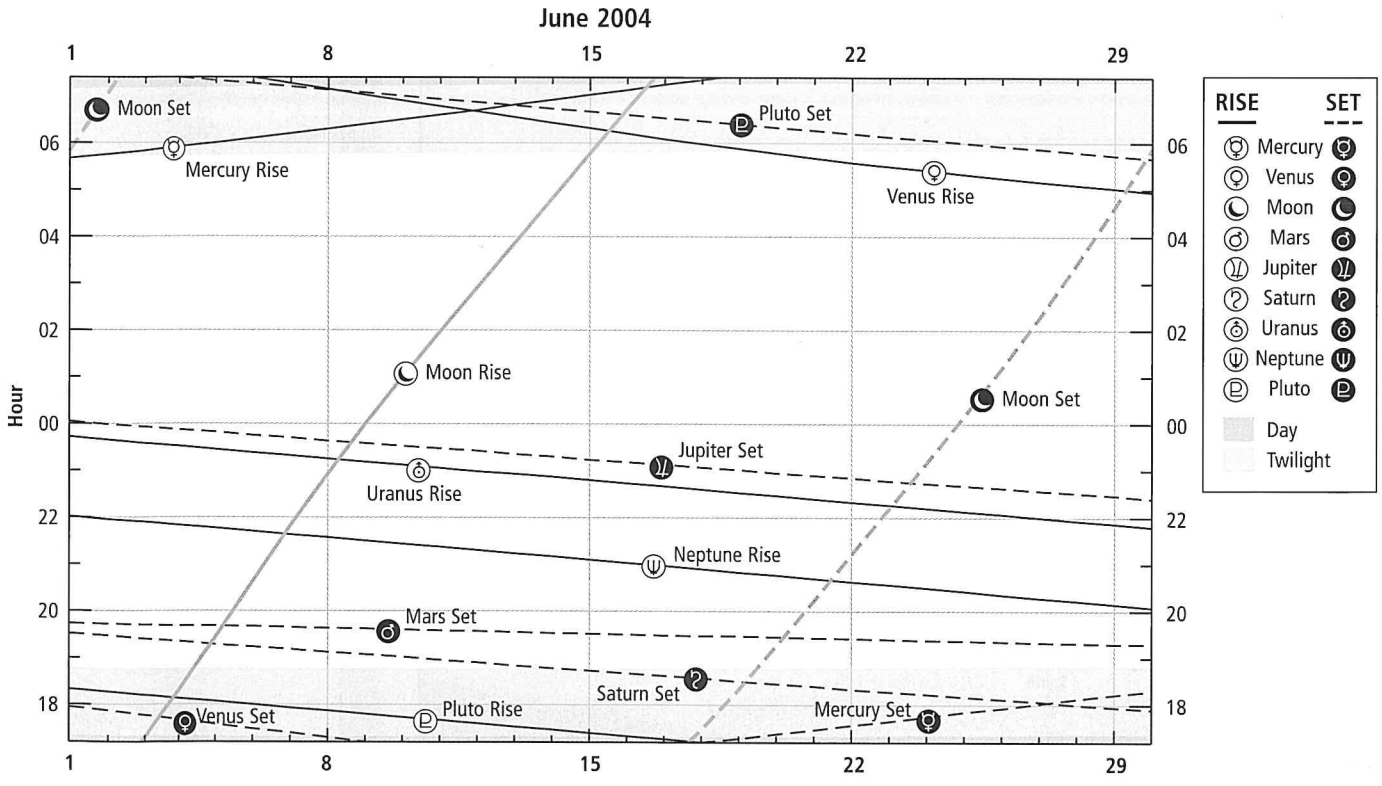


1 degree (1°) = 60 arc minutes (60') = 3600 arc seconds (3600")
Therefore 20" = 1/3' = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0536	1618	0807	1757	0946	1944	1244	0007	1	0927	1931	2343	1239	2201	1133	1820	0741
2	0540	1620	0800	1752	0945	1943	1241	0003	2	0923	1928	2339	1235	2157	1129	1816	0737
2								2359	2								
3	0545	1621	0753	1746	0943	1942	1237	2356	3	0920	1924	2335	1231	2154	1125	1812	0733
4	0550	1623	0746	1741	0942	1941	1233	2352	4	0916	1921	2331	1227	2150	1121	1808	0729
5	0555	1625	0738	1735	0940	1941	1230	2349	5	0913	1917	2327	1223	2146	1117	1804	0724
6	0600	1627	0731	1729	0939	1940	1226	2345	6	0909	1914	2323	1219	2142	1113	1800	0720
7	0606	1630	0724	1724	0937	1939	1222	2342	7	0906	1911	2319	1216	2138	1109	1756	0716
8	0612	1632	0716	1718	0936	1938	1219	2338	8	0903	1907	2315	1212	2134	1105	1752	0712
9	0618	1635	0709	1712	0934	1937	1215	2335	9	0859	1904	2311	1208	2130	1101	1748	0708
10	0624	1638	0701	1707	0933	1936	1211	2331	10	0856	1901	2307	1204	2126	1057	1744	0704
11	0630	1642	0654	1701	0931	1935	1208	2328	11	0852	1857	2303	1200	2122	1053	1740	0700
12	0636	1645	0647	1656	0930	1934	1204	2325	12	0849	1854	2259	1156	2118	1049	1736	0656
13	0642	1649	0640	1650	0928	1933	1200	2321	13	0845	1850	2256	1152	2114	1045	1732	0652
14	0649	1654	0633	1645	0927	1932	1157	2318	14	0842	1847	2252	1148	2110	1041	1728	0648
15	0655	1658	0626	1639	0925	1931	1153	2314	15	0839	1844	2248	1144	2106	1037	1724	0644
16	0702	1702	0619	1634	0923	1930	1149	2311	16	0835	1840	2244	1140	2102	1033	1720	0640
17	0708	1707	0612	1629	0922	1929	1146	2308	17	0832	1837	2240	1136	2058	1029	1716	0636
18	0715	1712	0605	1624	0920	1928	1142	2304	18	0828	1834	2236	1132	2054	1025	1712	0632
19	0721	1717	0559	1619	0919	1928	1138	2301	19	0825	1830	2232	1128	2050	1021	1708	0628
20	0727	1723	0553	1614	0917	1927	1135	2257	20	0821	1827	2228	1124	2046	1017	1704	0624
21	0733	1728	0547	1610	0915	1926	1131	2254	21	0818	1824	2224	1120	2042	1013	1700	0620
22	0739	1734	0541	1605	0914	1925	1128	2251	22	0815	1820	2220	1116	2038	1009	1656	0616
23	0745	1739	0535	1601	0912	1924	1124	2247	23	0811	1817	2216	1113	2034	1005	1652	0612
24	0750	1745	0530	1556	0910	1923	1120	2244	24	0808	1814	2212	1109	2030	1001	1648	0608
25	0755	1751	0525	1552	0908	1922	1117	2241	25	0804	1810	2208	1105	2026	0958	1643	0604
26	0800	1756	0520	1548	0907	1921	1113	2238	26	0801	1807	2204	1101	2021	0954	1639	0600
27	0805	1802	0515	1544	0905	1920	1110	2234	27	0757	1804	2200	1057	2017	0950	1635	0556
28	0809	1808	0510	1540	0903	1919	1106	2231	28	0754	1800	2156	1053	2013	0946	1631	0552
29	0813	1813	0506	1536	0902	1918	1103	2228	29	0751	1757	2152	1049	2009	0942	1627	0548
30	0817	1818	0502	1533	0900	1918	1059	2224	30	0747	1754	2148	1045	2005	0938	1623	0544

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

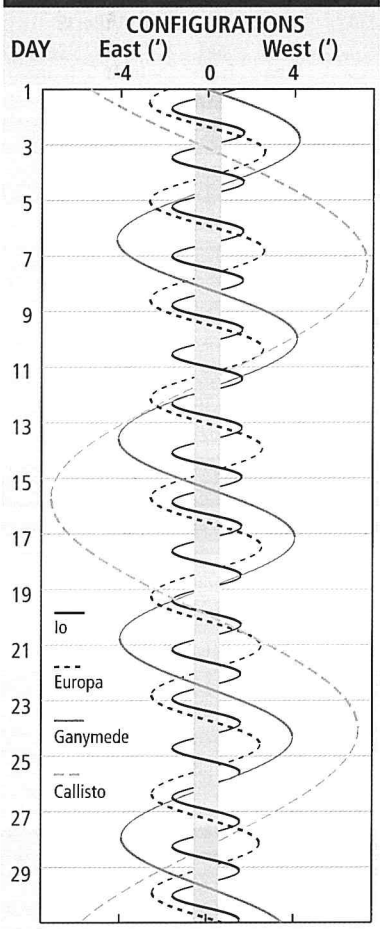
DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event
1	1821		GRS	5	2310	II	Sh.I.	12	2227		GRS	21	2010	II	Oc.D.
2	2315	I	Oc.D.	5	2326	II	Tr.E.	12	1804	I	Sh.I.	22	2047		GRS
3	2000		GRS	6	1730		GRS	12	1906	I	Tr.E.	22	1905	III	Sh.E.
3	2025	I	Tr.I.	7	2318		GRS	12	2020	I	Sh.E.	23	1742	II	Sh.I.
3	2141	I	Sh.I.	7	2013	II	Ec.R.	12	2314	II	Tr.I.	23	1807	II	Tr.E.
3	2241	I	Tr.E.	8	1909		GRS	13	1819		GRS	23	2030	II	Sh.E.
4	1744	I	Oc.D.	10	2048		GRS	13	1741	I	Ec.R.	24	2226		GRS
4	1804	III	Ec.D.	10	2220	I	Tr.I.	14	1731	II	Oc.D.	25	1817		GRS
4	2117	I	Ec.R.	11	1940	I	Oc.D.	14	2248	II	Ec.R.	26	2043	I	Tr.I.
4	2122	III	Ec.R.	11	2022	III	Oc.R.	15	1958		GRS	26	2154	I	Sh.I.
5	2139		GRS	11	2203	IV	Ec.D.	16	1754	II	Sh.E.	27	1956		GRS
5	1825	I	Sh.E.	11	2204	III	Ec.D.	17	2137		GRS	27	1804	I	Oc.D.
5	2035	II	Tr.I.	11	2312	I	Ec.R.	18	1729		GRS	27	2131	I	Ec.R.
								18	2100	III	Oc.D.	28	1729	I	Tr.E.
								18	2137	I	Oc.D.	28	1832	IV	Ec.R.
								19	1846	I	Tr.I.	28	1838	I	Sh.E.
								19	1919	IV	Tr.I.	29	2136		GRS
								19	1959	I	Sh.I.	29	1831	III	Tr.E.
								19	2102	I	Tr.E.	29	1950	III	Sh.I.
								19	2215	I	Sh.E.	30	1727		GRS
								19	2257	IV	Tr.E.	30	1758	II	Tr.I.
								20	1908		GRS	30	2018	II	Sh.I.
								20	1936	I	Ec.R.	30	2049	II	Tr.E.

Moons: I Io, II Europa, III Ganymede, IV Callisto

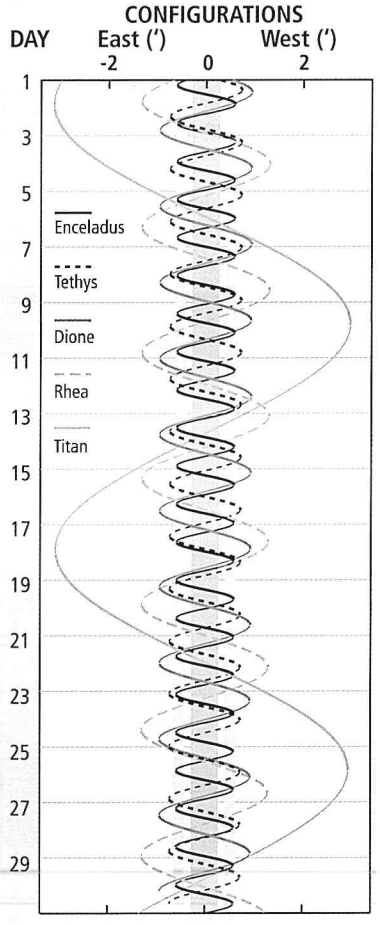
Events: D Disappear, E Egress, Ec Eclipse, Sh Shadow, R Reappear, I Ingress, Oc Occult, Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

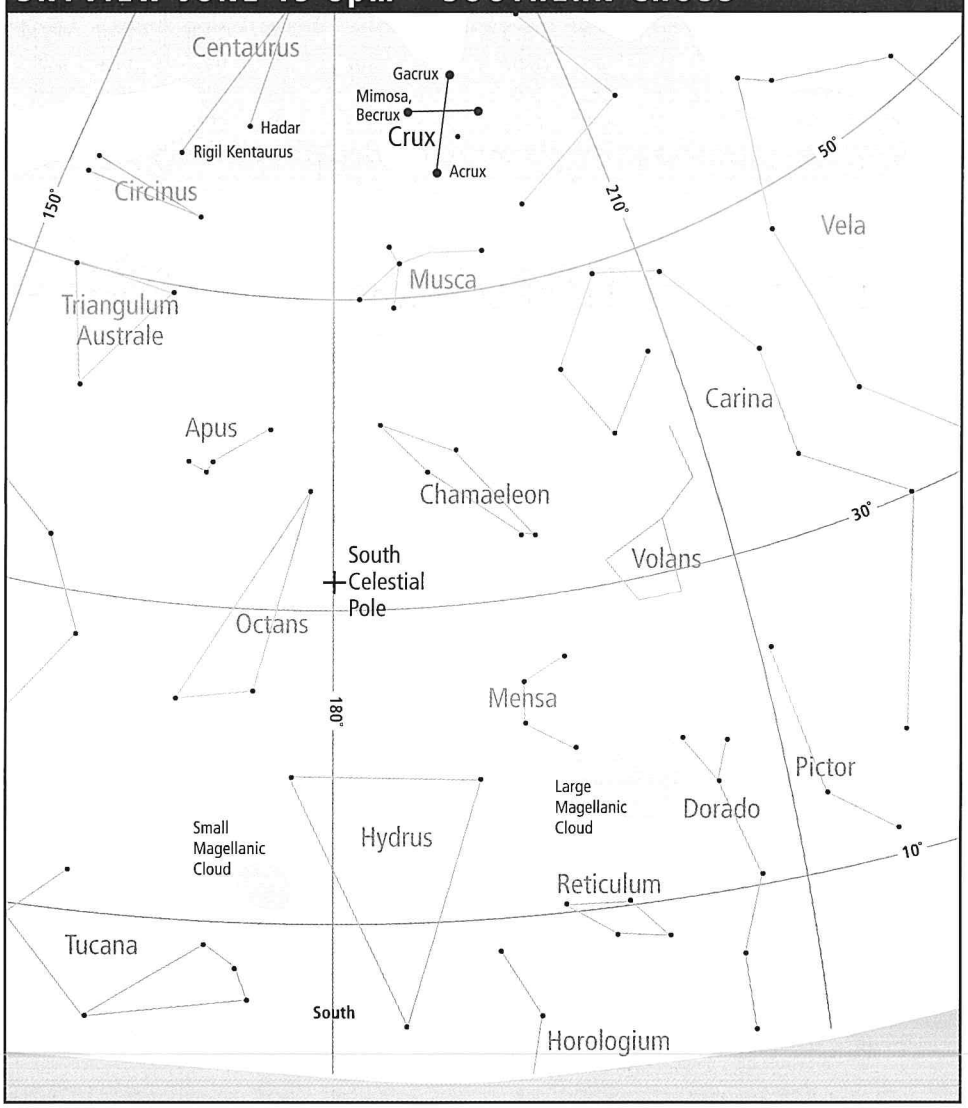
JUPITER MOONS

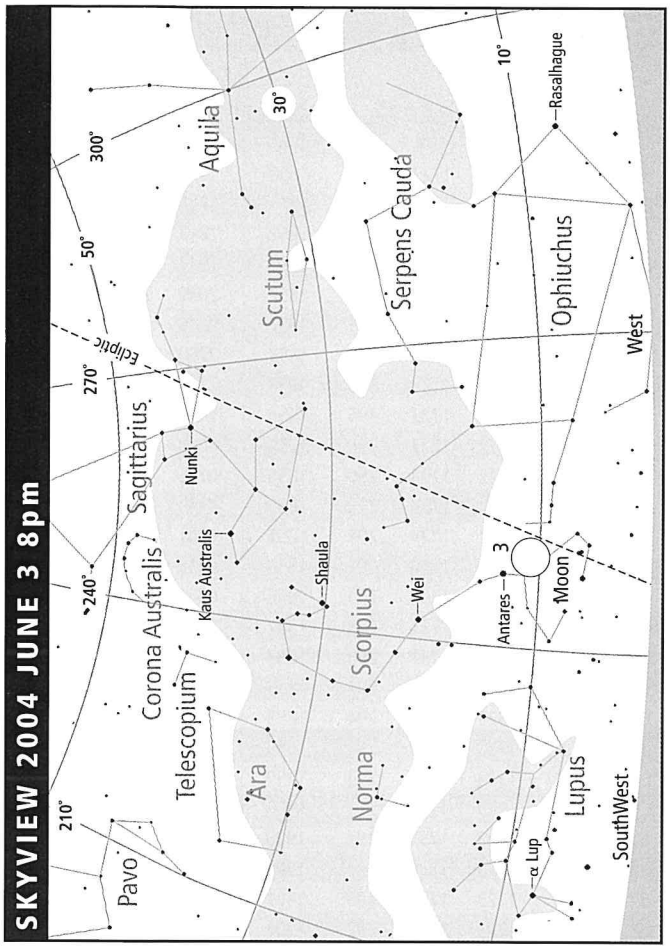


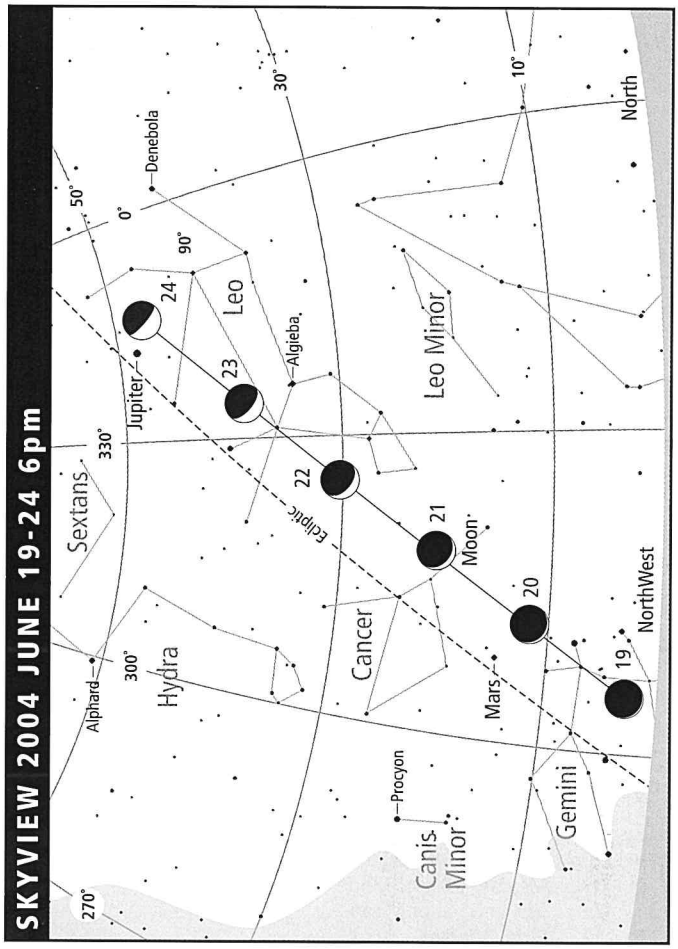
SATURN MOONS

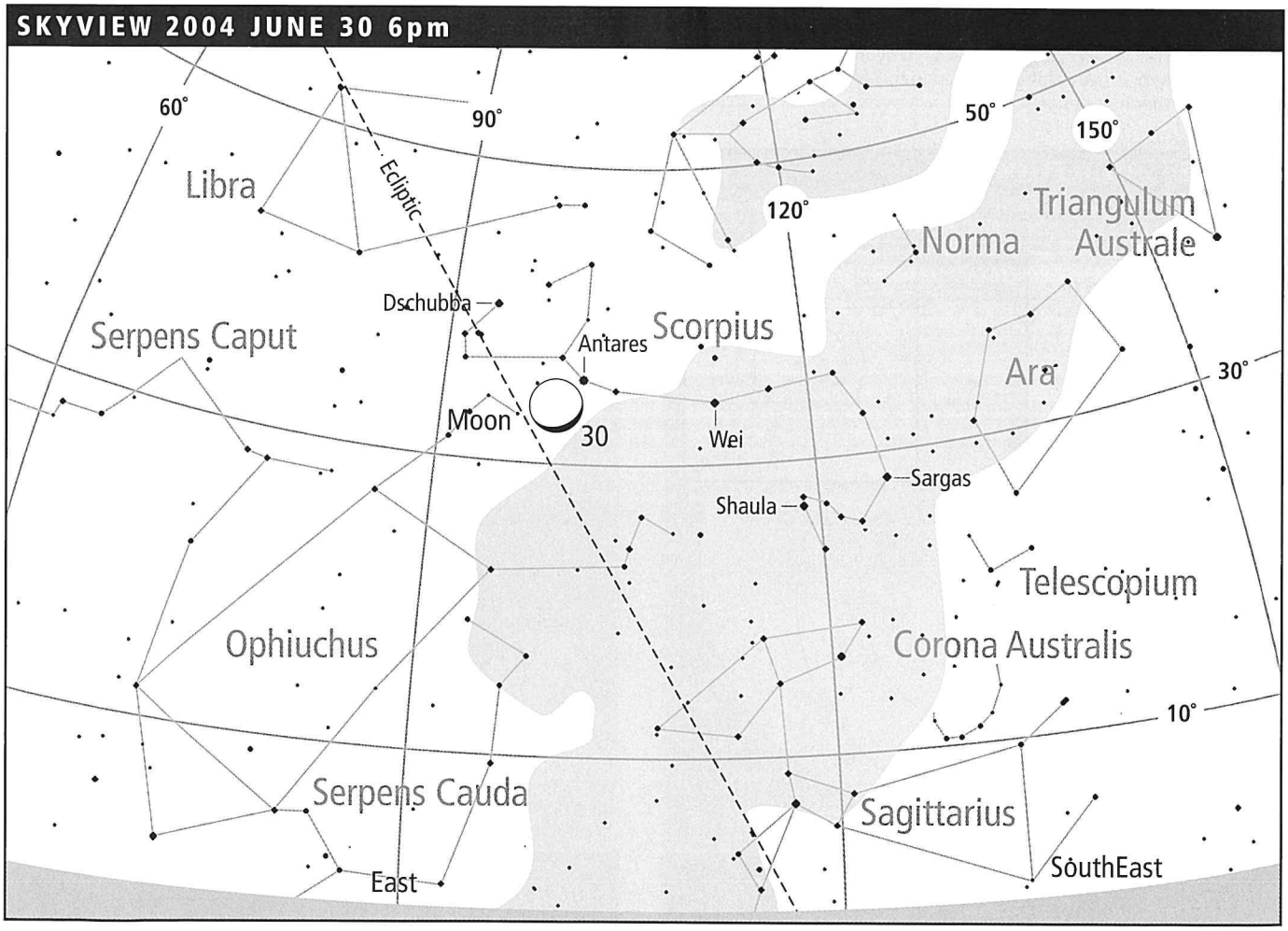


SKYVIEW JUNE 15 8pm – SOUTHERN CROSS




SKYVIEW 2004 JUNE 3 8pm
Aquila
Scutum
Serpens Cauda
Ophiuchus
Rasalhague
Sagittarius
Nunki
Corona Australis
Kaus Australis
Telescopium
Ara
Shaula
Scorpius
Wei
Antares
Moon
3
Norma
Lupus
Pavo
α Lup
SouthWest
West
Ecliptic
300°
50°
30°
10°
270°
240°
210°


SKYVIEW 2004 JUNE 19-24 6pm
Denebola
North
Leo
Algieba
Leo Minor
24
23
22
21
20
19
Jupiter
Moon
Sextans
Alphard
Hydra
Cancer
Mars
Procyon
Gemini
Canis Minor
NorthWest
Ecliptic
330°
300°
270°
90°
50°
0°
30°
10°


SKYVIEW 2004 JUNE 30 6pm
Libra
Ecliptic
Triangulum Australe
Norma
Serpens Caput
Dschubba
Antares
Scorpius
Ara
Moon
30
Wei
Sargas
Shaula
Telescopium
Ophiuchus
Corona Australis
Serpens Cauda
Sagittarius
East
SouthEast
60°
90°
50°
150°
120°
30°
10°

JULY 2004

HIGHLIGHTS

Mercury *visible around dusk, low in the west. Best visibility at end of month.*

Venus *easily visible in the morning sky.*

Mars *visible low after dusk in the constellation Cancer then Leo.*

Jupiter *visible in evening in Cancer.*

Saturn *visible only late in the month, around dawn in constellation Gemini.*

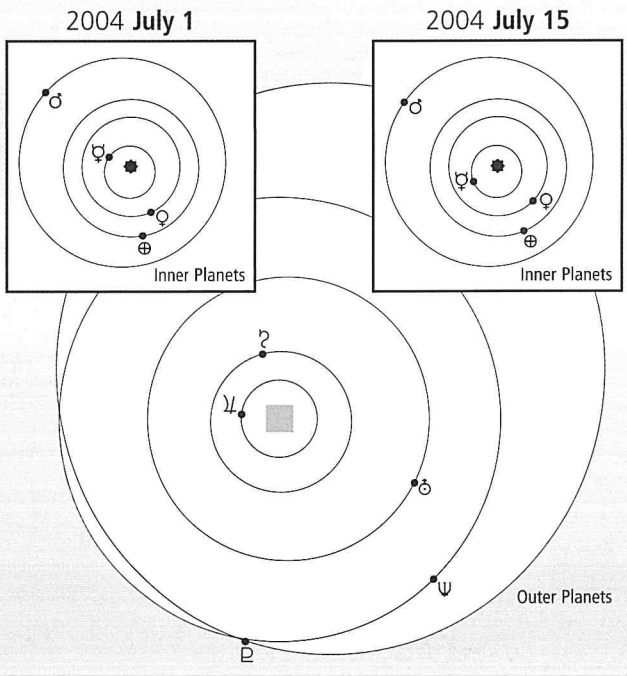
DIARY

Day	Hour	
1	19	Mercury 5° S. of Pollux
2	07	Moon at perigee
2	19	**Full Moon**
4	18	Venus 1°.1 N. of Aldebaran
4	23	Neptune 5° N. of Moon
5	19	Earth at aphelion
6	11	Uranus 4° N. of Moon
9		Max activity Pegasid meteor shower
9	01	Saturn in conjunction with Sun
9	16	**Last Quarter**
11	07	Mercury 0°.2 N. of Mars
14	08	Venus 8° S. of Moon
15	05	Moon at apogee
15	09	Venus greatest brilliancy
17	19	**New Moon**
19	10	Mars 4° S. of Moon
19	23	Mercury 5° S. of Moon
21	21	Jupiter 3° S. of Moon
25	12	**First Quarter**
26	08	Mercury 1°.5 S. of Regulus
27		Max activity Piscis Austrinid meteor s.
27	11	Mercury greatest elongation E. (27°)
28		Max activity delta-Aquarid S. meteor s.
29		Max activity alpha-Capricornid meteor s.
30	14	Moon at perigee

SUN+MOON RISE/SET

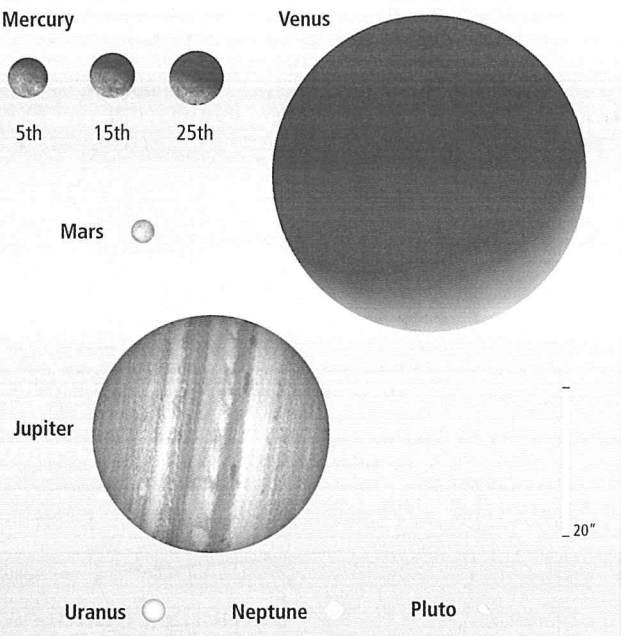
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0718	63	0551	1220	1723	297	1850	1557	0553	0.99
2	0718	63	0551	1221	1724	297	1851	1702	0705	1.00
3	0718	63	0551	1221	1724	297	1851	1813	0809	0.98
4	0718	63	0551	1221	1725	297	1852	1927	0904	0.93
5	0717	63	0551	1221	1725	297	1852	2039	0949	0.86
6	0717	64	0550	1221	1725	296	1852	2146	1027	0.77
7	0717	64	0550	1221	1726	296	1853	2250	1059	0.67
8	0717	64	0550	1222	1726	296	1853	2350	1128	0.57
9	0717	64	0550	1222	1727	296	1854	DNR	1156	0.47
10	0717	64	0550	1222	1727	296	1854	0048	1223	0.37
11	0716	64	0550	1222	1728	296	1854	0146	1252	0.28
12	0716	64	0550	1222	1728	296	1855	0243	1324	0.20
13	0716	65	0550	1222	1729	295	1855	0341	1359	0.13
14	0715	65	0549	1222	1730	295	1856	0438	1439	0.07
15	0715	65	0549	1223	1730	295	1856	0534	1524	0.03
16	0715	65	0549	1223	1731	295	1857	0627	1615	0.01
17	0714	65	0548	1223	1731	295	1857	0716	1710	0.00
18	0714	66	0548	1223	1732	294	1858	0759	1809	0.02
19	0713	66	0548	1223	1733	294	1858	0837	1908	0.05
20	0713	66	0547	1223	1733	294	1859	0911	2007	0.10
21	0713	66	0547	1223	1734	294	1859	0941	2106	0.17
22	0712	66	0547	1223	1734	293	1900	1010	2205	0.25
23	0711	67	0546	1223	1735	293	1900	1037	2305	0.34
24	0711	67	0546	1223	1736	293	1901	1106	DNS	0.45
25	0710	67	0545	1223	1736	293	1901	1136	0006	0.56
26	0710	67	0545	1223	1737	292	1902	1211	0111	0.67
27	0709	68	0544	1223	1737	292	1902	1252	0220	0.77
28	0708	68	0544	1223	1738	292	1903	1341	0332	0.86
29	0708	68	0543	1223	1739	292	1903	1440	0443	0.94
30	0707	69	0543	1223	1739	291	1904	1548	0550	0.98
31	0706	69	0542	1223	1740	291	1904	1701	0649	1.00

PLANET POSITIONS



☿ Mercury ♀ Venus ⊕ Earth ♂ Mars ♃ Jupiter ♄ Saturn ♅ Uranus ♆ Neptune ♇ Pluto

PLANET APPEARANCE

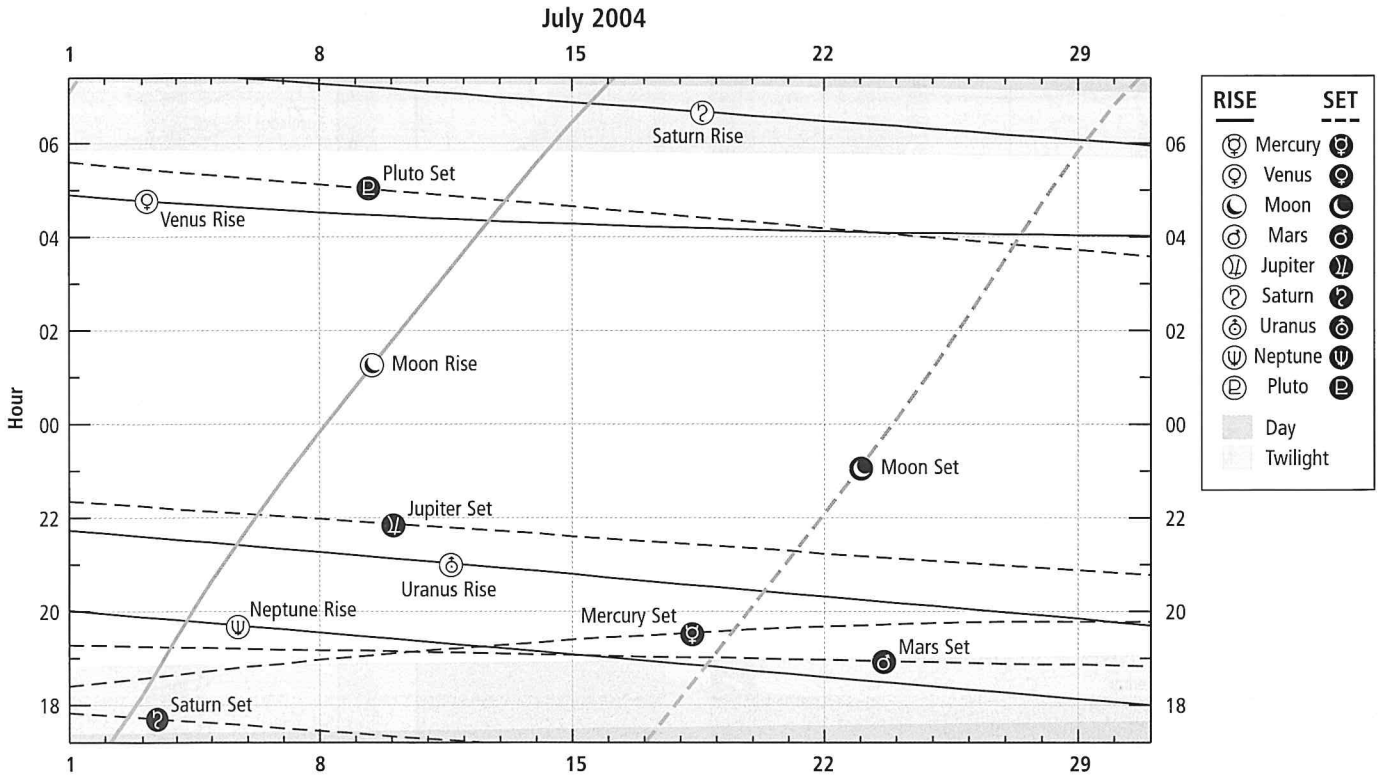


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0820	1824	0457	1529	0858	1917	1055	2221	1	0744	1750	2144	1041	2001	0934	1619	0540
2	0823	1829	0454	1526	0856	1916	1052	2218	2	0740	1747	2140	1037	1957	0930	1615	0536
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4	0829	1839	0446	1519	0853	1914	1045	2211	4	0733	1740	2132	1029	1949	0922	1607	0527
5	0831	1844	0443	1516	0851	1913	1041	2208	5	0730	1737	2128	1025	1945	0918	1603	0523
6	0833	1849	0440	1513	0849	1912	1038	2205	6	0727	1734	2124	1021	1941	0914	1559	0519
7	0835	1853	0437	1510	0847	1911	1034	2202	7	0723	1730	2120	1017	1937	0910	1555	0515
8	0837	1858	0434	1508	0845	1910	1031	2159	8	0720	1727	2116	1013	1933	0906	1551	0511
9	0838	1902	0431	1505	0843	1910	1027	2155	9	0716	1724	2112	1009	1929	0902	1547	0507
10	0839	1906	0429	1502	0842	1909	1024	2152	10	0713	1720	2108	1005	1925	0858	1543	0503
11	0840	1910	0427	1500	0840	1908	1020	2149	11	0710	1717	2104	1001	1921	0854	1539	0459
12	0841	1913	0424	1458	0838	1907	1017	2146	12	0706	1714	2100	0957	1917	0850	1535	0455
13	0842	1917	0422	1455	0836	1906	1013	2143	13	0703	1710	2056	0953	1913	0846	1531	0451
14	0842	1920	0420	1453	0834	1905	1010	2140	14	0659	1707	2052	0949	1909	0842	1527	0447
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18	0842	1932	0413	1445	0826	1901	0956	2127	18	0646	1654	2035	0933	1853	0825	1511	0431
19	0841	1934	0412	1443	0824	1901	0952	2124	19	0642	1650	2031	0929	1849	0821	1507	0427
20	0840	1937	0411	1442	0822	1900	0949	2121	20	0639	1647	2027	0925	1844	0817	1503	0423
21	0840	1939	0409	1440	0820	1859	0945	2118	21	0635	1643	2023	0921	1840	0813	1459	0419
22	0839	1941	0408	1439	0819	1858	0942	2114	22	0632	1640	2019	0917	1836	0809	1455	0415
23	0837	1942	0407	1437	0817	1857	0939	2111	23	0628	1637	2015	0913	1832	0805	1451	0411
24	0836	1944	0406	1436	0815	1856	0935	2108	24	0625	1633	2011	0909	1828	0801	1447	0407
25	0834	1945	0405	1434	0813	1855	0932	2105	25	0622	1630	2007	0905	1824	0757	1443	0403
26	0833	1946	0405	1433	0811	1854	0928	2102	26	0618	1627	2003	0901	1820	0753	1439	0359
27	0831	1947	0404	1432	0809	1853	0925	2059	27	0615	1623	1959	0857	1816	0749	1435	0355
28	0829	1947	0403	1431	0807	1852	0921	2056	28	0611	1620	1955	0853	1812	0745	1431	0351
29	0827	1947	0403	1430	0804	1852	0918	2053	29	0608	1617	1951	0849	1808	0741	1427	0347
30	0824	1947	0402	1429	0802	1851	0914	2050	30	0604	1613	1946	0845	1804	0737	1423	0343
31	0822	1947	0402	1428	0800	1850	0911	2047	31	0601	1610	1942	0841	1800	0733	1419	0339

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

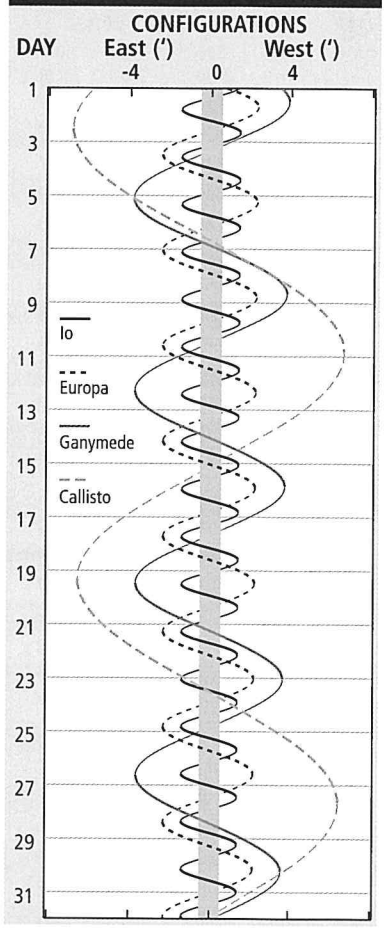
DAY	PHENOMENON h m	Satellite	Event	
2	1906		GRS	Great Red Spot
4	2045		GRS	Great Red Spot
4	2003	I	Oc.D.	Occult Disappear
5	1818	I	Sh.I.	Shadow Ingress
5	1927	I	Tr.E.	Transit Egress
5	2033	I	Sh.E.	Shadow Egress
6	1754	I	Ec.R.	Eclipse Reappear
6	1801	IV	Tr.E.	Transit Egress
6	1918	III	Tr.I.	Transit Ingress
7	1816		GRS	Great Red Spot
7	2042	II	Tr.I.	Transit Ingress
9	1955		GRS	Great Red Spot
9	1952	II	Ec.R.	Eclipse Reappear
11	2135		GRS	Great Red Spot
12	1910	I	Tr.I.	Transit Ingress
12	2012	I	Sh.I.	Shadow Ingress
12	2126	I	Tr.E.	Transit Egress
13	1949	I	Ec.R.	Eclipse Reappear
14	1905		GRS	Great Red Spot
16	2045		GRS	Great Red Spot
16	1739	II	Oc.D.	Occult Disappear
17	1801	III	Ec.D.	Eclipse Disappear
17	2114	III	Ec.R.	Eclipse Reappear
18	1735	II	Sh.E.	Shadow Egress
19	1815		GRS	Great Red Spot
19	2109	I	Tr.I.	Transit Ingress
20	1831	I	Oc.D.	Occult Disappear
21	1955		GRS	Great Red Spot
21	1755	I	Tr.E.	Transit Egress
21	1851	I	Sh.E.	Shadow Egress
23	1922	IV	Sh.I.	Shadow Ingress
23	2025	II	Oc.D.	Occult Disappear
24	1815	III	Oc.D.	Occult Disappear
25	1826	II	Tr.E.	Transit Egress
25	2011	II	Sh.E.	Shadow Egress
26	1905		GRS	Great Red Spot
27	2031	I	Oc.D.	Occult Disappear
28	2044		GRS	Great Red Spot
28	1739	I	Tr.I.	Transit Ingress
28	1831	I	Sh.I.	Shadow Ingress
28	1955	I	Tr.E.	Transit Egress
28	2046	I	Sh.E.	Shadow Egress
29	1807	I	Ec.R.	Eclipse Reappear
31	1815		GRS	Great Red Spot
31	1955	IV	Oc.D.	Occult Disappear

Moons: I Io, II Europa, III Ganymede, IV Callisto

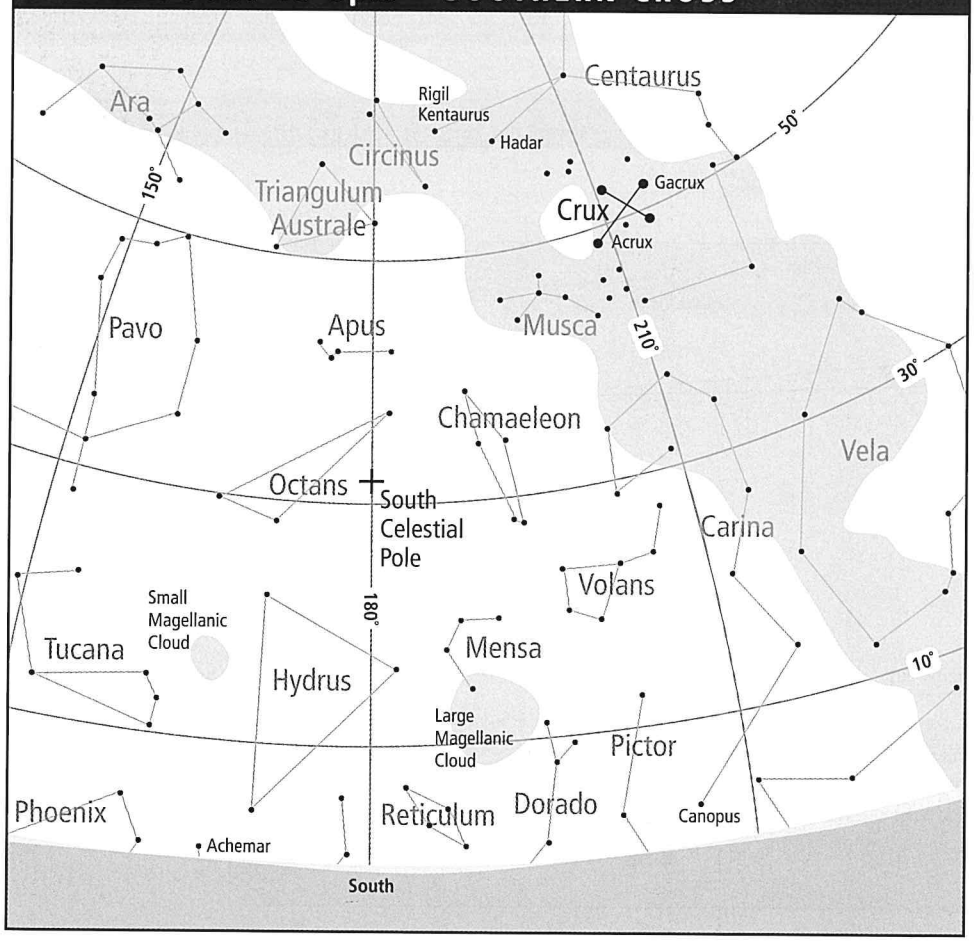
Events: D Disappear, E Egress, Ec Eclipse, Sh Shadow, R Reappear, I Ingress, Oc Occult, Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

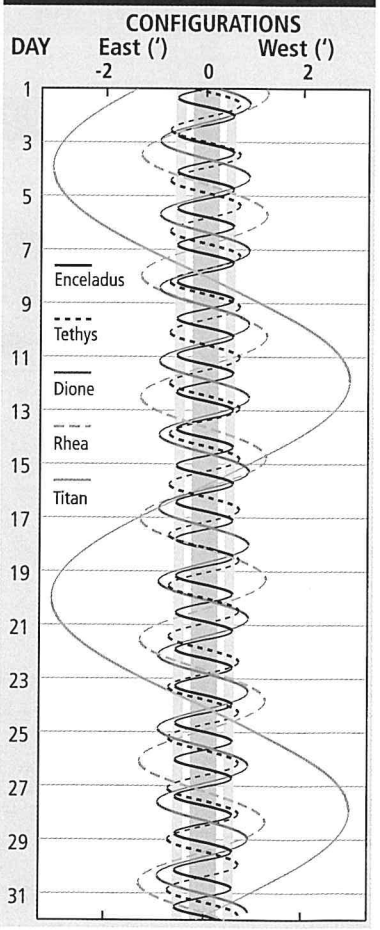
JUPITER MOONS



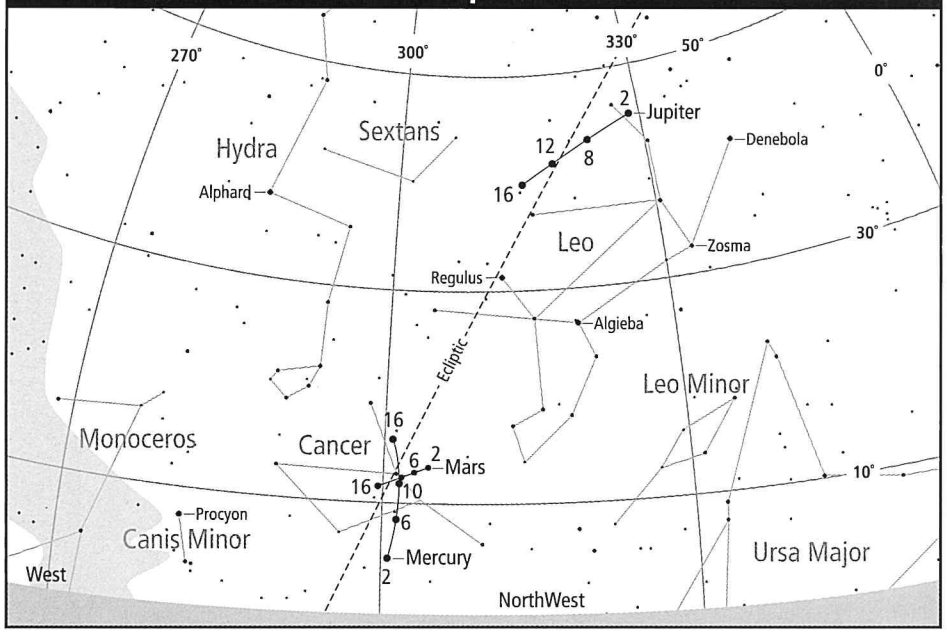
SKYVIEW JULY 15 8pm – SOUTHERN CROSS



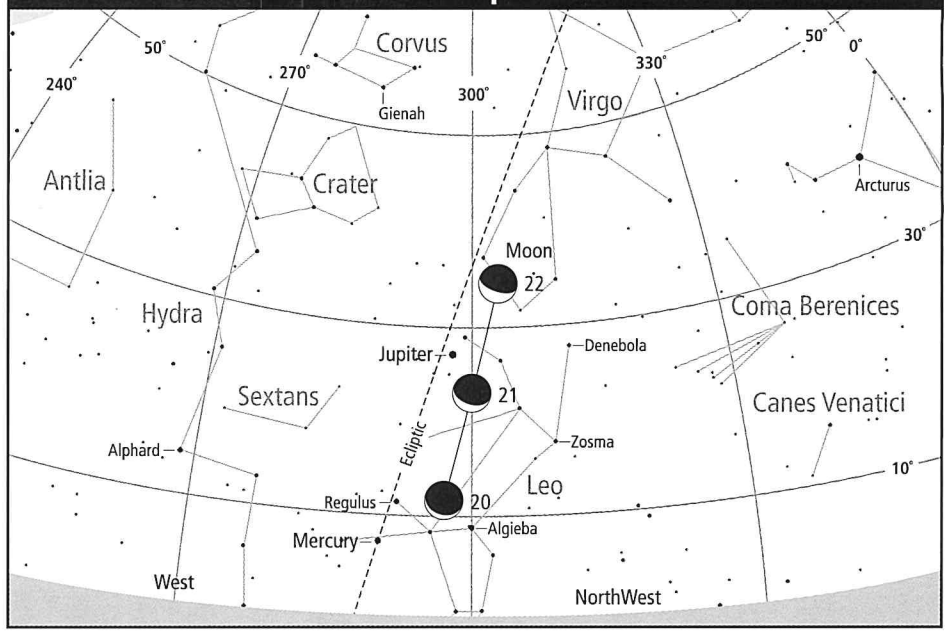
SATURN MOONS



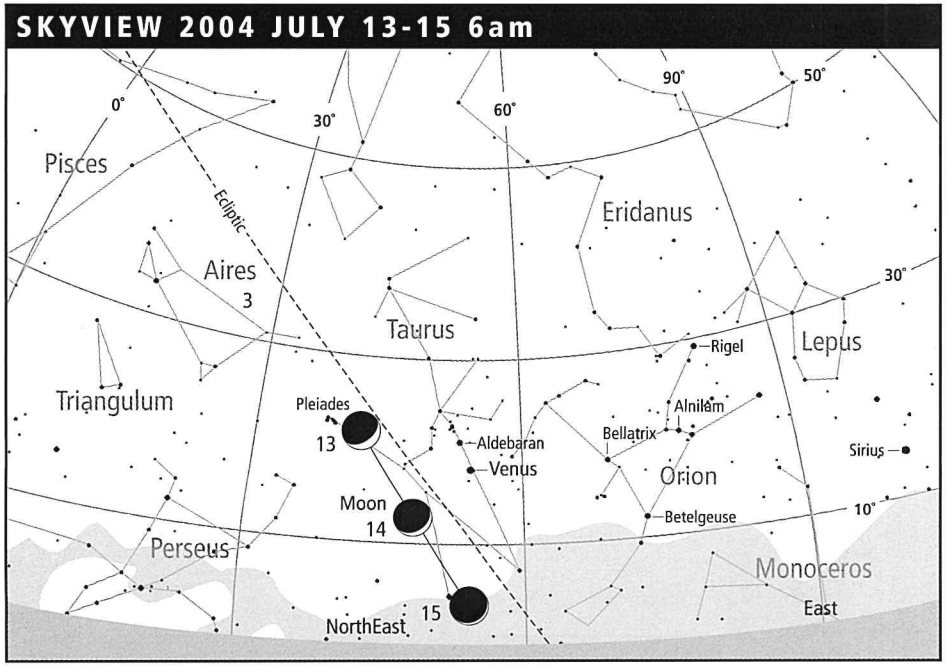
SKYVIEW 2004 JULY 2-16 6pm



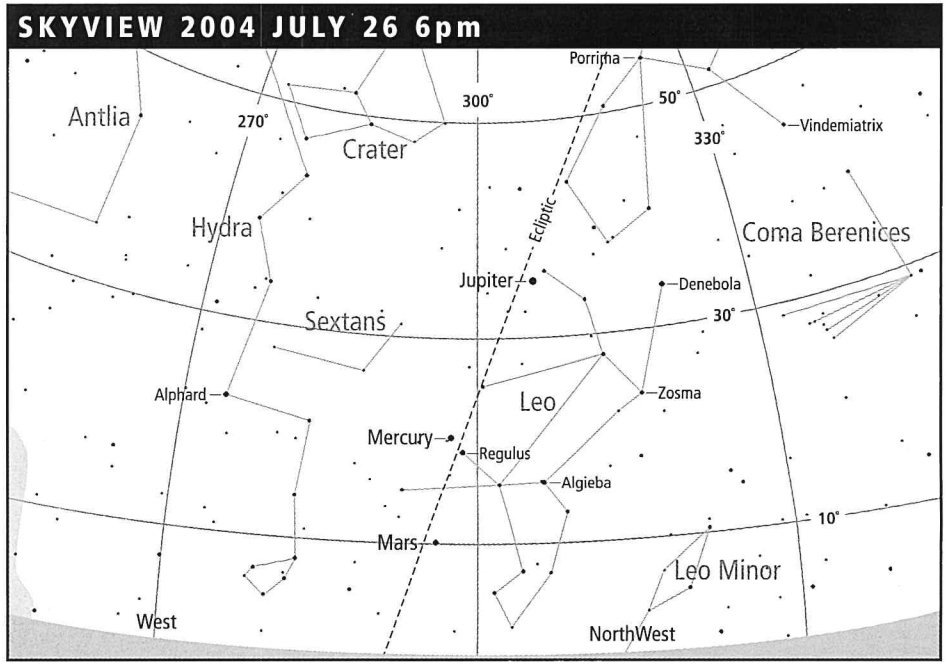
SKYVIEW 2004 JULY 20-22 7pm



SKYVIEW 2004 JULY 13-15 6am



SKYVIEW 2004 JULY 26 6pm



AUGUST 2004

HIGHLIGHTS

Mercury *low in the west after sunset in the first half of the month, then visibile in east around dawn.*

Venus *easily visible in the morning sky.*

Jupiter *visible in west in the early evening.*

Saturn *visible before dawn in Gemini low in the east.*

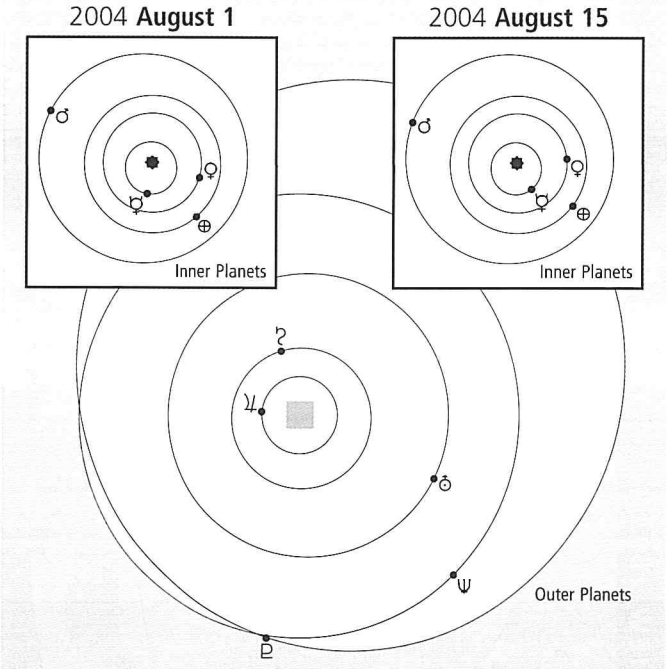
DIARY

Day	Hour	
1	02	**Full Moon**
1	08	Neptune 5° N. of Moon
2	20	Uranus 4° N. of Moon
4		Max activity iota-Aquarid S. meteor shwr
6	11	Neptune at opposition
8		Max activity delta-Aquarid N. meteor shwr
8	06	**Last Quarter**
8	08	Mars at aphelion
9	13	Mercury stationary
11	18	Moon at apogee
12	07	Venus 8° S. of Moon
13	17	Saturn 5° S. of Moon
16	09	**New Moon**
17	11	Mercury 6° S. of Mars
18	03	Venus greatest elongation W. (46°)
18	13	Jupiter 3° S. of Moon
19		Max activity iota-Aquarid N. meteor shwr
23	18	**First Quarter**
24	05	Mercury in inferior conjunction
27	14	Moon at perigee
28	03	Uranus at opposition
28	17	Neptune 5° N. of Moon
30	04	Uranus 4° N. of Moon
30	10	**Full Moon**

SUN+MOON RISE/SET

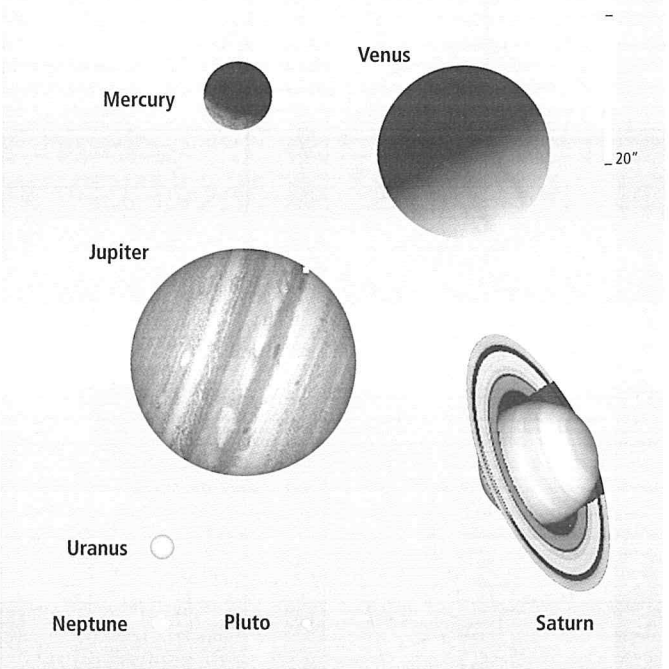
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0705	69	0541	1223	1741	291	1905	1815	0739	0.99
2	0705	70	0541	1223	1741	290	1905	1926	0820	0.95
3	0704	70	0540	1223	1742	290	1906	2033	0855	0.89
4	0703	70	0539	1223	1743	290	1906	2136	0926	0.81
5	0702	70	0539	1223	1743	289	1907	2237	0955	0.72
6	0701	71	0538	1222	1744	289	1907	2336	1023	0.62
7	0701	71	0537	1222	1744	289	1908	DNR	1052	0.53
8	0700	71	0536	1222	1745	288	1908	0034	1123	0.43
9	0659	72	0536	1222	1746	288	1909	0133	1157	0.34
10	0658	72	0535	1222	1746	288	1909	0231	1236	0.25
11	0657	72	0534	1222	1747	287	1910	0328	1319	0.17
12	0656	73	0533	1222	1748	287	1910	0422	1409	0.11
13	0655	73	0532	1221	1748	287	1911	0512	1503	0.06
14	0654	74	0531	1221	1749	286	1912	0557	1601	0.02
15	0653	74	0530	1221	1750	286	1912	0637	1700	0.00
16	0652	74	0529	1221	1750	286	1913	0712	1800	0.01
17	0651	75	0529	1221	1751	285	1913	0744	1900	0.03
18	0650	75	0528	1220	1751	285	1914	0813	1959	0.07
19	0649	75	0527	1220	1752	284	1914	0841	2059	0.13
20	0648	76	0526	1220	1753	284	1915	0909	2200	0.21
21	0646	76	0525	1220	1753	284	1915	0939	2304	0.31
22	0645	77	0524	1219	1754	283	1916	1011	DNS	0.42
23	0644	77	0522	1219	1755	283	1916	1049	0010	0.53
24	0643	77	0521	1219	1755	282	1917	1134	0119	0.64
25	0642	78	0520	1219	1756	282	1917	1228	0229	0.75
26	0641	78	0519	1218	1756	282	1918	1330	0336	0.84
27	0640	79	0518	1218	1757	281	1919	1440	0437	0.92
28	0638	79	0517	1218	1758	281	1919	1552	0529	0.97
29	0637	80	0516	1217	1758	280	1920	1704	0613	1.00
30	0636	80	0515	1217	1759	280	1920	1812	0650	1.00
31	0635	80	0513	1217	1800	279	1921	1918	0723	0.97

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ♅ Uranus ♇ Pluto
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

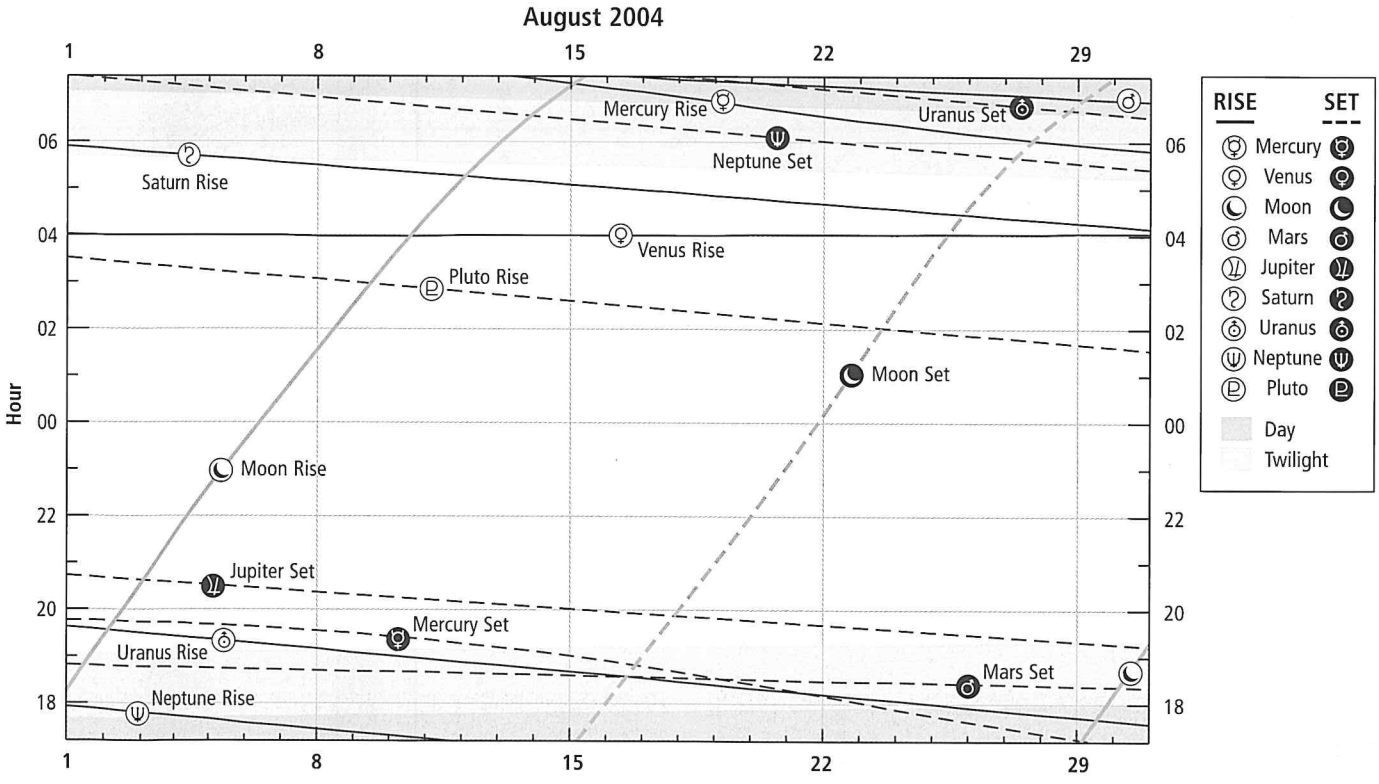


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0819	1946	0401	1427	0758	1849	0908	2044	1	0557	1607	1938	0837	1756	0729	1415	0335
2	0816	1946	0401	1426	0756	1848	0904	2041	2	0554	1603	1934	0833	1752	0725	1411	0331
3	0813	1944	0400	1426	0754	1847	0901	2038	3	0551	1600	1930	0829	1748	0721	1407	0327
4	0810	1943	0400	1425	0752	1846	0857	2035	4	0547	1557	1926	0825	1744	0717	1403	0323
5	0806	1941	0400	1424	0750	1845	0854	2032	5	0544	1553	1922	0821	1740	0713	1359	0319
6	0803	1939	0400	1424	0748	1844	0850	2029	6	0540	1550	1918	0817	1735	0709	1355	0315
7	0759	1936	0400	1423	0746	1843	0847	2026	7	0537	1547	1914	0813	1731	0705	1351	0311
8	0755	1933	0400	1423	0744	1842	0844	2022	8	0533	1543	1910	0808	1727	0701	1347	0307
9	0751	1930	0359	1422	0742	1841	0840	2019	9	0530	1540	1905	0804	1723	0657	1343	0304
10	0746	1926	0359	1422	0740	1841	0837	2016	10	0526	1536	1901	0800	1719	0653	1339	0300
11	0741	1922	0359	1422	0738	1840	0833	2013	11	0523	1533	1857	0756	1715	0649	1335	0256
12	0737	1917	0359	1422	0735	1839	0830	2010	12	0519	1530	1853	0752	1711	0645	1331	0252
13	0731	1912	0400	1422	0733	1838	0827	2007	13	0516	1526	1849	0748	1707	0641	1327	0248
14	0726	1907	0400	1421	0731	1837	0823	2004	14	0512	1523	1845	0744	1703	0637	1323	0244
15	0721	1901	0400	1421	0729	1836	0820	2001	15	0509	1520	1841	0740	1659	0633	1319	0240
16	0715	1855	0400	1421	0727	1835	0816	1958	16	0505	1516	1837	0736	1655	0629	1315	0236
17	0709	1848	0400	1422	0725	1834	0813	1955	17	0502	1513	1833	0732	1651	0625	1311	0232
18	0704	1841	0400	1422	0723	1833	0810	1952	18	0458	1509	1828	0728	1647	0621	1307	0228
19	0658	1833	0400	1422	0720	1832	0806	1950	19	0455	1506	1824	0724	1643	0617	1303	0224
20	0652	1826	0400	1422	0718	1831	0803	1947	20	0451	1503	1820	0720	1639	0613	1259	0220
21	0645	1818	0401	1422	0716	1830	0759	1944	21	0448	1459	1816	0716	1635	0609	1255	0216
22	0639	1810	0401	1423	0714	1829	0756	1941	22	0444	1456	1812	0712	1631	0605	1251	0212
23	0633	1802	0401	1423	0712	1828	0753	1938	23	0441	1452	1808	0708	1626	0601	1247	0208
24	0627	1753	0401	1423	0710	1828	0749	1935	24	0437	1449	1804	0704	1622	0557	1243	0204
25	0622	1745	0401	1424	0707	1827	0746	1932	25	0434	1446	1800	0700	1618	0553	1239	0200
26	0616	1737	0402	1424	0705	1826	0743	1929	26	0430	1442	1755	0656	1614	0549	1235	0156
27	0611	1730	0402	1425	0703	1825	0739	1926	27	0427	1439	1751	0652	1610	0545	1231	0152
28	0606	1722	0402	1425	0701	1824	0736	1923	28	0423	1435	1747	0648	1606	0541	1227	0149
29	0601	1715	0402	1426	0659	1823	0732	1920	29	0420	1432	1743	0644	1602	0537	1223	0145
30	0557	1709	0403	1427	0656	1822	0729	1917	30	0416	1428	1739	0640	1558	0533	1219	0141
31	0553	1703	0403	1427	0654	1821	0726	1914	31	0413	1425	1735	0636	1554	0529	1215	0137

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

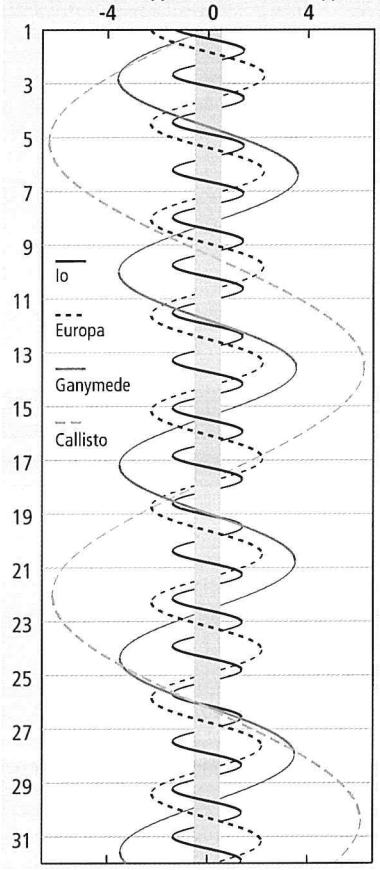
DAY	PHENOMENON h m	Satellite	Event	DAY	PHENOMENON h m	Satellite	Event
1	1822	II	Tr.I.	13	1826	I	Tr.E.
1	1959	II	Sh.I.	13	1904	I	Sh.E.
2	1954		GRS	14	1953		GRS
4	1856	III	Sh.E.	17	1812	II	Oc.D.
4	1939	I	Tr.I.	17	1924	IV	Oc.R.
4	2025	I	Sh.I.	19	1903		GRS
5	2001	I	Ec.R.	20	1811	I	Tr.I.
7	1904		GRS	20	1843	I	Sh.I.
10	1934	II	Ec.R.	21	1818	I	Ec.R.
11	1945	III	Sh.I.	24	1814		GRS
12	1814		GRS	26	1857	II	Tr.E.
12	1902	I	Oc.D.	31	1903		GRS

Moons:
I Io
II Europa
III Ganymede
IV Callisto

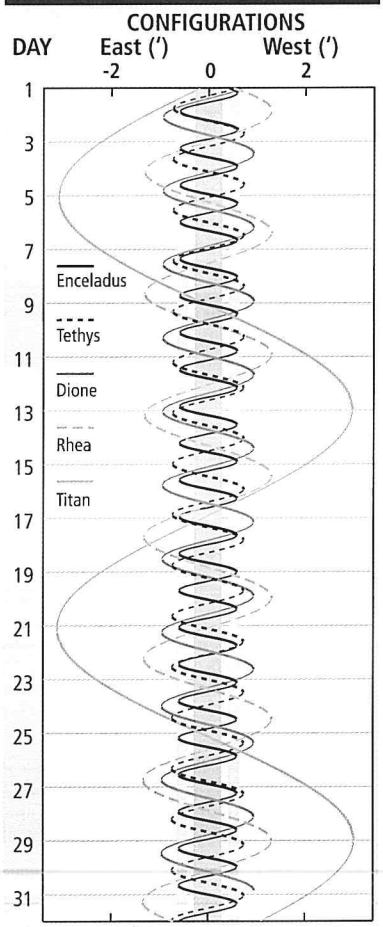
Events:
D Disappear
E Egress
Ec Eclipse
Sh Shadow
R Reappear
I Ingress
Oc Occult
Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

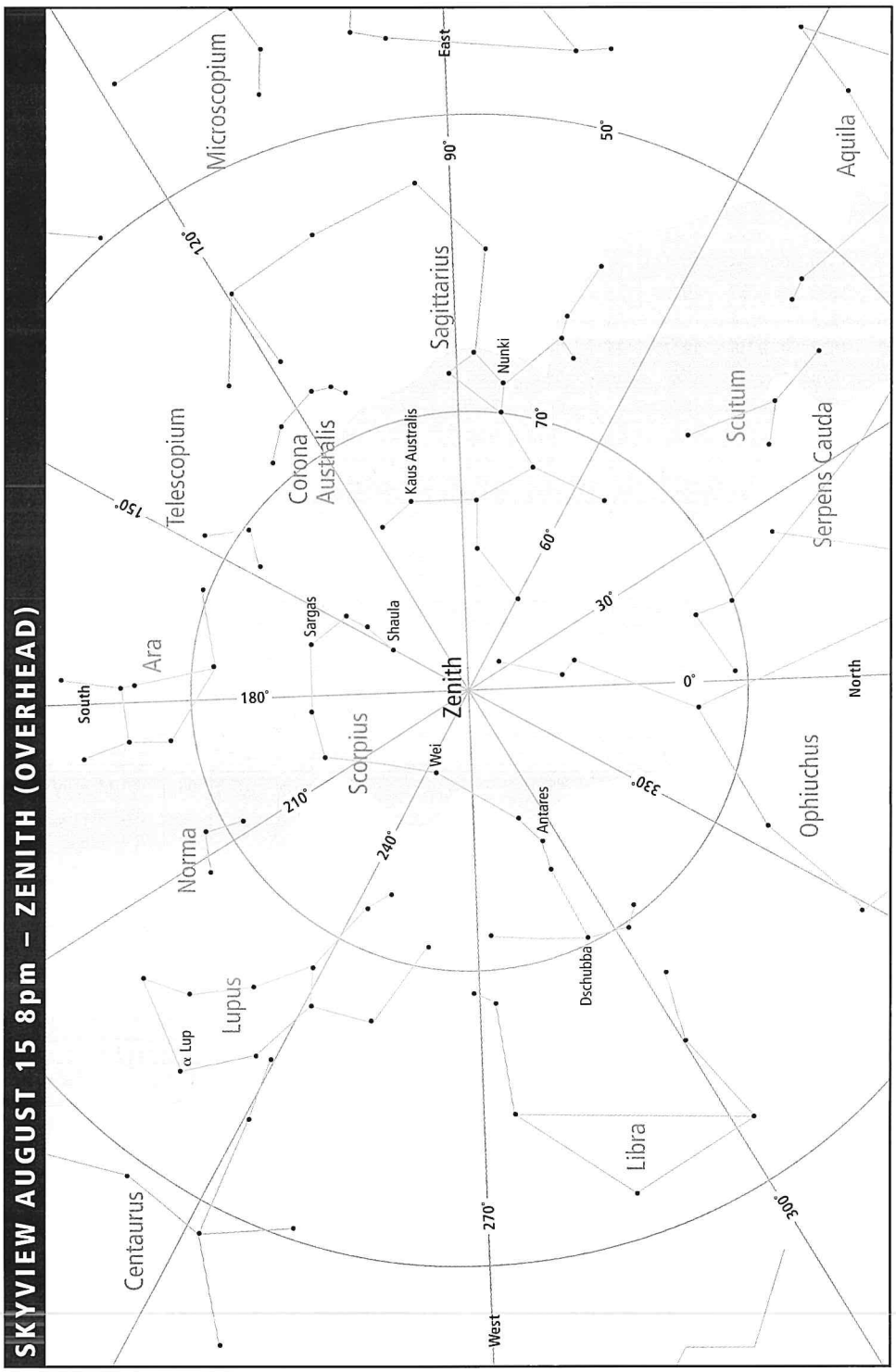
JUPITER MOONS



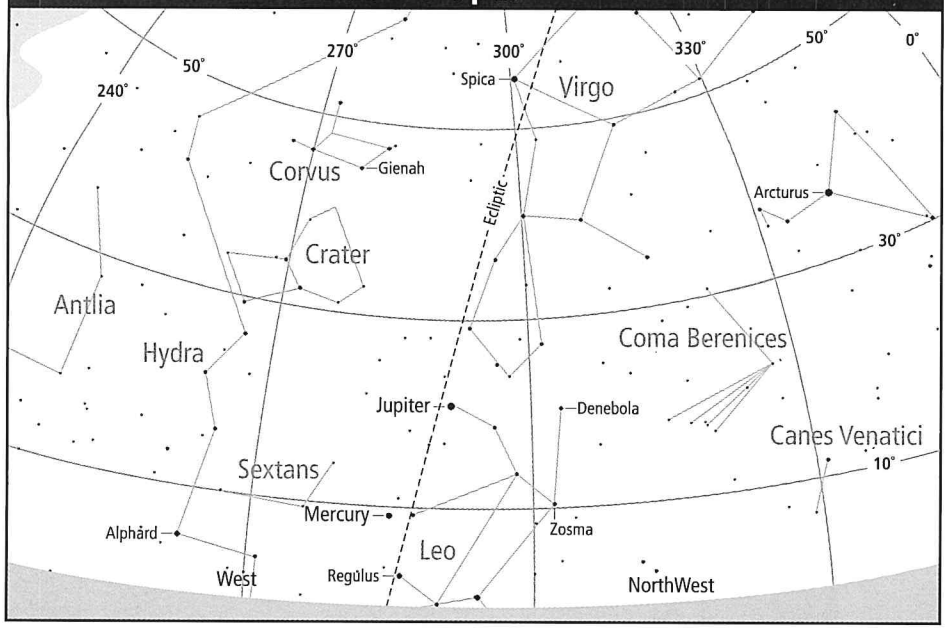
SATURN MOONS



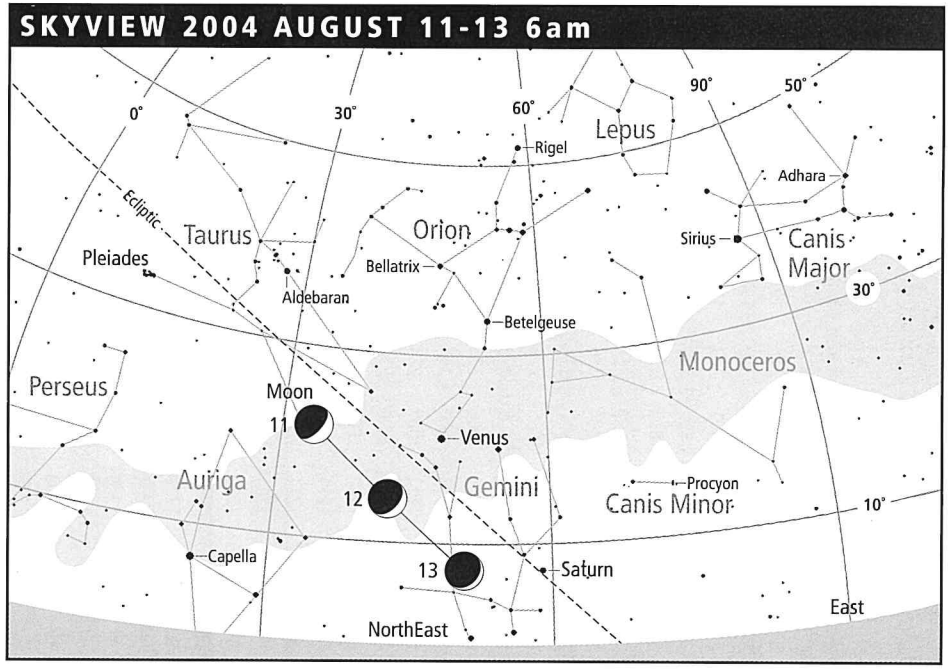
SKYVIEW AUGUST 15 8pm – ZENITH (OVERHEAD)



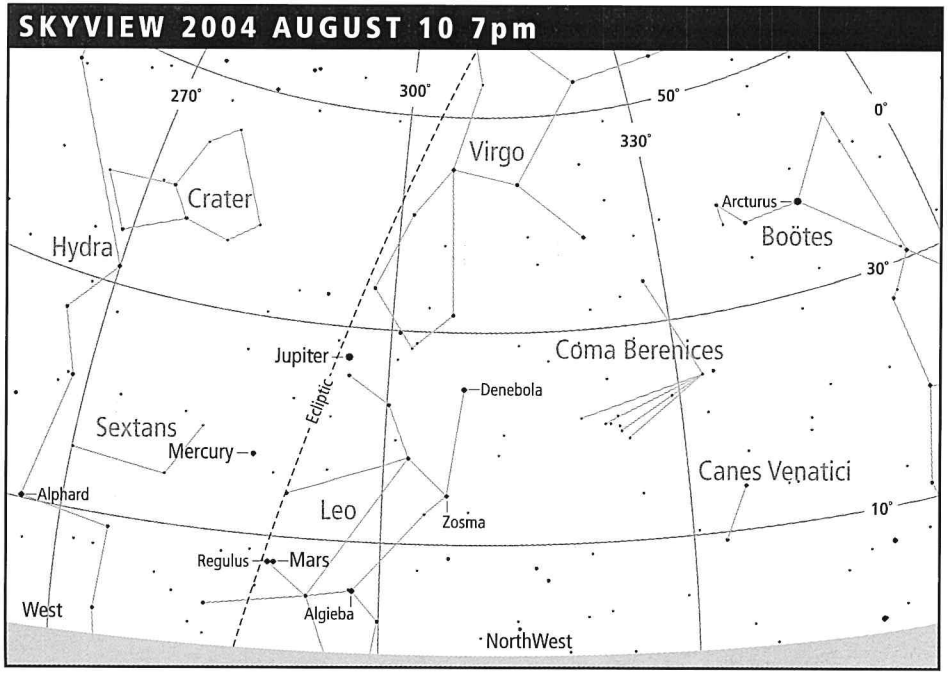
SKYVIEW 2004 AUGUST 1 7pm



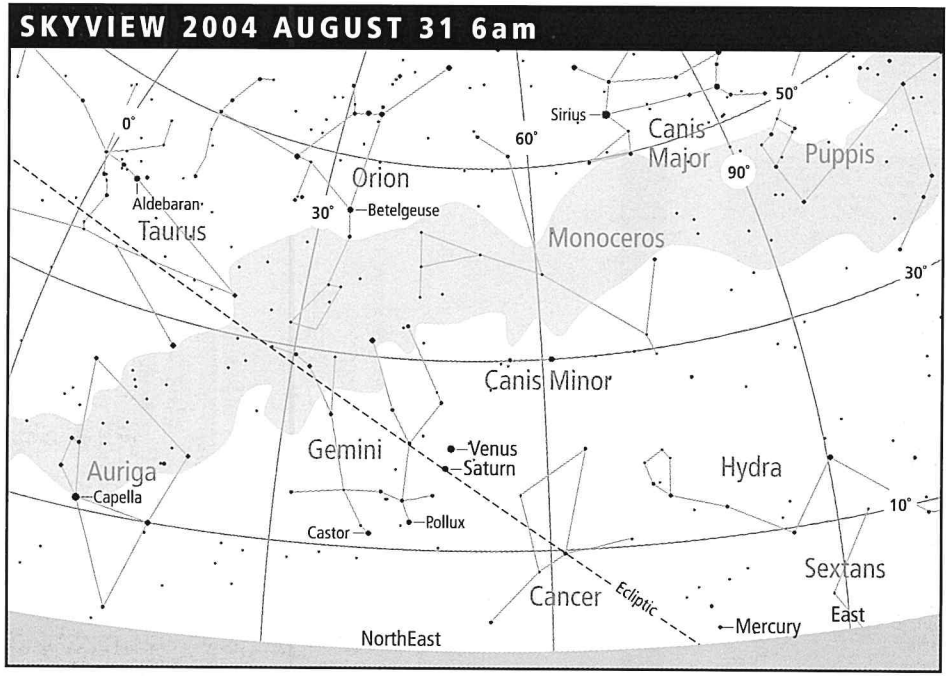
SKYVIEW 2004 AUGUST 11-13 6am



SKYVIEW 2004 AUGUST 10 7pm



SKYVIEW 2004 AUGUST 31 6am



SEPTEMBER 2004

HIGHLIGHTS

Venus *easily visible in the morning sky. Conjunction with Saturn on September 1.*

Saturn *visible well before dawn in constellation Gemini.*

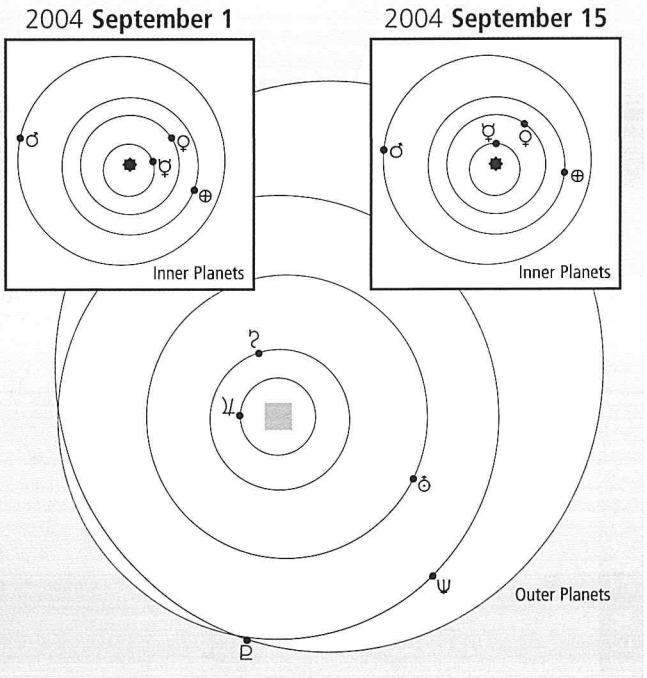
DIARY

Day	Hour	
1	01	Pluto stationary
1	09	Venus 1°.9 S. of Saturn
2	02	Mercury stationary
2	10	Venus 9° S. of Pollux
6	23	**Last Quarter**
8	11	Moon at apogee
9	22	Mercury greatest elongation W. (18°)
10	06	Saturn 5° S. of Moon
10	13	Mercury 0°.06 S. of Regulus
11	00	Venus 7° S. of Moon
12	12	Saturn 7° S. of Pollux
13	09	Mercury 4° S. of Moon
14	22	**New Moon**
15	21	Mars in conjunction with Sun
19		Maximum activity Piscid meteor shower
22	00	**First Quarter**
22	08	Jupiter in conjunction with Sun
23	00	Equinox
23	05	Moon at perigee
24	23	Neptune 5° N. of Moon
26	11	Uranus 4° N. of Moon
28	21	**Full Moon**

SUN+MOON RISE/SET

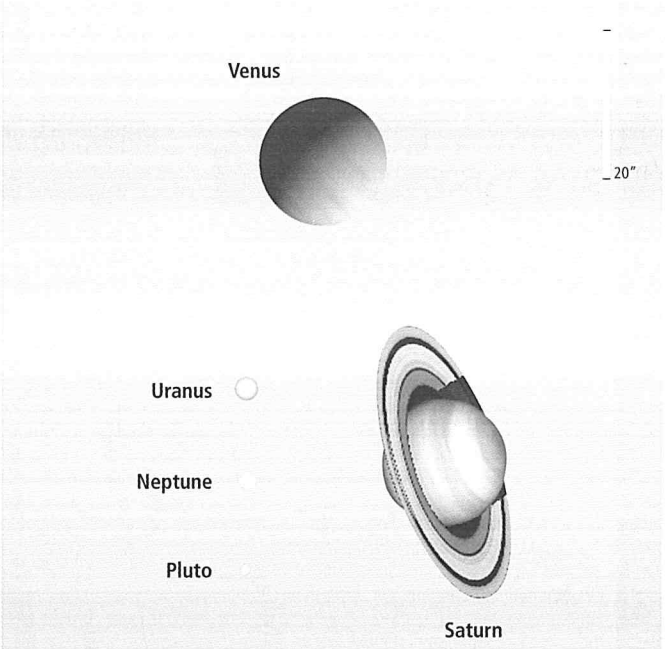
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0633	81	0512	1217	1800	279	1921	2020	0753	0.92
2	0632	81	0511	1216	1801	279	1922	2121	0822	0.85
3	0631	82	0510	1216	1801	278	1923	2222	0850	0.78
4	0630	82	0509	1216	1802	278	1923	2321	0921	0.69
5	0628	83	0507	1215	1803	277	1924	DNR	0954	0.59
6	0627	83	0506	1215	1803	277	1924	0021	1031	0.50
7	0626	83	0505	1215	1804	276	1925	0119	1113	0.40
8	0625	84	0504	1214	1804	276	1925	0214	1201	0.31
9	0623	84	0502	1214	1805	276	1926	0306	1253	0.23
10	0622	85	0501	1214	1806	275	1927	0353	1350	0.15
11	0621	85	0500	1213	1806	275	1927	0435	1449	0.09
12	0619	86	0458	1213	1807	274	1928	0511	1549	0.04
13	0618	86	0457	1212	1807	274	1928	0544	1649	0.01
14	0617	87	0456	1212	1808	273	1929	0614	1750	0.00
15	0615	87	0454	1212	1809	273	1930	0643	1851	0.01
16	0614	87	0453	1211	1809	272	1930	0711	1952	0.05
17	0613	88	0452	1211	1810	272	1931	0741	2056	0.11
18	0612	88	0450	1211	1810	271	1932	0813	2203	0.19
19	0610	89	0449	1210	1811	271	1932	0849	2312	0.28
20	0609	89	0448	1210	1812	271	1933	0932	DNS	0.39
21	0608	90	0446	1210	1812	270	1934	1022	0021	0.50
22	0606	90	0445	1209	1813	270	1934	1121	0129	0.62
23	0605	91	0443	1209	1813	269	1935	1227	0230	0.72
24	0604	91	0442	1209	1814	269	1936	1337	0324	0.82
25	0602	92	0441	1208	1815	268	1937	1447	0409	0.90
26	0601	92	0439	1208	1815	268	1937	1555	0448	0.96
27	0600	92	0438	1208	1816	267	1938	1701	0521	0.99
28	0558	93	0436	1207	1817	267	1939	1804	0552	1.00
29	0557	93	0435	1207	1817	266	1939	1906	0620	0.99
30	0556	94	0434	1207	1818	266	1940	2006	0649	0.95

PLANET POSITIONS



☿ Mercury ♁ Earth ♃ Jupiter ♅ Uranus ♇ Pluto
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

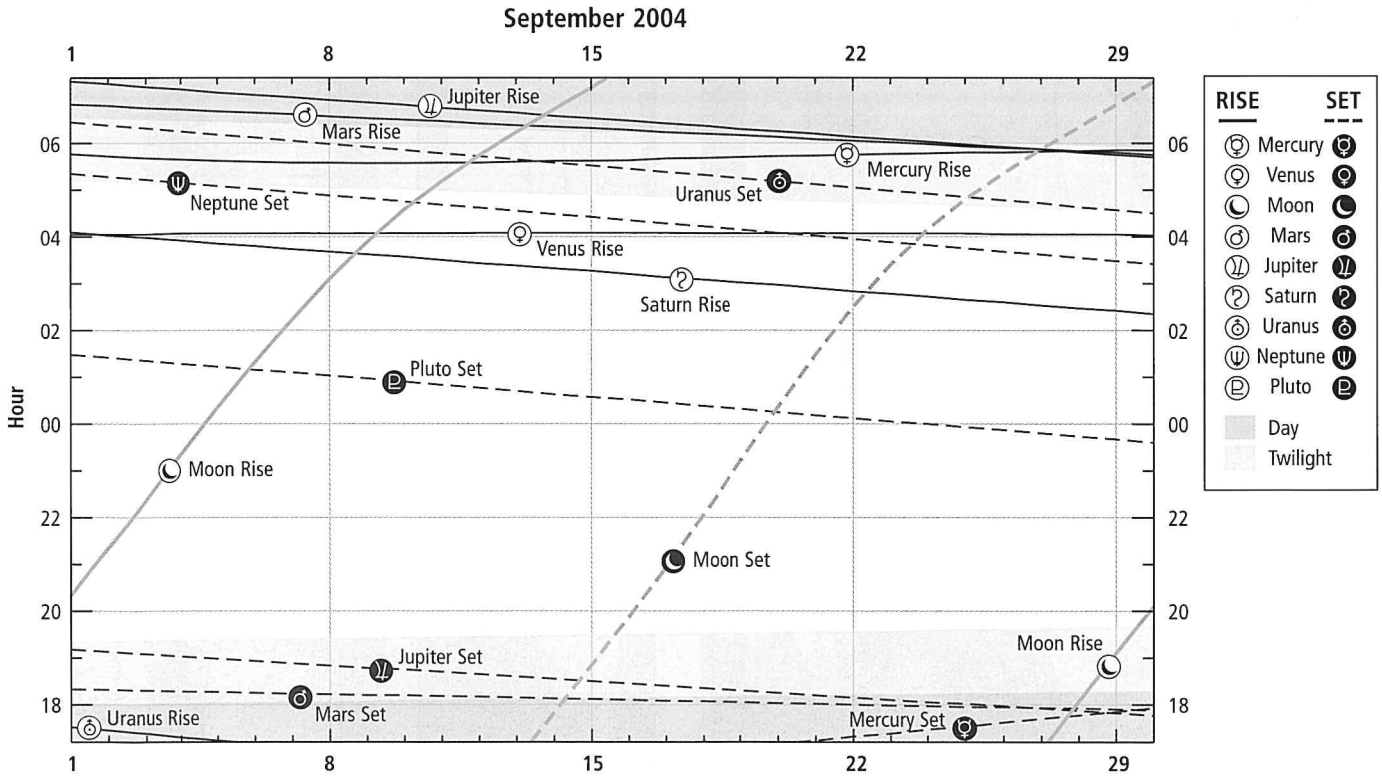


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0549	1658	0403	1428	0652	1820	0722	1911	1	0409	1422	1731	0632	1550	0525	1211	0133
2	0546	1653	0403	1429	0650	1819	0719	1908	2	0406	1418	1727	0627	1546	0521	1207	0129
3	0543	1649	0403	1430	0648	1818	0716	1905	3	0402	1415	1723	0623	1542	0517	1203	0125
4	0541	1646	0403	1431	0645	1817	0712	1902	4	0359	1411	1718	0619	1538	0513	1159	0121
5	0539	1643	0404	1432	0643	1816	0709	1859	5	0355	1408	1714	0615	1534	0509	1155	0117
6	0537	1641	0404	1432	0641	1815	0705	1856	6	0351	1404	1710	0611	1530	0505	1152	0113
7	0536	1640	0404	1433	0639	1814	0702	1853	7	0348	1401	1706	0607	1526	0501	1148	0109
8	0535	1639	0404	1434	0637	1813	0659	1850	8	0344	1357	1702	0603	1522	0457	1144	0106
9	0535	1639	0404	1435	0634	1812	0655	1847	9	0341	1354	1658	0559	1518	0453	1140	0102
10	0534	1640	0404	1436	0632	1812	0652	1845	10	0337	1350	1654	0555	1514	0449	1136	0058
11	0534	1641	0404	1438	0630	1811	0649	1842	11	0334	1347	1650	0551	1510	0445	1132	0054
12	0535	1642	0404	1439	0628	1810	0645	1839	12	0330	1343	1645	0547	1506	0441	1128	0050
13	0535	1645	0405	1440	0625	1809	0642	1836	13	0326	1340	1641	0543	1502	0437	1124	0046
14	0536	1647	0405	1441	0623	1808	0639	1833	14	0323	1336	1637	0539	1458	0433	1120	0042
15	0537	1650	0405	1442	0621	1807	0635	1830	15	0319	1333	1633	0535	1454	0429	1116	0038
16	0537	1654	0405	1443	0619	1806	0632	1827	16	0316	1329	1629	0531	1449	0425	1112	0034
17	0538	1657	0405	1445	0617	1805	0629	1824	17	0312	1326	1625	0527	1445	0421	1108	0031
18	0540	1701	0405	1446	0614	1804	0625	1821	18	0308	1322	1621	0523	1441	0417	1104	0027
19	0541	1705	0404	1447	0612	1803	0622	1818	19	0305	1319	1617	0519	1437	0413	1101	0023
20	0542	1710	0404	1448	0610	1802	0618	1815	20	0301	1315	1613	0515	1433	0409	1057	0019
21	0543	1714	0404	1450	0608	1801	0615	1812	21	0258	1312	1609	0511	1429	0405	1053	0015
22	0544	1719	0404	1451	0605	1800	0612	1809	22	0254	1308	1604	0507	1425	0401	1049	0011
23	0545	1723	0404	1452	0603	1759	0608	1806	23	0250	1304	1600	0503	1421	0357	1045	0007
24	0546	1728	0404	1454	0601	1758	0605	1803	24	0247	1301	1556	0459	1417	0353	1041	0003
24									24								2400
25	0547	1732	0404	1455	0559	1757	0602	1801	25	0243	1257	1552	0455	1413	0349	1037	2356
26	0548	1737	0404	1457	0556	1757	0558	1758	26	0239	1254	1548	0451	1409	0345	1033	2352
27	0548	1742	0403	1458	0554	1756	0555	1755	27	0236	1250	1544	0447	1405	0341	1029	2348
28	0549	1746	0403	1459	0552	1755	0552	1752	28	0232	1247	1540	0443	1401	0337	1025	2344
29	0550	1751	0403	1501	0550	1754	0548	1749	29	0228	1243	1536	0438	1357	0333	1022	2340
30	0551	1756	0403	1502	0548	1753	0545	1746	30	0225	1239	1532	0434	1353	0329	1018	2336

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

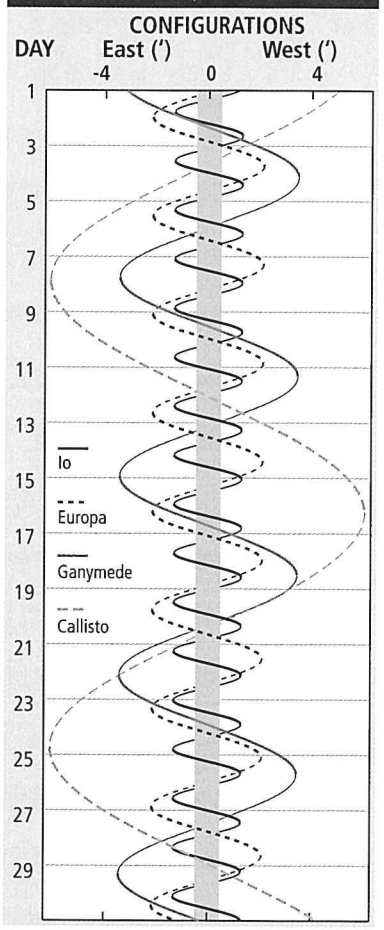
DAY	PHENOMENON h m	Satellite	Event		
2	1857	II	Tr.I.	Transit	Ingress
5	1813		GRS	Great Red Spot	
13	1829	I	Ec.R.	Eclipse	Reappear
16	1826	III	Tr.E.	Transit	Egress
17	1812		GRS	Great Red Spot	

Moons: I Io, II Europa, III Ganymede, IV Callisto

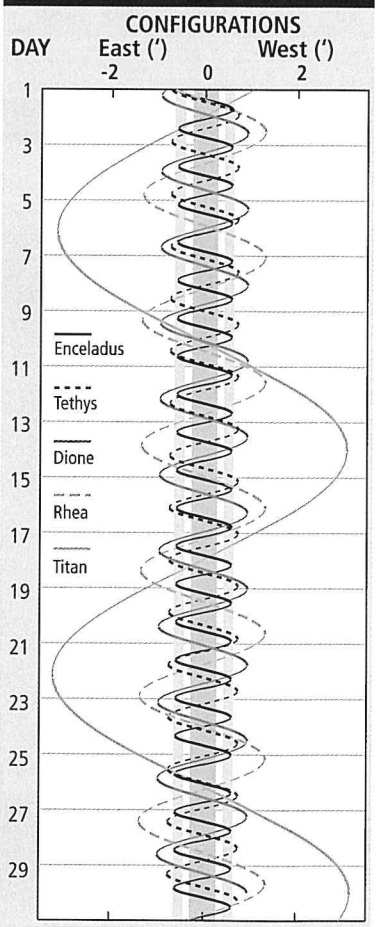
Events: D Disappear, E Egress, Ec Eclipse, Sh Shadow, R Reappear, I Ingress, Oc Occult, Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

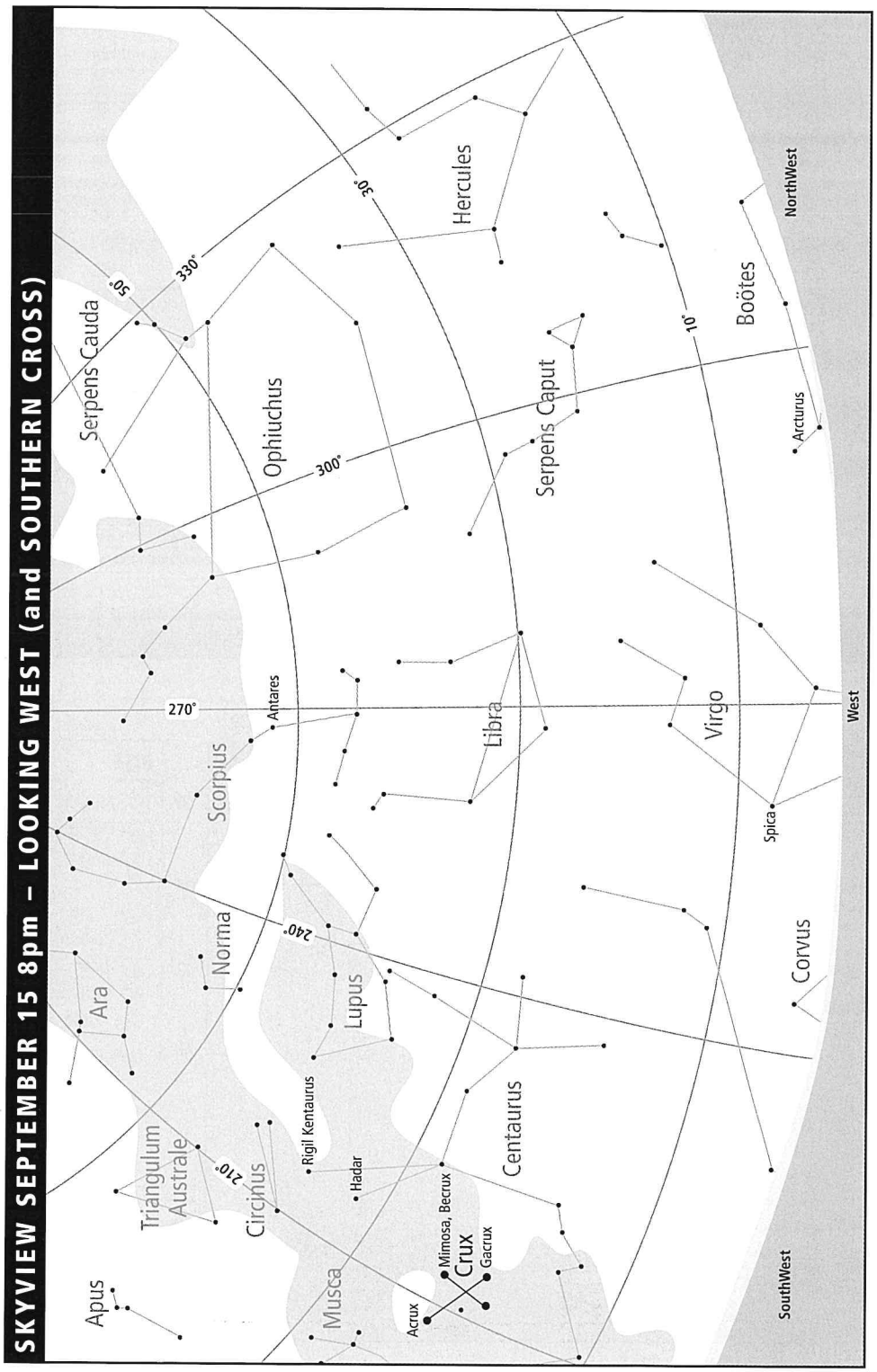
JUPITER MOONS

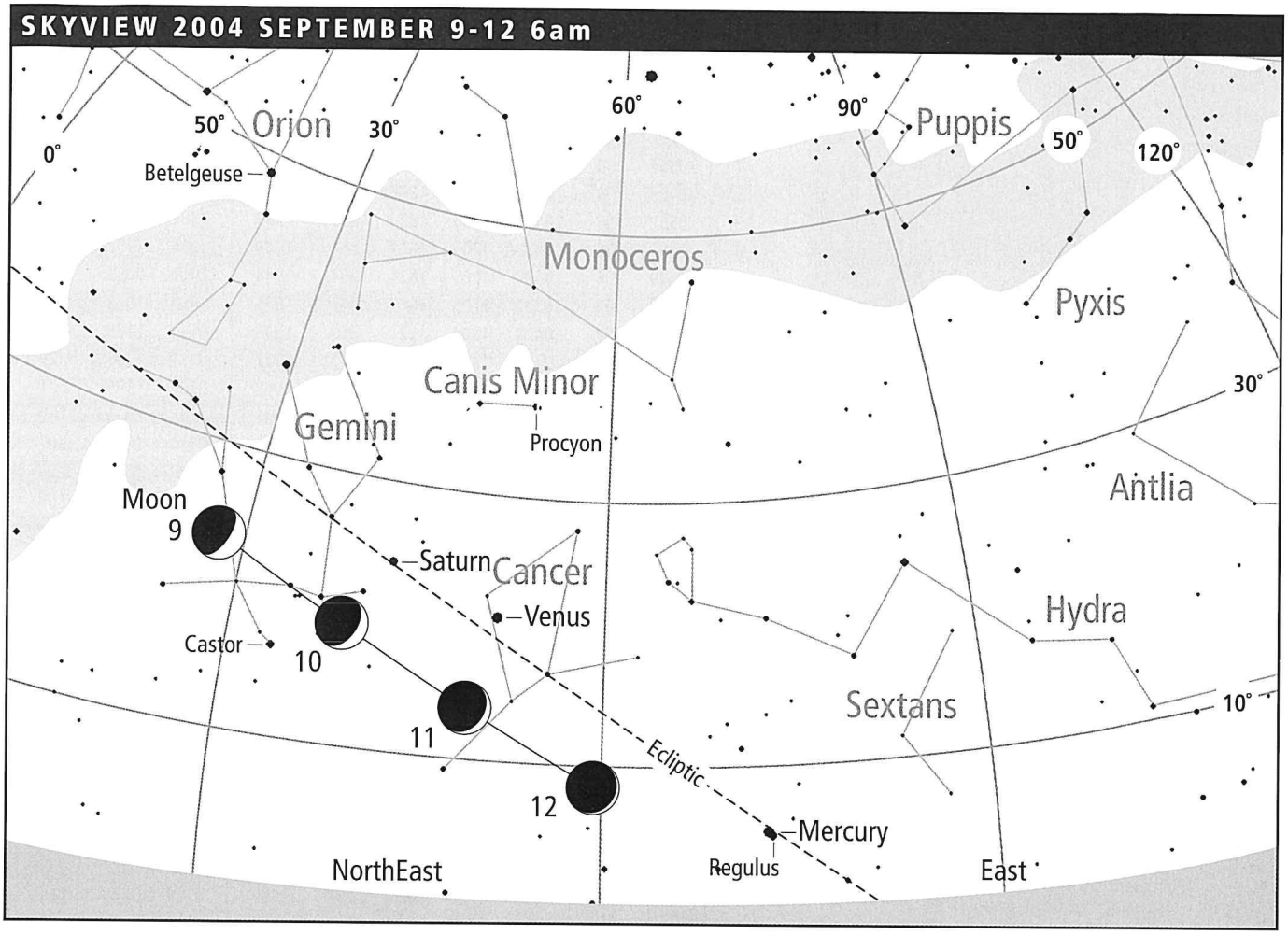


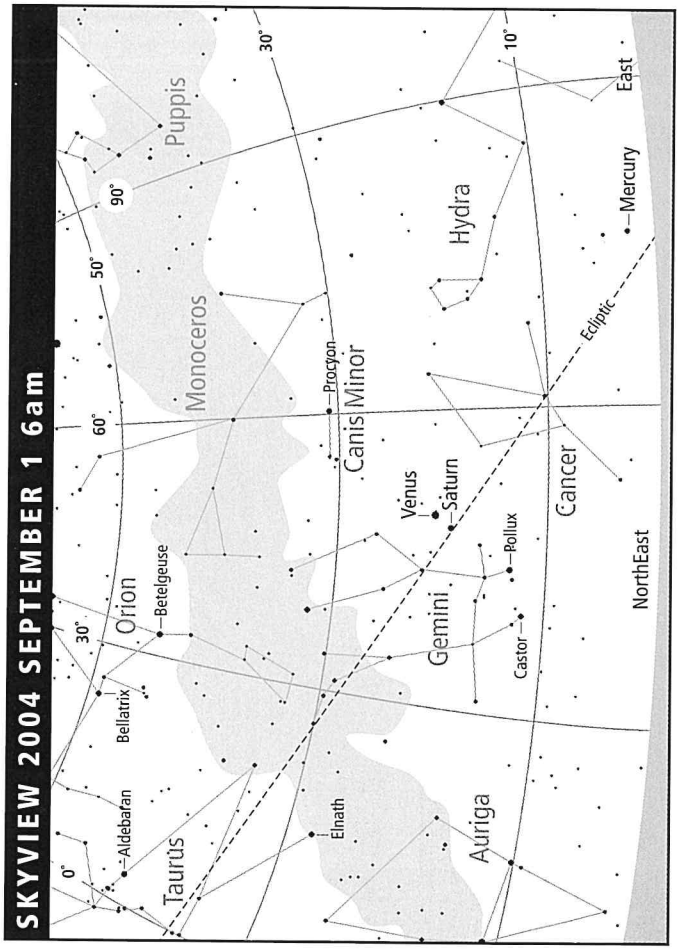
SATURN MOONS

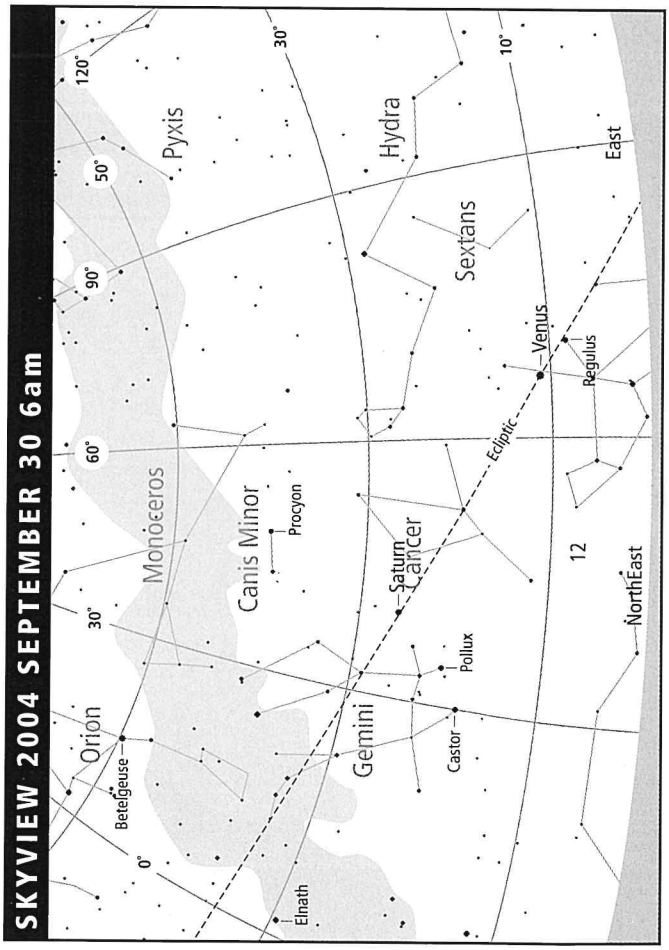


SKYVIEW SEPTEMBER 15 8pm – LOOKING WEST (and SOUTHERN CROSS)




SKYVIEW 2004 SEPTEMBER 9-12 6am
0°
50°
Orion
30°
60°
90°
Puppis
50°
120°
Betelgeuse
Monoceros
Pyxis
Canis Minor
30°
Gemini
Procyon
Antlia
Moon
9
Saturn
Cancer
Venus
Hydra
Castor
10
Sextans
10°
11
Ecliptic
12
Mercury
Regulus
NorthEast
East


SKYVIEW 2004 SEPTEMBER 1 6am
Puppis
30°
10°
East
90°
50°
Hydra
Mercury
Monoceros
Procyon
Canis Minor
60°
Ecliptic
Venus
Saturn
Pollux
Cancer
Orion
Betelgeuse
Gemini
NorthEast
30°
Bellatrix
Castor
Aldebaran
Elnath
Auriga
0°
Taurus


SKYVIEW 2004 SEPTEMBER 30 6am
120°
30°
10°
Pyxis
50°
Hydra
East
90°
Sextans
Venus
Regulus
Monoceros
60°
Ecliptic
Canis Minor
Procyon
Saturn
Cancer
12
30°
Pollux
NorthEast
Orion
Gemini
Castor
Betelgeuse
0°
Elnath

OCTOBER 2004

HIGHLIGHTS

Mercury *low in the west after sunset in the last half of the month.*

Venus *easily visible in the dawn sky.*

Mars *visible low around dawn in the constellation Virgo.*

Jupiter *visible just before dawn in constellation Virgo.*

Saturn *visible in the morning in constellation Gemini.*

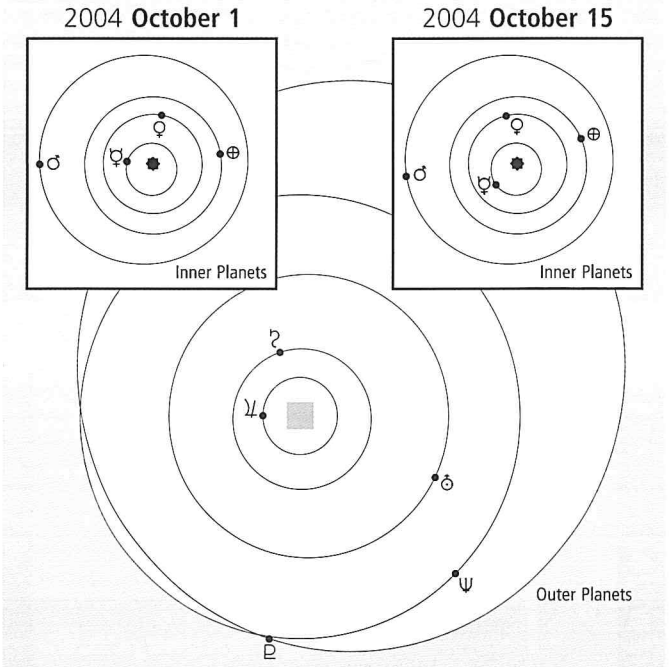
DIARY

Day	Hour	
4	00	Venus 0°.2 S. of Regulus
6		Jupiter crosses from North Celestial Hemisphere to South
6	03	Mercury in superior conjunction
6	06	Moon at apogee
6	18	**Last Quarter**
7	18	Saturn 5° S. of Moon
11	03	Venus 4° S. of Moon
13	03	Jupiter 1°.6 S. of Moon
14	11	**New Moon – Eclipse**
18		Maximum activity epsilon-Geminid meteor shower
18	08	Moon at perigee
21	06	**First Quarter**
22		Max activity epsilon-Orionid meteor shower
22	05	Neptune 5° N. of Moon
23	16	Uranus 4° N. of Moon
24	18	Neptune stationary
28	11	**Full Moon – Eclipse**
31	16	Mars 3° N. of Spica

SUN+MOON RISE/SET

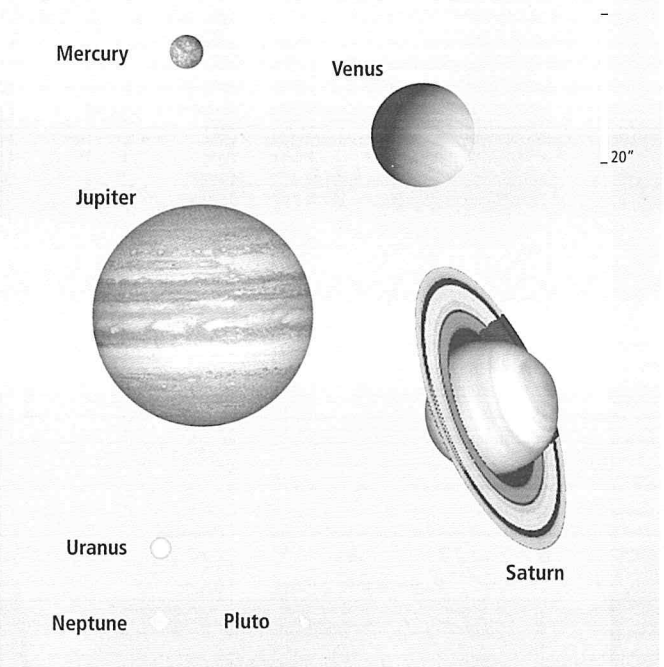
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0554	94	0432	1206	1819	265	1941	2107	0719	0.90
2	0553	95	0431	1206	1819	265	1942	2208	0751	0.83
3	0552	95	0429	1206	1820	265	1943	2307	0826	0.75
4	0551	96	0428	1205	1821	264	1943	0004	0907	0.67
5	0549	96	0427	1205	1821	264	1944	DNR	0952	0.57
6	0548	97	0425	1205	1822	263	1945	0058	1043	0.48
7	0547	97	0424	1204	1823	263	1946	0147	1138	0.38
8	0545	97	0422	1204	1823	262	1947	0231	1235	0.29
9	0544	98	0421	1204	1824	262	1948	0309	1335	0.21
10	0543	98	0419	1204	1825	261	1948	0343	1435	0.13
11	0542	99	0418	1203	1825	261	1949	0414	1535	0.07
12	0541	99	0417	1203	1826	261	1950	0443	1636	0.03
13	0539	100	0415	1203	1827	260	1951	0511	1738	0.00
14	0538	100	0414	1203	1828	260	1952	0540	1842	0.00
15	0537	101	0413	1202	1828	259	1953	0612	1950	0.03
16	0536	101	0411	1202	1829	259	1954	0647	2100	0.08
17	0535	101	0410	1202	1830	258	1955	0728	2211	0.16
18	0534	102	0408	1202	1831	258	1956	0817	2321	0.25
19	0532	102	0407	1202	1831	257	1957	0914	DNS	0.36
20	0531	103	0406	1201	1832	257	1958	1019	0026	0.47
21	0530	103	0404	1201	1833	257	1959	1128	0122	0.59
22	0529	104	0403	1201	1834	256	2000	1237	0209	0.69
23	0528	104	0402	1201	1834	256	2001	1345	0248	0.79
24	0527	104	0400	1201	1835	255	2002	1450	0323	0.87
25	0526	105	0359	1201	1836	255	2003	1552	0353	0.94
26	0525	105	0358	1201	1837	255	2004	1653	0422	0.98
27	0524	106	0357	1200	1838	254	2005	1754	0449	1.00
28	0523	106	0355	1200	1838	254	2006	1854	0518	1.00
29	0522	106	0354	1200	1839	253	2007	1954	0549	0.98
30	0521	107	0353	1200	1840	253	2008	2055	0623	0.94
31	0520	107	0352	1200	1841	253	2010	2153	0701	0.88

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ♅ Uranus ♇ Pluto
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

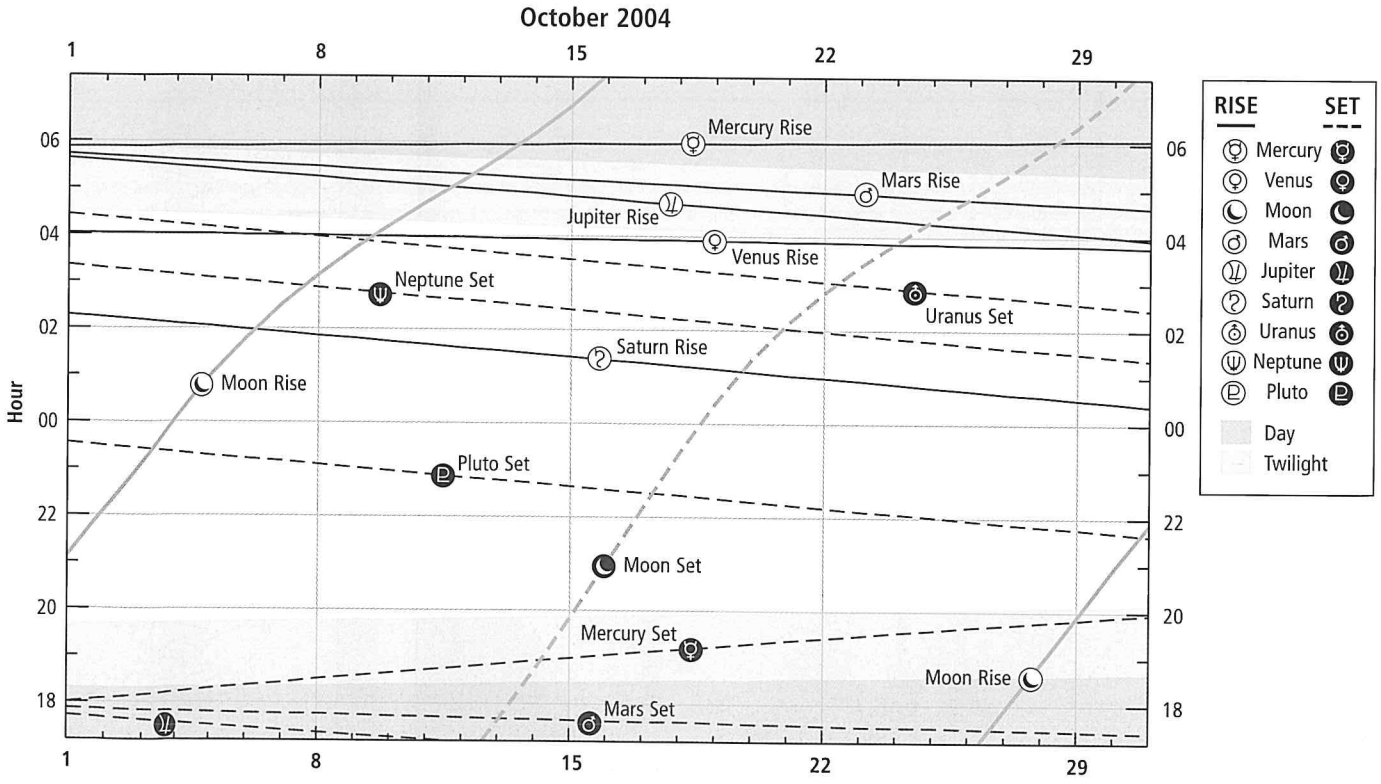


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0551	1800	0402	1504	0545	1752	0542	1743	1	0221	1236	1528	0430	1349	0325	1014	2333
2	0552	1805	0402	1505	0543	1751	0538	1740	2	0217	1232	1524	0426	1345	0321	1010	2329
3	0553	1809	0402	1507	0541	1750	0535	1737	3	0214	1228	1520	0422	1341	0317	1006	2325
4	0553	1813	0402	1508	0539	1749	0532	1734	4	0210	1225	1515	0418	1337	0313	1002	2321
5	0554	1818	0401	1510	0536	1748	0528	1731	5	0206	1221	1511	0414	1333	0309	0958	2317
6	0554	1822	0401	1511	0534	1747	0525	1728	6	0203	1218	1507	0410	1329	0305	0954	2313
7	0554	1826	0400	1513	0532	1746	0521	1725	7	0159	1214	1503	0406	1325	0301	0950	2310
8	0555	1831	0400	1514	0530	1746	0518	1722	8	0155	1210	1459	0402	1321	0257	0947	2306
9	0555	1835	0400	1516	0528	1745	0515	1719	9	0151	1207	1455	0358	1318	0253	0943	2302
10	0556	1839	0359	1517	0525	1744	0511	1717	10	0148	1203	1451	0354	1314	0249	0939	2258
11	0556	1843	0359	1519	0523	1743	0508	1714	11	0144	1159	1447	0350	1310	0245	0935	2254
12	0556	1847	0358	1520	0521	1742	0505	1711	12	0140	1155	1443	0346	1306	0241	0931	2250
13	0557	1851	0358	1522	0519	1741	0501	1708	13	0136	1152	1439	0342	1302	0238	0927	2247
14	0557	1855	0357	1524	0517	1740	0458	1705	14	0133	1148	1435	0338	1258	0234	0923	2243
15	0557	1859	0357	1525	0514	1739	0455	1702	15	0129	1144	1431	0334	1254	0230	0920	2239
16	0558	1903	0356	1527	0512	1738	0451	1659	16	0125	1141	1427	0330	1250	0226	0916	2235
17	0558	1907	0356	1528	0510	1737	0448	1656	17	0121	1137	1423	0326	1246	0222	0912	2231
18	0558	1910	0355	1530	0508	1737	0444	1653	18	0118	1133	1419	0322	1242	0218	0908	2228
19	0559	1914	0355	1532	0506	1736	0441	1650	19	0114	1129	1415	0318	1238	0214	0904	2224
20	0559	1918	0354	1533	0503	1735	0438	1647	20	0110	1126	1411	0314	1234	0210	0900	2220
21	0559	1922	0354	1535	0501	1734	0434	1644	21	0106	1122	1407	0310	1230	0206	0856	2216
22	0600	1925	0353	1536	0459	1733	0431	1641	22	0102	1118	1403	0306	1226	0202	0853	2212
23	0600	1929	0353	1538	0457	1732	0428	1638	23	0059	1114	1359	0302	1222	0158	0849	2208
24	0600	1933	0352	1540	0455	1731	0424	1635	24	0055	1110	1355	0258	1218	0154	0845	2205
25	0601	1936	0351	1541	0453	1731	0421	1632	25	0051	1107	1351	0254	1214	0150	0841	2201
26	0601	1940	0351	1543	0450	1730	0417	1629	26	0047	1103	1347	0250	1210	0146	0837	2157
27	0602	1943	0350	1545	0448	1729	0414	1626	27	0043	1059	1343	0247	1206	0142	0833	2153
28	0602	1947	0350	1546	0446	1728	0411	1623	28	0039	1055	1339	0243	1203	0138	0830	2149
29	0603	1950	0349	1548	0444	1727	0407	1620	29	0036	1051	1335	0239	1159	0135	0826	2146
30	0604	1954	0349	1550	0442	1726	0404	1617	30	0032	1047	1331	0235	1155	0131	0822	2142
31	0604	1957	0348	1551	0440	1725	0401	1614	31	0028	1044	1327	0231	1151	0127	0818	2138

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

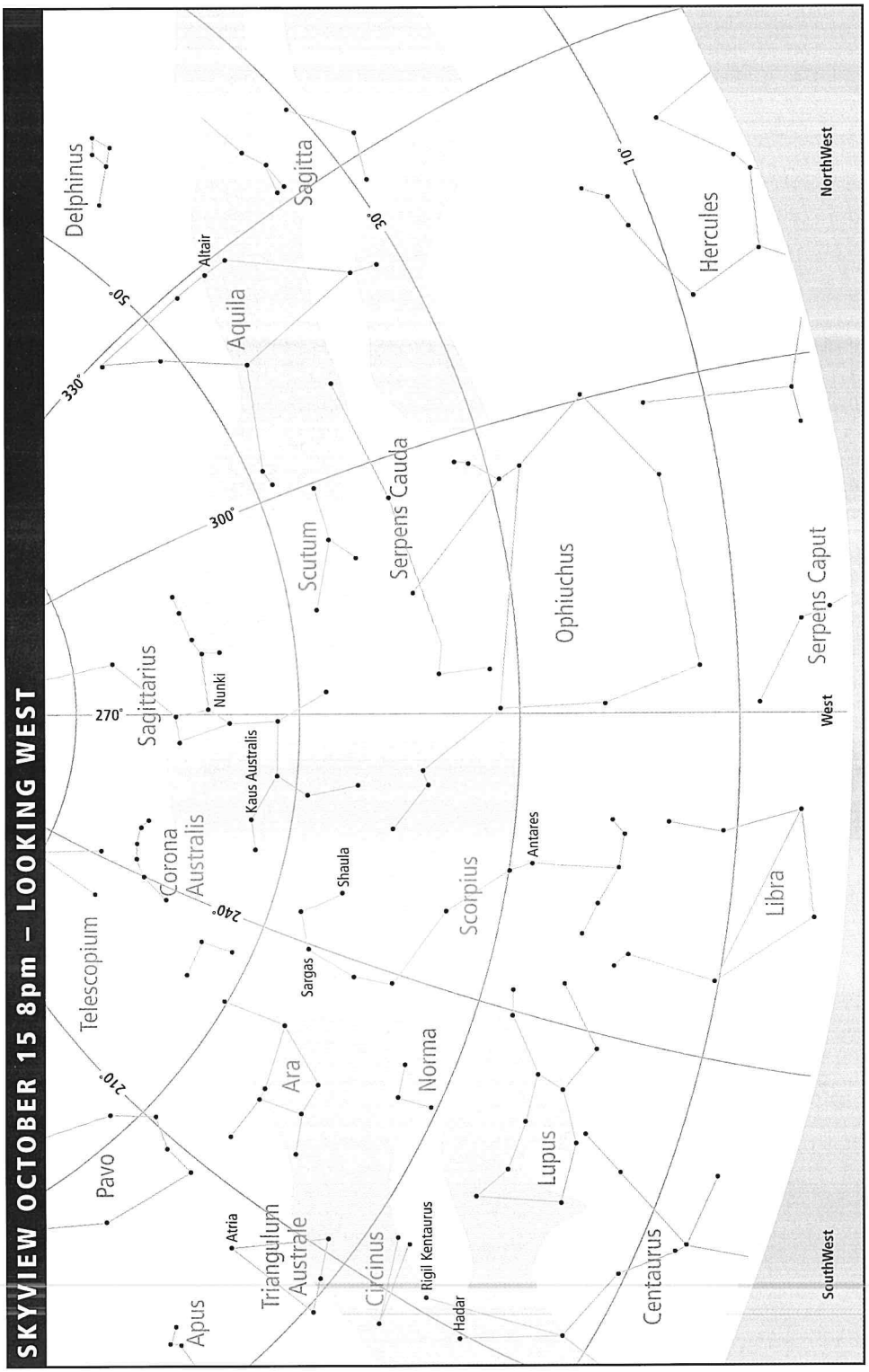
DAY	PHENOMENON h m	Satellite	Event	
1	0552	II	Sh.I.	Shadow Ingress
2	0546		GRS	Great Red Spot
3	0552	I	Oc.R.	Occult Reappear
10	0521	I	Ec.D.	Eclipse Disappear
17	0531	II	Ec.D.	Eclipse Disappear
18	0452	I	Tr.I.	Transit Ingress
19	0454		GRS	Great Red Spot
31	0452		GRS	Great Red Spot

Moons: I Io, II Europa, III Ganymede, IV Callisto

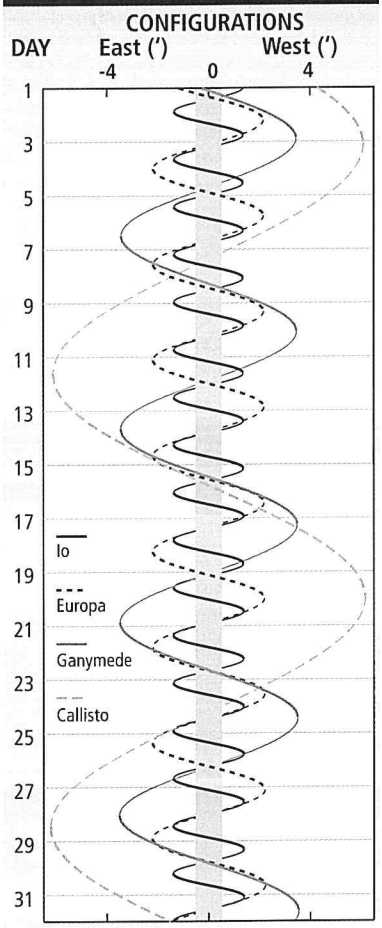
Events: D Disappear, E Egress, Ec Eclipse, Sh Shadow, R Reappear, I Ingress, Oc Occult, Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

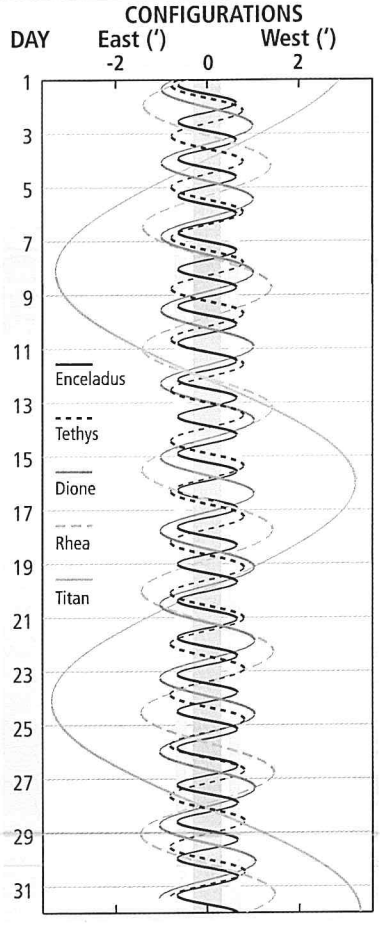
SKYVIEW OCTOBER 15 8pm – LOOKING WEST

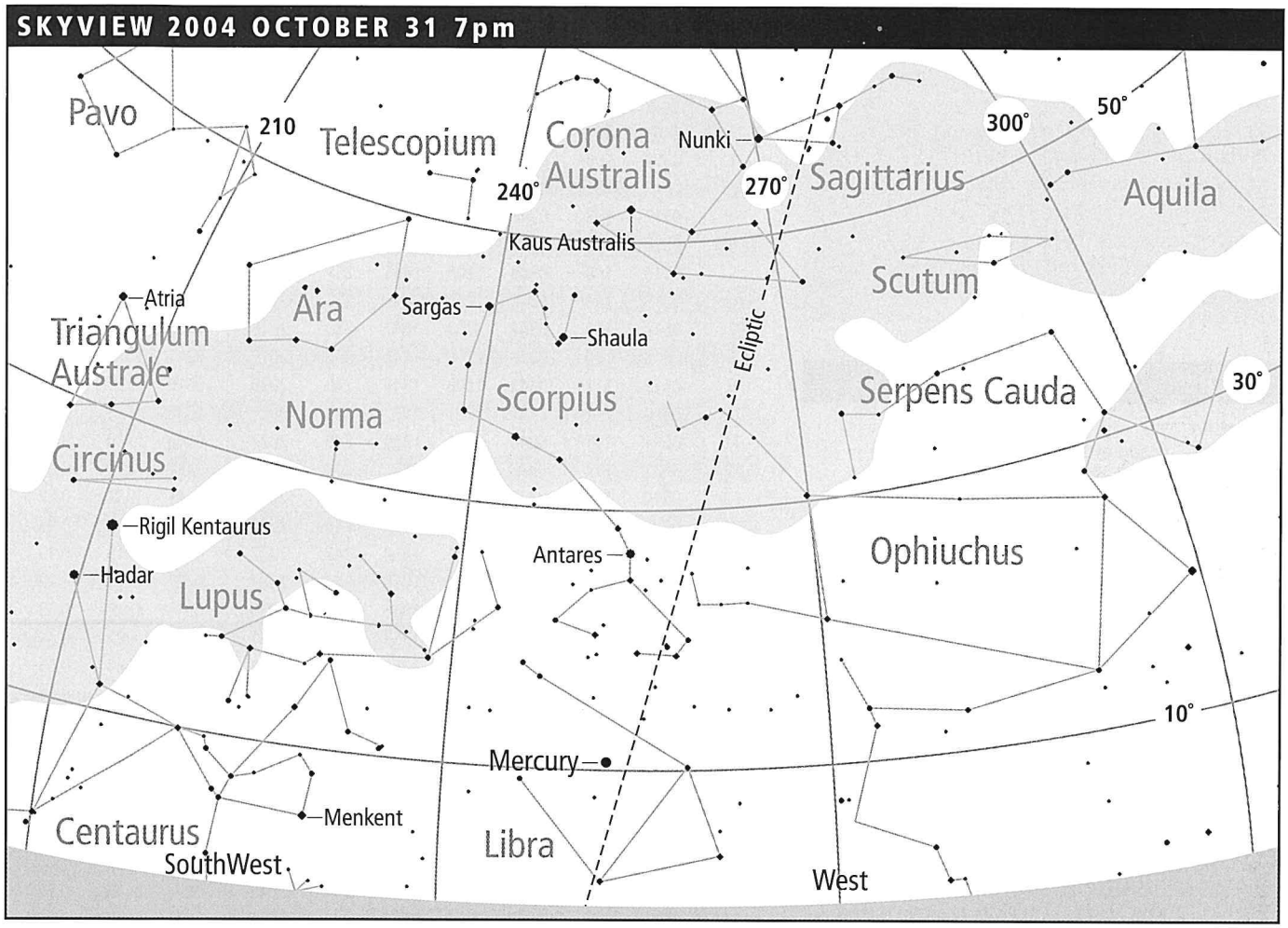


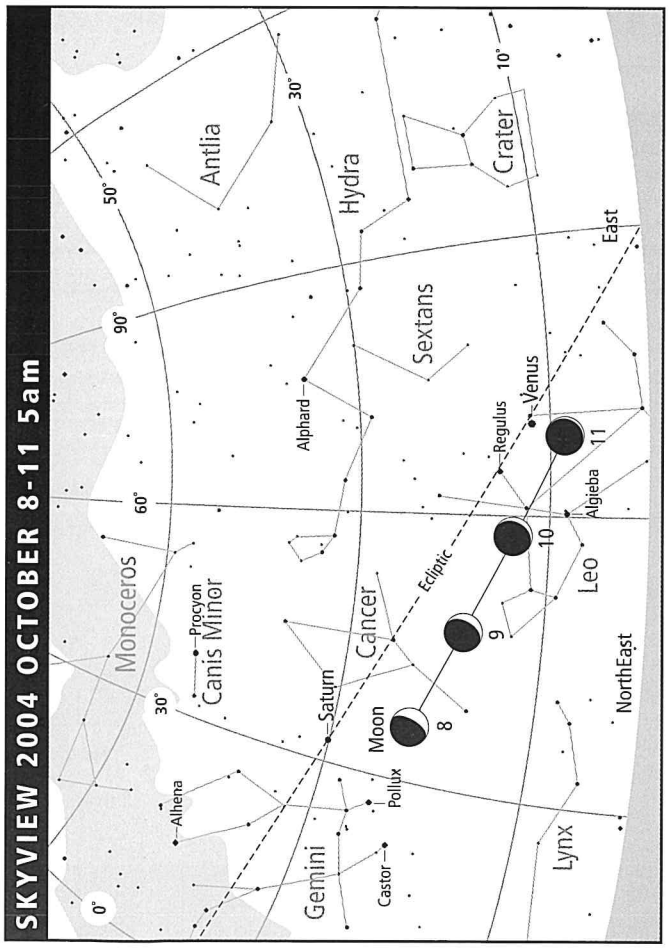
JUPITER MOONS

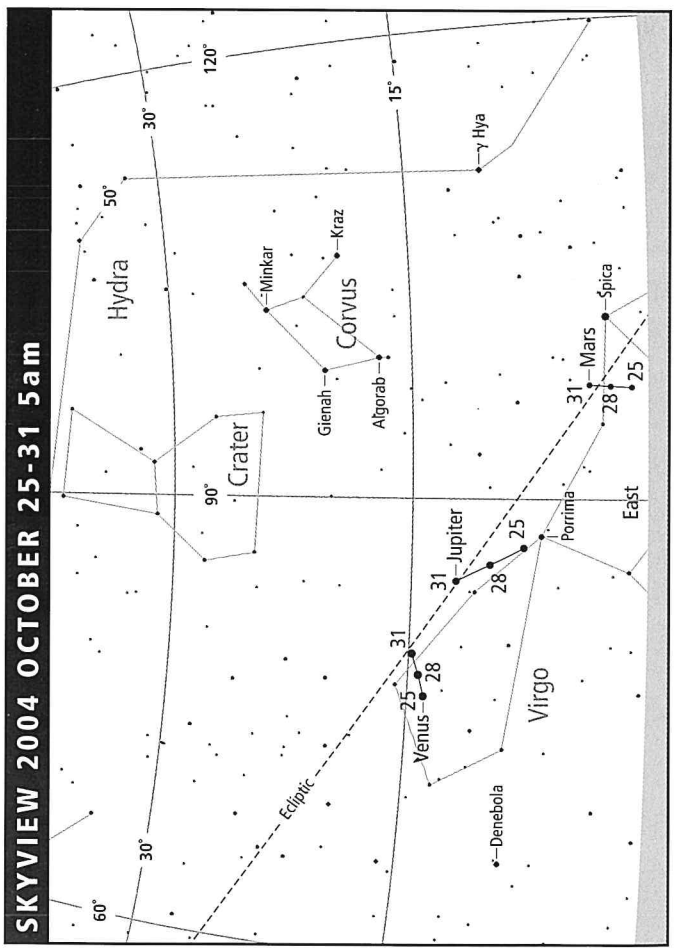


SATURN MOONS




SKYVIEW 2004 OCTOBER 31 7pm
Pavo
210
Telescopium
Corona Australis
Nunki
240°
270°
300°
50°
Sagittarius
Aquila
Kaus Australis
Scutum
Atria
Ara
Sargas
Shaula
Triangulum Australe
Ecliptic
Norma
Scorpius
Serpens Cauda
30°
Circinus
Rigil Kentaurus
Antares
Ophiuchus
Hadar
Lupus
10°
Mercury
Menkent
Centaurus
Libra
SouthWest
West


SKYVIEW 2004 OCTOBER 8-11 5am
Antlia
Hydra
Crater
East
Sextans
Alphard
Venus
Regulus
Algieba
Monoceros
Procyon
Canis Minor
Ecliptic
Cancer
Leo
Saturn
Moon
NorthEast
Alhena
Pollux
Gemini
Castor
Lynx


SKYVIEW 2004 OCTOBER 25-31 5am
Hydra
Minkar
Kraz
Corvus
Spica
Mars
Gienah
Algorab
Crater
East
Porrima
Jupiter
Virgo
Venus
Ecliptic
Denebola

NOVEMBER 2004

HIGHLIGHTS

Mercury *visible in the evening sky, low in the west after sunset.*

Venus *easily visible in the morning sky. Conjunction with Jupiter on the 4th.*

Mars *visible low before dawn in the constellation Virgo then Libra.*

Jupiter *visible just before dawn in Virgo.*

Saturn *visible in the morning in Gemini. Rises before midnight late in month.*

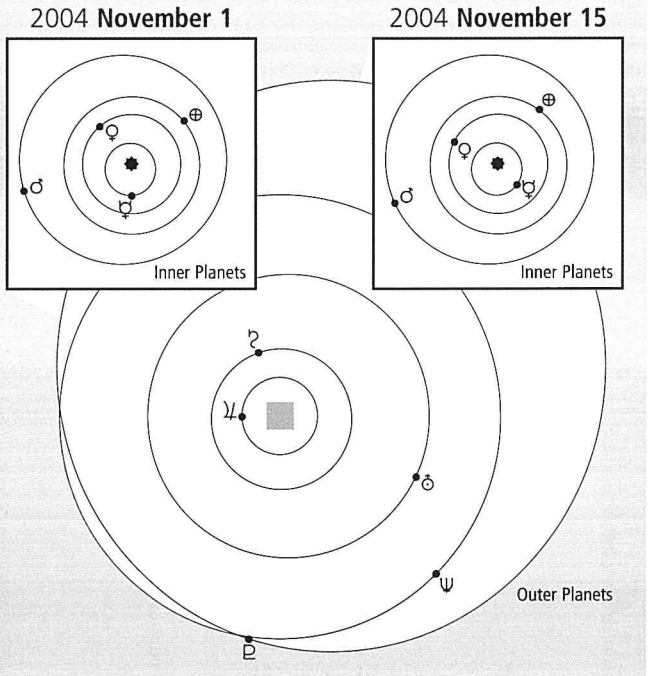
DIARY

Day	Hour	
3	02	Moon at apogee
4	04	Saturn 5° S. of Moon
5		Max activity Southern Taurid meteor s.
5	05	Venus 0°.6 N. of Jupiter
5	14	**Last Quarter**
8	19	Saturn stationary
10	00	Jupiter 1°.0 S. of Moon – Occultation
10	10	Venus 0°.2 N. of Moon – Occultation
11	12	Mars 0°.5 N. of Moon – Occultation
11	18	Mercury 2° N. of Antares
12		Max activity Northern Taurid meteor s.
12	10	Uranus stationary
12	22	**New Moon**
14	11	Mercury 0°.9 N. of Moon – Occultation
14	22	Moon at perigee
16	17	Venus 4° N. of Spica
17		Max activity Leonid meteor shower
18	11	Neptune 5° N. of Moon
19	14	**First Quarter**
19	21	Uranus 4° N. of Moon
21		Max activity alpha-Monocerotid meteor s.
21	09	Mercury greatest elongation E. (22°)
27	04	**Full Moon**
30	19	Moon at apogee
30	21	Mercury stationary

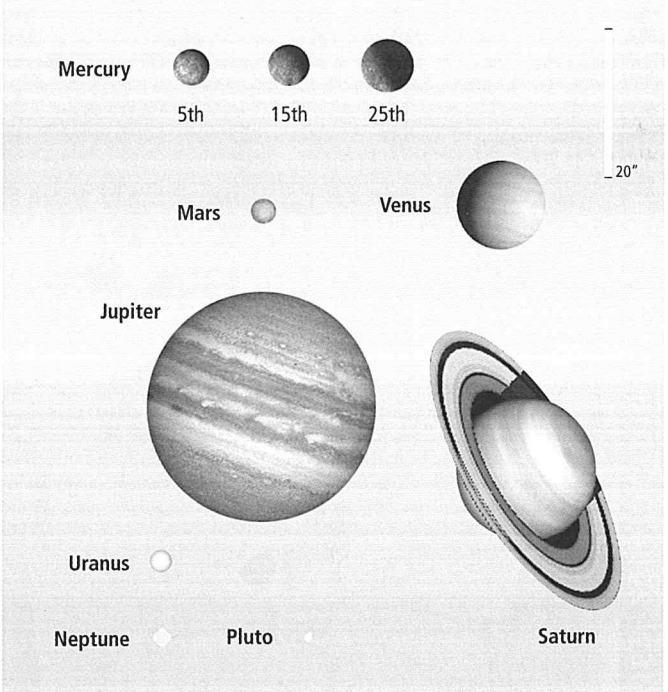
SUN+MOON RISE/SET

DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0519	108	0350	1200	1842	252	2011	2249	0745	0.82
2	0518	108	0349	1200	1843	252	2012	2340	0834	0.74
3	0517	108	0348	1200	1843	251	2013	0026	0927	0.65
4	0517	109	0347	1200	1844	251	2014	DNR	1023	0.56
5	0516	109	0346	1200	1845	251	2015	0106	1122	0.46
6	0515	109	0345	1200	1846	250	2016	0141	1220	0.37
7	0514	110	0344	1200	1847	250	2018	0212	1319	0.27
8	0513	110	0343	1200	1848	250	2019	0241	1419	0.18
9	0513	111	0342	1200	1849	249	2020	0310	1520	0.11
10	0512	111	0341	1201	1850	249	2021	0338	1622	0.05
11	0511	111	0340	1201	1850	249	2022	0408	1729	0.01
12	0511	112	0339	1201	1851	248	2024	0442	1839	0.00
13	0510	112	0338	1201	1852	248	2025	0521	1952	0.02
14	0509	112	0337	1201	1853	248	2026	0608	2105	0.06
15	0509	113	0336	1201	1854	247	2027	0703	2215	0.13
16	0508	113	0335	1201	1855	247	2028	0807	2316	0.22
17	0508	113	0334	1202	1856	247	2030	0917	DNS	0.33
18	0507	113	0333	1202	1857	246	2031	1028	0007	0.44
19	0507	114	0333	1202	1858	246	2032	1137	0049	0.55
20	0506	114	0332	1202	1859	246	2033	1243	0125	0.66
21	0506	114	0331	1203	1859	246	2035	1346	0156	0.75
22	0506	115	0330	1203	1900	245	2036	1446	0225	0.84
23	0505	115	0330	1203	1901	245	2037	1546	0253	0.91
24	0505	115	0329	1203	1902	245	2038	1645	0320	0.96
25	0505	115	0329	1204	1903	245	2039	1744	0350	0.99
26	0504	115	0328	1204	1904	244	2040	1844	0422	1.00
27	0504	116	0328	1204	1905	244	2042	1944	0459	0.99
28	0504	116	0327	1205	1906	244	2043	2041	0540	0.97
29	0504	116	0327	1205	1907	244	2044	2134	0627	0.93
30	0503	116	0326	1205	1907	244	2045	2221	0719	0.87

PLANET POSITIONS



PLANET APPEARANCE

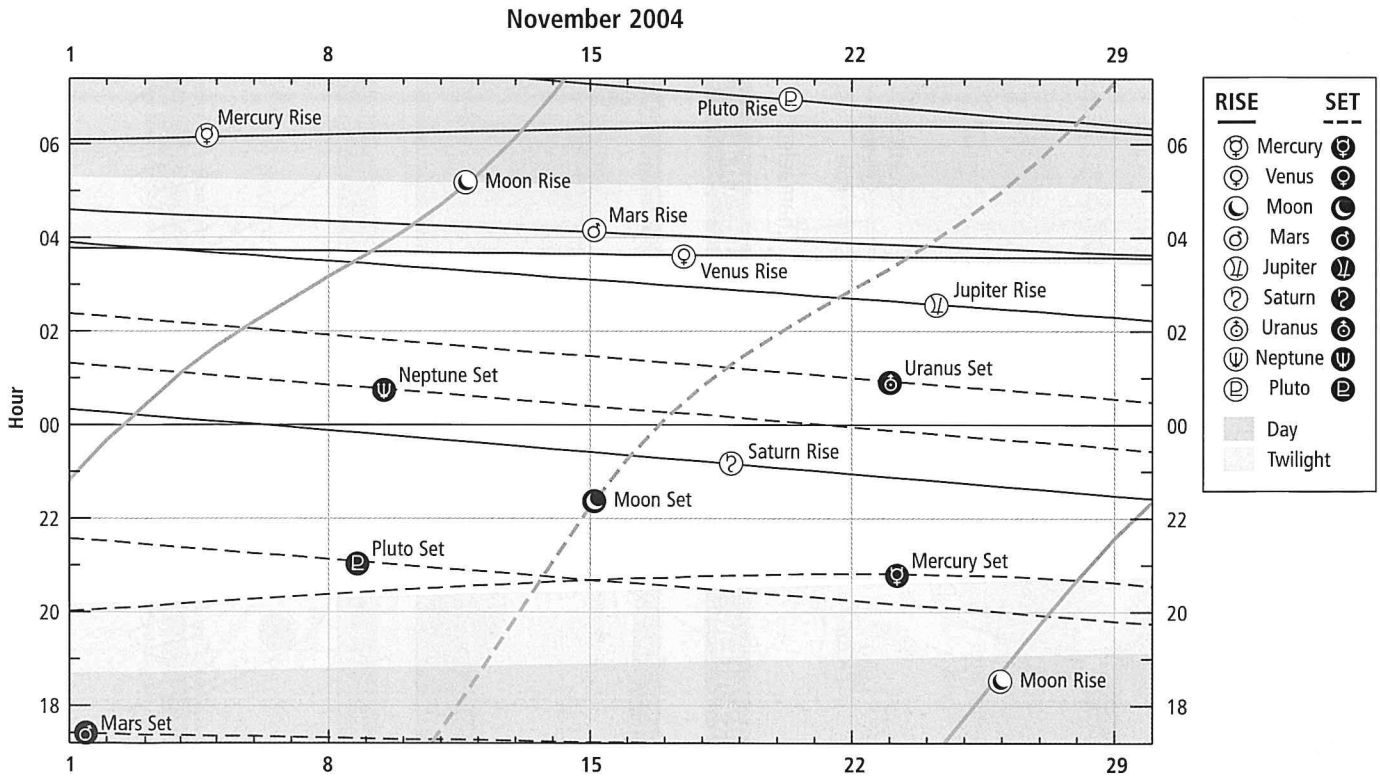


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0605	2001	0347	1553	0438	1725	0357	1611	1	0024	1040	1323	0227	1147	0123	0814	2134
2	0606	2004	0347	1555	0436	1724	0354	1608	2	0020	1036	1319	0223	1143	0119	0810	2131
3	0606	2007	0346	1556	0433	1723	0350	1605	3	0016	1032	1315	0219	1139	0115	0807	2127
4	0607	2011	0346	1558	0431	1722	0347	1602	4	0012	1028	1311	0215	1135	0111	0803	2123
5	0608	2014	0345	1600	0429	1721	0344	1559	5	0008	1024	1307	0211	1131	0107	0759	2119
6	0609	2017	0344	1602	0427	1721	0340	1556	6	0004	1020	1303	0207	1127	0103	0755	2115
7	0610	2020	0344	1603	0425	1720	0337	1553	7	0001	1016	1259	0203	1123	0059	0751	2112
7									7	2357							
8	0611	2023	0343	1605	0423	1719	0333	1550	8	2353	1012	1255	0159	1120	0055	0747	2108
9	0612	2026	0343	1607	0421	1718	0330	1547	9	2349	1009	1251	0155	1116	0051	0744	2104
10	0613	2029	0342	1609	0419	1717	0327	1544	10	2345	1005	1247	0151	1112	0048	0740	2100
11	0614	2031	0342	1610	0417	1717	0323	1541	11	2341	1001	1243	0147	1108	0044	0736	2056
12	0615	2034	0341	1612	0415	1716	0320	1538	12	2337	0957	1239	0143	1104	0040	0732	2053
13	0616	2036	0340	1614	0413	1715	0316	1535	13	2333	0953	1235	0139	1100	0036	0728	2049
14	0617	2039	0340	1616	0411	1714	0313	1532	14	2329	0949	1232	0135	1056	0032	0725	2045
15	0618	2041	0339	1617	0409	1713	0309	1529	15	2325	0945	1228	0131	1052	0028	0721	2041
16	0619	2043	0339	1619	0407	1713	0306	1526	16	2321	0941	1224	0128	1048	0024	0717	2038
17	0620	2044	0338	1621	0405	1712	0303	1522	17	2317	0937	1220	0124	1045	0020	0713	2034
18	0621	2046	0338	1623	0403	1711	0259	1519	18	2313	0933	1216	0120	1041	0016	0709	2030
19	0621	2047	0337	1625	0401	1710	0256	1516	19	2309	0929	1212	0116	1037	0013	0706	2026
20	0622	2048	0337	1627	0359	1710	0252	1513	20	2305	0925	1208	0112	1033	0009	0702	2022
21	0623	2049	0337	1628	0357	1709	0249	1510	21	2301	0921	1204	0108	1029	0005	0658	2019
22	0623	2049	0336	1630	0355	1708	0245	1507	22	2257	0917	1200	0104	1025	0001	0654	2015
22									22						2357		
23	0623	2049	0336	1632	0353	1707	0242	1504	23	2253	0912	1156	0100	1021	2353	0650	2011
24	0623	2048	0335	1634	0351	1707	0239	1501	24	2249	0908	1153	0056	1018	2349	0647	2007
25	0623	2047	0335	1636	0349	1706	0235	1458	25	2245	0904	1149	0052	1014	2345	0643	2004
26	0622	2046	0335	1638	0347	1705	0232	1454	26	2241	0900	1145	0048	1010	2341	0639	2000
27	0621	2044	0334	1640	0345	1704	0228	1451	27	2237	0856	1141	0045	1006	2338	0635	1956
28	0620	2041	0334	1642	0343	1704	0225	1448	28	2233	0852	1137	0041	1002	2334	0631	1952
29	0618	2038	0334	1644	0341	1703	0221	1445	29	2229	0848	1133	0037	0958	2330	0628	1948
30	0615	2033	0334	1646	0339	1702	0218	1442	30	2225	0844	1129	0033	0955	2326	0624	1945

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Satellite	Event
3	0458	I	Sh.E.
4	0411	II	Oc.R.
5	0401		GRS
10	0437	I	Sh.I.
11	0450	I	Oc.R.
12	0449		GRS
17	0359		GRS
18	0344	I	Ec.D.
19	0314	I	Sh.E.
19	0407	I	Tr.E.
20	0325	III	Sh.I.
20	0413	II	Tr.E.
22	0308		GRS
24	0447		GRS
26	0253	I	Sh.I.

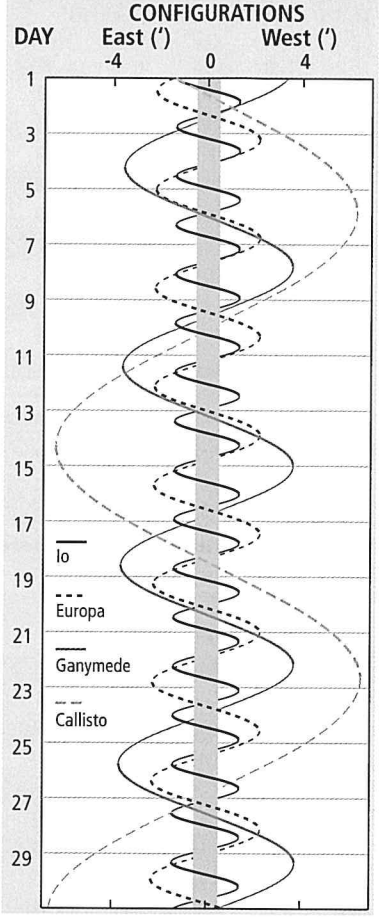
DAY	PHENOMENON h m	Satellite	Event
26	0351	I	Tr.I.
27	0316	I	Oc.R.
27	0414	II	Tr.I.
27	0501	II	Sh.E.
29	0356		GRS

Moons: I Io; II Europa; III Ganymede; IV Callisto

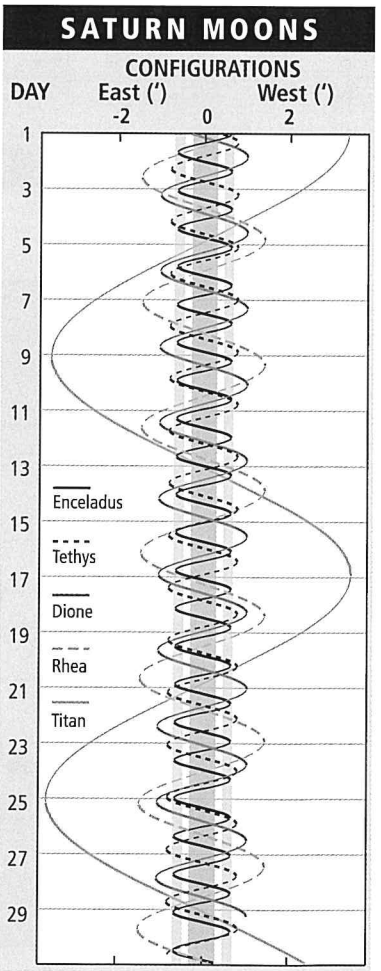
Events: D Disappear; E Egress; Ec Eclipse; Sh Shadow; R Reappear; I Ingress; Oc Occult; Tr Transit

GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

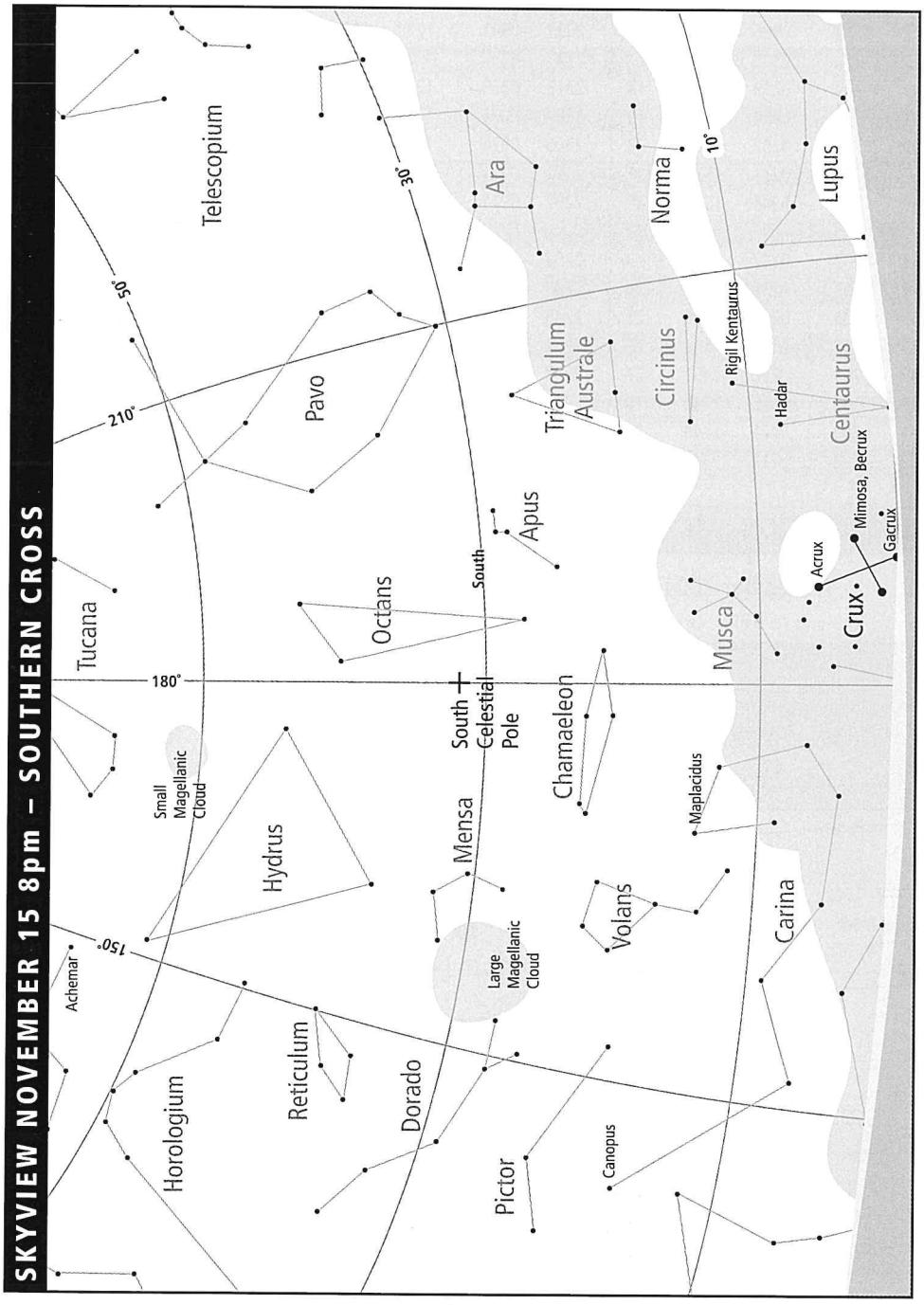
JUPITER MOONS



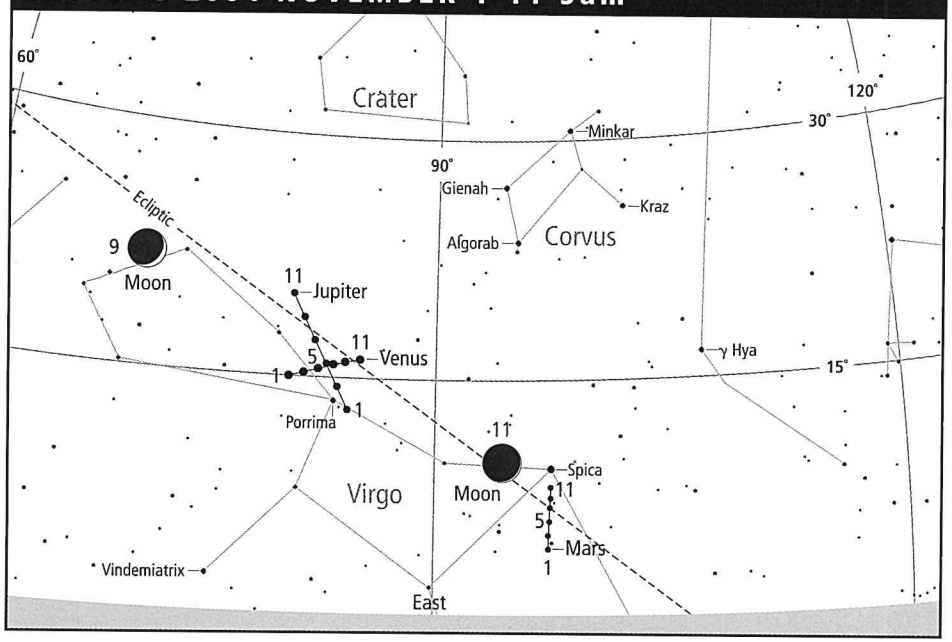
SATURN MOONS



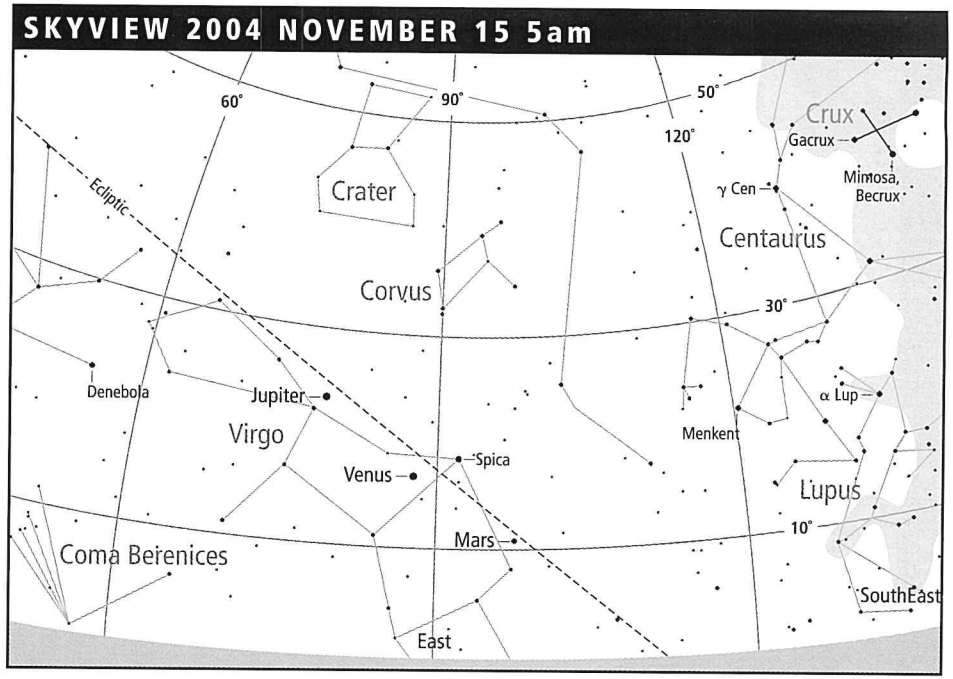
SKYVIEW NOVEMBER 15 8pm – SOUTHERN CROSS



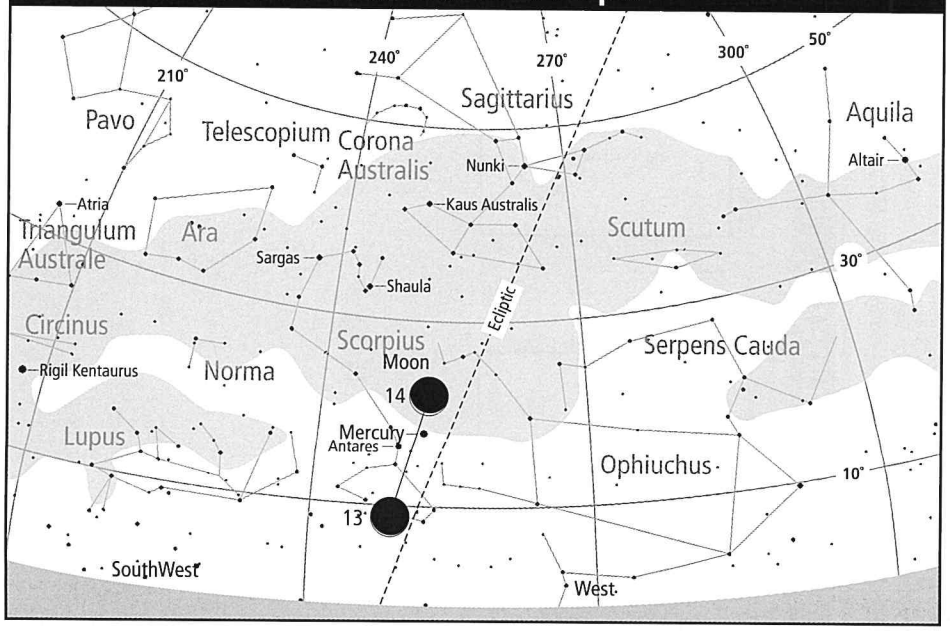
SKYVIEW 2004 NOVEMBER 1-11 5am



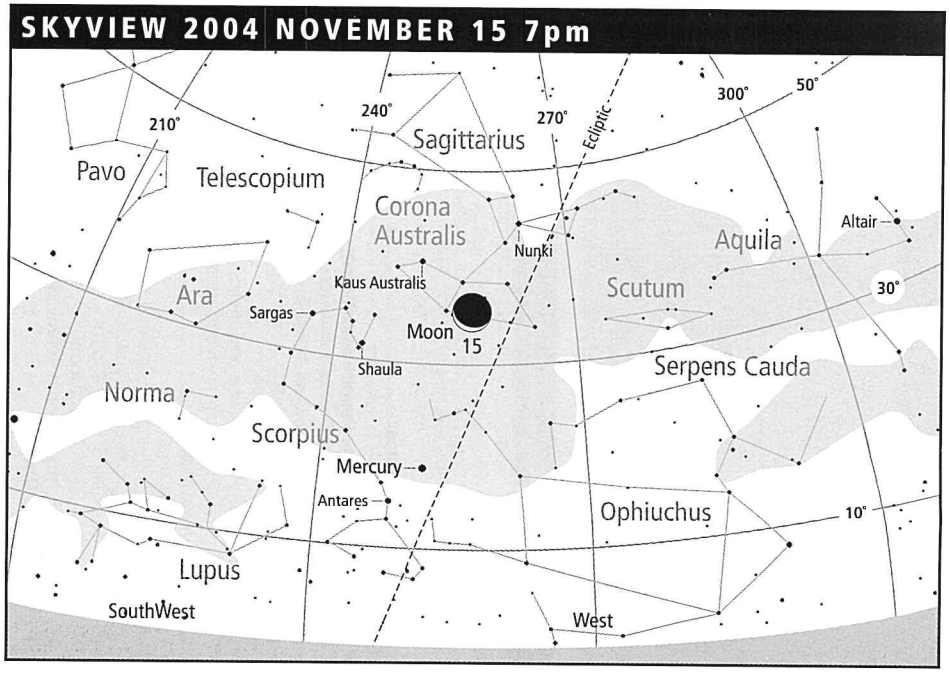
SKYVIEW 2004 NOVEMBER 15 5am



SKYVIEW 2004 NOVEMBER 13-14 7pm



SKYVIEW 2004 NOVEMBER 15 7pm



DECEMBER 2004

HIGHLIGHTS

Mercury *visible mornings, low in east around dawn, in the second half of the month.*

Venus *easily visible in the morning sky. Conjunction with Mars on December 5. Conjunction with Mercury on 29th.*

Mars *visible in the morning sky in the constellation Libra then Scorpius.*

Jupiter *visible in morning in Virgo.*

Saturn *visible in the morning and late evening in Gemini. Visible all night by end of month.*

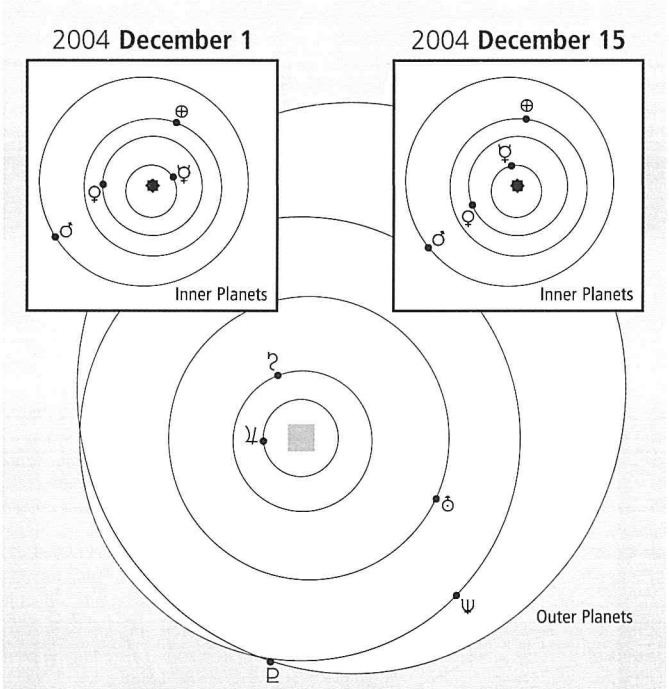
DIARY

Day	Hour	
1		Max activity chi-Orionid meteor shower
1	10	Saturn 5° S. of Moon
5		Max activity Phoenicid meteor shower
5	09	**Last Quarter**
5	15	Venus 2°.3 N. of Mars
7		Max activity Puppid-Velid meteor shower
7	19	Jupiter 0°.3 S. of Moon – Occultation
9		Max activity Monocerotid (Dec.) meteor s.
10	08	Mars 2° N. of Moon
10	13	Venus 4° N. of Moon
10	16	Mercury in inferior conjunction
11		Max activity sigma-Hydrid meteor shower
12	09	**New Moon**
13	05	Moon at perigee
14		Maximum activity Geminid meteor shower
14	01	Pluto in conjunction with Sun
15	19	Neptune 5° N. of Moon
17	05	Uranus 4° N. of Moon
19		Max activity Coma Berenicid meteor shwr
19	01	**First Quarter**
20	15	Mercury stationary
21	21	Solstice
24	05	Venus 6° N. of Antares
26	23	**Full Moon**
28	03	Moon at apogee
28	14	Saturn 5° S. of Moon
29	13	Mercury 1°.2 N. of Venus
30	05	Mercury greatest elongation W. (22°)

SUN+MOON RISE/SET

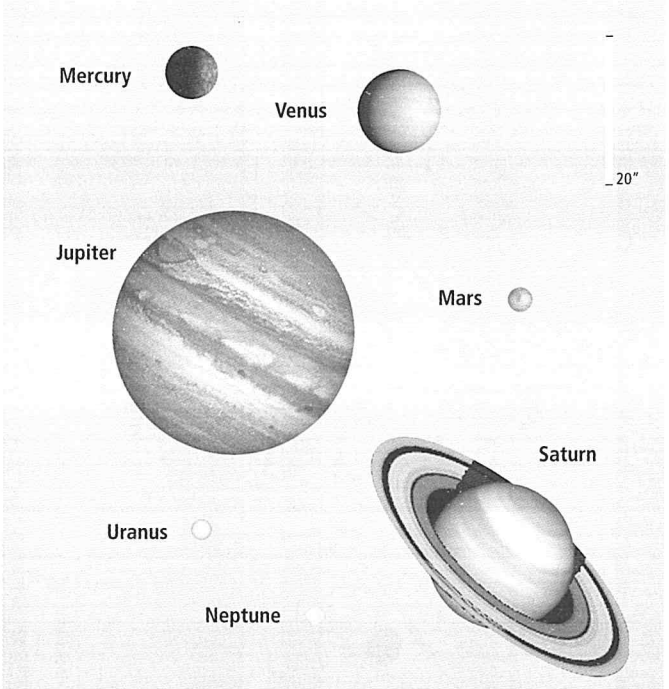
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn fraction
1	0503	117	0326	1206	1908	243	2046	2303	0814	0.80
2	0503	117	0326	1206	1909	243	2047	2339	0912	0.72
3	0503	117	0325	1206	1910	243	2048	0012	1010	0.63
4	0503	117	0325	1207	1911	243	2049	DNR	1108	0.54
5	0503	117	0325	1207	1911	243	2050	0041	1205	0.44
6	0503	117	0325	1208	1912	243	2051	0108	1303	0.34
7	0503	118	0325	1208	1913	242	2052	0136	1403	0.24
8	0503	118	0324	1209	1914	242	2053	0204	1506	0.16
9	0504	118	0324	1209	1915	242	2054	0235	1613	0.08
10	0504	118	0324	1209	1915	242	2055	0311	1724	0.03
11	0504	118	0324	1210	1916	242	2056	0354	1839	0.00
12	0504	118	0325	1210	1917	242	2056	0445	1952	0.01
13	0504	118	0325	1211	1917	242	2057	0547	2100	0.04
14	0505	118	0325	1211	1918	242	2058	0657	2157	0.10
15	0505	118	0325	1212	1919	242	2059	0811	2245	0.19
16	0505	118	0325	1212	1919	242	2059	0924	2325	0.28
17	0506	118	0326	1213	1920	242	2100	1033	2358	0.39
18	0506	118	0326	1213	1921	241	2101	1139	DNS	0.50
19	0506	119	0326	1214	1921	241	2101	1240	0028	0.60
20	0507	119	0327	1214	1922	241	2102	1340	0056	0.70
21	0507	119	0327	1215	1922	241	2102	1439	0124	0.79
22	0508	119	0328	1215	1923	241	2103	1538	0153	0.86
23	0508	119	0328	1216	1923	241	2103	1637	0224	0.92
24	0509	119	0329	1216	1923	241	2104	1737	0258	0.97
25	0509	118	0329	1217	1924	242	2104	1834	0338	0.99
26	0510	118	0330	1217	1924	242	2104	1928	0423	1.00
27	0511	118	0331	1218	1925	242	2105	2018	0513	0.99
28	0511	118	0331	1218	1925	242	2105	2101	0608	0.96
29	0512	118	0332	1219	1925	242	2105	2139	0705	0.92
30	0513	118	0333	1219	1926	242	2105	2212	0803	0.86
31	0513	118	0334	1220	1926	242	2105	2242	0900	0.79

PLANET POSITIONS



☿ Mercury ♁ Earth ♃ Jupiter ♅ Uranus ♇ Pluto
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

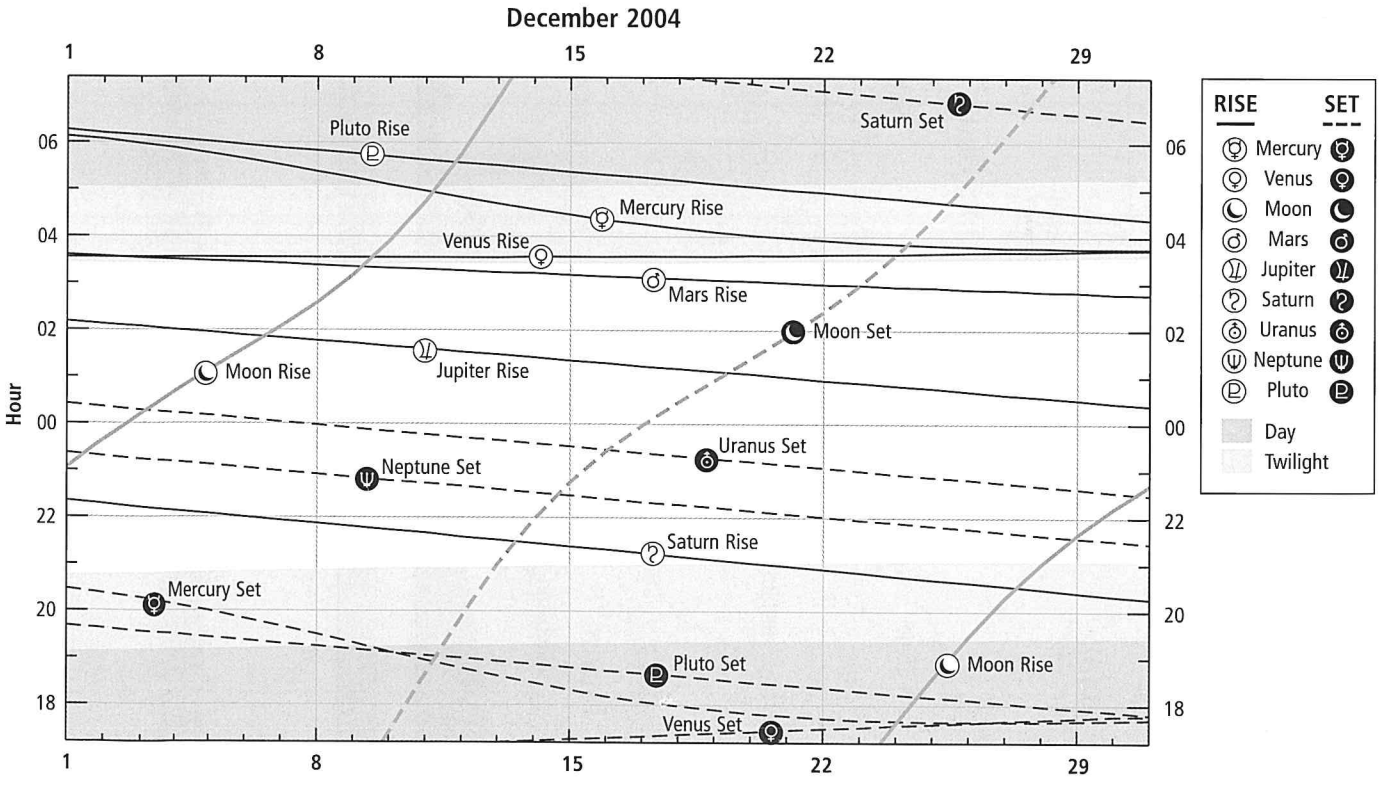


1 degree (1°) = 60 arc minutes (60') = 3600 arc seconds (3600")
Therefore 20" = 1/3' = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		DAY	SATURN		URANUS		NEPTUNE		PLUTO	
	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m		Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m	Rise h m	Set h m
1	0612	2028	0333	1648	0338	1702	0214	1439	1	2221	0840	1125	0029	0951	2322	0620	1941
2	0608	2022	0333	1650	0336	1701	0211	1435	2	2217	0836	1122	0025	0947	2318	0616	1937
3	0604	2016	0333	1652	0334	1700	0207	1432	3	2212	0831	1118	0021	0943	2314	0612	1933
4	0558	2008	0333	1654	0332	1659	0204	1429	4	2208	0827	1114	0017	0939	2311	0609	1930
5	0553	2000	0333	1656	0330	1659	0200	1426	5	2204	0823	1110	0013	0935	2307	0605	1926
6	0546	1950	0333	1658	0328	1658	0157	1423	6	2200	0819	1106	0010	0932	2303	0601	1922
7	0539	1940	0333	1700	0327	1657	0153	1419	7	2156	0815	1102	0006	0928	2259	0557	1918
8	0531	1930	0333	1702	0325	1657	0150	1416	8	2152	0811	1059	0002	0924	2255	0553	1915
8									8				2358				
9	0523	1919	0333	1704	0323	1656	0146	1413	9	2148	0806	1055	2354	0920	2251	0550	1911
10	0515	1908	0333	1706	0321	1655	0143	1410	10	2144	0802	1051	2350	0916	2247	0546	1907
11	0506	1857	0333	1708	0319	1655	0139	1406	11	2140	0758	1047	2346	0912	2244	0542	1903
12	0458	1847	0333	1710	0318	1654	0136	1403	12	2135	0754	1043	2342	0909	2240	0538	1900
13	0450	1837	0333	1712	0316	1653	0132	1400	13	2131	0750	1039	2339	0905	2236	0534	1856
14	0442	1828	0333	1714	0314	1653	0129	1356	14	2127	0745	1036	2335	0901	2232	0531	1852
15	0435	1819	0334	1716	0313	1652	0125	1353	15	2123	0741	1032	2331	0857	2228	0527	1848
16	0428	1811	0334	1718	0311	1651	0121	1350	16	2119	0737	1028	2327	0853	2224	0523	1844
17	0421	1804	0334	1720	0309	1651	0118	1346	17	2115	0733	1024	2323	0850	2220	0519	1841
18	0416	1759	0335	1722	0308	1650	0114	1343	18	2110	0728	1020	2319	0846	2217	0516	1837
19	0411	1754	0335	1724	0306	1649	0111	1340	19	2106	0724	1017	2315	0842	2213	0512	1833
20	0406	1749	0335	1726	0304	1649	0107	1336	20	2102	0720	1013	2312	0838	2209	0508	1829
21	0402	1746	0336	1728	0303	1648	0104	1333	21	2058	0716	1009	2308	0834	2205	0504	1826
22	0359	1743	0336	1730	0301	1647	0100	1330	22	2054	0711	1005	2304	0831	2201	0500	1822
23	0356	1741	0337	1732	0259	1647	0056	1326	23	2050	0707	1002	2300	0827	2157	0457	1818
24	0353	1740	0338	1734	0258	1646	0053	1323	24	2045	0703	0958	2256	0823	2154	0453	1814
25	0351	1739	0338	1736	0256	1645	0049	1320	25	2041	0659	0954	2252	0819	2150	0449	1810
26	0349	1739	0339	1738	0255	1645	0046	1316	26	2037	0654	0950	2249	0816	2146	0445	1807
27	0348	1739	0340	1740	0253	1644	0042	1313	27	2033	0650	0947	2245	0812	2142	0441	1803
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29	0346	1740	0341	1744	0250	1643	0035	1306	29	2024	0641	0939	2237	0804	2134	0434	1755
30	0345	1741	0342	1746	0249	1642	0031	1302	30	2020	0637	0935	2233	0800	2131	0430	1752
31	0345	1742	0343	1747	0247	1642	0027	1259	31	2016	0633	0931	2229	0757	2127	0426	1748

SOLAR SYSTEM RISE/SET



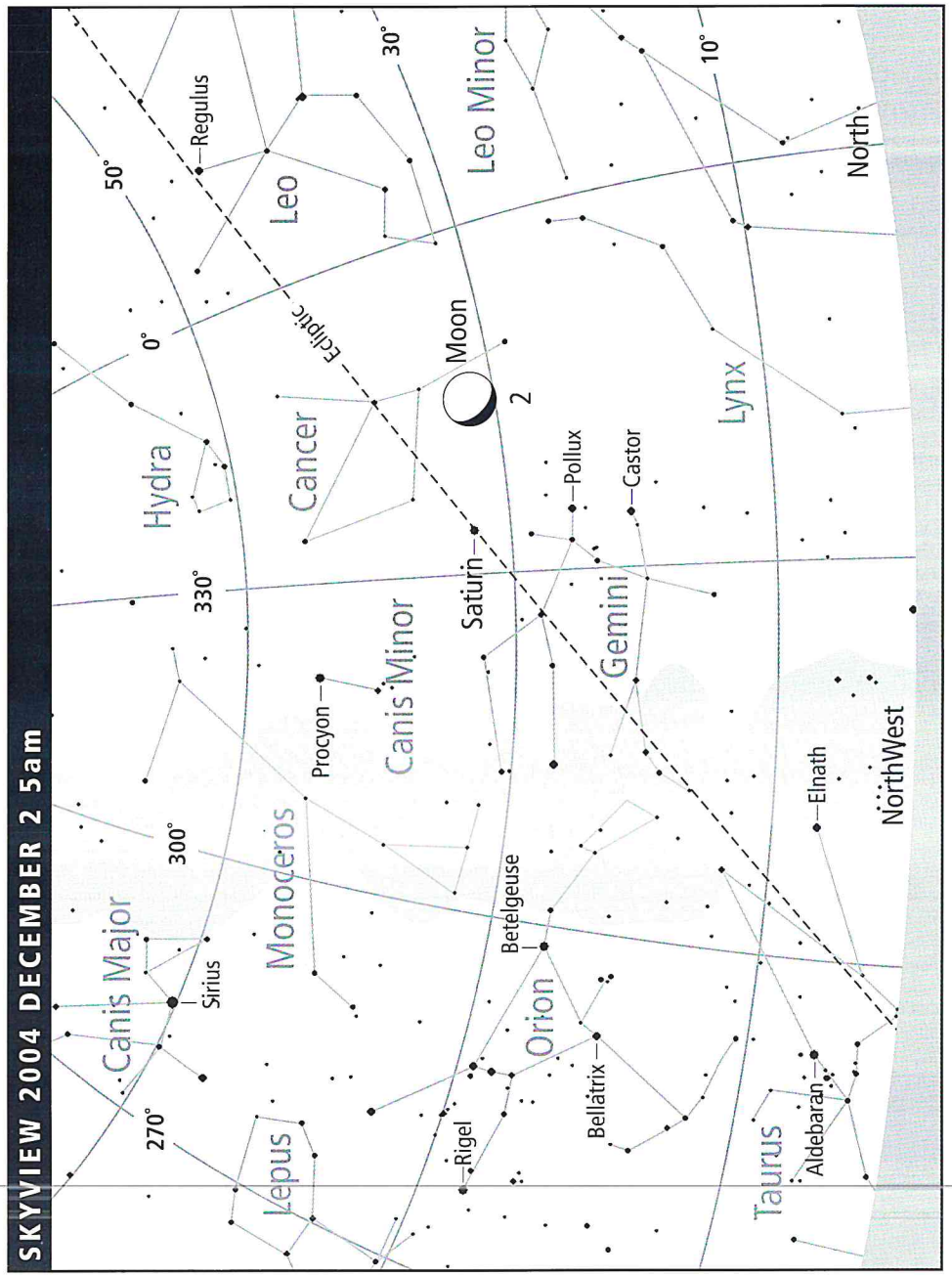
JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Satellite	Event
1	0427	III	Oc.R.
3	0447	I	Sh.I.
4	0304		GRS
4	0451	II	Sh.I.
5	0232	I	Tr.E.
6	0438	II	Oc.R.
6	0443		GRS
8	0422	III	Ec.R.
9	0213		GRS
11	0351	I	Ec.D.
11	0352		GRS
12	0216	I	Tr.I.
12	0322	I	Sh.E.
12	0429	I	Tr.E.
13	0139	I	Oc.R.
13	0219	II	Ec.D.
15	0136	II	Tr.E.
16	0300		GRS
18	0439		GRS
19	0243	III	Tr.E.
19	0302	I	Sh.I.
19	0413	I	Tr.I.
20	0335	I	Oc.R.
20	0455	II	Ec.D.
21	0209		GRS
22	0135	II	Tr.I.
22	0156	II	Sh.E.
22	0414	II	Tr.E.
23	0348		GRS
26	0205	III	Sh.E.
26	0117		GRS
26	0414	III	Tr.I.
26	0455	I	Sh.I.
27	0205	I	Ec.D.
28	0256		GRS
28	0137	I	Sh.E.
28	0249	I	Tr.E.
29	0146	II	Sh.I.
29	0412	II	Tr.I.
29	0429	II	Sh.E.
30	0434		GRS
31	0158	II	Oc.R.

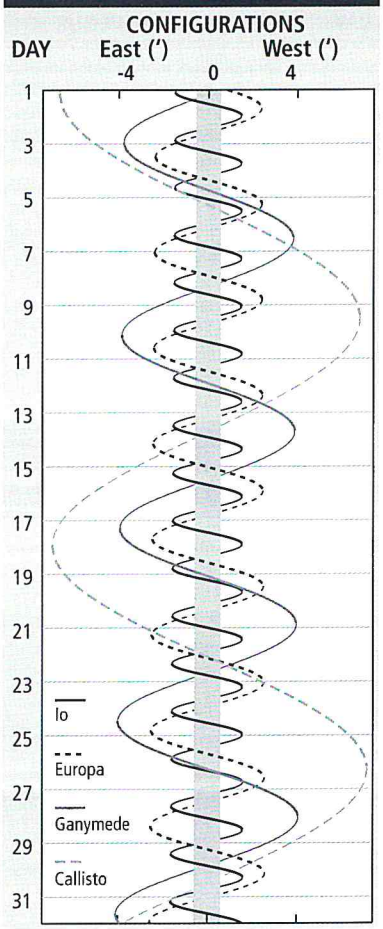
Moons:
I Io
II Europa
III Ganymede
IV Callisto

Events:
D Disappear
E Egress
Ec Eclipse
Sh Shadow
R Reappear
I Ingress
Oc Occult
Tr Transit

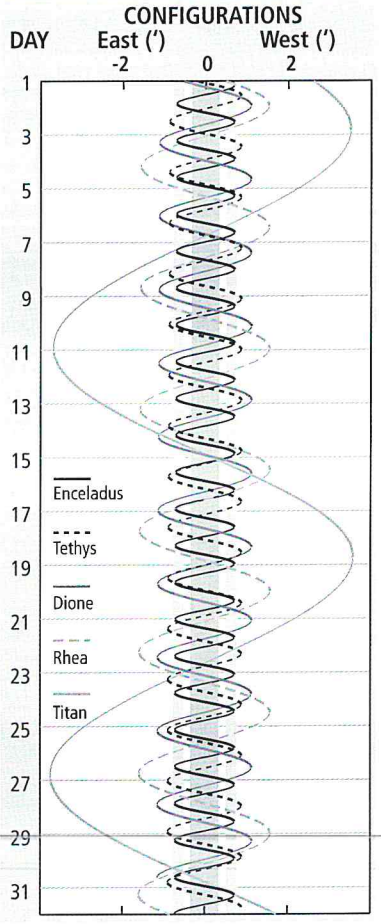
GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown



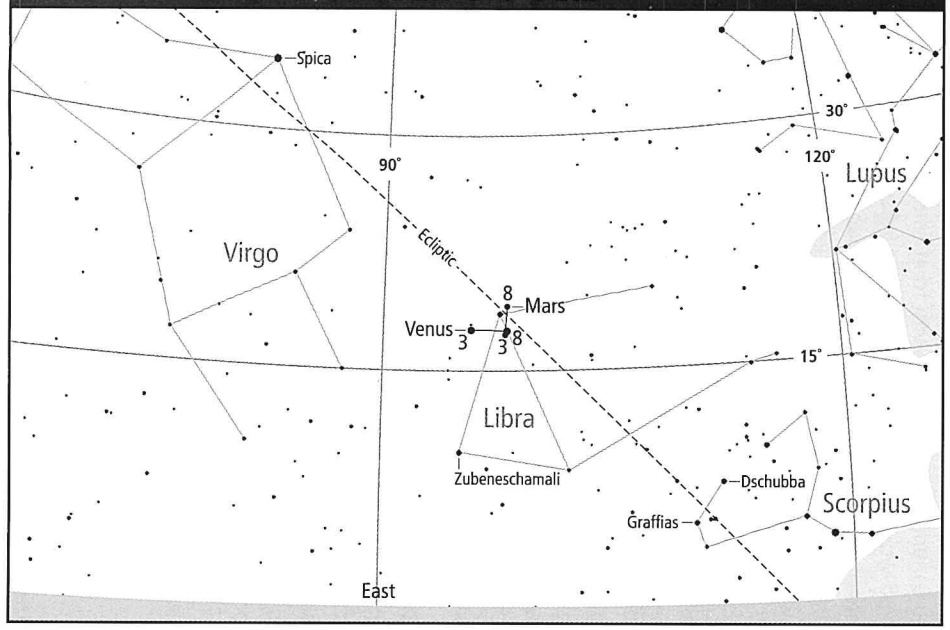
JUPITER MOONS



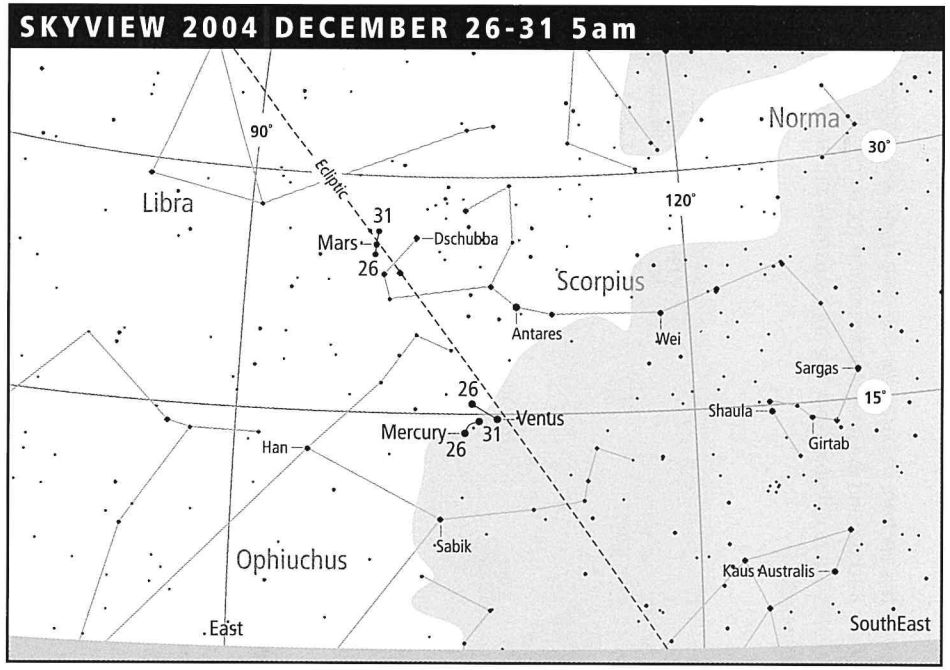
SATURN MOONS



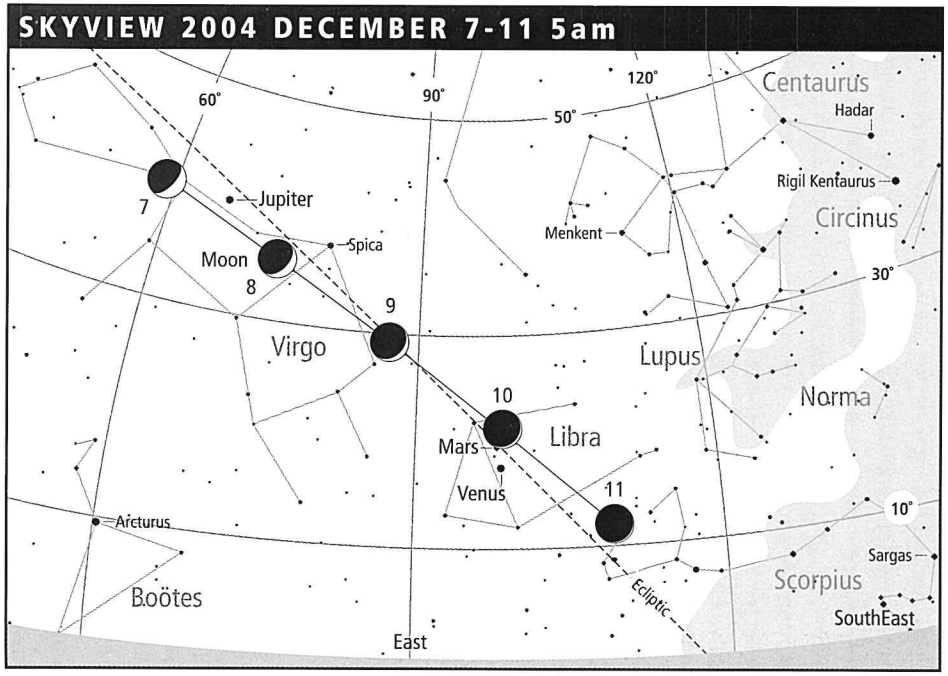
SKYVIEW 2004 DECEMBER 3-8 5am



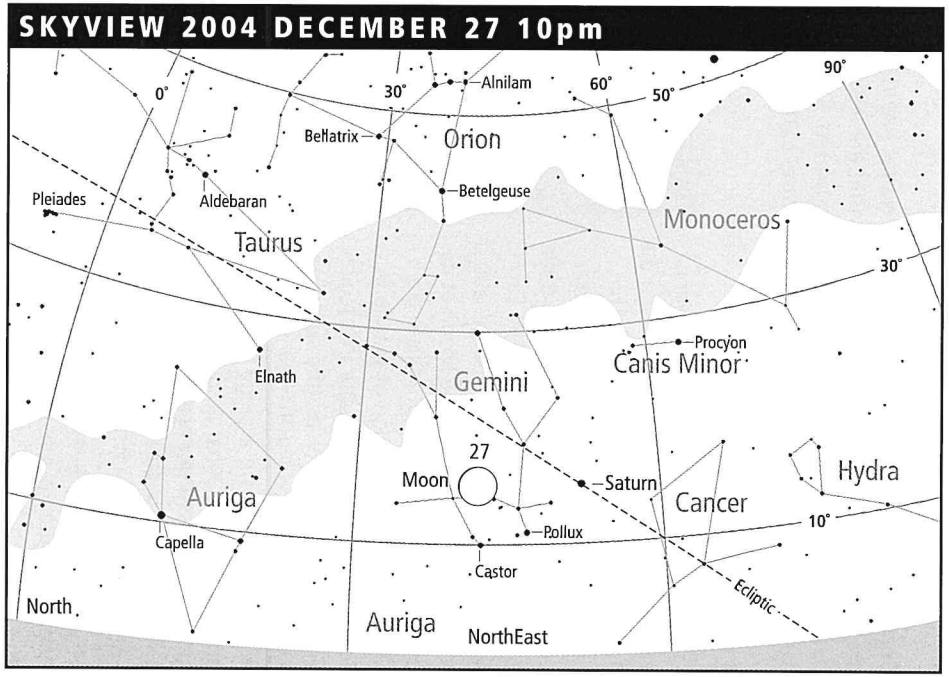
SKYVIEW 2004 DECEMBER 26-31 5am



SKYVIEW 2004 DECEMBER 7-11 5am



SKYVIEW 2004 DECEMBER 27 10pm

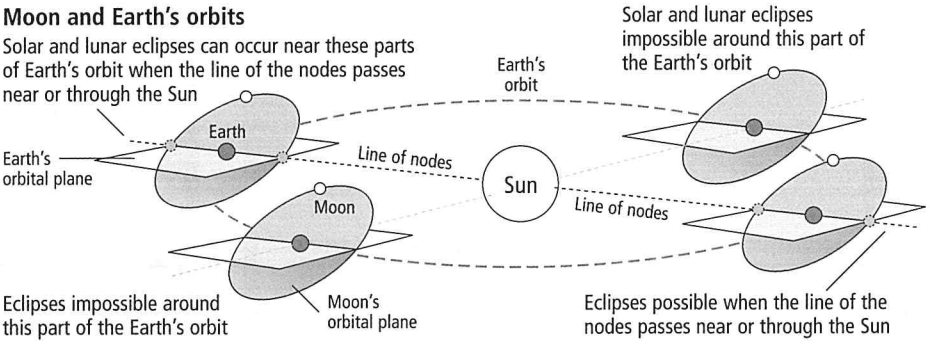


***Some** of the more spectacular and/or rare celestial events are discussed in this section. In particular the date, time and region where the event is actually visible are provided. Consult the definitions in section:* Background & General Information *for a concise description of these events and the terminology used. Some of these events are not visible from Western Australia but are included for completeness and may assist those who travel to other parts of the world.*

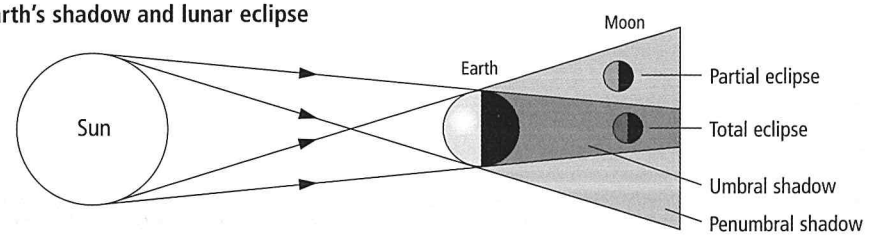
Lunar eclipses

Eclipses are a geometrical phenomenon and occur when either the Moon is in the Earth's shadow (a lunar eclipse) or the Earth is shadowed by the Moon (a solar eclipse). This shadowing requires all three objects to be aligned in space. The Earth's full shadow (umbra) is rather large, about three times the width of the Moon at its orbital distance, and lunar eclipses are visible from a wide region of the globe. Total solar eclipses only occur in a region approximately 20km wide (the size of the Moon's shadow on Earth), that moves across the globe. On average there are about 1.5 umbral lunar eclipses per year, and even more of the fainter penumbral lunar eclipses, where the Moon does not enter the full shadow of the Earth. Also, for any given year there is a 2/3 chance of having two umbral lunar eclipses.

Moon and Earth's orbits



Earth's shadow and lunar eclipse



On the night on a lunar eclipse it is Full Moon phase, where the Moon and Sun are on opposite sides of the Earth. So the Moon starts out very bright and dims significantly in the total eclipse. However, the Moon doesn't necessarily get completely obscured in the shadow – during total eclipse it can have a grey, orange, red or copper hue. Some sunlight can refract and bend through the Earth's atmosphere and this casts a glow on the Moon which is then reflected back to Earth. The colour and brightness can vary between eclipses as it depends on the type and amount of dust in the atmosphere that the sunlight traverses.

Lunar eclipses are necessarily nighttime eclipses, and are safe to view because the Moon is nowhere near as bright as the Sun. **(Solar (daytime) eclipses are unsafe to view.)** Special equipment is not necessary to observe lunar eclipses and a good view can be obtained with the unaided eye. Binoculars are easy to use and assist observation while providing a wide-field view.

Lunar eclipses have played an important part in history. Some historical battles have been lost because of a belief by one side that a lunar eclipse was a bad omen. In 413 BCE, the Syracusan navy destroyed an Athenian fleet after its leader delayed a retreat on account of a total lunar eclipse, in 1453 the defenders of Constantinople were so frightened by a partial lunar eclipse that the fall of the city was hastened, and in 1917 Lawrence of Arabia's force was assisted in the capture of Aqaba when the town's superstitious defenders panicked during a lunar eclipse.

Before the night of a lunar eclipse in 1504, Christopher Columbus tricked disgruntled natives, in what is now Jamaica, to continue supplying him with food when he told them that God would make the Moon "appear inflamed with wrath, denoting the evils God would inflict upon them". The natives were so frightened that they continued supplying Columbus with food.

Lunar eclipses have aided our understanding of the world. Greek scientist/philosopher Aristotle (384-322 BCE) used the fact that the Earth's shadow seen in lunar eclipses was always circular to infer that the shape of the Earth was round. Aristarchus of Samos calculated the diameter of the Moon, in the 3rd C BCE, by measuring the duration of a lunar eclipse. Also, a partial solution to the 'longitude problem' was derived in the 17th C CE that involved the simultaneous observation of a lunar eclipse from many locations.

Solar and lunar eclipses often occur in pairs, and this is evident in the two pairs of eclipses that occur this year. This pairing occurs because the orbital plane of Moon about the Earth is aligned with the Earth to Sun direction around these times. This is the basic requirement in order for an eclipse to occur. The orientation of the Moon's orbital plane slowly changes and so eclipses don't always occur at New Moon (when solar eclipses can occur) and Full Moon (when lunar eclipses can occur).

REMEMBER:
never look at the Sun with the unaided eye or with an optical instrument. You may suffer permanent eye damage.

April 19: Partial Eclipse of the Sun

This event is not visible from anywhere in Australia.

This event is visible from southern Africa and part of Antarctica.

The eclipse begins at 1930 WAST at longitude 49° 58′ West and latitude 69° 34′ South and ends at 2338 WAST at longitude 30° 53′ East and latitude 20° 02′ South. The magnitude of greatest eclipse is 0.737, that is, at maximum only the Moon covers about 74% of the Sun.

REMEMBER: never look at the Sun with the unaided eye or with an optical instrument. You may suffer permanent eye damage.

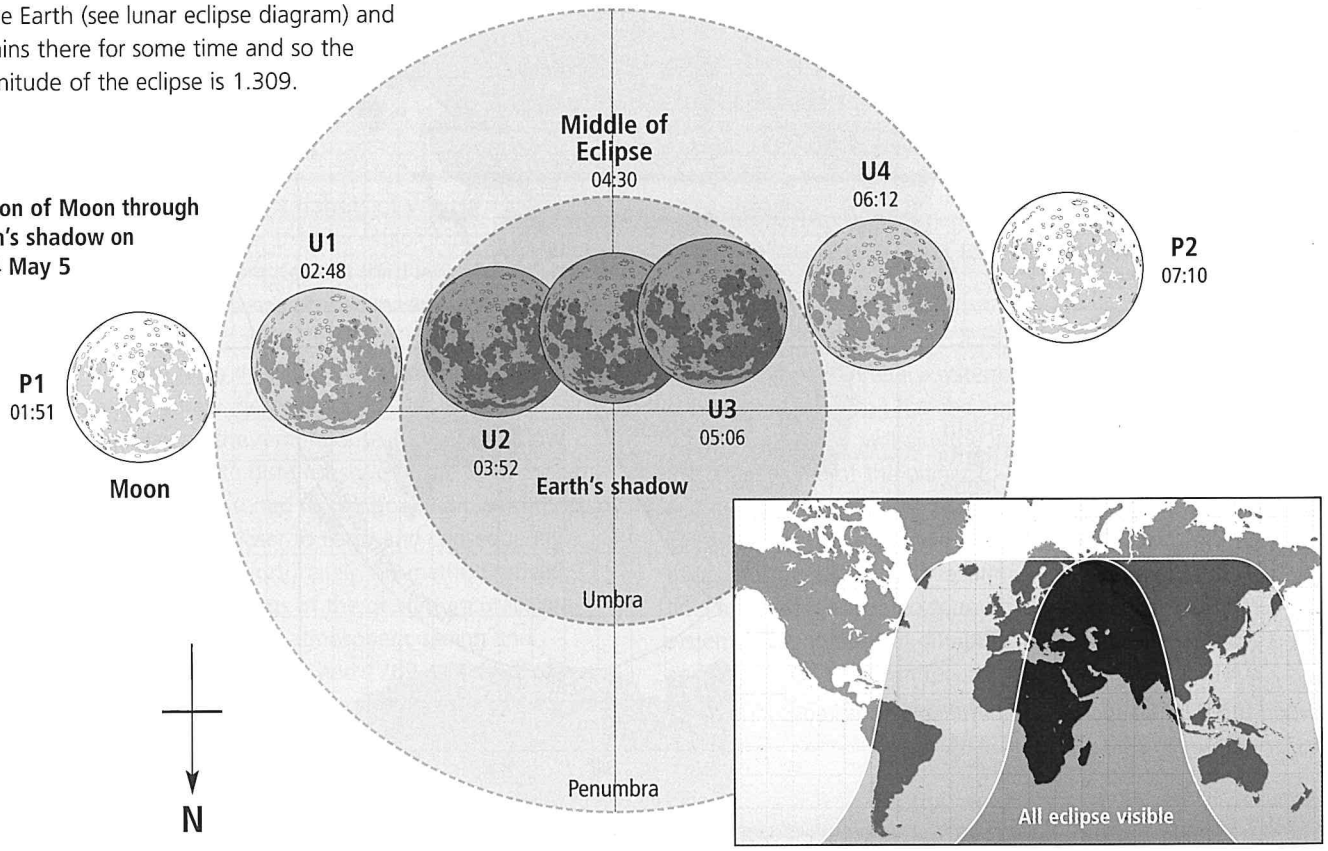
May 5: Total Eclipse of the Moon

Nearly all of this eclipse is visible from the far South-west corner of WA. The Moon sets before the end of the eclipse for all other regions of Australia. For Perth, the Moon sets at 0702 WAST, eight minutes before the end of the eclipse and eleven minutes after Sunrise. (See section: *May*)

All the eclipse is visible from Western Asia, Eastern Africa and Eastern Europe.

EVENT	HOUR	MINUTE (WAST)
Moon enters penumbra	01	51
Moon enters umbra	02	48
Moon enters totality	03	52
Middle of eclipse	04	30
Moon leaves totality	05	06
Moon leaves umbra	06	12
Moon leaves penumbra	07	10

The Moon traverses deep into the full shadow of the Earth (see lunar eclipse diagram) and remains there for some time and so the magnitude of the eclipse is 1.309.



June 8: Transit of Venus

See overleaf for information on this event.

October 14: Partial Eclipse of the Sun

This event is not visible from anywhere in Australia.

This event is visible from north-eastern Asia, Alaska and the north Pacific.

The eclipse begins at 0854 WAST at longitude 94° 04′ East and latitude 68° 15′ North and ends at 1304 WAST at longitude 171° 40′ West and latitude 14° 15′ North. The magnitude of greatest eclipse is 0.929.

REMEMBER: never look at the Sun with the unaided eye or with an optical instrument. You may suffer permanent eye damage.

October 28: Total Eclipse of the Moon

This event is not visible from anywhere in Australia.

This event is visible in its entirety from North America, Central America, South America, Europe and western Africa.

EVENT	HOUR	MINUTE (WAST)
Moon enters penumbra	08	05
Moon enters umbra	09	14
Moon enters totality	10	23
Middle of eclipse	11	04
Moon leaves totality	11	45
Moon leaves umbra	12	54
Moon leaves penumbra	14	03

June 8: Transit of Venus

Venus will transit over the disk of the Sun on June 8. The entire transit will be visible in Asia except the extreme eastern portion, Africa except the western portion, Europe except the extreme South-west, and most of the Indian Ocean. The path of Venus is shown in the diagram and the least angular distance will be 10′ 26″.9. Readers are cautioned about trying to observe this event. If you do not have specialised equipment, or know how to correctly use it, you may permanently damage your eyesight. The event is a rather subtle as Venus only appears as a black dot against the extremely bright background of the Sun's disk and proceeds rather slowly for over six hours.

Observers in Perth can observe the transit for a longer time than those in Eastern Australia. However, the Sun still sets while the transit is in progress. The timings of the major transit events are given in the table, and the meanings of these events are illustrated in the diagram.

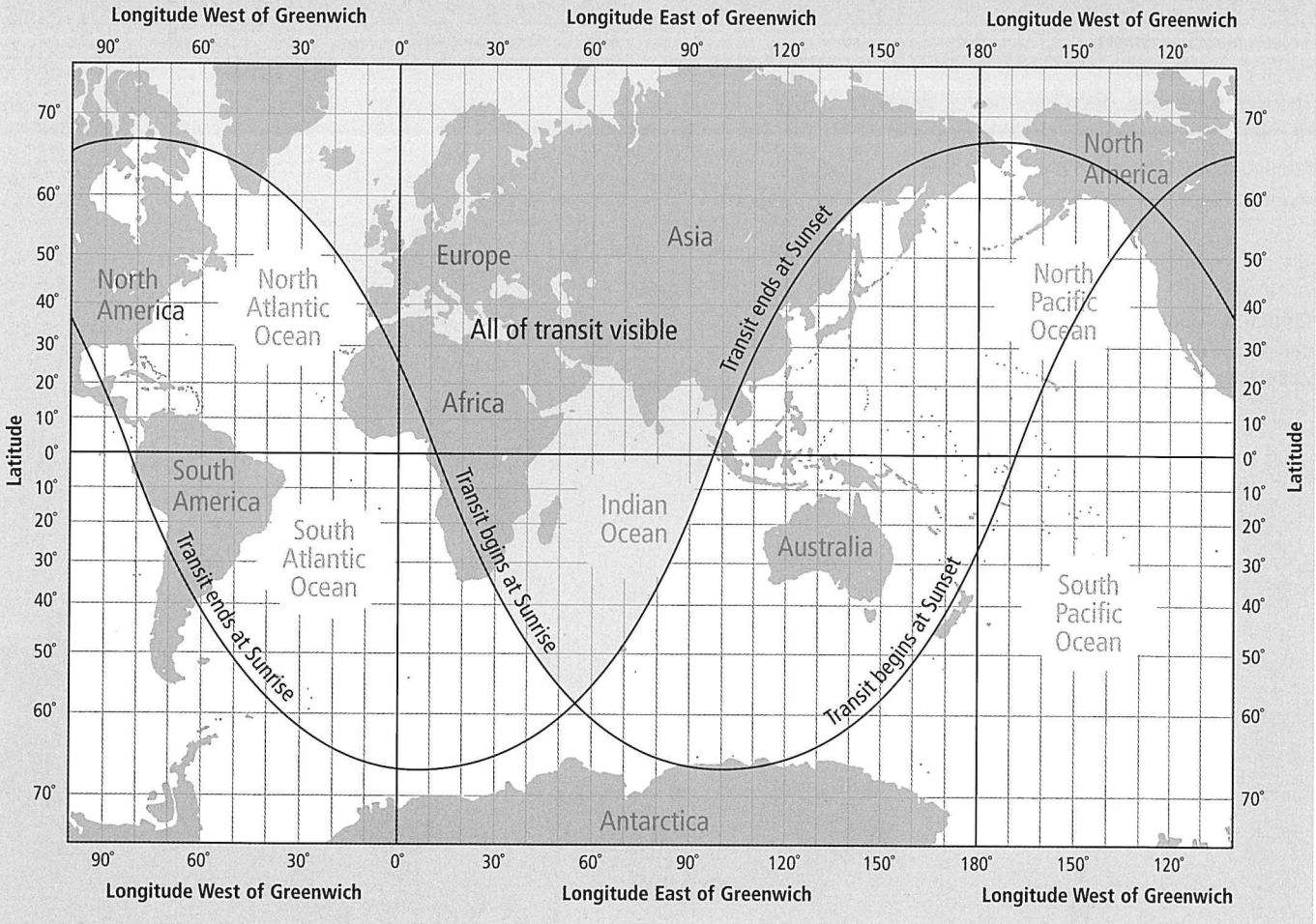
EVENT	HOUR	MINUTE (WAST)
I – Ingress, exterior contact	13	09
II – Ingress, interior contact	13	28
Least angular distance	16	16
Sunset	17	19
III – Egress, interior contact	-	-
IV – Egress, exterior contact	-	-

Geocentric information is provided in the following table in order to provide an overview of the transit's timing. Obviously, no one can observe from the centre of the Earth (the geo-centre) but this information is relevant for observers with Venus overhead (Venus, observer and geo-centre completely aligned).

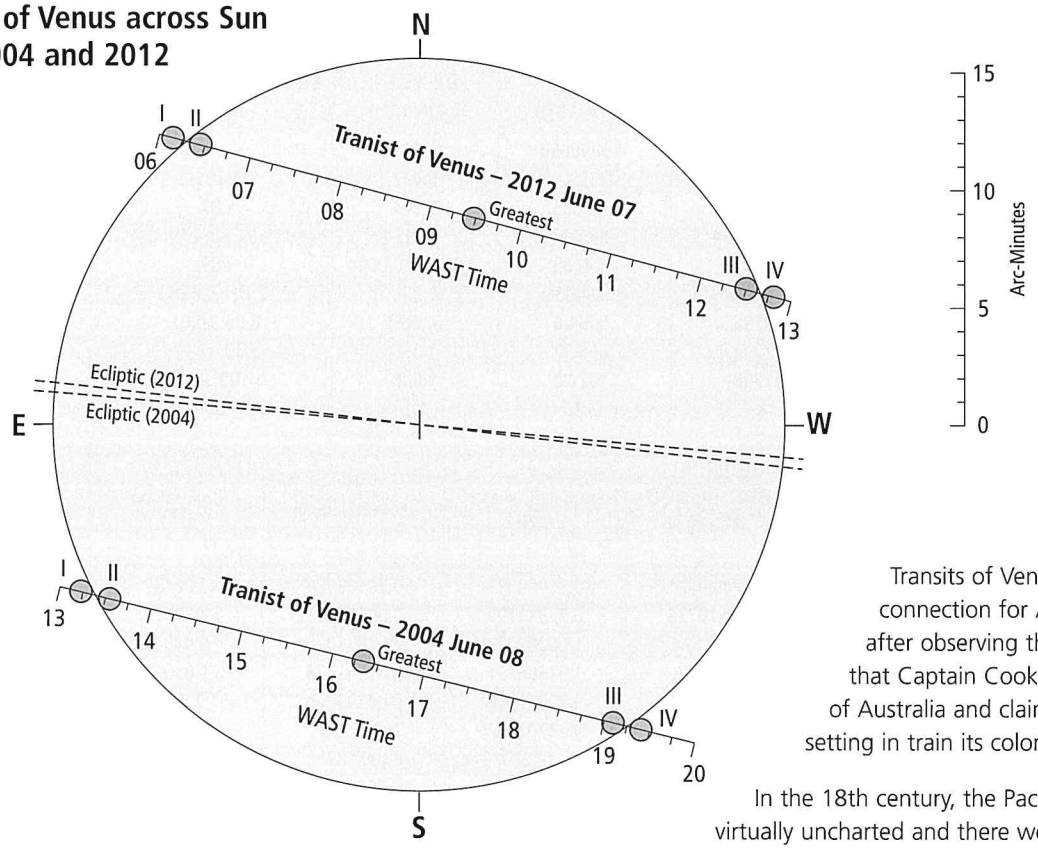
EVENT	HOUR (UT)	MINUTE (UT)	LONGITUDE ° ′	LATITUDE ° ′
I – Ingress, exterior contact	05	13	+101 38.7	+22 45.3
II – Ingress, interior contact	05	32	+96 48.2	+22 45.1
Least angular distance	08	19	+54 53.3	+22 43.1
III – Egress, interior contact	11	06	+12 58.4	+22 41.0
IV – Egress, exterior contact	11	25	+08 07.9	+22 40.8

Transits of Venus across the disk of the Sun are among the rarest of planetary alignments. During the interval from 2000 BCE to CE 4000, a total of 81 transits of Venus occur, that is, one every 74 years. However, they almost always occur in pairs (separated by 8 years) and so even a long-lived person may not get to witness a Venus transit in their lifetime. The next transit of Venus will occur in 2012. More than a century will elapse before the next pair of transits in 2117 and 2125, and the two previous transits occurred 1874 and 1882.

TRANSIT OF VENUS • 2004 JUNE 8



Path of Venus across Sun in 2004 and 2012



Transits of Venus have a special connection for Australians because it was after observing the 1769 transit in Tahiti that Captain Cook arrived on the East Coast of Australia and claimed it for Britain, thus setting in train its colonisation by Europeans.

It is only during early December and early June that transits of Venus are possible. This is the time when Venus's orbital nodes pass across the Sun. If Venus reaches inferior conjunction (Sun, Venus and Earth aligned) at this time, a transit will occur. Transits show a pattern of recurrence at intervals of 8, 121.5, 8 and 105.5 years. The planet Mercury can also transit the Sun, and it orbits the Sun more quickly than does Venus, so it undergoes transits much more frequently. There are about 13 or 14 transits of Mercury each century. However, the size of Venus is larger (about 3% the Sun's diameter) and is more easily observable, and its proximity to Earth makes the highly desirable effect of parallax more pronounced.

Edmund Halley first realized that transits of Venus could be used to measure the Sun's distance, thereby establishing the absolute scale of the Solar System from Kepler's third law. This is also the first step in determining the size of the Universe. Halley realized that the careful timing of transits could be used to determine the distance of Earth from the Sun. The technique relied on observations made from widely separated sites across the Earth. The effect of parallax on the remote observers would allow them to derive the absolute distance scale of the Solar System. Venus transits were better suited to this goal than were those of Mercury because Venus is closer to Earth and consequently exhibits a larger parallax. Unfortunately, his method proved impractical since contact timings of the desired accuracy are impossible due to the effects of atmospheric seeing and diffraction. Nevertheless, the 1761 and 1769 expeditions to observe the transits of Venus gave astronomers their first sound value for the Sun's distance.

In the 18th century, the Pacific Ocean was still virtually uncharted and there were rumours of a large southern continent called Terra Australis Nondum Cognita (the southern land not yet known). French, Dutch and English sailors, had hunted in vain for this mythical land. The British Admiralty wanted to organise a scientific expedition to observe the transit of Venus due in June 1769 and the expedition was also given the secret mission of finding the southern continent.

After an observing the transit in Tahiti, Cook sailed on to the North Island of New Zealand and then the South Island. He found that neither island was joined to a large southern continent. He continued towards Tasmania and then northward, arriving at Botany Bay in April 1770.

Radar measurements currently provide very accurate distances to the Sun and planets, so transits are now of less scientific importance. However, these rare and remarkable events remind us of a technique important to the development of modern astronomy.

Transit observations are also a modern research tool for the study of distant planetary systems around stars other than our Sun. If a planet's orbit has the appropriate geometry with respect to Earth, it will dim the light of the star, in proportion to the relative area of the planet to star, as it transits. Such geometry is rare, but one planetary transit (across star HD 209548) has been observed in this manner. Observing many thousands of stars, and measuring their brightness over long time intervals is expected to reveal many more transiting systems. The amount of dimming reveals the size of the planet, and the period of transit recurrence reveals basic orbital information. It should be noted that the actual planet and its orbit cannot be imaged with current technology.

REMEMBER:
never look at the Sun with the unaided eye or with an optical instrument. You may suffer permanent eye damage.

SOLAR SYSTEM INFORMATION

SUN & PLANET DATA

NAME	MEAN RADIUS (kilometres)	VOLUME (Earth =1)	FLATTENING (Earth =1)	MASS (x 10^{23} kg)	DENSITY (g/cm³)	EQUATORIAL GRAVITY (m/s²)	GEOMETRIC ALBEDO
Sun	696265	1305000		19890850	1.407		
Mercury	2440 ±1	0.056	0	3.302	5.427	3.701	0.106
Venus	6051.84 ±0.01	0.857	0	48.685	5.204	8.87	0.65
Earth	6371.01 ±0.02	1	0.00335364	59.736	5.515	9.780327	0.367
Mars	3389.92 ±0.04	0.151	0.006476	6.4185	3.9335 ±0.0004	3.69	0.15
Jupiter	69911 ±6	1321	0.064874	18986	1.326	23.12 ±0.01	0.52
Saturn	58232 ±6	764	0.097962	5684.6	0.6873	8.96 ±0.01	0.47
Uranus	25362 ±12	63	0.022927	868.32	1.318	8.69 ±0.01	0.51
Neptune	24624 ±21	58	0.017081	1024.3	1.638	11.00 ±0.05	0.41
Pluto	1151	0.006	0	0.15	1.1	0.655	0.3

NAME	V (1,0) Brightness at opposition	SIDEREAL ROTATION PERIOD (hours)	SIDEREAL ORBIT PERIOD (Years)	a Semi-major axis (AU)	e eccentricity	i inclination (°)	OBLIQUITY (°)
Sun	-26.8	609.12					7.25
Mercury	-0.42	1407.509	0.2408467	0.38709893	0.20563069	7.00487	0.01
Venus	-4.4	-5832.444	0.61519726	0.72333199	0.00677323	3.39471	2.64
Earth	-3.86	23.93419	1.0000174	1.00000011	0.01671022	0.00005	23.44
Mars	-1.52	24.622962	1.8808476	1.52366231	0.09341233	1.85061	25.19
Jupiter	-9.4	9.92425	11.862615	5.20336301	0.04839266	1.3053	3.13
Saturn	-8.88	10.65622	29.447498	9.53707032	0.0541506	2.48446	26.73
Uranus	-7.19	17.24 ±0.01	84.016846	19.19126393	0.04716771	0.76986	82.23
Neptune	-6.87	16.11 ±0.01	164.79132	30.06896348	0.00858587	1.76917	28.32
Pluto	-1.0	153.28	247.92065	39.48168677	0.24880766	17.14175	57.43

Legend:

Flattening Degree to which poles are flattened with respect to the equator (difference between polar and equatorial radius as a proportion of the mean radius)

Geometric Albedo Proportion of incident light reflected

Sidereal Rotation Period Rotation period as measured from a fixed star (not measured from the orbiting Earth)

Sidereal Orbit Period Orbital period as measured from a fixed star (not measured from the orbiting Earth)

V (1,0) Brightness at opposition

a Semi-major Axis

e Eccentricity

i Inclination with respect to the reference plane: ecliptic(1), ICRF(2), or local Laplace (mean value)(3)

Obliquity Angle between rotation axis and orbital axis

± The uncertainty in the quantity

Data from NASA/JPL (http://ssd.jpl.nasa.gov/)

MOON & SATELLITE DATA

NAME	$1/m_{pl}$ Proportion of Planet Mass	MEAN RADIUS (kilometres)	MEAN DENSITY (g/cm³)	MAGNITUDE (V_0 or R)	GEOMETRIC ALBEDO	a Semi-major axis (km)	e eccentricity	i inclination (°)	P Sidereal Period (days)
EARTH									
Moon	0.0123002	1737.5 ± 0.1	3.344 ± 0.005	-12.74	0.12	384400	0.0554	5.16	27.322
MARS									
Phobos	1.66667E-08	11.1 ± 0.15	1.867 ± 0.076	11.4 ± 0.2	0.071 ± 0.012	9380	0.0151	1.075	0.319
Deimos	3.49538E-09	6.2 ± 0.18	2.247 ± 0.251	12.45 ± 0.05	0.068 ± 0.007	23460	0.0002	1.793	1.262
JUPITER									
Io	4.70448E-05	1821.6 ± 0.5	3.528 ± 0.006	5.02 ± 0.03	0.63 ± 0.02	421800	0.0041	0.036	1.769
Europa	2.5281E-05	1560.8 ± 0.5	3.014 ± 0.005	5.29 ± 0.02	0.67 ± 0.03	671100	0.0094	0.469	3.551
Ganymede	7.805E-05	2631.2 ± 1.7	1.942 ± 0.005	4.61 ± 0.03	0.43 ± 0.02	1070400	0.0011	0.170	7.155
Callisto	5.667E-05	2410.3 ± 1.5	1.834 ± 0.004	5.65 ± 0.10	0.17 ± 0.02	1882700	0.0074	0.187	16.69
Carme	6.94632E-11	23	2.6	17.55 ± 0.02	0.04	23404000	0.2533	164.907	702.28
Elara	4.57826E-10	43	2.6	16.32 ± 0.02	0.04	11741000	0.2174	26.627	259.64
Amalthea	3.94677E-09	83.5 ± 2.4	0.862 ± 0. 257	14.1 ± 0.2	0.090 ± 0.005	181400	0.0031	0.388	0.498
Ananke	1.57871E-11	14	2.6	18.75 ± 0.02	0.04	21276000	0.2435	148.889	610.45
Himalia	3.5521E-09	85	2.6	14.62 ± 0.02	0.04	11461000	0.1623	27.496	250.56
Adrastea	3.94677E-12	8.2 ± 2.0	3.0	18.7	0.100 ± 0.045	129000	0.0018	0.054	0.298
Leda	5.76229E-12	10	2.6	19.50 ± 0.03	0.04	11165000	0.1636	27.457	240.92
Lysithea	3.31529E-12	18	2.6	18.25 ± 0.04	0.04	11717000	0.1124	28.302	259.2
Metis	6.31484E-11	21.5 ± 2.0	3.0	17.5	0.061 ± 0.003	128000	0.0012	0.019	0.295
Pasiphae	1.57871E-11	30	2.6	17.00 ± 0.20	0.04	23624000	0.409	151.431	708.04
Sinope	3.94677E-11	19	2.6	18.05 ± 0.02	0.04	23939000	0.2495	158.109	724.51
Thebe	7.89354E-10	49.3 ± 2.0	3.0	16.0	0.047 ± 0.003	221900	0.0177	1.070	0.675
Callirrhoe	4.57826E-13	4.3	2.6	20.73 ± 0.04	0.04	24103000	0.2828	147.158	758.77
Chaldene	3.94677E-14	1.9	2.6	22.5	0.04	23100000	0.2519	165.191	733.70
S/2000 J 11	4.73613E-14	2.0	2.6	22.4	0.04	12555000	0.2484	28.273	286.95

MOON & SATELLITE DATA (continued)

NAME	$1/m_{pl}$ Proportion of Planet Mass	MEAN RADIUS (kilometres)	MEAN DENSITY (g/cm^3)	MAGNITUDE (V_0 or R)	GEOMETRIC ALBEDO	a Semi-major axis (km)	e eccentricity	i inclination (°)	P Sidereal Period (days)
Kalyke	1.02616E-13	2.6	2.6	21.8	0.04	23566000	0.2465	165.159	742.03
Iocaste	1.02616E-13	2.6	2.6	21.8	0.04	21061000	0.2160	149.429	631.60
Erinome	2.36806E-14	1.6	2.6	22.8	0.04	23196000	0.2665	164.934	728.51
Harpalyke	6.31484E-14	2.2	2.6	22.2	0.04	20858000	0.2268	148.644	623.31
Isonoe	3.94677E-14	1.9	2.6	22.5	0.04	23155000	0.2471	165.268	726.25
Praxidike	2.28913E-13	3.4	2.6	21.2	0.04	20907000	0.2308	148.967	625.38
Magaclite	1.1051E-13	2.7	2.6	21.7	0.04	23493000	0.4197	152.769	752.88
Taygete	8.6829E-14	2.5	2.6	21.9	0.04	23280000	0.2525	165.272	732.41
Autonoe	3.63103E-13	2.0	2.6	22.0	0.04	24046000	0.3168	152.416	760.95
Euporie	4.73613E-14	1.0	2.6	23.1	0.04	19304000	0.1432	145.767	550.74
Aitne	1.57871E-13	1.5	2.6	22.7	0.04	23229000	0.2643	165.091	730.18
Thyone	3.63103E-13	2.0	2.6	22.3	0.04	20939000	0.2286	148.509	627.21
Hermippe	3.63103E-13	2.0	2.6	22.1	0.04	21131000	0.2096	150.725	633.90
Eurydome	1.57871E-13	1.3	2.6	22.8	0.04	22865000	0.2759	150.274	717.33
Sponde	4.73613E-14	1.0	2.6	23.0	0.04	23487000	0.3121	150.998	748.34
Pasithee	4.73613E-14	1.0	2.6	23.2	0.04	23004000	0.2675	165.138	719.44
Euanthe	1.57871E-13	1.5	2.6	22.8	0.04	20797000	0.2321	148.910	620.49
Kale	4.73613E-14	1.0	2.6	23.0	0.04	23217000	0.2599	164.996	729.47
Orthosie	4.73613E-14	1.0	2.6	23.0	0.04	20720000	0.2808	145.921	622.56
Themisto	3.63103E-13	4.0	2.6	21.0	0.04	7284000	0.2426	43.259	130.02
S/2002 J 1		1.5	2.6	22.8	0.04	22931000	0.2588	165.001	723.90
S/2003 J 1		2	2.6	22.6	0.04	23749000	0.2976	163.214	747.7
S/2003 J 2		1	2.6	23.2	0.04	26658000	0.3316	151.191	889.2
S/2003 J 3		1	2.6	23.4	0.04	17929000	0.2217	143.685	490.45
S/2003 J 4		1	2.6	23	0.04	19294000	0.3664	141.494	547.5
S/2003 J 5		2	2.6	22.4	0.04	24450000	0.1634	165.013	781.03
S/2003 J 6		2	2.6	22.6	0.04	20890000	0.1411	156.558	616.82
S/2003 J 7		2	2.6	22.5	0.04	23030000	0.403	159.045	714
S/2003 J 8		1.5	2.6	22.9	0.04	21038000	0.2372	152.027	623.39
S/2003 J 9		0.5	2.6	23.7	0.04	23020000	0.2133	165.167	713.51
S/2003 J 10		1	2.6	23.6	0.04	0 21078000.	0.3491	163.022	625.16
S/2003 J 11		1	2.6	23.7	0.04	1 22792000.	0.2623	163.787	702.95
S/2003 J 12		0.5	2.6	23.9	0.04	2 19028000.	0.3679	146.458	536.23
S/2003 J 13		1	2.6	23.2	0.04	3 23648000.	0.432	141.363	742.93
S/2003 J 14		1	2.6	23.6	0.04	4 24039000.	0.307	139.15	761.45
S/2003 J 15		1	2.6	23.5	0.04	5 22253000.	0.1199	141.313	678.19
S/2003 J 16		1	2.6	23.3	0.04	6 20464000.	0.2419	148.655	598.04
S/2003 J 17		1	2.6	23.4	0.04	7 22918000.	0.1947	163.83	708.81
S/2003 J 18		1	2.6	23.4	0.04	8 18445000.	0.2322	145.061	511.75
S/2003 J 19		1	2.6	23.7	0.04	9 23348000.	0.3108	163.205	728.84
S/2003 J 20		1.5	2.6	23	0.04	0 17033000.	0.2886	55.28	454.13
S/2003 J 21		1	2.6	23.3	0.04	1 20813000.	0.1886	147.577	613.4
SATURN									
Atlas	1.89818E-11	16 ± 4	0.63	19.0	0.4	137700	0.000	0.000	0.602
Calypso	6.32728E-12	9.5 ± 1.5	1.0	18.7	0.7	294700	0.0005	1.473	1.888
Dione	1.92866E-06	559. ± 5.	1.498 ± 0.040	10.4	0.6	377400	0.0002	0.002	2.737
Enceladus	1.14155E-07	249.4 ± 0.2	1.33 ± 0.30	11.8	1.0	238100	0.0001	0.01	1.37
Epimetheus	9.41183E-10	59.5 ± 3.0	0.606 ± 0.096	15.6	0.5	151400	0.0205	0.335	0.694
Helene	4.48182E-11	16 ± 4	1.5	18.4	0.6	377400	0.0001	0.212	2.737
Hyperion	2.61E-08	133 ± 8	1.1 ± 0.5	14.4	0.3	1464100	0.0175	0.568	21.28
Iapetus	2.79455E-06	718 ± 8	1.273 ± 0.152	11	0.6	3560800	0.0284	7.570	79.33
Janus	3.38509E-09	88.8 ± 4.0	0.656 ± 0.094	14.4	0.6	151500	0.0073	0.165	0.695
Mimas	6.59091E-08	198.6 ± 0.6	1.169 ± 0.025	12.8	0.6	185600	0.0206	1.566	0.942
Pan	4.74546E-12	10 ± 3	0.63	19.4	0.5	133600	0.0000	0.000	0.575
Pandora	3.42728E-10	41.9 ± 2.	0.63 ±0.10	16.4	0.5	141700	0.0044	0.000	0.629
Phoebe	1.26546E-08	110 ± 10	1.3 ±0.5	16.4	0.081 ± 0.002	12944300	0.1644	174.751	548.21
Prometheus	5.8E-10	50.1 ± 3.	0.63 ±0.10	15.8	0.6	139400	0.0023	0.000	0.613
Rhea	4.06E-06	764 ± 4	1.240 ± 0.036	9.6	0.6	527100	0.0009	0.327	4.518
Telesto	1.26546E-11	12 ± 3	1.0	18.5	1.0	294700	0.0010	1.158	1.888
Tethys	1.10221E-06	529.8 ± 1.5	0.991 ± 0.009	10.2	0.8	294700	0.0001	0.168	1.888
Titan	0.000236698	2575 ± 2	1.881 ± 0.005	8.4	0.2	1221900	0.0288	1.634	15.95
Ymir	8.70001E-12	8	2.3	21.7	0.06	23130000	0.3339	173.133	1315.33
Erriapo	1.34455E-12	4.3	2.3	23.0	0.06	17604000	0.4740	34.469	871.25

MOON & SATELLITE DATA (continued)

NAME	$1/m_{pl}$ Proportion of Planet Mass	MEAN RADIUS (kilometres)	MEAN DENSITY (g/cm^3)	MAGNITUDE (V_0 or R)	GEOMETRIC ALBEDO	a Semi-major axis (km)	e eccentricity	i inclination (°)	P Sidereal Period (days)
Albiorix	3.69091E-11	13	2.3	20.5	0.06	16394000	0.4791	33.979	783.47
Suttung	3.69091E-13	2.8	2.3	23.9	0.06	19465000	0.1140	175.811	1016.51
Paaliaq	1.45E-11	9.5	2.3	21.3	0.06	15198000	0.3632	45.077	686.94
Siarnaq	6.85455E-11	16	2.3	20.1	0.06	18195000	0.2962	45.539	895.55
Tarvos	4.74546E-12	6.5	2.3	22.1	0.06	18239000	0.5365	33.495	926.13
Kiviuq	5.8E-12	7	2.3	22.0	0.06	11365000	0.3336	46.148	449.22
Ijiraq	2.10909E-12	5	2.3	22.6	0.06	11442000	0.3215	46.730	451.47
Thrym	3.69091E-13	2.8	2.3	23.9	0.06	20219000	0.4652	175.815	1091.76
Skadi	5.53637E-13	3.2	2.3	23.6	0.06	15641000	0.2690	152.621	728.18
Mundilfari	3.69091E-13	2.8	2.3	23.8	0.06	18722000	0.2078	167.476	951.56
S/2003 S 1		3.3	2.3	24.0	0.06	18719000	0.3522	134.592	956.19
URANUS									
Ariel	1.55852E-05	578.9 ± 0.6	1.665 ± 0.147	13.70 ± 0.04	0.39 ± 0.04	190900	0.0012	0.041	2.520
Belinda	4.10774E-09	40.3 ± 8.	1.3	21.47 ± 0.09	0.07	75300	0.0001	0.031	0.624
Bianca	1.07008E-09	25.7 ± 2.	1.3	22.52 ± 0.24	0.07	59200	0.0009	0.193	0.435
Caliban	8.45711E-09	49	1.5	22.42 ± 0.03	0.07	7231000	0.1588	140.881	579.73
Cordelia	5.17782E-10	20.1 ± 3.	1.3	23.62 ± 0.35	0.07	49800	0.0003	0.085	0.335
Cressida	3.9524E-09	39.8 ± 2.	1.3	21.58 ± 0.11	0.07	61800	0.0004	0.006	0.464
Desdemona	2.05387E-09	32.0 ± 4.	1.3	21.99 ± 0.16	0.07	62700	0.0001	0.113	0.474
Juliet	6.4205E-09	46.8 ± 4.	1.3	21.12 ± 0.05	0.07	64400	0.0007	0.065	0.493
Miranda	7.59414E-07	235.8 ± 0.7	1.201 ± 0.137	15.79 ± 0.04	0.32 ± 0.03	129900	0.0013	4.338	1.413
Oberon	3.47087E-05	761.4 ± 2.6	1.630 ± 0.043	13.70 ± 0.04	0.23 ± 0.03	583500	0.0014	0.068	13.46
Ophelia	6.21338E-10	21.4 ± 4.	1.3	23.26 ± 0.25	0.07	53800	0.0099	0.104	0.376
Portia	1.9365E-08	67.6 ± 4.	1.3	20.42 ± 0.05	0.07	66100	0.0001	0.059	0.513
Prospero	2.41632E-10	15	1.5	23.2	0.07	16256000	0.4448	151.966	1978.29
Puck	3.33279E-08	81 ± 2	1.3	19.75 ± 0.05	0.07	86000	0.0001	0.319	0.762
Rosalind	2.9341E-09	36 ± 6	1.3	21.79 ± 0.13	0.07	69900	0.0001	0.279	0.558
Setebos	2.41632E-10	15	1.5	23.3	0.07	17418000	0.5914	158.202	2225.21
Stephano	6.90376E-11	10	1.5	24.1	0.07	8004000	0.2292	144.113	677.36
Sycorax	6.19613E-08	95	1.5	20.82 ± 0.04	0.07	12179000	0.5224	159.404	1288.30
Titania	4.06114E-05	788.9 ± 1.8	1.715 ± 0.044	13.49 ± 0.04	0.27 ± 0.03	436300	0.0011	0.079	8.706
Umbriel	1.34969E-05	584.7 ± 2.8	1.400 ± 0.163	14.47 ± 0.04	0.21 ± 0.02	266000	0.0039	0.128	4.144
Trinculo						8504000	0.2200	167.050	749.24
S/2001 U 2						20901000	0.3682	169.84	887.21
S/2001 U 3						4276000	0.1459	145.22	266.56
S/2003 U 3						14345000	0.6608	56.63	687.01
NEPTUNE									
Despina	2.19467E-08	74 ± 10	1.3	22.5	0.756 ± 0.041	52500	0.0001	0.065	0.335
Galatea	2.63361E-08	79 ± 12	1.3	22.4	0.059	62000	0.0001	0.054	0.429
Larissa	4.68197E-08	96 ± 7	1.3	22	0.063	73500	0.0014	0.201	0.555
Naiad	1.30217E-09	33 ± 3	1.3	23.9	0.072	48200	0.0003	4.738	0.294
Nereid	3.01402E-07	170 ± 25	1.5	19.7	0.155	5513400	0.7512	7.232	360.14
Proteus	4.78439E-07	210 ± 7	1.3	19.8	0.096	117600	0.0004	0.039	1.122
Thalassa	3.36516E-09	41 ± 3	1.3	23.3	0.091	50100	0.0002	0.205	0.311
Triton	0.000208918	1353.4 ± 0.9	2.061 ± 0.007	13.472 ± 0.041	0.756 ± 0.041	354800	0	156.834	5.877
S/2002 N 1		24	1.5	25.0	0.155	15686000	0.5720	134.067	1874.83
S/2002 N 2		24	1.5	25.0	0.155	22452000	0.2973	48.393	2918.94
S/2002 N 3		24	1.5	25.0	0.155	22580000	0.4789	34.619	2982.27
S/2002 N 4						46570000	0.5273	49.886	9136.11
S/2003 N 1		14	1.5	26.0	0.155	46738000	0.4503	137.337	8863.08
PLUTO									
Charon	0.107904127	593 ± 13	1.853 ± 0.158	17.26 ± 0.01	0.372 ± 0.012	19410	0.0002	99.089	6.387

Table column headings:

- **$1/m_{pl}$** — Proportion of its planet's mass
- **Mean radius** — If no uncertainty is given, the value is computed from the magnitude and albedo
- **Mean density** — Derived from the GM and mean radius when an uncertainty is given, otherwise assumed
- **Magnitude** — Mean opposition magnitude: V_0, or red magnitude, R
- **Geometric Albedo** — Proportion of incident light reflected
- **a** — Semi-major Axis (mean value)
- **e** — Eccentricity (mean value)
- **i** — Inclination with respect to the reference plane: ecliptic(1), ICRF(2), or local Laplace (mean value)(3)
- **P** — Sidereal period (mean value)

Note 1: Some data is unavailable owing to the relatively short time since the body was discovered

Note 2: Scientific notation is used in order to save space. Eg. 1.66667E-08 is the 'computer notation' equivalent to $1.66667 \times 10^{-08} = 0.0000000166667$

Data from NASA/JPL (http://ssd.jpl.nasa.gov/)

Planet and satellite names

The naked eye planets were named in antiquity. But what about newly discovered moons (21 for Jupiter, 1 for Saturn, 3 for Uranus and 1 for Neptune in the first ten months of 2003!) and the geographical features revealed but spacecraft? A commission of the International Astronomical Union (the organisation of professional astronomers) oversees and regulates naming. The rules are based on the needs of the astronomical community and reflect its international character and historical traditions. Planetary geographical features have Latin names. Latin is traditional, apolitical, and the closest thing to a universal language in history. The major rules are:

1. Nomenclature should be simple, clear, and unambiguous.
2. The number of names chosen for each body should be kept to a minimum, and their placement governed by the requirements of the scientific community.
3. Individual names chosen for each body should be expressed in the language of origin.
4. Where possible, the themes established in early solar system nomenclature should be used and expanded on.
5. Solar System nomenclature should be international in its choice of names.
6. No names having political, military or religious significance may be used, except for names of political figures prior to the 19th century.
7. Features cannot be named after living people. Persons being so honoured must have been deceased for at least three years.
8. Features cannot be named for any religious figures from Christianity, Judaism, Islam, Hinduism, Buddhism or Confucianism.

MEANINGS OF PLANET AND SATELLITE NAMES

NAME	MEANING
Mercury	Named Mercurius by the Romans, because it appears to move so swiftly.
Venus	Roman name for the goddess of love. This planet was considered to be the brightest and most beautiful planet or star in the heavens. Other civilizations have named it for their god(ess) of love/war.
Earth	The name Earth comes from the Indo-European base 'er', which produced the Germanic noun 'ertho', and ultimately German 'erde', Dutch 'aarde', Danish and Swedish 'jord', and English 'earth'. Related forms include Greek 'eraze', meaning 'on the ground', and Welsh 'erw', meaning 'field'.
Moon	Every civilization has had a name for the satellite of Earth that is known, in English, as the Moon. The name is of Anglo-Saxon derivation.
Mars	Named by the Romans for their god of war because of its red, bloodlike colour. Other civilizations also named this planet from this attribute; for example, the Egyptians named it 'Her Desher', meaning 'the red one'.
Phobos	Inner satellite of Mars. Named for one of the horses that drew Mars' chariot; also called an attendant or son of Mars. This Greek word means fear.
Deimos	Outer Martian satellite and named for one of Mars' horses/sons/companions. Deimos means fear or terror in Greek.
Jupiter	The largest and most massive of the planets was named Zeus by the Greeks and Jupiter by the Romans; he was the most important deity in both pantheons.
Metis	First wife of Zeus. He swallowed her when she became pregnant; Athena was subsequently born from the forehead of Zeus.
Adrastea	A nymph of Crete to whose care Rhea entrusted the infant Zeus.
Amalthea	Amalthea (a goat in some accounts, a princess of Crete in others) suckled Zeus (Jupiter) as a young child.
Thebe	A nymph abducted by Zeus, she is the namesake of the Greek city of Thebes.

Galileo discovered Io, Europa, Ganymede, and Callisto in 1610. Galileo suggested that the four be known as 'Medicea Sidera' to honour his patron, but the name was not accepted by other astronomers. Instead, they chose names given the four satellites by Marius (who claimed to have discovered the Jovian satellites shortly before Galileo) in 1613; the names were of four of Jupiter's illicit loves. (Galileo refused to accept Marius' names; instead he identified the moons by Roman numerals, a secondary designation system that has been adopted for all satellite systems to the present.)

Io	Io, the daughter of Inachus, was changed by Jupiter into a cow to protect her from Hera's jealous wrath. But Hera recognised Io and sent a gadfly to torment her. Io, maddened by the fly, wandered throughout the Mediterranean region.

NAME	MEANING
Europa	Beautiful daughter of Agenor, king of Tyre, she was seduced by Jupiter, who had assumed the shape of a white bull. When Europa climbed on his back he swam with her to Crete, where she bore several children, including Minos.
Ganymede	Beautiful young boy who was carried to Olympus by Jupiter disguised as an eagle. Ganymede then became the cupbearer of the Olympian gods.
Callisto	Beautiful daughter of Lycaon, she was seduced by Jupiter, who changed her into a bear to protect her from Hera's jealousy.
Themisto	Wife of Athamas, King of Thebes. She tried to kill Ino's children, but killed her own by mistake. There is also another Themisto who was involved in a love affair with Zeus.
Leda	Seduced by Zeus in the form of a swan, she was the mother of Pollux and Helen.
Himalia	Nymph who bore three sons of Zeus.
Lysithia	Daughter of Oceanus and one of Zeus' many lovers.
Elara	Daughter of King Orchomenus, a paramour of Zeus, and the mother of the giant Tityus.
Harpalyke	Daughter and wife of Clymenus. In revenge for this incestuous relationship, she killed the son she bore him, cooked the corpse, and served it to Clymenus. She was transformed into a bird of prey, and Clymenus hanged himself.
Praxidike	Greek goddess of punishment of evil actions, of justice, and of retribution.
Iocaste	Wife of Laius, King of Thebes, and mother of Oedipus. After Laius was killed, Iocaste unknowingly married her own son Oedipus. When she learned that her husband was her son, she killed herself.
Ananke	Daughter of Zeus and Adrastea, goddess of fate and necessity.
Chaldene	Bore the son Solymos with Zeus.
Isonoe	Bore with Zeus the son Orchomenos or Chrysen.
Erinome	Daughter of Celes, compelled by Venus to fall in love with Zeus.
Taygete	One of the Greek Pleiades. Daughter of Atlas, mother of Lacedaemon by Zeus.
Carme	Nymph and attendant of Artemis; mother, by Zeus, of Britomartis.
Kalyke	Nymph who bore the handsome son Endymion with Zeus.
Pasiphaë	Wife of Minos, mother of the Minotaur.
Megaclite	Daughter of Macareus, who with Zeus gave birth to Thebe and Locrus.
Sinope	Daughter of the river god Asopus and Merope, she was abducted by Apollo.
Callirrhoe	Daughter of Achelous, wife of Alcmaeon who lost the war for Thebes.

MEANINGS OF PLANET AND SATELLITE NAMES

NAME	MEANING
Saturn	Roman name for the Greek Cronos, father of Zeus/Jupiter. Other civilizations have given other names to Saturn, which is the farthest planet from Earth that can be observed by the naked human eye. Most of its satellites were named for Titans who, according to Greek mythology, were brothers and sisters of Saturn. In Greek mythology, the Titans are a race of godlike giants who were considered to be the personifications of the forces of nature. They are the twelve children (six sons and six daughters) of Gaia and Uranus.
Pan	Son of Hermes and Dryope. He was half human, half goat – god of pastoralism.
Atlas	Held the heavens on his shoulders.
Prometheus	Brother of Atlas and Epimetheus, he gave many gifts to humanity, including fire which he stole from Zeus and the gods.
Pandora	Made of clay by Hephaestus at the request of Zeus. She married Epimetheus and opened the box that loosed a host of plagues upon humanity.
Janus	Named for the two-faced Roman god who could look forward and backward at the same time. Shares the same orbit with Epimetheus but they never actually collide.
Epimetheus	Named for the Greek backward-looking god. Shares the same orbit Janus but they never actually collide.
Mimas	Named for a Titan felled by Hephaestus (or Ares) in the war between the Titans and Olympian gods.
Enceladus	Enceladus was crushed by Athene in the battle between the Olympian gods and the Titans. Earth piled on top of him became the island of Sicily.
Tethys	Tethys was the wife of Oceanus and mother of all rivers and Oceanids.
Telesto	One of 3,000 Oceanides, water nymphs born to Oceanus and Tethys.
Calypso	A daughter of Atlas and paramour of Odysseus.
Dione	Dione was the sister of Cronos and mother (by Zeus) of Aphrodite.
Helene	The daughter of Tityrus, and one of the Amazons.
Rhea	Daughter of Cronos and mother of Zeus.
Titan	Discovered and named in 1655 by C. Huygens, who first called it 'Luna Saturni'.
Hyperion	A Titan who married his sister Theia and has three children – Helios, Selene and Eos.
Iapetus	A Titan whose wife was Clymene, with whom he had four children - Atlas, Menoetius, Prometheus and Epimetheus.
Phoebe	She married her brother Coeus and was the mother of Leto and Asteria. It is said that she owned the oracle of Delphi before Apollo took it over.
Ymir	Norse mythology, Ymir is the primordial giant and the progenitor of the race of frost giants.
Albiorix	'King of the world'. An alternative name of the Gaulish god Teutates. He is the god of war, fertility, and wealth.
Tarvos	Gallic bull god.
Skadi	A giantess, called the 'snow-shoe goddess', and the embodiment of winter. She is the wife of the god Njord.
Mundilfari	In Norse myth, there was once a giant named Mundilfari who was married to Glaur. Their children were so beautiful that he named his son Mani (Moon) and his daughter Sol (Sun).
Uranus	Uranus was discovered by William Herschel in 1781. Several astronomers, including Flamsteed and Le Monnier, had observed it earlier but had recorded it as a fixed star. Herschel tried unsuccessfully to name his discovery 'Georgian Sidus' after George III; the planet was named by Johann Bode in 1781 for the father of Saturn.
	Uranus is the only body in the Solar System with moons not named from classical mythology – its moons are named from works by Shakespeare and Alexander Pope. Any future satellites will follow that naming convention.

NAME	MEANING
Cordelia	Daughter of Lear in Shakespeare's 'King Lear'.
Ophelia	Daughter of Polonius, fiance of Hamlet in Shakespeare's 'Hamlet, Prince of Denmark'.
Bianca	Daughter of Baptista, sister of Kate in Shakespeare's 'Taming of the Shrew'.
Cressida	Title character in Shakespeare's 'Troilus and Cressida'.
Desdemona	Wife of Othello in Shakespeare's 'Othello, the Moor of Venice'.
Juliet	Heroine of Shakespeare's Romeo and Juliet'.
Portia	Wife of Brutus in Shakespeare's 'Julius Caesar'.
Rosalind	Daughter of the banished duke in Shakespeare's 'As You Like It'.
Belinda	Character in Pope's 'Rape of the Lock'.
Puck	Mischievous spirit in Shakespeare's 'A Midsummer Night's Dream'.
Miranda	Heroine of Shakespeare's 'The Tempest'
Ariel	Benevolent spirit in Shakespeare's 'The Tempest'.
Umbriel	Malevolent spirit in Pope's 'Rape of the Lock'.
Titania	Queen of the fairies in Shakespeare's 'A Midsummer Night's Dream'.
Oberon	King of the fairies in Shakespeare's 'A Midsummer Night's Dream'.
Caliban	Named for the grotesque, brutish slave in Shakespeare's 'The Tempest'.
Sycorax	Named for Caliban's mother in Shakespeare's 'The Tempest'.
Prospero	Named for the rightful Duke of Milan in 'The Tempest'.
Setebos	Setebos was a new-world (South American) deity's name that Shakespeare popularised as Sycorax's god in 'The Tempest'.
Stephano	Named for a drunken butler in 'The Tempest'.
Trinculo	Trinculo is an entertainer without an audience in 'The Tempest'.
Neptune	Neptune was actually 'observed' as early as 1690 by John Flamsteed, who thought it was a fixed star. It was 'predicted' by John Couch Adams and Urbain Le Verrier who, independently, were able to account for the irregularities in the motion of Uranus by correctly predicting the orbital elements of a trans-Uranian body. Using the predicted parameters of Le Verrier (Adams never published his predictions), Johann Galle observed the planet in 1846. Galle wanted to name the planet for Le Verrier, but that was not acceptable to the international astronomical community.
Naiad	The name of a group of Greek water nymphs who were guardians of lakes, fountains, springs and rivers.
Thalassa	Greek sea goddess. Mother of Aphrodite in some legends; others say she bore the Telchines.
Despina	Daughter of Poseidon (Neptune) and Demeter.
Galatea	One of the Nereids, attendants of Poseidon.
Larissa	A lover of Poseidon.
Proteus	Greek sea god, son of Oceanus and Tethys.
Triton	Triton is named for the sea-god son of Poseidon (Neptune) and Amphitrite.
Nereid	The Nereids were the fifty daughters of Nereus and Doris and were attendants of Neptune.
Pluto	Discovered in 1930 by American astronomer Clyde W. Tombaugh at Lowell Observatory in Flagstaff, Arizona, during a systematic search for a trans-Neptune planet predicted by Percival Lowell and William H. Pickering. Named after Greek god of the underworld who was able to render himself invisible.
Charon	Discovered in 1978 by James W. Christy. Named after the mythological boatman who ferried souls across the river Styx to Pluto for judgement.

GEOCENTRIC POSITION OF SUN (EPOCH J2000.0)

Note: positions refer to 0000 WAST

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (AU)
January	**1**	**18**	**45**	**47.0**	**-23**	**01**	**18**	**0.983**
Jan	2	18	50	11.8	-22	56	14	0.983
Jan	3	18	54	36.2	-22	50	44	0.983
Jan	4	18	59	00.2	-22	44	46	0.983
Jan	5	19	03	23.8	-22	38	20	0.983
Jan	6	19	07	46.9	-22	31	28	0.983
Jan	7	19	12	09.6	-22	24	10	0.983
Jan	8	19	16	31.8	-22	16	25	0.983
Jan	9	19	20	53.6	-22	08	14	0.983
Jan	10	19	25	14.7	-21	59	36	0.983
Jan	11	19	29	35.4	-21	50	33	0.983
Jan	12	19	33	55.4	-21	41	05	0.983
Jan	13	19	38	14.9	-21	31	11	0.984
Jan	14	19	42	33.8	-21	20	52	0.984
Jan	15	19	46	52.0	-21	10	09	0.984
Jan	16	19	51	09.7	-20	59	01	0.984
Jan	17	19	55	26.6	-20	47	29	0.984
Jan	18	19	59	42.9	-20	35	34	0.984
Jan	19	20	03	58.4	-20	23	15	0.984
Jan	20	20	08	13.3	-20	10	32	0.984
Jan	21	20	12	27.4	-19	57	27	0.984
Jan	22	20	16	40.7	-19	43	60	0.984
Jan	23	20	20	53.3	-19	30	10	0.984
Jan	24	20	25	05.1	-19	15	59	0.984
Jan	25	20	29	16.1	-19	01	26	0.984
Jan	26	20	33	26.2	-18	46	33	0.985
Jan	27	20	37	35.6	-18	31	19	0.985
Jan	28	20	41	44.1	-18	15	45	0.985
Jan	29	20	45	51.9	-17	59	51	0.985
Jan	30	20	49	58.7	-17	43	39	0.985
Jan	31	20	54	04.8	-17	27	07	0.985
February	**1**	**20**	**58**	**10.0**	**-17**	**10**	**16**	**0.985**
Feb	2	21	02	14.4	-16	53	08	0.985
Feb	3	21	06	17.9	-16	35	42	0.986
Feb	4	21	10	20.6	-16	17	59	0.986
Feb	5	21	14	22.5	-15	59	59	0.986
Feb	6	21	18	23.6	-15	41	42	0.986
Feb	7	21	22	23.9	-15	23	09	0.986
Feb	8	21	26	23.4	-15	04	21	0.986
Feb	9	21	30	22.2	-14	45	17	0.987
Feb	10	21	34	20.1	-14	25	59	0.987
Feb	11	21	38	17.3	-14	06	25	0.987
Feb	12	21	42	13.8	-13	46	38	0.987
Feb	13	21	46	09.5	-13	26	37	0.987
Feb	14	21	50	04.4	-13	06	23	0.988
Feb	15	21	53	58.7	-12	45	56	0.988
Feb	16	21	57	52.2	-12	25	16	0.988
Feb	17	22	01	45.1	-12	04	25	0.988
Feb	18	22	05	37.2	-11	43	21	0.988
Feb	19	22	09	28.7	-11	22	07	0.989
Feb	20	22	13	19.5	-11	00	42	0.989
Feb	21	22	17	09.7	-10	39	06	0.989
Feb	22	22	20	59.1	-10	17	21	0.989
Feb	23	22	24	48.0	-09	55	26	0.989
Feb	24	22	28	36.2	-09	33	22	0.990
Feb	25	22	32	23.8	-09	11	09	0.990
Feb	26	22	36	10.8	-08	48	48	0.990
Feb	27	22	39	57.2	-08	26	20	0.990
Feb	28	22	43	43.1	-08	03	44	0.991
Feb	29	22	47	28.4	-07	41	02	0.991
March	**1**	**22**	**51**	**13.2**	**-07**	**18**	**12**	**0.991**
Mar	2	22	54	57.5	-06	55	17	0.991
Mar	3	22	58	41.3	-06	32	16	0.992
Mar	4	23	02	24.6	-06	09	09	0.992
Mar	5	23	06	07.5	-05	45	58	0.992
Mar	6	23	09	49.9	-05	22	41	0.992
Mar	7	23	13	32.0	-04	59	21	0.993
Mar	8	23	17	13.7	-04	35	57	0.993
Mar	9	23	20	55.0	-04	12	29	0.993
Mar	10	23	24	36.0	-03	48	57	0.993
Mar	11	23	28	16.7	-03	25	23	0.994
Mar	12	23	31	57.1	-03	01	47	0.994
Mar	13	23	35	37.3	-02	38	08	0.994
Mar	14	23	39	17.2	-02	14	28	0.994
Mar	15	23	42	56.9	-01	50	46	0.995
Mar	16	23	46	36.3	-01	27	03	0.995
Mar	17	23	50	15.6	-01	03	19	0.995
Mar	18	23	53	54.8	-00	39	35	0.996
Mar	19	23	57	33.8	-00	15	52	0.996
Mar	20	00	01	12.6	-00	07	52	0.996
Mar	21	00	04	51.4	-00	31	34	0.996
Mar	22	00	08	30.0	-00	55	15	0.997
Mar	23	00	12	08.6	-01	18	55	0.997
Mar	24	00	15	47.0	-01	42	32	0.997
Mar	25	00	19	25.5	-02	06	07	0.998
Mar	26	00	23	03.9	-02	29	39	0.998
Mar	27	00	26	42.3	-02	53	08	0.998
Mar	28	00	30	20.7	-03	16	33	0.998
Mar	29	00	33	59.2	-03	39	55	0.999
Mar	30	00	37	37.7	-04	03	12	0.999
Mar	31	00	41	16.2	-04	26	25	0.999
April	**1**	**00**	**44**	**54.9**	**-04**	**49**	**33**	**0.999**
Apr	2	00	48	33.7	-05	12	35	1.000
Apr	3	00	52	12.5	-05	35	32	1.000
Apr	4	00	55	51.6	-05	58	23	1.000
Apr	5	00	59	30.8	-06	21	07	1.001
Apr	6	01	03	10.2	-06	43	45	1.001
Apr	7	01	06	49.9	-07	06	17	1.001
Apr	8	01	10	29.7	-07	28	41	1.001
Apr	9	01	14	09.9	-07	50	57	1.002
Apr	10	01	17	50.3	-08	13	06	1.002
Apr	11	01	21	31.0	-08	35	07	1.002
Apr	12	01	25	12.1	-08	56	59	1.003
Apr	13	01	28	53.5	-09	18	42	1.003
Apr	14	01	32	35.2	-09	40	16	1.003
Apr	15	01	36	17.3	-10	01	41	1.004
Apr	16	01	39	59.8	-10	22	56	1.004
Apr	17	01	43	42.6	-10	44	01	1.004
Apr	18	01	47	25.9	-11	04	55	1.004
Apr	19	01	51	09.6	-11	25	38	1.005
Apr	20	01	54	53.6	-11	46	10	1.005
Apr	21	01	58	38.2	-12	06	30	1.005
Apr	22	02	02	23.1	-12	26	38	1.005
Apr	23	02	06	08.5	-12	46	34	1.006
Apr	24	02	09	54.4	-13	06	17	1.006
Apr	25	02	13	40.7	-13	25	47	1.006
Apr	26	02	17	27.5	-13	45	04	1.007
Apr	27	02	21	14.8	-14	04	07	1.007
Apr	28	02	25	02.6	-14	22	56	1.007
Apr	29	02	28	50.8	-14	41	31	1.007
Apr	30	02	32	39.6	-14	59	51	1.008
May	**1**	**02**	**36**	**28.9**	**-15**	**17**	**56**	**1.008**

GEOCENTRIC POSITION OF SUN (continued)

Note: positions refer to 0000 WAST

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (AU)
May	2	02	40	18.8	-15	35	46	1.008
May	3	02	44	09.2	-15	53	20	1.008
May	4	02	48	00.1	-16	10	38	1.009
May	5	02	51	51.6	-16	27	41	1.009
May	6	02	55	43.6	-16	44	27	1.009
May	7	02	59	36.2	-17	00	56	1.009
May	8	03	03	29.4	-17	17	08	1.009
May	9	03	07	23.2	-17	33	03	1.010
May	10	03	11	17.6	-17	48	41	1.010
May	11	03	15	12.5	-18	04	01	1.010
May	12	03	19	08.1	-18	19	02	1.010
May	13	03	23	04.3	-18	33	46	1.011
May	14	03	27	01.0	-18	48	10	1.011
May	15	03	30	58.3	-19	02	16	1.011
May	16	03	34	56.2	-19	16	02	1.011
May	17	03	38	54.7	-19	29	29	1.012
May	18	03	42	53.7	-19	42	36	1.012
May	19	03	46	53.3	-19	55	23	1.012
May	20	03	50	53.4	-20	07	49	1.012
May	21	03	54	54.1	-20	19	55	1.012
May	22	03	58	55.2	-20	31	40	1.013
May	23	04	02	56.9	-20	43	03	1.013
May	24	04	06	59.1	-20	54	05	1.013
May	25	04	11	01.7	-21	04	46	1.013
May	26	04	15	04.8	-21	15	04	1.013
May	27	04	19	08.4	-21	25	00	1.013
May	28	04	23	12.4	-21	34	35	1.014
May	29	04	27	16.9	-21	43	46	1.014
May	30	04	31	21.7	-21	52	35	1.014
May	31	04	35	27.0	-22	01	01	1.014
June	**1**	**04**	**39**	**32.6**	**-22**	**09**	**04**	**1.014**
Jun	2	04	43	38.7	-22	16	44	1.014
Jun	3	04	47	45.0	-22	24	01	1.014
Jun	4	04	51	51.8	-22	30	54	1.015
Jun	5	04	55	58.9	-22	37	23	1.015
Jun	6	05	00	06.3	-22	43	29	1.015
Jun	7	05	04	14.0	-22	49	11	1.015
Jun	8	05	08	22.0	-22	54	29	1.015
Jun	9	05	12	30.3	-22	59	23	1.015
Jun	10	05	16	38.8	-23	03	52	1.015
Jun	11	05	20	47.6	-23	07	58	1.015
Jun	12	05	24	56.5	-23	11	38	1.016
Jun	13	05	29	05.7	-23	14	55	1.016
Jun	14	05	33	15.0	-23	17	47	1.016
Jun	15	05	37	24.4	-23	20	14	1.016
Jun	16	05	41	33.9	-23	22	16	1.016
Jun	17	05	45	43.6	-23	23	54	1.016
Jun	18	05	49	53.2	-23	25	06	1.016
Jun	19	05	54	02.9	-23	25	54	1.016
Jun	20	05	58	12.6	-23	26	18	1.016
Jun	21	06	02	22.3	-23	26	16	1.016
Jun	22	06	06	31.9	-23	25	49	1.016
Jun	23	06	10	41.4	-23	24	58	1.016
Jun	24	06	14	50.8	-23	23	42	1.016
Jun	25	06	19	00.1	-23	22	01	1.017
Jun	26	06	23	09.2	-23	19	55	1.017
Jun	27	06	27	18.1	-23	17	25	1.017
Jun	28	06	31	26.8	-23	14	31	1.017
Jun	29	06	35	35.3	-23	11	12	1.017
Jun	30	06	39	43.6	-23	07	28	1.017
July	**1**	**06**	**43**	**51.6**	**-23**	**03**	**21**	**1.017**
Jul	2	06	47	59.3	-22	58	49	1.017
Jul	3	06	52	06.7	-22	53	53	1.017
Jul	4	06	56	13.8	-22	48	34	1.017
Jul	5	07	00	20.6	-22	42	50	1.017
Jul	6	07	04	27.0	-22	36	44	1.017
Jul	7	07	08	33.2	-22	30	13	1.017
Jul	8	07	12	38.9	-22	23	19	1.017
Jul	9	07	16	44.2	-22	16	02	1.017
Jul	10	07	20	49.2	-22	08	22	1.017
Jul	11	07	24	53.7	-22	00	19	1.017
Jul	12	07	28	57.8	-21	51	54	1.017
Jul	13	07	33	01.4	-21	43	06	1.017
Jul	14	07	37	04.5	-21	33	55	1.017
Jul	15	07	41	07.2	-21	24	23	1.016
Jul	16	07	45	09.4	-21	14	29	1.016
Jul	17	07	49	11.0	-21	04	13	1.016
Jul	18	07	53	12.1	-20	53	35	1.016
Jul	19	07	57	12.6	-20	42	37	1.016
Jul	20	08	01	12.6	-20	31	17	1.016
Jul	21	08	05	12.0	-20	19	37	1.016
Jul	22	08	09	10.8	-20	07	36	1.016
Jul	23	08	13	09.0	-19	55	15	1.016
Jul	24	08	17	06.7	-19	42	35	1.016
Jul	25	08	21	03.7	-19	29	35	1.016
Jul	26	08	25	00.1	-19	16	15	1.016
Jul	27	08	28	55.8	-19	02	37	1.015
Jul	28	08	32	51.0	-18	48	39	1.015
Jul	29	08	36	45.5	-18	34	24	1.015
Jul	30	08	40	39.4	-18	19	50	1.015
Jul	31	08	44	32.7	-18	04	58	1.015
August	**1**	**08**	**48**	**25.4**	**-17**	**49**	**48**	**1.015**
Aug	2	08	52	17.5	-17	34	21	1.015
Aug	3	08	56	09.0	-17	18	37	1.015
Aug	4	08	59	59.9	-17	02	36	1.014
Aug	5	09	03	50.2	-16	46	19	1.014
Aug	6	09	07	40.0	-16	29	45	1.014
Aug	7	09	11	29.2	-16	12	55	1.014
Aug	8	09	15	17.8	-15	55	50	1.014
Aug	9	09	19	05.8	-15	38	29	1.014
Aug	10	09	22	53.3	-15	20	53	1.014
Aug	11	09	26	40.2	-15	03	02	1.013
Aug	12	09	30	26.6	-14	44	57	1.013
Aug	13	09	34	12.4	-14	26	37	1.013
Aug	14	09	37	57.7	-14	08	04	1.013
Aug	15	09	41	42.5	-13	49	17	1.013
Aug	16	09	45	26.8	-13	30	16	1.012
Aug	17	09	49	10.5	-13	11	03	1.012
Aug	18	09	52	53.7	-12	51	38	1.012
Aug	19	09	56	36.4	-12	32	00	1.012
Aug	20	10	00	18.7	-12	12	11	1.012
Aug	21	10	04	00.4	-11	52	09	1.011
Aug	22	10	07	41.7	-11	31	57	1.011
Aug	23	10	11	22.5	-11	11	34	1.011
Aug	24	10	15	02.9	-10	51	01	1.011
Aug	25	10	18	42.8	-10	30	17	1.011
Aug	26	10	22	22.3	-10	09	23	1.010
Aug	27	10	26	01.4	-09	48	20	1.010
Aug	28	10	29	40.2	-09	27	08	1.010
Aug	29	10	33	18.6	-09	05	46	1.010
Aug	30	10	36	56.6	-08	44	16	1.009
Aug	31	10	40	34.4	-08	22	38	1.009

GEOCENTRIC POSITION OF SUN (continued)

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (AU)
September	**1**	**10**	**44**	**11.8**	**-08**	**00**	**51**	**1.009**
Sep	2	10	47	49.0	-07	38	57	1.009
Sep	3	10	51	25.9	-07	16	55	1.008
Sep	4	10	55	02.6	-06	54	46	1.008
Sep	5	10	58	39.0	-06	32	30	1.008
Sep	6	11	02	15.3	-06	10	08	1.008
Sep	7	11	05	51.4	-05	47	39	1.008
Sep	8	11	09	27.3	-05	25	05	1.007
Sep	9	11	13	03.1	-05	02	25	1.007
Sep	10	11	16	38.7	-04	39	39	1.007
Sep	11	11	20	14.3	-04	16	49	1.006
Sep	12	11	23	49.7	-03	53	54	1.006
Sep	13	11	27	25.1	-03	30	55	1.006
Sep	14	11	31	00.4	-03	07	52	1.006
Sep	15	11	34	35.6	-02	44	46	1.005
Sep	16	11	38	10.9	-02	21	36	1.005
Sep	17	11	41	46.1	-01	58	24	1.005
Sep	18	11	45	21.3	-01	35	09	1.005
Sep	19	11	48	56.6	-01	11	52	1.004
Sep	20	11	52	31.9	-00	48	33	1.004
Sep	21	11	56	07.2	-00	25	13	1.004
Sep	22	11	59	42.7	-00	01	52	1.003
Sep	23	12	03	18.2	-00	21	29	1.003
Sep	24	12	06	53.8	-00	44	51	1.003
Sep	25	12	10	29.6	-01	08	13	1.003
Sep	26	12	14	05.6	-01	31	35	1.002
Sep	27	12	17	41.8	-01	54	56	1.002
Sep	28	12	21	18.2	-02	18	16	1.002
Sep	29	12	24	54.8	-02	41	34	1.001
Sep	30	12	28	31.7	-03	04	52	1.001
October	**1**	**12**	**32**	**08.9**	**-03**	**28**	**07**	**1.001**
Oct	2	12	35	46.4	-03	51	20	1.001
Oct	3	12	39	24.2	-04	14	30	1.000
Oct	4	12	43	02.4	-04	37	38	1.000
Oct	5	12	46	40.9	-05	00	42	1.000
Oct	6	12	50	19.9	-05	23	43	0.999
Oct	7	12	53	59.3	-05	46	39	0.999
Oct	8	12	57	39.1	-06	09	32	0.999
Oct	9	13	01	19.4	-06	32	19	0.999
Oct	10	13	05	00.1	-06	55	02	0.998
Oct	11	13	08	41.4	-07	17	39	0.998
Oct	12	13	12	23.1	-07	40	10	0.998
Oct	13	13	16	05.4	-08	02	35	0.998
Oct	14	13	19	48.2	-08	24	53	0.997
Oct	15	13	23	31.5	-08	47	04	0.997
Oct	16	13	27	15.5	-09	09	07	0.997
Oct	17	13	30	60.0	-09	31	03	0.996
Oct	18	13	34	45.1	-09	52	50	0.996
Oct	19	13	38	30.8	-10	14	28	0.996
Oct	20	13	42	17.1	-10	35	58	0.996
Oct	21	13	46	04.1	-10	57	17	0.995
Oct	22	13	49	51.7	-11	18	27	0.995
Oct	23	13	53	39.9	-11	39	26	0.995
Oct	24	13	57	28.9	-12	00	15	0.994
Oct	25	14	01	18.6	-12	20	53	0.994
Oct	26	14	05	08.9	-12	41	19	0.994
Oct	27	14	09	00.1	-13	01	33	0.994
Oct	28	14	12	51.9	-13	21	35	0.993
Oct	29	14	16	44.5	-13	41	25	0.993
Oct	30	14	20	38.0	-14	01	02	0.993
Oct	31	14	24	32.2	-14	20	25	0.993

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (AU)
November	**1**	**14**	**28**	**27.2**	**-14**	**39**	**34**	**0.992**
Nov	2	14	32	23.0	-14	58	30	0.992
Nov	3	14	36	19.6	-15	17	11	0.992
Nov	4	14	40	17.1	-15	35	37	0.992
Nov	5	14	44	15.5	-15	53	47	0.991
Nov	6	14	48	14.6	-16	11	42	0.991
Nov	7	14	52	14.7	-16	29	21	0.991
Nov	8	14	56	15.6	-16	46	43	0.991
Nov	9	15	00	17.3	-17	03	49	0.990
Nov	10	15	04	19.9	-17	20	36	0.990
Nov	11	15	08	23.4	-17	37	07	0.990
Nov	12	15	12	27.7	-17	53	18	0.990
Nov	13	15	16	32.9	-18	09	11	0.989
Nov	14	15	20	38.9	-18	24	45	0.989
Nov	15	15	24	45.8	-18	39	60	0.989
Nov	16	15	28	53.5	-18	54	55	0.989
Nov	17	15	33	02.0	-19	09	29	0.989
Nov	18	15	37	11.3	-19	23	43	0.988
Nov	19	15	41	21.4	-19	37	35	0.988
Nov	20	15	45	32.3	-19	51	06	0.988
Nov	21	15	49	44.0	-20	04	16	0.988
Nov	22	15	53	56.5	-20	17	03	0.987
Nov	23	15	58	09.7	-20	29	28	0.987
Nov	24	16	02	23.7	-20	41	30	0.987
Nov	25	16	06	38.5	-20	53	09	0.987
Nov	26	16	10	54.0	-21	04	24	0.987
Nov	27	16	15	10.2	-21	15	16	0.987
Nov	28	16	19	27.1	-21	25	44	0.986
Nov	29	16	23	44.8	-21	35	48	0.986
Nov	30	16	28	03.1	-21	45	27	0.986
December	**1**	**16**	**32**	**22.0**	**-21**	**54**	**41**	**0.986**
Dec	2	16	36	41.6	-22	03	30	0.986
Dec	3	16	41	01.9	-22	11	53	0.986
Dec	4	16	45	22.7	-22	19	51	0.985
Dec	5	16	49	44.1	-22	27	23	0.985
Dec	6	16	54	06.1	-22	34	28	0.985
Dec	7	16	58	28.6	-22	41	08	0.985
Dec	8	17	02	51.6	-22	47	20	0.985
Dec	9	17	07	15.1	-22	53	06	0.985
Dec	10	17	11	39.0	-22	58	25	0.985
Dec	11	17	16	03.3	-23	03	16	0.985
Dec	12	17	20	28.0	-23	07	40	0.985
Dec	13	17	24	53.0	-23	11	36	0.984
Dec	14	17	29	18.3	-23	15	05	0.984
Dec	15	17	33	43.8	-23	18	05	0.984
Dec	16	17	38	09.6	-23	20	38	0.984
Dec	17	17	42	35.5	-23	22	42	0.984
Dec	18	17	47	01.6	-23	24	19	0.984
Dec	19	17	51	27.8	-23	25	27	0.984
Dec	20	17	55	54.1	-23	26	07	0.984
Dec	21	18	00	20.4	-23	26	19	0.984
Dec	22	18	04	46.8	-23	26	03	0.984
Dec	23	18	09	13.1	-23	25	18	0.984
Dec	24	18	13	39.4	-23	24	05	0.984
Dec	25	18	18	05.6	-23	22	24	0.983
Dec	26	18	22	31.7	-23	20	15	0.983
Dec	27	18	26	57.7	-23	17	38	0.983
Dec	28	18	31	23.4	-23	14	32	0.983
Dec	29	18	35	49.0	-23	10	59	0.983
Dec	30	18	40	14.4	-23	06	58	0.983
Dec	31	18	44	39.5	-23	02	30	0.983

GEOCENTRIC POSITION OF MOON (EPOCH J2000.0)

Note: positions refer to 0000 WAST

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (1,000 km)
January	**1**	**02**	**14**	**01.3**	**+12**	**08**	**53**	**403.2**
Jan	2	02	59	08.6	+16	47	25	405.0
Jan	3	03	46	10.2	+20	46	29	405.7
Jan	4	04	35	31.6	+23	55	20	405.4
Jan	5	05	27	12.9	+26	02	58	404.3
Jan	6	06	20	43.9	+26	59	43	402.5
Jan	7	07	15	07.6	+26	39	17	400.3
Jan	8	08	09	15.5	+25	00	33	397.6
Jan	9	09	02	09.3	+22	07	59	394.6
Jan	10	09	53	17.2	+18	10	35	391.4
Jan	11	10	42	39.9	+13	20	08	387.9
Jan	12	11	30	46.2	+07	49	40	384.2
Jan	13	12	18	25.7	+01	52	50	380.4
Jan	14	13	06	41.6	-04	15	57	376.4
Jan	15	13	56	45.3	-10	20	31	372.5
Jan	16	14	49	49.0	-16	01	38	368.9
Jan	17	15	46	51.3	-20	56	17	365.8
Jan	18	16	48	13.0	-24	38	27	363.7
Jan	19	17	53	06.9	-26	43	23	362.8
Jan	20	18	59	28.9	-26	54	53	363.3
Jan	21	20	04	33.8	-25	12	07	365.4
Jan	22	21	06	04.5	-21	50	21	368.9
Jan	23	22	02	57.5	-17	14	40	373.5
Jan	24	22	55	20.1	-11	52	04	378.9
Jan	25	23	44	02.7	-06	06	08	384.7
Jan	26	00	30	12.8	-00	15	25	390.3
Jan	27	01	14	59.9	+05	26	03	395.3
Jan	28	01	59	29.4	+10	47	16	399.5
Jan	29	02	44	39.7	+15	38	47	402.5
Jan	30	03	31	19.3	+19	51	23	404.3
Jan	31	04	20	02.6	+23	15	26	404.8
February	**1**	**05**	**11**	**02.3**	**+25**	**40**	**45**	**404.1**
Feb	2	06	04	03.7	+26	57	39	402.4
Feb	3	06	58	23.2	+26	58	34	399.9
Feb	4	07	52	58.5	+25	40	05	396.8
Feb	5	08	46	46.7	+23	04	11	393.3
Feb	6	09	39	04.6	+19	18	10	389.8
Feb	7	10	29	38.3	+14	33	27	386.3
Feb	8	11	18	43.7	+09	04	02	382.9
Feb	9	12	07	00.0	+03	05	15	379.9
Feb	10	12	55	21.9	-03	06	43	377.2
Feb	11	13	44	53.3	-09	14	45	374.7
Feb	12	14	36	40.1	-15	00	12	372.5
Feb	13	15	31	39.7	-20	02	24	370.7
Feb	14	16	30	22.8	-23	58	58	369.3
Feb	15	17	32	30.5	-26	28	08	368.5
Feb	16	18	36	39.3	-27	13	23	368.4
Feb	17	19	40	37.7	-26	09	01	369.1
Feb	18	20	42	14.5	-23	22	51	370.9
Feb	19	21	40	06.9	-19	13	39	373.6
Feb	20	22	33	55.4	-14	05	28	377.2
Feb	21	23	24	08.3	-08	22	16	381.6
Feb	22	00	11	39.4	-02	25	03	386.3
Feb	23	00	57	31.0	+03	29	04	391.1
Feb	24	01	42	44.3	+09	06	19	395.6
Feb	25	02	28	15.9	+14	15	21	399.4
Feb	26	03	14	53.9	+18	46	07	402.2
Feb	27	04	03	14.6	+22	29	02	403.9
Feb	28	04	53	36.7	+25	14	39	404.2
Feb	29	05	45	55.5	+26	53	56	403.3
March	**1**	**06**	**39**	**40.8**	**+27**	**19**	**21**	**401.2**
Mar	2	07	34	02.0	+26	26	23	398.0
Mar	3	08	28	02.5	+24	14	47	394.0
Mar	4	09	20	57.5	+20	49	05	389.6
Mar	5	10	12	26.0	+16	18	15	385.1
Mar	6	11	02	34.7	+10	54	45	380.9
Mar	7	11	51	53.8	+04	53	46	377.1
Mar	8	12	41	11.1	-01	27	24	374.0
Mar	9	13	31	24.3	-07	49	34	371.7
Mar	10	14	23	34.0	-13	51	54	370.3
Mar	11	15	18	32.6	-19	12	08	369.6
Mar	12	16	16	48.5	-23	27	33	369.6
Mar	13	17	18	05.9	-26	17	10	370.1
Mar	14	18	21	12.6	-27	25	40	371.2
Mar	15	19	24	13.3	-26	47	26	372.6
Mar	16	20	25	09.7	-24	28	33	374.5
Mar	17	21	22	43.2	-20	44	39	376.8
Mar	18	22	16	30.3	-15	56	32	379.6
Mar	19	23	06	52.8	-10	25	51	382.8
Mar	20	23	54	37.9	-04	32	43	386.4
Mar	21	00	40	43.1	+01	25	19	390.2
Mar	22	01	26	06.2	+07	13	06	394.0
Mar	23	02	11	40.8	+12	37	29	397.6
Mar	24	02	58	13.1	+17	26	48	400.6
Mar	25	03	46	18.0	+21	30	17	403.0
Mar	26	04	36	14.1	+24	37	55	404.3
Mar	27	05	27	59.1	+26	40	44	404.4
Mar	28	06	21	07.3	+27	31	25	403.3
Mar	29	07	14	54.6	+27	05	27	400.9
Mar	30	08	08	30.2	+25	21	54	397.4
Mar	31	09	01	12.2	+22	23	44	392.9
April	**1**	**09**	**52**	**39.5**	**+18**	**17**	**28**	**387.7**
Apr	2	10	42	56.5	+13	12	45	382.3
Apr	3	11	32	30.6	+07	22	02	377.0
Apr	4	12	22	07.2	+01	00	41	372.3
Apr	5	13	12	43.4	-05	32	41	368.5
Apr	6	14	05	20.7	-11	56	01	365.9
Apr	7	15	00	54.2	-17	44	19	364.7
Apr	8	15	59	55.0	-22	31	06	364.8
Apr	9	17	02	07.8	-25	51	43	366.0
Apr	10	18	06	15.7	-27	28	14	368.2
Apr	11	19	10	13.7	-27	14	06	371.0
Apr	12	20	11	54.2	-25	15	51	374.2
Apr	13	21	09	53.4	-21	49	59	377.7
Apr	14	22	03	48.3	-17	17	37	381.2
Apr	15	22	54	04.2	-11	59	51	384.7
Apr	16	23	41	32.5	-06	15	41	388.2
Apr	17	00	27	13.8	-00	21	37	391.5
Apr	18	01	12	08.8	+05	27	56	394.8
Apr	19	01	57	13.0	+10	59	50	397.9
Apr	20	02	43	14.2	+16	01	49	400.6
Apr	21	03	30	48.6	+20	22	10	402.9
Apr	22	04	20	16.0	+23	49	43	404.5
Apr	23	05	11	34.6	+26	14	32	405.3
Apr	24	06	04	18.3	+27	28	40	405.2
Apr	25	06	57	41.9	+27	27	22	403.9
Apr	26	07	50	52.5	+26	09	39	401.5
Apr	27	08	43	06.1	+23	38	20	397.8
Apr	28	09	33	59.8	+19	59	19	393.2
Apr	29	10	23	36.7	+15	20	42	387.7
Apr	30	11	12	23.9	+09	52	27	381.7
May	**1**	**12**	**01**	**07.5**	**+03**	**46**	**31**	**375.6**

GEOCENTRIC POSITION OF MOON (continued)

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (1,000 km)
May	2	12	50	47.1	-02	42	05	370.0
May	3	13	42	30.3	-09	14	13	365.2
May	4	14	37	23.9	-15	25	46	361.8
May	5	15	36	16.5	-20	48	11	360.1
May	6	16	39	11.8	-24	51	26	360.0
May	7	17	45	01.6	-27	10	11	361.6
May	8	18	51	27.3	-27	31	19	364.6
May	9	19	55	47.9	-25	58	20	368.6
May	10	20	56	06.8	-22	48	41	373.3
May	11	21	51	43.0	-18	26	29	378.2
May	12	22	42	59.1	-13	15	40	383.0
May	13	23	30	52.2	-07	36	41	387.6
May	14	00	16	30.8	-01	46	10	391.8
May	15	01	01	03.0	+04	02	07	395.5
May	16	01	45	30.9	+09	36	04	398.7
May	17	02	30	48.3	+14	44	13	401.3
May	18	03	17	37.4	+19	15	06	403.5
May	19	04	06	24.0	+22	57	18	405.0
May	20	04	57	11.3	+25	39	56	406.0
May	21	05	49	35.9	+27	13	55	406.3
May	22	06	42	50.8	+27	33	22	405.7
May	23	07	35	57.2	+26	36	41	404.2
May	24	08	28	02.7	+24	26	40	401.8
May	25	09	18	36.2	+21	09	33	398.3
May	26	10	07	34.7	+16	53	41	393.8
May	27	10	55	21.5	+11	48	33	388.5
May	28	11	42	40.6	+06	04	25	382.6
May	29	12	30	31.8	-00	06	51	376.3
May	30	13	20	05.5	-06	30	32	370.3
May	31	14	12	37.9	-12	47	19	364.9
June	**1**	**15**	**09**	**18.5**	**-18**	**32**	**02**	**360.6**
Jun	2	16	10	46.4	-23	14	17	358.0
Jun	3	17	16	34.4	-26	22	45	357.3
Jun	4	18	24	44.4	-27	33	53	358.5
Jun	5	19	32	13.6	-26	41	02	361.4
Jun	6	20	36	12.3	-23	56	50	365.8
Jun	7	21	35	10.5	-19	46	42	371.1
Jun	8	22	29	04.7	-14	39	02	376.9
Jun	9	23	18	46.5	-08	58	44	382.8
Jun	10	00	05	29.1	-03	05	20	388.3
Jun	11	00	50	28.3	+02	46	14	393.2
Jun	12	01	34	54.0	+08	23	57	397.4
Jun	13	02	19	47.8	+13	37	12	400.8
Jun	14	03	05	59.8	+18	15	33	403.4
Jun	15	03	54	04.6	+22	08	19	405.2
Jun	16	04	44	15.1	+25	04	44	406.2
Jun	17	05	36	16.7	+26	54	59	406.6
Jun	18	06	29	26.6	+27	31	55	406.2
Jun	19	07	22	44.0	+26	52	34	405.2
Jun	20	08	15	07.9	+24	58	51	403.5
Jun	21	09	05	55.6	+21	56	60	401.0
Jun	22	09	54	53.0	+17	56	02	397.7
Jun	23	10	42	14.6	+13	06	15	393.7
Jun	24	11	28	38.2	+07	38	18	388.9
Jun	25	12	14	58.7	+01	43	19	383.6
Jun	26	13	02	23.5	-04	26	19	377.8
Jun	27	13	52	08.4	-10	35	23	372.1
Jun	28	14	45	31.3	-16	24	09	366.7
Jun	29	15	43	36.5	-21	27	09	362.2
Jun	30	16	46	44.1	-25	14	21	359.0
July	**1**	**17**	**53**	**53.4**	**-27**	**16**	**45**	**357.5**
Jul	2	19	02	31.2	-27	16	03	357.9
Jul	3	20	09	23.0	-25	13	04	360.2
Jul	4	21	11	59.8	-21	27	20	364.2
Jul	5	22	09	25.5	-16	28	15	369.4
Jul	6	23	02	03.0	-10	45	30	375.4
Jul	7	23	50	57.1	-04	43	45	381.6
Jul	8	00	37	24.9	+01	18	19	387.6
Jul	9	01	22	41.5	+07	06	40	393.1
Jul	10	02	07	54.4	+12	30	07	397.7
Jul	11	02	54	00.3	+17	18	45	401.4
Jul	12	03	41	42.0	+21	22	46	404.0
Jul	13	04	31	22.5	+24	32	16	405.6
Jul	14	05	22	59.0	+26	37	39	406.2
Jul	15	06	15	59.4	+27	31	07	406.0
Jul	16	07	09	28.1	+27	08	18	405.0
Jul	17	08	02	21.7	+25	29	35	403.4
Jul	18	08	53	48.5	+22	40	11	401.2
Jul	19	09	43	22.6	+18	49	02	398.5
Jul	20	10	31	07.3	+14	07	06	395.4
Jul	21	11	17	31.2	+08	46	13	391.8
Jul	22	12	03	21.3	+02	58	25	387.7
Jul	23	12	49	38.2	-03	03	46	383.3
Jul	24	13	37	31.5	-09	06	26	378.6
Jul	25	14	28	15.5	-14	52	58	373.9
Jul	26	15	22	60.0	-20	02	39	369.3
Jul	27	16	22	29.2	-24	10	22	365.4
Jul	28	17	26	30.4	-26	48	57	362.3
Jul	29	18	33	27.6	-27	35	45	360.6
Jul	30	19	40	35.1	-26	21	15	360.5
Jul	31	20	45	03.8	-23	14	04	362.0
August	**1**	**21**	**45**	**10.0**	**-18**	**37**	**40**	**365.1**
Aug	2	22	40	33.8	-13	01	42	369.6
Aug	3	23	31	54.9	-06	54	35	375.1
Aug	4	00	20	20.5	-00	39	41	381.0
Aug	5	01	07	03.4	+05	24	59	387.0
Aug	6	01	53	12.2	+11	05	38	392.5
Aug	7	02	39	46.6	+16	11	08	397.3
Aug	8	03	27	33.7	+20	31	40	401.0
Aug	9	04	17	03.5	+23	57	52	403.6
Aug	10	05	08	22.6	+26	20	47	405.0
Aug	11	06	01	10.4	+27	32	46	405.3
Aug	12	06	54	41.6	+27	28	46	404.5
Aug	13	07	47	57.5	+26	07	46	402.9
Aug	14	08	40	04.4	+23	33	19	400.5
Aug	15	09	30	29.0	+19	53	07	397.7
Aug	16	10	19	05.0	+15	17	43	394.6
Aug	17	11	06	11.6	+09	59	23	391.3
Aug	18	11	52	28.1	+04	11	13	387.9
Aug	19	12	38	47.4	-01	52	58	384.4
Aug	20	13	26	11.7	-07	58	26	380.9
Aug	21	14	15	48.4	-13	48	44	377.5
Aug	22	15	08	42.0	-19	04	49	374.2
Aug	23	16	05	39.8	-23	24	47	371.2
Aug	24	17	06	48.1	-26	25	02	368.5
Aug	25	18	11	07.9	-27	44	18	366.5
Aug	26	19	16	34.3	-27	09	57	365.3
Aug	27	20	20	37.2	-24	43	23	365.2
Aug	28	21	21	21.3	-20	40	10	366.4
Aug	29	22	18	00.0	-15	24	54	368.8
Aug	30	23	10	48.4	-09	24	45	372.4
Aug	31	00	00	37.3	-03	04	53	377.0

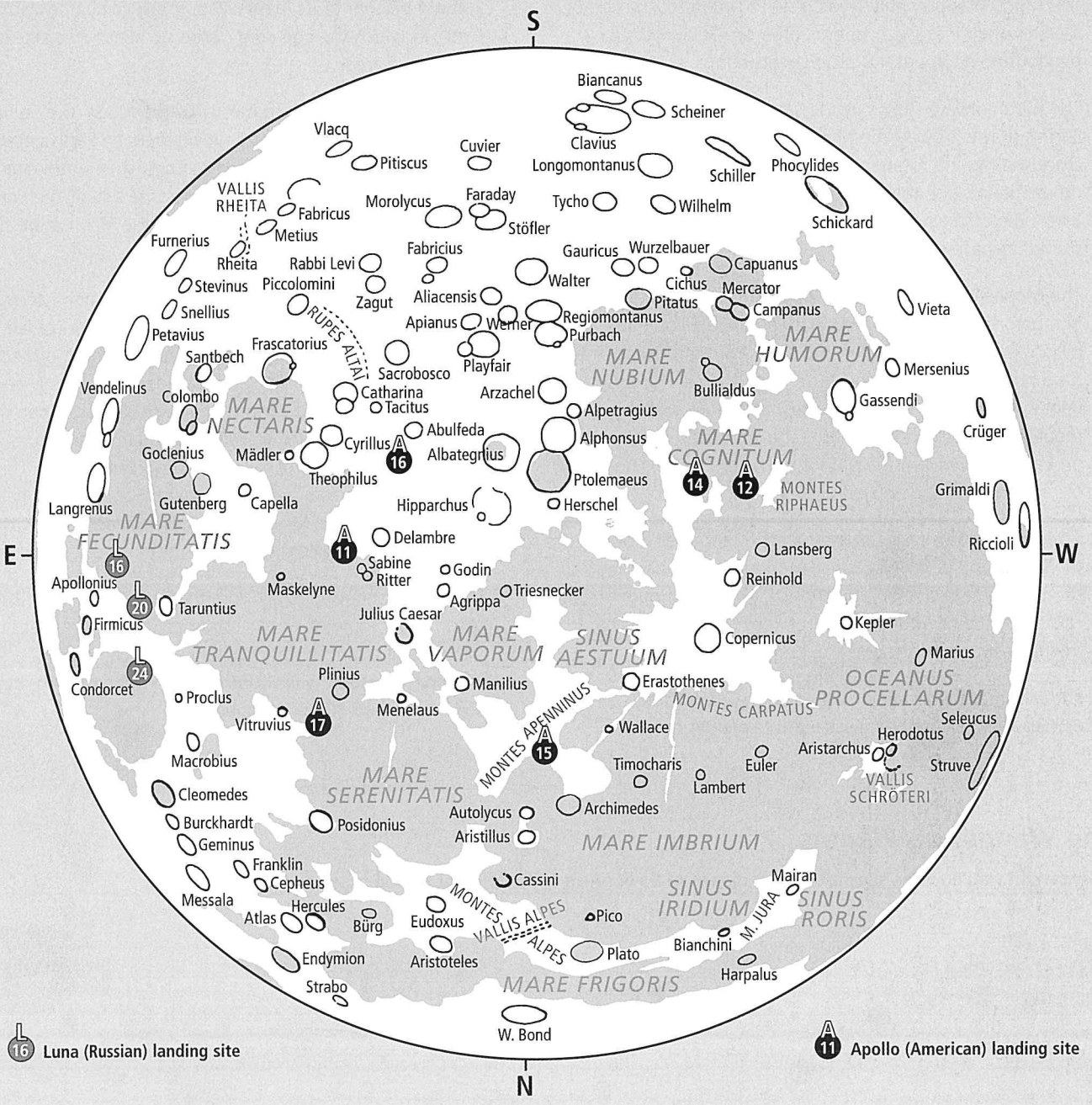
GEOCENTRIC POSITION OF MOON

Note: positions refer to 0000 WAST

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (1,000 km)
September	**1**	**00**	**48**	**31.4**	**+03**	**13**	**25**	**382.1**
Sep	2	01	35	35.7	+09	13	00	387.5
Sep	3	02	22	48.3	+14	39	59	392.6
Sep	4	03	10	57.0	+19	22	46	397.1
Sep	5	04	00	33.5	+23	11	15	400.7
Sep	6	04	51	48.9	+25	56	27	403.1
Sep	7	05	44	29.5	+27	30	55	404.3
Sep	8	06	37	57.7	+27	49	38	404.3
Sep	9	07	31	21.7	+26	50	55	403.0
Sep	10	08	23	50.7	+24	37	06	400.7
Sep	11	09	14	50.1	+21	14	13	397.6
Sep	12	10	04	09.1	+16	51	19	394.0
Sep	13	10	52	01.8	+11	39	36	390.1
Sep	14	11	39	01.9	+05	51	50	386.1
Sep	15	12	25	57.5	-00	17	40	382.5
Sep	16	13	13	46.1	-06	33	00	379.1
Sep	17	14	03	30.0	-12	36	16	376.3
Sep	18	14	56	08.6	-18	07	21	374.0
Sep	19	15	52	25.3	-22	44	05	372.2
Sep	20	16	52	27.5	-26	03	45	370.9
Sep	21	17	55	25.8	-27	46	29	370.0
Sep	22	18	59	32.8	-27	40	13	369.6
Sep	23	20	02	35.1	-25	44	50	369.8
Sep	24	21	02	44.8	-22	12	24	370.6
Sep	25	21	59	12.0	-17	23	16	372.1
Sep	26	22	52	03.4	-11	41	07	374.4
Sep	27	23	42	02.4	-05	29	14	377.5
Sep	28	00	30	08.1	+00	51	17	381.2
Sep	29	01	17	22.7	+07	01	56	385.4
Sep	30	02	04	42.9	+12	46	45	389.8
October	**1**	**02**	**52**	**56.0**	**+17**	**51**	**49**	**394.1**
Oct	2	03	42	34.3	+22	05	01	398.0
Oct	3	04	33	49.7	+25	15	58	401.2
Oct	4	05	26	29.9	+27	16	24	403.3
Oct	5	06	19	58.9	+28	00	58	404.3
Oct	6	07	13	26.4	+27	27	49	404.0
Oct	7	08	06	02.1	+25	38	55	402.4
Oct	8	08	57	10.8	+22	39	35	399.6
Oct	9	09	46	41.2	+18	37	32	395.8
Oct	10	10	34	46.1	+13	42	17	391.3
Oct	11	11	21	58.1	+08	04	43	386.4
Oct	12	12	09	05.1	+01	57	32	381.5
Oct	13	12	57	04.8	-04	24	15	377.1
Oct	14	13	47	00.5	-10	42	29	373.3
Oct	15	14	39	53.7	-16	35	34	370.4
Oct	16	15	36	30.4	-21	38	53	368.6
Oct	17	16	36	59.8	-25	26	52	367.8
Oct	18	17	40	31.3	-27	37	13	368.0
Oct	19	18	45	12.1	-27	56	36	368.9
Oct	20	19	48	40.8	-26	24	48	370.4
Oct	21	20	49	03.6	-23	14	17	372.4
Oct	22	21	45	28.6	-18	45	26	374.7
Oct	23	22	38	04.3	-13	21	00	377.3
Oct	24	23	27	37.0	-07	22	38	380.1
Oct	25	00	15	09.1	-01	09	42	383.3
Oct	26	01	01	45.5	+05	00	35	386.6
Oct	27	01	48	26.5	+10	52	37	390.1
Oct	28	02	36	02.8	+16	11	53	393.7
Oct	29	03	25	10.5	+20	44	55	397.1
Oct	30	04	16	05.5	+24	19	30	400.1
Oct	31	05	08	37.2	+26	45	34	402.6

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (1,000 km)
November	**1**	**06**	**02**	**09.0**	**+27**	**56**	**12**	**404.3**
Nov	2	06	55	45.9	+27	48	42	405.0
Nov	3	07	48	31.2	+26	24	48	404.5
Nov	4	08	39	43.3	+23	49	53	402.7
Nov	5	09	29	06.2	+20	11	43	399.7
Nov	6	10	16	50.7	+15	39	10	395.6
Nov	7	11	03	29.5	+10	21	44	390.5
Nov	8	11	49	51.3	+04	29	43	384.9
Nov	9	12	36	57.0	-01	44	50	379.1
Nov	10	13	25	54.9	-08	06	40	373.6
Nov	11	14	17	56.2	-14	16	00	368.8
Nov	12	15	14	02.2	-19	47	56	365.1
Nov	13	16	14	41.7	-24	13	35	363.0
Nov	14	17	19	20.0	-27	04	34	362.3
Nov	15	18	26	01.1	-28	00	44	363.2
Nov	16	19	31	57.5	-26	57	15	365.3
Nov	17	20	34	39.4	-24	06	04	368.4
Nov	18	21	32	49.4	-19	50	01	372.1
Nov	19	22	26	27.7	-14	34	53	376.1
Nov	20	23	16	23.4	-08	44	10	380.2
Nov	21	00	03	46.5	-02	37	28	384.2
Nov	22	00	49	49.6	+03	28	57	388.0
Nov	23	01	35	40.8	+09	20	55	391.6
Nov	24	02	22	18.1	+14	45	13	394.9
Nov	25	03	10	26.4	+19	28	60	397.9
Nov	26	04	00	30.4	+23	19	43	400.6
Nov	27	04	52	28.4	+26	05	59	402.8
Nov	28	05	45	48.3	+27	39	02	404.6
Nov	29	06	39	33.4	+27	54	14	405.7
Nov	30	07	32	38.3	+26	52	06	405.9
December	**1**	**08**	**24**	**09.1**	**+24**	**37**	**44**	**405.3**
Dec	2	09	13	38.2	+21	19	24	403.5
Dec	3	10	01	07.9	+17	06	44	400.6
Dec	4	10	47	06.0	+12	09	30	396.5
Dec	5	11	32	19.1	+06	37	15	391.5
Dec	6	12	17	47.1	+00	39	58	385.7
Dec	7	13	04	40.1	-05	30	39	379.4
Dec	8	13	54	15.2	-11	39	27	373.1
Dec	9	14	47	49.7	-17	25	53	367.3
Dec	10	15	46	23.7	-22	23	11	362.6
Dec	11	16	50	06.8	-26	00	09	359.4
Dec	12	17	57	41.4	-27	47	50	358.0
Dec	13	19	06	19.4	-27	29	54	358.5
Dec	14	20	12	44.4	-25	10	03	360.9
Dec	15	21	14	39.4	-21	09	51	364.6
Dec	16	22	11	24.1	-15	59	03	369.4
Dec	17	23	03	33.4	-10	06	30	374.8
Dec	18	23	52	18.0	-03	55	56	380.3
Dec	19	00	38	58.1	+02	14	22	385.6
Dec	20	01	24	49.6	+08	10	02	390.4
Dec	21	02	10	59.3	+13	38	49	394.6
Dec	22	02	58	21.1	+18	29	18	398.2
Dec	23	03	47	30.7	+22	30	08	401.1
Dec	24	04	38	39.2	+25	30	21	403.4
Dec	25	05	31	27.0	+27	20	27	405.0
Dec	26	06	25	04.6	+27	54	13	406.1
Dec	27	07	18	25.5	+27	10	12	406.5
Dec	28	08	10	26.5	+25	12	10	406.2
Dec	29	09	00	26.2	+22	08	05	405.3
Dec	30	09	48	13.9	+18	08	13	403.4
Dec	31	10	34	06.9	+13	23	27	400.7

MAP OF THE MOON



MOON PHASES

Lunation	NEW MOON Month	d	h m	FIRST QUARTER Month	d	h m	FULL MOON Month	d	h m	LAST QUARTER Month	d	h m
1002							January	7	2340	January	15	1246
1003	January	22	0505	January	29	1403	February	6	1647	February	13	2140
1004	February	20	1718	February	28	1124	March	7	0714	March	14	0501
1005	March	21	0641	March	29	0748	April	5	1903	April	12	1146
1006	April	19	2121	April	28	0132	May	5	0433	May	11	1904
1007	May	19	1252	May	27	1557	June	3	1220	June	10	0402
1008	June	18	0427	June	26	0308	July	2	1909	July	9	1534
1009	July	17	1924	July	25	1137	August	1	0205	August	8	0601
1010	August	16	0924	August	23	1812	August	30	1022	September	6	2311
1011	September	14	2229	September	21	2354	September	28	2109	October	6	1812
1012	October	14	1048	October	21	0559	October	28	1107	November	5	1353
1013	November	12	2227	November	19	1350	November	27	0407	December	5	0853
1014	December	12	0929	December	19	0040	December	26	2306			

Moon Facts

1. The Moon was probably created when an object the size of Mars crashed into Earth, shortly after the Solar System began forming about 4.5 billion years ago.

2. The Moon always shows us the same face. Long ago, the Earth's gravity slowed the Moon's rotation about its axis. Once the Moon's rotation slowed enough to match its orbital period (the time it takes the Moon to go around Earth) the effect steadied. Many of the moons around other planets behave similarly.

3. The Moon's heavily cratered surface is the result of intense bombardment by space rocks between 4.1 billion and 3.8 billion years ago. The craters are scars from this event. They have not changed much because, the Moon is not very geologically active, so earthquakes, volcanoes and mountain-building don't destroy the landscape as they do on Earth, and with virtually no atmosphere there is no wind or rain, so very little erosion occurs.

4. Apollo astronauts used seismometers during their visits to the Moon and discovered small moonquakes originating several kilometres below the surface. They are thought to be caused by the gravitational pull of Earth. Sometimes tiny fractures appear at the surface, and gas escapes.

5. The Moon probably has a small core that is hot and perhaps partially molten, as is Earth's core. It's between 2 and 4 percent of its mass which is tiny compared with Earth, in which the iron core makes up about 30 percent of the planet's mass.

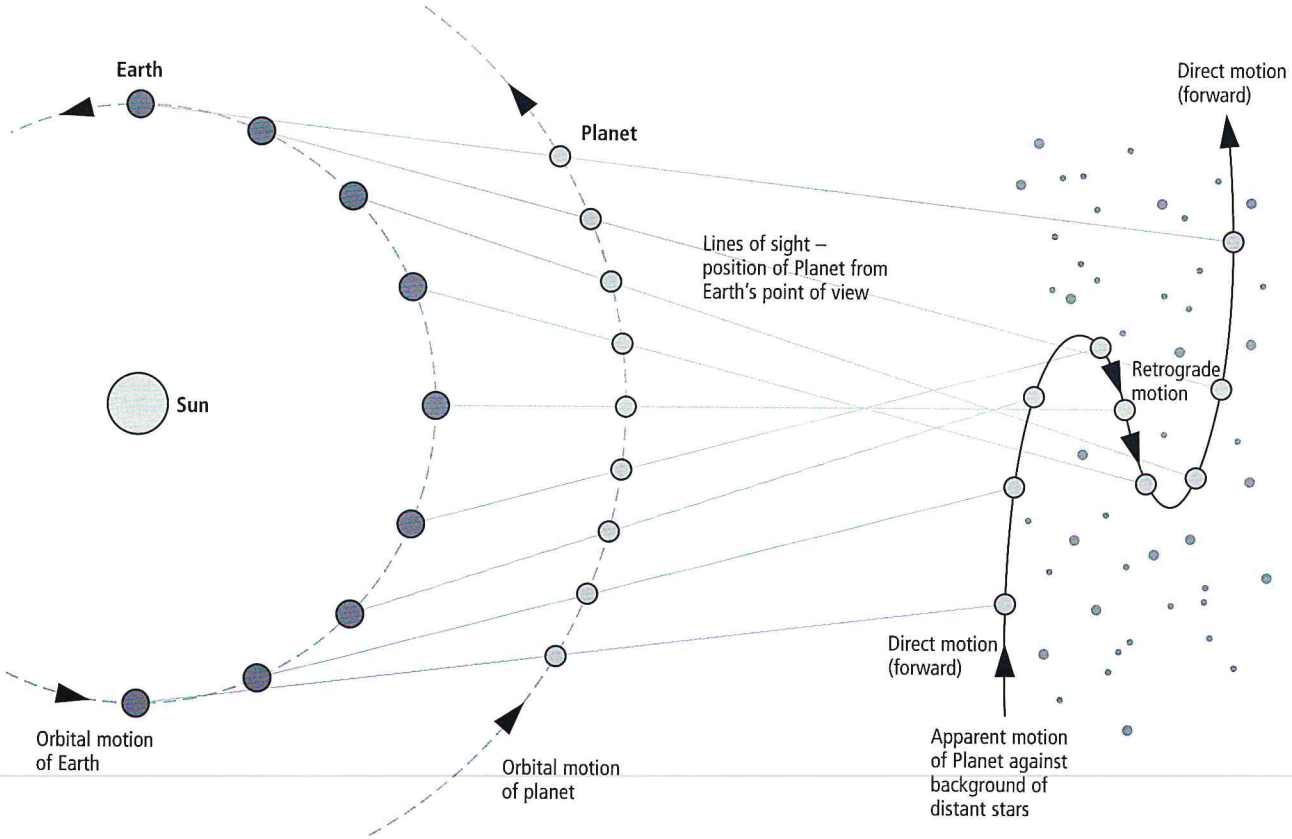
6. Tides on Earth are caused mostly by the Moon (the Sun has a smaller effect). The Moon's gravity pulls on Earth's oceans. High tide aligns with the Moon as Earth spins underneath. Another high tide occurs on the opposite side of the Earth because gravity pulls the Earth toward the Moon more than it pulls the water.

   At Full Moon and New Moon, the Sun, Earth and Moon are lined up, producing the higher than normal tides (called spring tides, for the way they spring up). When the Moon is at first or last quarter, smaller neap tides form. The Moon's 29.5-day orbit around Earth is not quite circular. When the Moon is closest to Earth (called its perigee), spring tides are even higher, and they're called perigean spring tides. This has another interesting effect: Some of Earth's rotational energy is lost to the Moon, causing our planet to slow down by about 1.5 milliseconds every century.

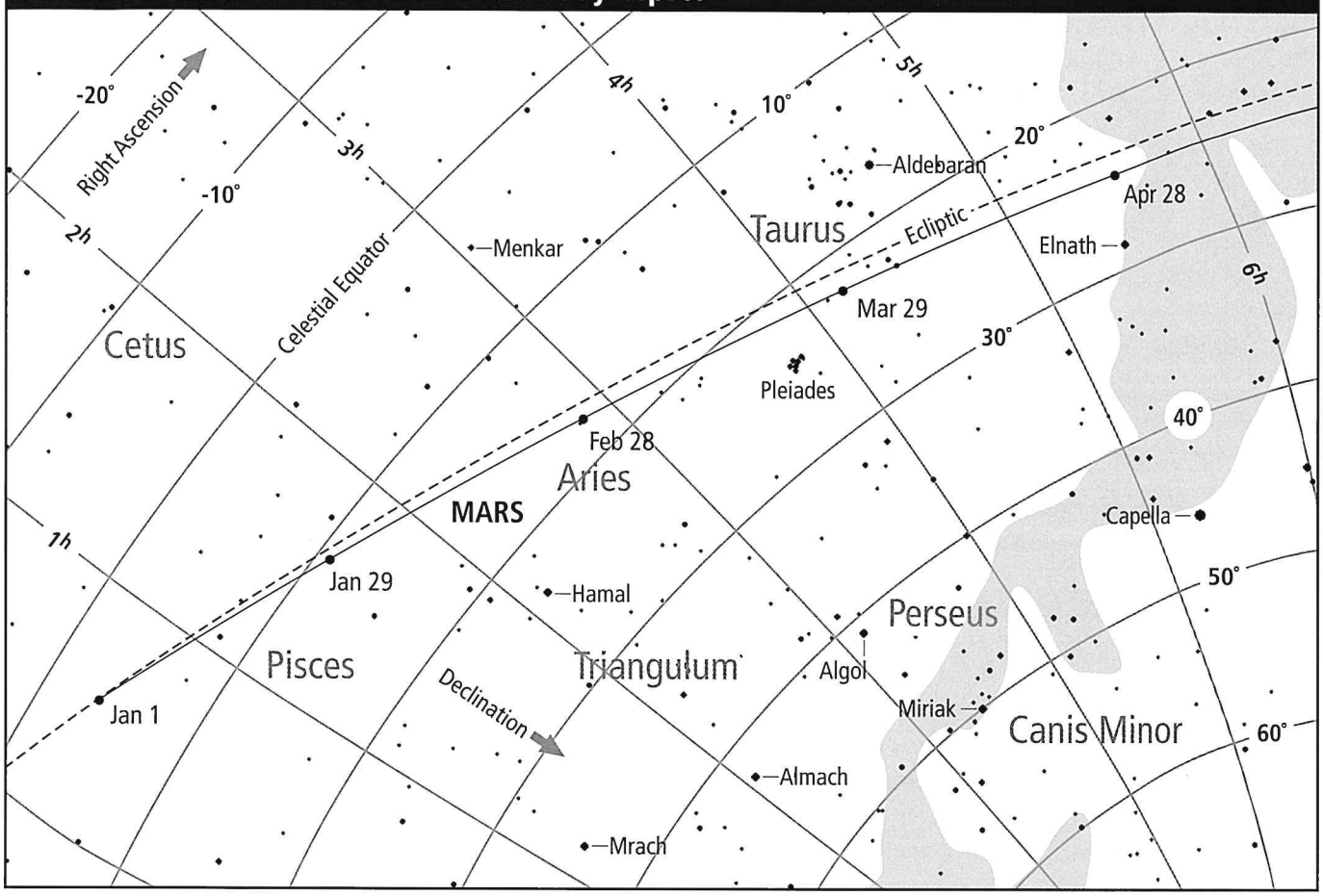
7. The Moon is moving away from the Earth. Each year, the Moon takes some of Earth's rotational energy, and uses it to propel itself about 38 mm higher in its orbit. When it formed, the Moon was about 22,530 km from Earth, but it's now more than 380,000 km away.

The Wandering Planets

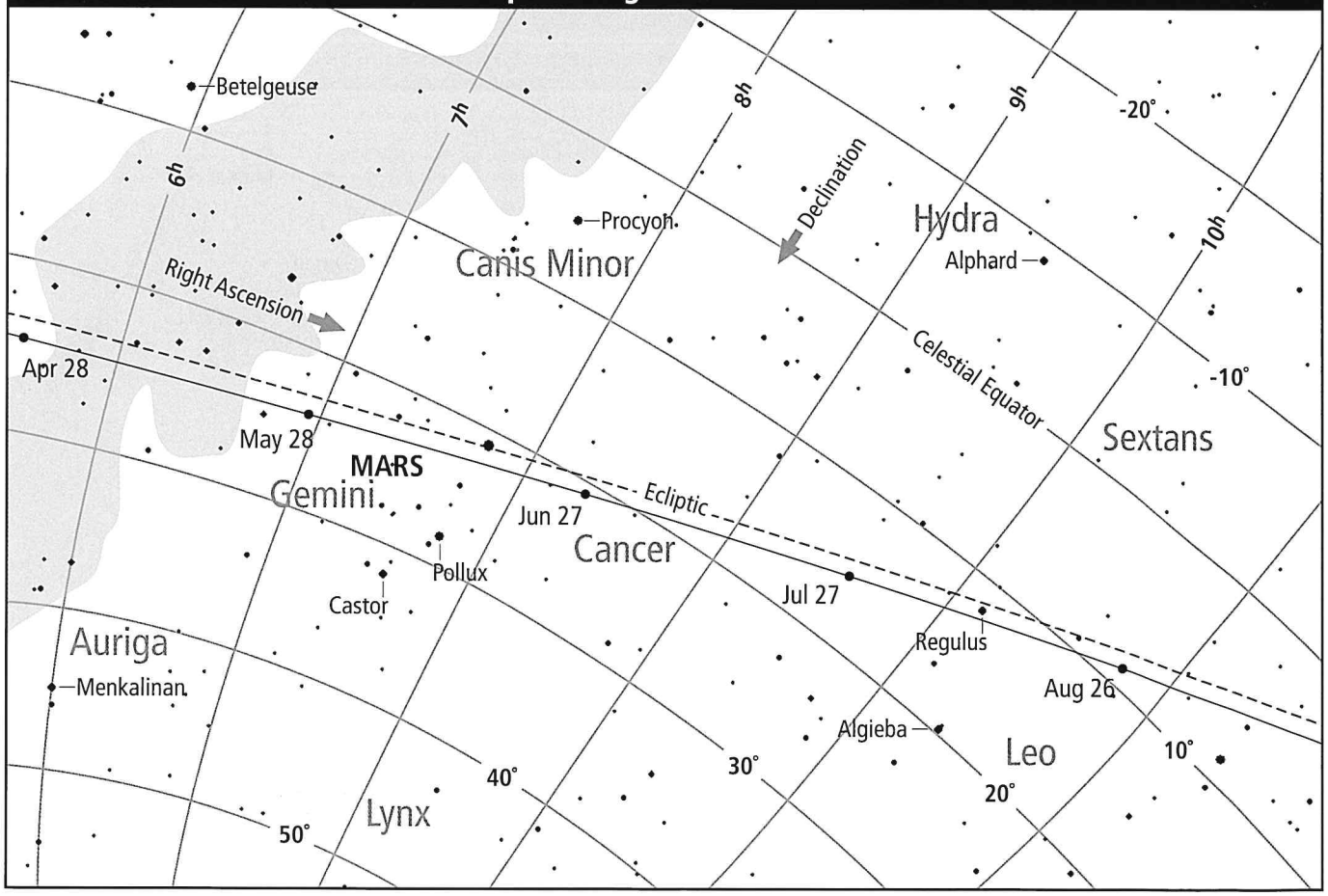
Diagram showing how the sky motion of a planet arises because of its different orbital speed to that of the Earth.



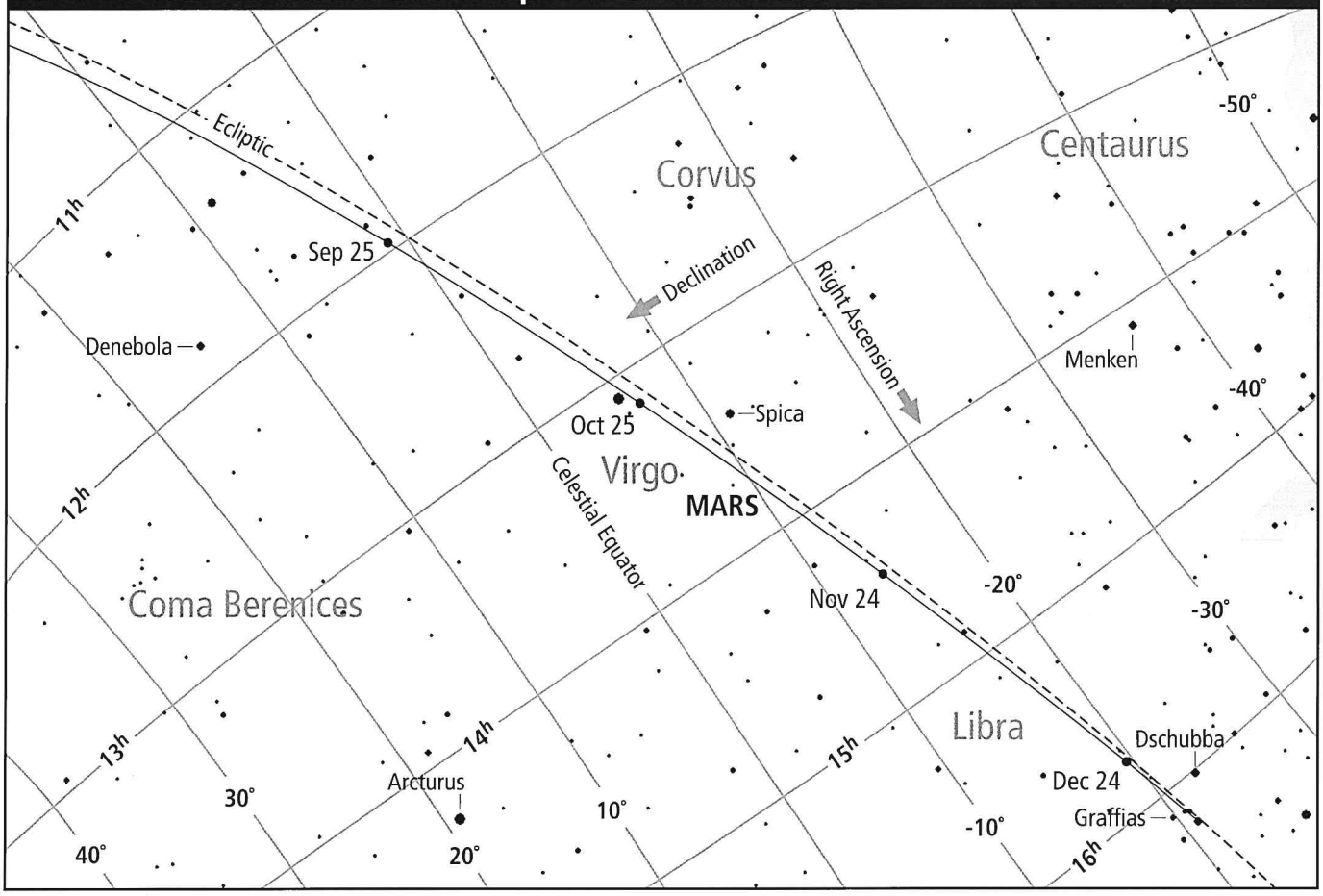
PLANET FINDER: MARS 2004 January-April



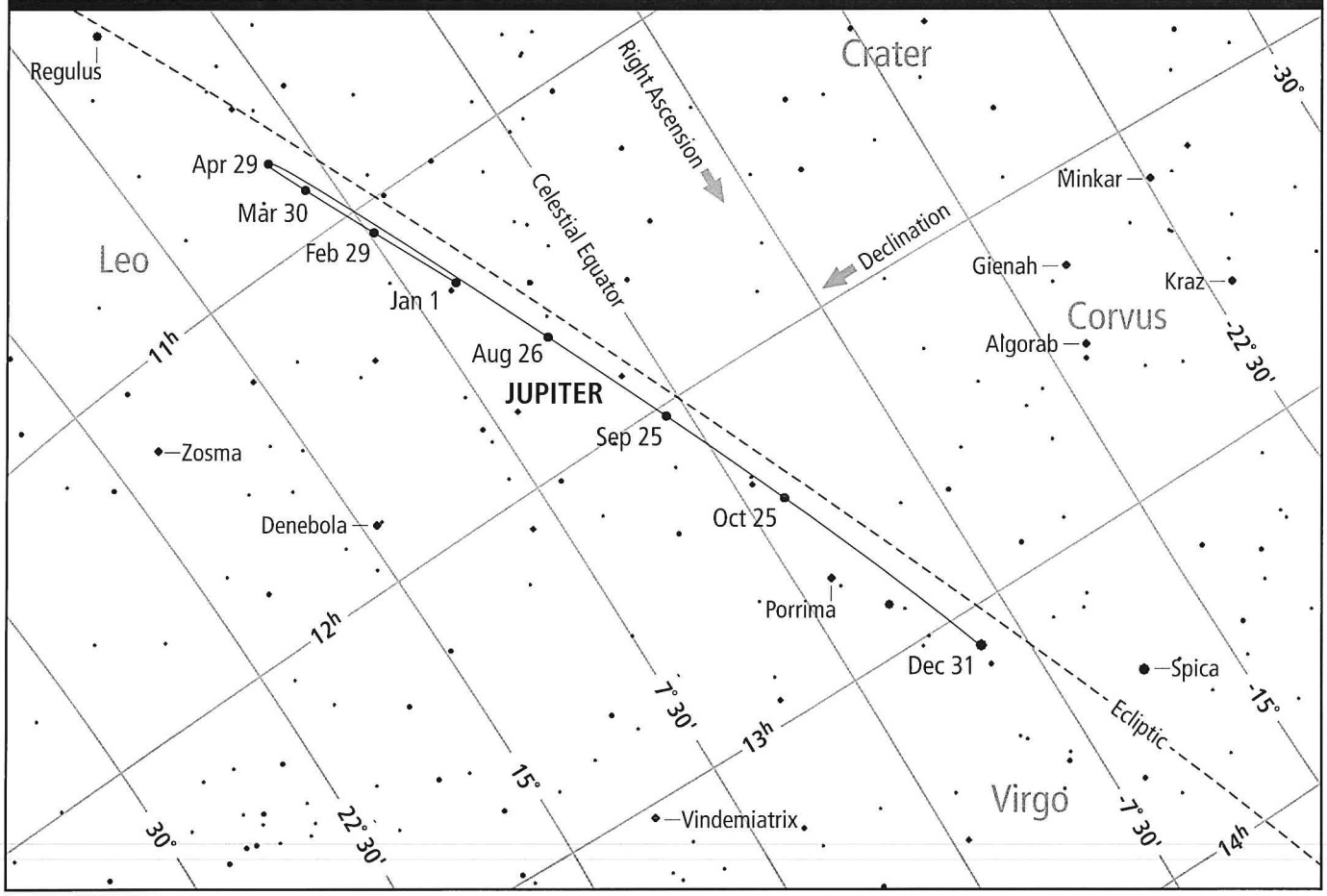
PLANET FINDER: MARS 2004 April-August



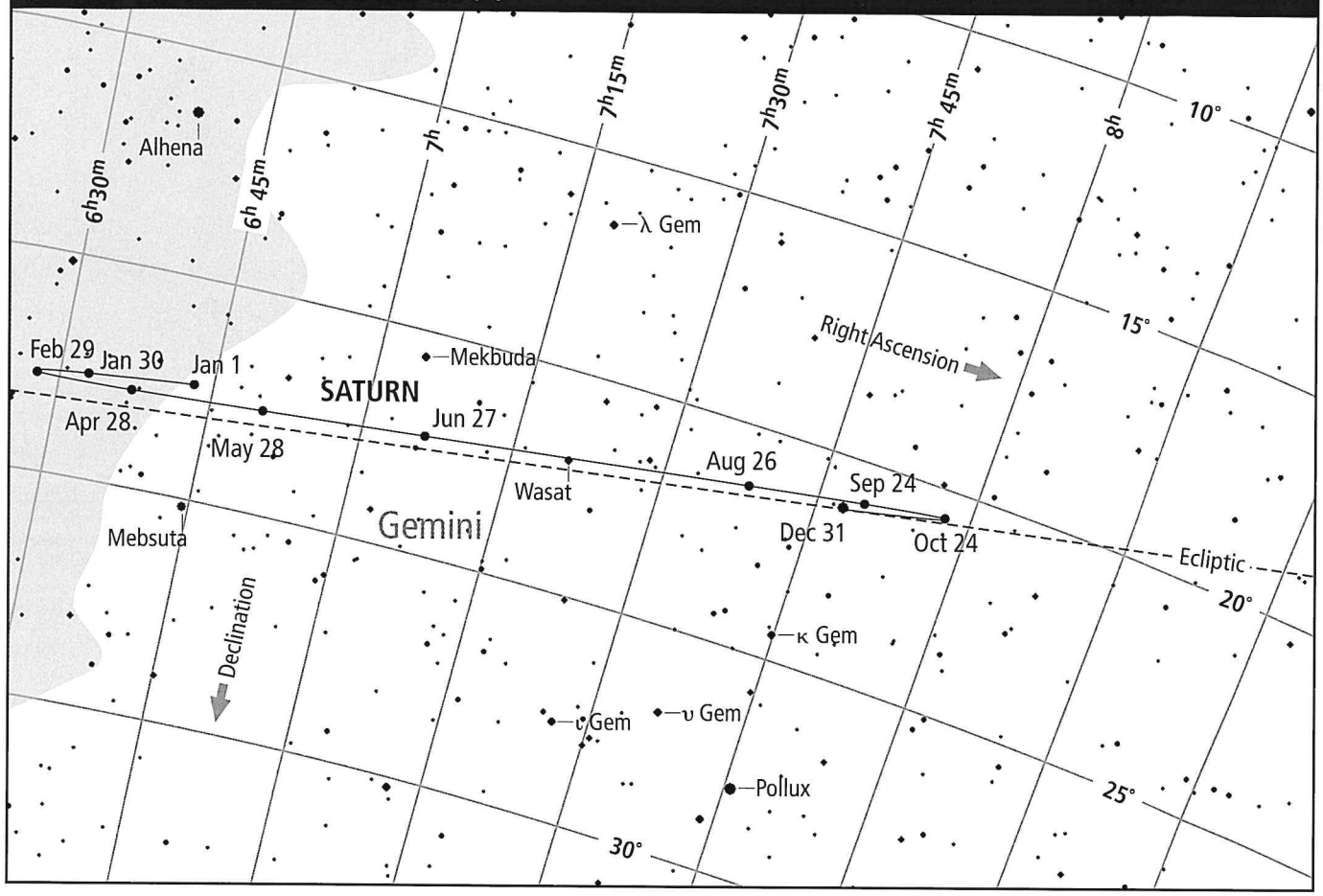
PLANET FINDER: MARS 2004 September-December



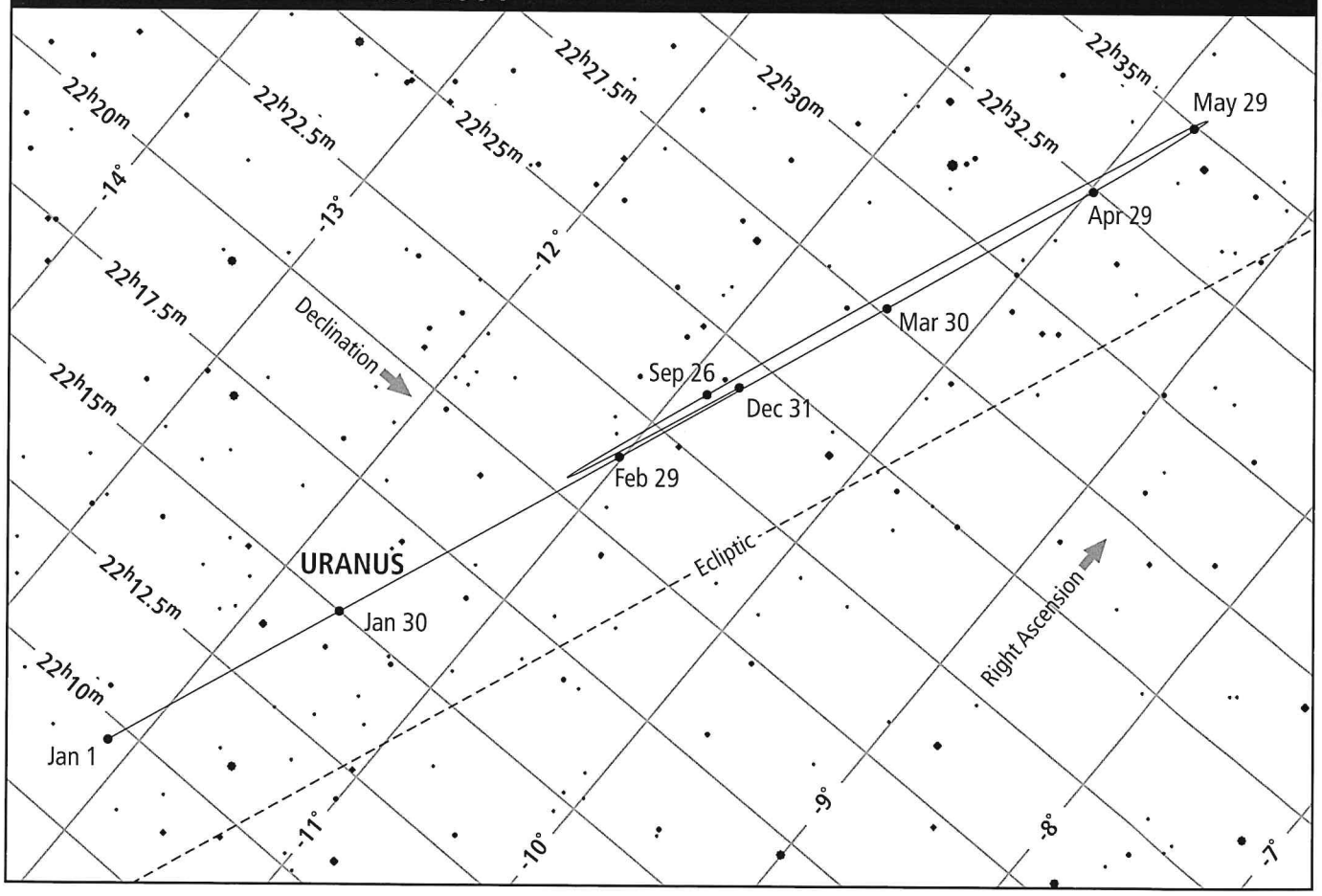
PLANET FINDER: JUPITER 2004



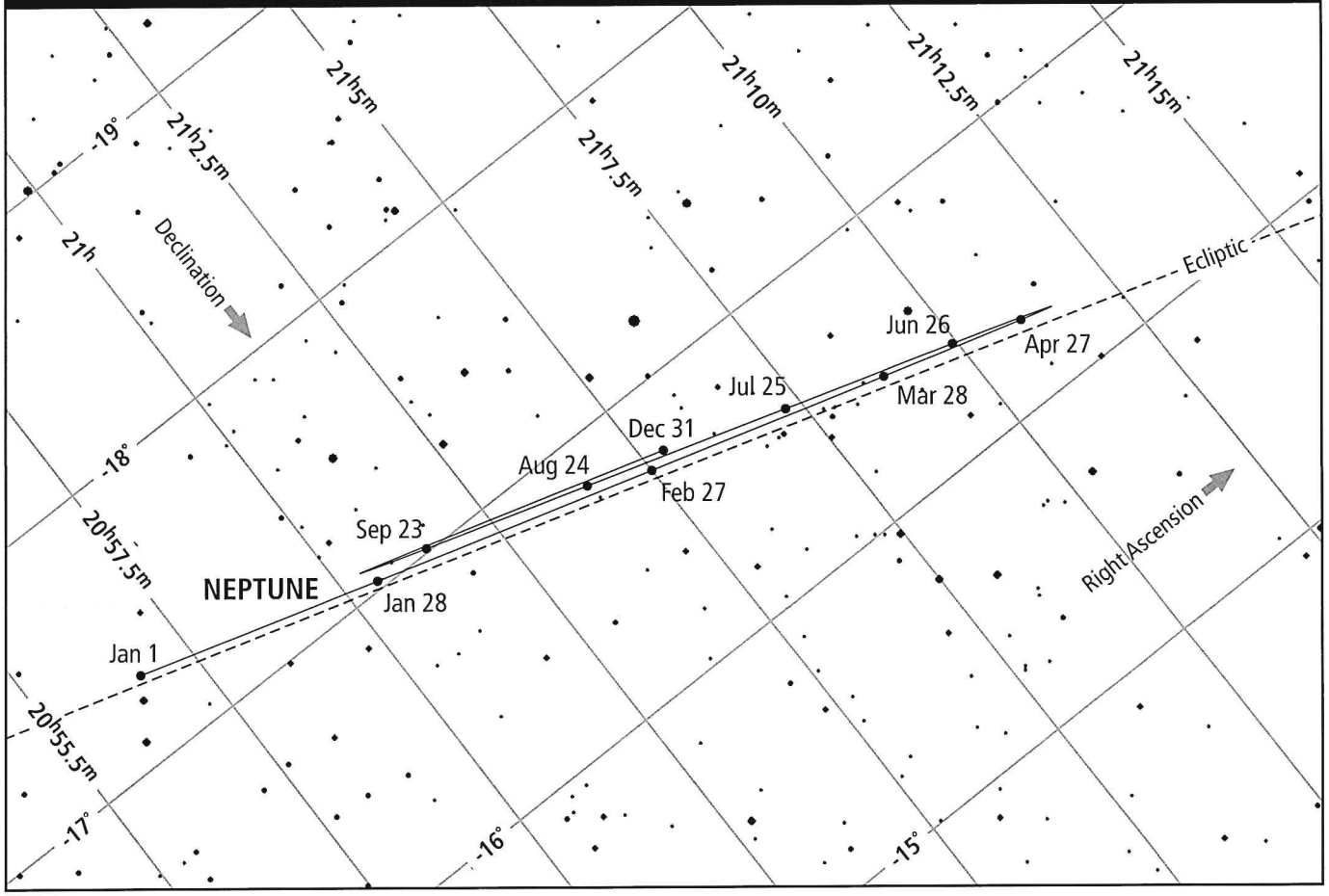
PLANET FINDER: SATURN 2004



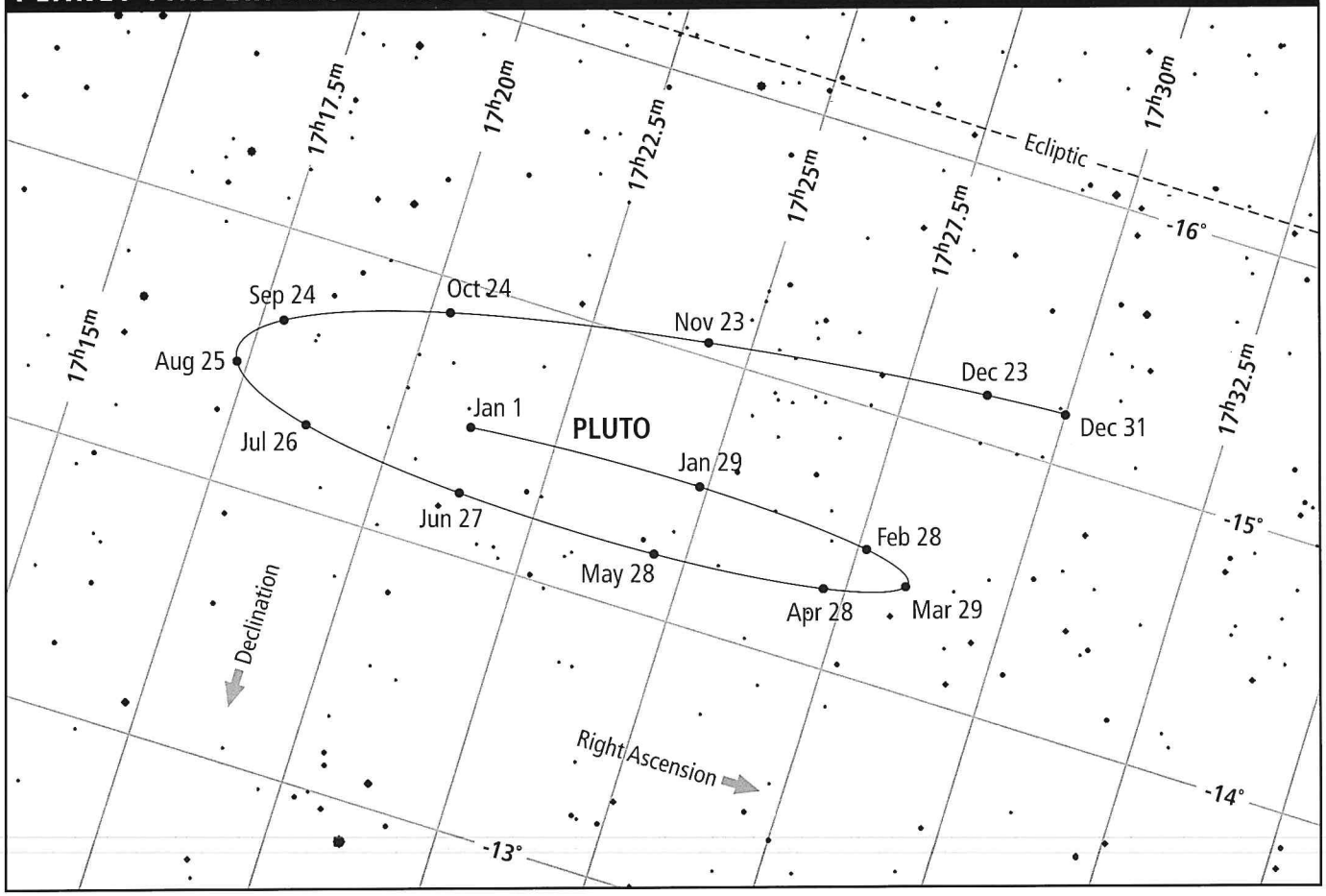
PLANET FINDER: URANUS 2004



PLANET FINDER: NEPTUNE 2004



PLANET FINDER: PLUTO 2004



PLANET POSITIONS Note: positions refer to 0000 WAST

MTH	DAY	MERCURY RA h m s	MERCURY Declination ° ′ ″	MERCURY Dist. (AU)	VENUS RA h m s	VENUS Declination ° ′ ″	VENUS Dist. (AU)	MARS RA h m s	MARS Declination ° ′ ″	MARS Dist. (AU)	JUPITER RA h m s	JUPITER Declination ° ′ ″	JUPITER Dist. (AU)
Jan	1	17 52 16.1	-20 15 17	0.713	21 08 01.5	-18 22 27	1.302	00 34 51.7	+03 50 29	1.117	11 20 52.2	+05 31 49	4.963
Jan	2	17 49 09.4	-20 13 24	0.727	21 12 57.3	-18 00 22	1.297	00 37 04.1	+04 06 05	1.126	11 20 53.9	+05 31 57	4.949
Jan	3	17 46 46.6	-20 13 28	0.743	21 17 51.6	-17 37 48	1.291	00 39 16.9	+04 21 41	1.135	11 20 54.9	+05 32 08	4.934
Jan	4	17 45 07.4	-20 15 24	0.760	21 22 44.5	-17 14 46	1.286	00 41 30.1	+04 37 16	1.144	11 20 55.2	+05 32 25	4.919
Jan	5	17 44 10.5	-20 19 02	0.779	21 27 35.9	-16 51 16	1.280	00 43 43.7	+04 52 50	1.153	11 20 54.7	+05 32 46	4.905
Jan	6	17 43 54.1	-20 24 10	0.798	21 32 25.8	-16 27 19	1.275	00 45 57.7	+05 08 22	1.162	11 20 53.6	+05 33 11	4.891
Jan	7	17 44 15.4	-20 30 35	0.818	21 37 14.3	-16 02 56	1.269	00 48 12.1	+05 23 54	1.171	11 20 51.7	+05 33 41	4.877
Jan	8	17 45 11.7	-20 38 04	0.838	21 42 01.4	-15 38 08	1.263	00 50 26.9	+05 39 24	1.180	11 20 49.2	+05 34 16	4.863
Jan	9	17 46 40.2	-20 46 24	0.858	21 46 47.1	-15 12 55	1.258	00 52 42.0	+05 54 52	1.189	11 20 45.9	+05 34 55	4.849
Jan	10	17 48 38.1	-20 55 21	0.879	21 51 31.3	-14 47 19	1.252	00 54 57.5	+06 10 19	1.198	11 20 41.9	+05 35 38	4.835
Jan	11	17 51 02.7	-21 04 43	0.899	21 56 14.2	-14 21 19	1.246	00 57 13.5	+06 25 44	1.207	11 20 37.2	+05 36 26	4.821
Jan	12	17 53 51.5	-21 14 19	0.919	22 00 55.7	-13 54 58	1.240	00 59 29.7	+06 41 07	1.216	11 20 31.8	+05 37 18	4.808
Jan	13	17 57 02.1	-21 23 60	0.939	22 05 35.9	-13 28 15	1.234	01 01 46.4	+06 56 28	1.225	11 20 25.6	+05 38 15	4.795
Jan	14	18 00 32.5	-21 33 35	0.959	22 10 14.8	-13 01 12	1.229	01 04 03.5	+07 11 47	1.234	11 20 18.8	+05 39 16	4.781
Jan	15	18 04 20.7	-21 42 55	0.978	22 14 52.4	-12 33 48	1.223	01 06 20.9	+07 27 04	1.243	11 20 11.2	+05 40 22	4.768
Jan	16	18 08 25.0	-21 51 54	0.997	22 19 28.7	-12 06 06	1.217	01 08 38.7	+07 42 19	1.252	11 20 03.0	+05 41 32	4.756
Jan	17	18 12 43.9	-22 00 25	1.016	22 24 03.7	-11 38 05	1.211	01 10 56.9	+07 57 31	1.261	11 19 54.0	+05 42 46	4.743
Jan	18	18 17 15.8	-22 08 21	1.034	22 28 37.6	-11 09 47	1.205	01 13 15.5	+08 12 41	1.270	11 19 44.4	+05 44 05	4.731
Jan	19	18 21 59.6	-22 15 38	1.052	22 33 10.3	-10 41 12	1.199	01 15 34.5	+08 27 48	1.280	11 19 34.0	+05 45 28	4.718
Jan	20	18 26 54.1	-22 22 10	1.069	22 37 41.8	-10 12 22	1.193	01 17 53.9	+08 42 52	1.289	11 19 23.0	+05 46 55	4.706
Jan	21	18 31 58.3	-22 27 53	1.086	22 42 12.1	-09 43 16	1.187	01 20 13.7	+08 57 53	1.298	11 19 11.2	+05 48 27	4.694
Jan	22	18 37 11.4	-22 32 44	1.102	22 46 41.4	-09 13 55	1.181	01 22 33.8	+09 12 52	1.307	11 18 58.8	+05 50 02	4.683
Jan	23	18 42 32.4	-22 36 39	1.118	22 51 09.5	-08 44 21	1.175	01 24 54.4	+09 27 47	1.316	11 18 45.8	+05 51 42	4.671
Jan	24	18 48 00.8	-22 39 35	1.134	22 55 36.6	-08 14 35	1.168	01 27 15.3	+09 42 40	1.325	11 18 32.0	+05 53 25	4.660
Jan	25	18 53 35.7	-22 41 30	1.149	23 00 02.7	-07 44 36	1.162	01 29 36.6	+09 57 28	1.335	11 18 17.7	+05 55 13	4.649
Jan	26	18 59 16.8	-22 42 21	1.163	23 04 27.8	-07 14 26	1.156	01 31 58.3	+10 12 14	1.344	11 18 02.6	+05 57 05	4.638
Jan	27	19 05 03.3	-22 42 07	1.177	23 08 51.8	-06 44 05	1.150	01 34 20.4	+10 26 55	1.353	11 17 47.0	+05 58 60	4.628
Jan	28	19 10 54.9	-22 40 45	1.190	23 13 15.0	-06 13 35	1.143	01 36 42.8	+10 41 33	1.362	11 17 30.7	+06 00 59	4.617
Jan	29	19 16 51.0	-22 38 14	1.203	23 17 37.2	-05 42 56	1.137	01 39 05.6	+10 56 07	1.371	11 17 13.8	+06 03 02	4.607
Jan	30	19 22 51.4	-22 34 32	1.216	23 21 58.5	-05 12 09	1.131	01 41 28.7	+11 10 37	1.381	11 16 56.3	+06 05 08	4.597
Jan	31	19 28 55.7	-22 29 37	1.228	23 26 19.0	-04 41 15	1.124	01 43 52.2	+11 25 02	1.390	11 16 38.2	+06 07 18	4.588
Feb	1	19 35 03.5	-22 23 30	1.240	23 30 38.7	-04 10 14	1.118	01 46 16.1	+11 39 24	1.399	11 16 19.5	+06 09 31	4.578
Feb	2	19 41 14.5	-22 16 09	1.251	23 34 57.6	-03 39 07	1.112	01 48 40.3	+11 53 40	1.408	11 16 00.2	+06 11 47	4.569
Feb	3	19 47 28.5	-22 07 32	1.262	23 39 15.7	-03 07 55	1.105	01 51 04.9	+12 07 52	1.417	11 15 40.4	+06 14 07	4.560
Feb	4	19 53 45.3	-21 57 39	1.272	23 43 33.1	-02 36 38	1.099	01 53 29.9	+12 21 60	1.427	11 15 20.1	+06 16 30	4.552
Feb	5	20 00 04.6	-21 46 29	1.282	23 47 49.8	-02 05 18	1.092	01 55 55.2	+12 36 02	1.436	11 14 59.2	+06 18 56	4.543
Feb	6	20 06 26.2	-21 34 01	1.291	23 52 05.8	-01 33 55	1.086	01 58 20.8	+12 49 60	1.445	11 14 37.7	+06 21 25	4.535
Feb	7	20 12 49.9	-21 20 16	1.300	23 56 21.3	-01 02 29	1.079	02 00 46.8	+13 03 52	1.454	11 14 15.8	+06 23 57	4.527
Feb	8	20 19 15.6	-21 05 11	1.309	00 00 36.1	-00 31 02	1.072	02 03 13.2	+13 17 39	1.463	11 13 53.4	+06 26 31	4.520
Feb	9	20 25 43.1	-20 48 47	1.317	00 04 50.4	+00 00 25	1.066	02 05 39.9	+13 31 21	1.473	11 13 30.5	+06 29 09	4.512
Feb	10	20 32 12.3	-20 31 04	1.324	00 09 04.2	+00 31 53	1.059	02 08 06.9	+13 44 58	1.482	11 13 07.1	+06 31 48	4.505
Feb	11	20 38 43.2	-20 11 60	1.332	00 13 17.4	+01 03 21	1.052	02 10 34.4	+13 58 29	1.491	11 12 43.3	+06 34 31	4.499
Feb	12	20 45 15.4	-19 51 35	1.339	00 17 30.3	+01 34 47	1.046	02 13 02.1	+14 11 54	1.500	11 12 19.0	+06 37 16	4.492
Feb	13	20 51 49.1	-19 29 49	1.345	00 21 42.7	+02 06 12	1.039	02 15 30.3	+14 25 14	1.509	11 11 54.3	+06 40 02	4.486
Feb	14	20 58 24.1	-19 06 43	1.351	00 25 54.7	+02 37 33	1.032	02 17 58.8	+14 38 27	1.519	11 11 29.2	+06 42 52	4.480
Feb	15	21 05 00.3	-18 42 14	1.356	00 30 06.4	+03 08 52	1.025	02 20 27.7	+14 51 35	1.528	11 11 03.7	+06 45 43	4.475
Feb	16	21 11 37.7	-18 16 25	1.361	00 34 17.7	+03 40 07	1.018	02 22 57.0	+15 04 37	1.537	11 10 37.9	+06 48 36	4.469
Feb	17	21 18 16.3	-17 49 13	1.366	00 38 28.8	+04 11 17	1.012	02 25 26.6	+15 17 33	1.546	11 10 11.6	+06 51 31	4.464
Feb	18	21 24 56.0	-17 20 39	1.370	00 42 39.5	+04 42 22	1.005	02 27 56.6	+15 30 23	1.555	11 09 45.1	+06 54 27	4.459
Feb	19	21 31 36.7	-16 50 43	1.374	00 46 50.1	+05 13 21	0.998	02 30 27.0	+15 43 06	1.565	11 09 18.2	+06 57 25	4.455
Feb	20	21 38 18.5	-16 19 25	1.377	00 51 00.4	+05 44 14	0.991	02 32 57.8	+15 55 43	1.574	11 08 51.1	+07 00 25	4.451
Feb	21	21 45 01.4	-15 46 45	1.379	00 55 10.5	+06 14 59	0.984	02 35 28.9	+16 08 13	1.583	11 08 23.6	+07 03 25	4.447
Feb	22	21 51 45.3	-15 12 43	1.382	00 59 20.4	+06 45 36	0.977	02 38 00.4	+16 20 37	1.592	11 07 55.9	+07 06 27	4.444
Feb	23	21 58 30.2	-14 37 19	1.383	01 03 30.1	+07 16 04	0.970	02 40 32.2	+16 32 54	1.601	11 07 28.0	+07 09 30	4.440
Feb	24	22 05 16.3	-14 00 34	1.384	01 07 39.7	+07 46 23	0.963	02 43 04.4	+16 45 04	1.610	11 06 59.8	+07 12 34	4.438
Feb	25	22 12 03.4	-13 22 27	1.384	01 11 49.2	+08 16 32	0.956	02 45 37.0	+16 57 06	1.619	11 06 31.5	+07 15 38	4.435
Feb	26	22 18 51.7	-12 42 60	1.384	01 15 58.5	+08 46 30	0.949	02 48 09.9	+17 09 02	1.628	11 06 03.0	+07 18 43	4.433
Feb	27	22 25 41.1	-12 02 12	1.383	01 20 07.7	+09 16 16	0.942	02 50 43.2	+17 20 51	1.638	11 05 34.3	+07 21 48	4.431
Feb	28	22 32 31.6	-11 20 05	1.382	01 24 16.9	+09 45 50	0.934	02 53 16.9	+17 32 32	1.647	11 05 05.6	+07 24 54	4.429
Feb	29	22 39 23.3	-10 36 39	1.379	01 28 25.9	+10 15 12	0.927	02 55 50.8	+17 44 05	1.656	11 04 36.7	+07 27 59	4.428
Mar	1	22 46 16.1	-09 51 55	1.376	01 32 34.9	+10 44 20	0.920	02 58 25.1	+17 55 31	1.665	11 04 07.7	+07 31 05	4.427
Mar	2	22 53 10.1	-09 05 56	1.373	01 36 43.8	+11 13 13	0.913	03 00 59.8	+18 06 49	1.674	11 03 38.6	+07 34 11	4.426
Mar	3	23 00 05.2	-08 18 43	1.368	01 40 52.6	+11 41 52	0.905	03 03 34.8	+18 17 59	1.683	11 03 09.5	+07 37 16	4.426
Mar	4	23 07 01.4	-07 30 17	1.362	01 45 01.4	+12 10 16	0.898	03 06 10.1	+18 29 02	1.692	11 02 40.4	+07 40 21	4.426
Mar	5	23 13 58.5	-06 40 42	1.356	01 49 10.2	+12 38 23	0.891	03 08 45.7	+18 39 56	1.701	11 02 11.3	+07 43 25	4.426
Mar	6	23 20 56.5	-05 50 02	1.349	01 53 18.8	+13 06 14	0.883	03 11 21.7	+18 50 42	1.710	11 01 42.2	+07 46 29	4.426
Mar	7	23 27 55.1	-04 58 19	1.340	01 57 27.5	+13 33 47	0.876	03 13 58.0	+19 01 20	1.719	11 01 13.1	+07 49 32	4.427

PLANET POSITIONS (continued)

Note: positions refer to 0000 WAST

		MERCURY							VENUS							MARS							JUPITER						
MTH	DAY	RA			Declination			Dist. (AU)	RA			Declination			Dist. (AU)	RA			Declination			Dist. (AU)	RA			Declination			Dist. (AU)
		h	m	s	°	′	″		h	m	s	°	′	″		h	m	s	°	′	″		h	m	s	°	′	″	
Mar	8	23	34	54.2	-04	05	38	1.331	02	01	36.1	+14	01	02	0.869	03	16	34.6	+19	11	49	1.727	11	00	44.1	+07	52	34	4.429
Mar	9	23	41	53.4	-03	12	05	1.320	02	05	44.6	+14	27	59	0.861	03	19	11.5	+19	22	10	1.736	11	00	15.1	+07	55	35	4.430
Mar	10	23	48	52.4	-02	17	45	1.308	02	09	53.1	+14	54	37	0.854	03	21	48.8	+19	32	23	1.745	10	59	46.3	+07	58	35	4.432
Mar	11	23	55	50.7	-01	22	47	1.295	02	14	01.5	+15	20	55	0.846	03	24	26.4	+19	42	27	1.754	10	59	17.5	+08	01	34	4.434
Mar	12	00	02	47.8	-00	27	18	1.281	02	18	09.9	+15	46	53	0.839	03	27	04.3	+19	52	22	1.763	10	58	48.9	+08	04	31	4.436
Mar	13	00	09	42.9	+00	28	31	1.266	02	22	18.2	+16	12	30	0.832	03	29	42.5	+20	02	08	1.772	10	58	20.5	+08	07	27	4.439
Mar	14	00	16	35.3	+01	24	31	1.249	02	26	26.5	+16	37	46	0.824	03	32	21.1	+20	11	46	1.781	10	57	52.2	+08	10	22	4.442
Mar	15	00	23	24.0	+02	20	30	1.231	02	30	34.6	+17	02	40	0.817	03	34	59.9	+20	21	15	1.789	10	57	24.1	+08	13	14	4.445
Mar	16	00	30	08.0	+03	16	14	1.212	02	34	42.6	+17	27	11	0.809	03	37	39.1	+20	30	35	1.798	10	56	56.3	+08	16	05	4.449
Mar	17	00	36	46.2	+04	11	30	1.192	02	38	50.5	+17	51	20	0.801	03	40	18.6	+20	39	46	1.807	10	56	28.7	+08	18	53	4.453
Mar	18	00	43	17.3	+05	06	03	1.170	02	42	58.2	+18	15	05	0.794	03	42	58.5	+20	48	47	1.816	10	56	01.3	+08	21	40	4.457
Mar	19	00	49	39.8	+05	59	38	1.147	02	47	05.7	+18	38	26	0.786	03	45	38.6	+20	57	40	1.824	10	55	34.2	+08	24	25	4.462
Mar	20	00	55	52.3	+06	51	59	1.123	02	51	12.9	+19	01	23	0.779	03	48	19.1	+21	06	23	1.833	10	55	07.4	+08	27	07	4.467
Mar	21	01	01	53.3	+07	42	51	1.099	02	55	19.9	+19	23	55	0.771	03	50	59.8	+21	14	56	1.842	10	54	41.0	+08	29	46	4.472
Mar	22	01	07	41.3	+08	31	58	1.073	02	59	26.5	+19	46	01	0.763	03	53	40.8	+21	23	20	1.851	10	54	14.8	+08	32	23	4.477
Mar	23	01	13	14.8	+09	19	05	1.047	03	03	32.8	+20	07	41	0.756	03	56	22.2	+21	31	35	1.859	10	53	49.0	+08	34	58	4.483
Mar	24	01	18	32.1	+10	03	58	1.021	03	07	38.6	+20	28	55	0.748	03	59	03.8	+21	39	40	1.868	10	53	23.6	+08	37	30	4.489
Mar	25	01	23	31.8	+10	46	24	0.994	03	11	44.0	+20	49	42	0.740	04	01	45.7	+21	47	35	1.876	10	52	58.6	+08	39	58	4.495
Mar	26	01	28	12.6	+11	26	10	0.967	03	15	48.7	+21	10	01	0.733	04	04	27.8	+21	55	20	1.885	10	52	34.0	+08	42	24	4.502
Mar	27	01	32	33.1	+12	03	07	0.940	03	19	52.9	+21	29	53	0.725	04	07	10.2	+22	02	55	1.893	10	52	09.8	+08	44	47	4.508
Mar	28	01	36	32.1	+12	37	03	0.913	03	23	56.4	+21	49	16	0.717	04	09	52.9	+22	10	21	1.902	10	51	46.0	+08	47	07	4.515
Mar	29	01	40	08.7	+13	07	50	0.887	03	27	59.1	+22	08	10	0.709	04	12	35.8	+22	17	36	1.910	10	51	22.7	+08	49	24	4.523
Mar	30	01	43	21.7	+13	35	20	0.861	03	32	00.9	+22	26	36	0.702	04	15	19.0	+22	24	41	1.919	10	50	59.9	+08	51	37	4.530
Mar	31	01	46	10.5	+13	59	26	0.835	03	36	01.9	+22	44	32	0.694	04	18	02.4	+22	31	36	1.927	10	50	37.6	+08	53	47	4.538
Apr	1	01	48	34.4	+14	20	03	0.811	03	40	01.8	+23	01	58	0.686	04	20	46.0	+22	38	20	1.935	10	50	15.7	+08	55	54	4.547
Apr	2	01	50	33.0	+14	37	05	0.787	03	44	00.6	+23	18	55	0.678	04	23	29.9	+22	44	54	1.944	10	49	54.3	+08	57	57	4.555
Apr	3	01	52	06.0	+14	50	28	0.764	03	47	58.2	+23	35	21	0.671	04	26	13.9	+22	51	18	1.952	10	49	33.5	+08	59	56	4.564
Apr	4	01	53	13.5	+15	00	09	0.742	03	51	54.5	+23	51	17	0.663	04	28	58.2	+22	57	31	1.960	10	49	13.2	+09	01	52	4.572
Apr	5	01	53	55.6	+15	06	06	0.721	03	55	49.4	+24	06	42	0.655	04	31	42.6	+23	03	34	1.969	10	48	53.4	+09	03	45	4.582
Apr	6	01	54	12.9	+15	08	18	0.701	03	59	42.7	+24	21	36	0.647	04	34	27.3	+23	09	26	1.977	10	48	34.2	+09	05	33	4.591
Apr	7	01	54	06.0	+15	06	46	0.683	04	03	34.5	+24	35	58	0.639	04	37	12.2	+23	15	07	1.985	10	48	15.6	+09	07	18	4.601
Apr	8	01	53	36.1	+15	01	33	0.666	04	07	24.5	+24	49	50	0.632	04	39	57.2	+23	20	38	1.993	10	47	57.5	+09	08	60	4.610
Apr	9	01	52	44.6	+14	52	43	0.650	04	11	12.6	+25	03	11	0.624	04	42	42.4	+23	25	58	2.001	10	47	40.0	+09	10	37	4.620
Apr	10	01	51	33.1	+14	40	24	0.635	04	14	58.8	+25	15	60	0.616	04	45	27.8	+23	31	07	2.009	10	47	23.1	+09	12	11	4.631
Apr	11	01	50	03.6	+14	24	46	0.622	04	18	42.9	+25	28	17	0.608	04	48	13.4	+23	36	06	2.017	10	47	06.7	+09	13	40	4.641
Apr	12	01	48	18.4	+14	06	02	0.611	04	22	24.7	+25	40	03	0.601	04	50	59.2	+23	40	53	2.025	10	46	51.0	+09	15	06	4.652
Apr	13	01	46	20.1	+13	44	28	0.601	04	26	04.2	+25	51	18	0.593	04	53	45.1	+23	45	30	2.033	10	46	36.0	+09	16	28	4.663
Apr	14	01	44	11.3	+13	20	23	0.592	04	29	41.1	+26	02	01	0.585	04	56	31.2	+23	49	56	2.041	10	46	21.5	+09	17	45	4.674
Apr	15	01	41	54.9	+12	54	09	0.585	04	33	15.4	+26	12	13	0.577	04	59	17.4	+23	54	11	2.049	10	46	07.7	+09	18	59	4.685
Apr	16	01	39	33.8	+12	26	10	0.580	04	36	46.8	+26	21	53	0.570	05	02	03.8	+23	58	15	2.057	10	45	54.5	+09	20	08	4.697
Apr	17	01	37	11.1	+11	56	52	0.575	04	40	15.2	+26	31	02	0.562	05	04	50.4	+24	02	08	2.065	10	45	42.0	+09	21	14	4.709
Apr	18	01	34	49.5	+11	26	41	0.573	04	43	40.4	+26	39	39	0.554	05	07	37.0	+24	05	50	2.073	10	45	30.1	+09	22	15	4.721
Apr	19	01	32	31.7	+10	56	05	0.571	04	47	02.3	+26	47	45	0.547	05	10	23.8	+24	09	21	2.081	10	45	18.9	+09	23	12	4.733
Apr	20	01	30	20.4	+10	25	32	0.571	04	50	20.5	+26	55	20	0.539	05	13	10.7	+24	12	40	2.088	10	45	08.3	+09	24	05	4.745
Apr	21	01	28	17.8	+09	55	26	0.572	04	53	35.0	+27	02	24	0.532	05	15	57.7	+24	15	49	2.096	10	44	58.5	+09	24	54	4.757
Apr	22	01	26	26.0	+09	26	13	0.575	04	56	45.5	+27	08	58	0.524	05	18	44.8	+24	18	46	2.104	10	44	49.3	+09	25	38	4.770
Apr	23	01	24	46.6	+08	58	14	0.578	04	59	51.8	+27	14	60	0.516	05	21	32.0	+24	21	32	2.112	10	44	40.7	+09	26	18	4.783
Apr	24	01	23	21.2	+08	31	48	0.583	05	02	53.6	+27	20	32	0.509	05	24	19.3	+24	24	07	2.119	10	44	32.9	+09	26	54	4.796
Apr	25	01	22	10.7	+08	07	13	0.588	05	05	50.8	+27	25	33	0.501	05	27	06.6	+24	26	30	2.127	10	44	25.8	+09	27	26	4.809
Apr	26	01	21	16.2	+07	44	41	0.595	05	08	43.1	+27	30	04	0.494	05	29	54.0	+24	28	42	2.134	10	44	19.3	+09	27	53	4.822
Apr	27	01	20	38.2	+07	24	24	0.602	05	11	30.3	+27	34	05	0.487	05	32	41.4	+24	30	43	2.142	10	44	13.5	+09	28	16	4.836
Apr	28	01	20	17.0	+07	06	31	0.611	05	14	12.0	+27	37	36	0.479	05	35	28.9	+24	32	33	2.149	10	44	08.5	+09	28	35	4.849
Apr	29	01	20	12.8	+06	51	06	0.620	05	16	48.1	+27	40	38	0.472	05	38	16.4	+24	34	11	2.156	10	44	04.1	+09	28	50	4.863
Apr	30	01	20	25.7	+06	38	15	0.630	05	19	18.3	+27	43	10	0.465	05	41	03.9	+24	35	38	2.164	10	44	00.4	+09	29	00	4.877
May	1	01	20	55.4	+06	27	57	0.640	05	21	42.3	+27	45	12	0.458	05	43	51.4	+24	36	53	2.171	10	43	57.4	+09	29	06	4.891
May	2	01	21	41.7	+06	20	14	0.652	05	23	59.9	+27	46	45	0.450	05	46	39.0	+24	37	58	2.178	10	43	55.1	+09	29	08	4.905
May	3	01	22	44.4	+06	15	05	0.663	05	26	10.7	+27	47	49	0.443	05	49	26.5	+24	38	51	2.186	10	43	53.4	+09	29	06	4.919
May	4	01	24	02.8	+06	12	26	0.676	05	28	14.5	+27	48	25	0.436	05	52	14.0	+24	39	32	2.193	10	43	52.5	+09	28	59	4.933
May	5	01	25	36.7	+06	12	15	0.688	05	30	11.1	+27	48	31	0.429	05	55	01.5	+24	40	02	2.200	10	43	52.2	+09	28	49	4.948
May	6	01	27	25.6	+06	14	27	0.702	05	32	00.1	+27	48	08	0.423	05	57	48.9	+24	40	21	2.207	10	43	52.7	+09	28	34	4.962
May	7	01	29	29.0	+06	18	60	0.715	05	33	41.3	+27	47	17	0.416	06	00	36.3	+24	40	29	2.214	10	43	53.8	+09	28	15	4.977
May	8	01	31	46.3	+06	25	46	0.729	05	35	14.4	+27	45	57	0.409	06	03	23.7	+24	40	25	2.221	10	43	55.6	+09	27	52	4.991
May	9	01	34	17.2	+06	34	42	0.744	05	36	39.1	+27	44	08	0.403	06	06	11.1	+24	40	10	2.228	10	43	58.1	+09	27	24	5.006
May	10	01	37	01.1	+06	45	43	0.759	05	37	55.2	+27	41	50	0.396	06	08	58.3	+24	39	44	2.235	10	44	01.2	+09	26	53	5.021
May	11	01	39	57.7	+06	58	42	0.774	05	39	02.5	+27	39	03	0.390	06	11	45.6	+24	39	06	2.242	10	44	05.0	+09	26	18	5.036
May	12	01	43	06.5	+07	13	36	0.789	05	40	00.5	+27	35	47	0.384	06	14	32.8	+24	38	18	2.249	10	44	09.5	+09	25	38	5.051
May	13	01	46	27.2	+07	30	17	0.805	05	40	49.2	+27	32	00	0.378	06	17	19.9	+24	37	18	2.255	10	44	14.7	+09	24	55	5.066

PLANET POSITIONS (continued)

MTH	DAY	MERCURY							VENUS							MARS							JUPITER						
		RA			Declination			Dist.	RA			Declination			Dist.	RA			Declination			Dist.	RA			Declination			Dist.
		h	m	s	°	′	″	(AU)	h	m	s	°	′	″	(AU)	h	m	s	°	′	″	(AU)	h	m	s	°	′	″	(AU)
May	14	01	49	59.5	+07	48	42	0.821	05	41	28.3	+27	27	44	0.372	06	20	06.9	+24	36	07	2.262	10	44	20.6	+09	24	07	5.082
May	15	01	53	42.9	+08	08	44	0.837	05	41	57.5	+27	22	56	0.366	06	22	53.9	+24	34	44	2.269	10	44	27.1	+09	23	16	5.097
May	16	01	57	37.4	+08	30	19	0.854	05	42	16.6	+27	17	38	0.360	06	25	40.7	+24	33	11	2.276	10	44	34.3	+09	22	20	5.112
May	17	02	01	42.7	+08	53	23	0.870	05	42	25.5	+27	11	47	0.354	06	28	27.5	+24	31	26	2.282	10	44	42.1	+09	21	20	5.128
May	18	02	05	58.5	+09	17	49	0.887	05	42	24.0	+27	05	25	0.349	06	31	14.2	+24	29	30	2.289	10	44	50.6	+09	20	17	5.143
May	19	02	10	24.8	+09	43	33	0.904	05	42	11.9	+26	58	28	0.344	06	34	00.7	+24	27	24	2.295	10	44	59.8	+09	19	09	5.159
May	20	02	15	01.5	+10	10	30	0.921	05	41	49.1	+26	50	58	0.339	06	36	47.1	+24	25	06	2.302	10	45	09.6	+09	17	58	5.174
May	21	02	19	48.5	+10	38	36	0.939	05	41	15.7	+26	42	53	0.334	06	39	33.4	+24	22	37	2.308	10	45	20.1	+09	16	43	5.190
May	22	02	24	45.8	+11	07	45	0.956	05	40	31.6	+26	34	13	0.329	06	42	19.6	+24	19	57	2.315	10	45	31.2	+09	15	23	5.205
May	23	02	29	53.4	+11	37	53	0.974	05	39	36.8	+26	24	56	0.325	06	45	05.5	+24	17	06	2.321	10	45	42.9	+09	14	00	5.221
May	24	02	35	11.4	+12	08	56	0.992	05	38	31.6	+26	15	03	0.321	06	47	51.4	+24	14	05	2.327	10	45	55.3	+09	12	34	5.237
May	25	02	40	39.9	+12	40	47	1.010	05	37	16.0	+26	04	31	0.317	06	50	37.1	+24	10	52	2.333	10	46	08.3	+09	11	03	5.252
May	26	02	46	18.9	+13	13	23	1.027	05	35	50.3	+25	53	22	0.313	06	53	22.5	+24	07	29	2.339	10	46	21.9	+09	09	29	5.268
May	27	02	52	08.7	+13	46	37	1.045	05	34	14.9	+25	41	35	0.309	06	56	07.9	+24	03	55	2.346	10	46	36.2	+09	07	51	5.284
May	28	02	58	09.4	+14	20	25	1.063	05	32	30.2	+25	29	10	0.306	06	58	53.0	+24	00	10	2.352	10	46	51.0	+09	06	09	5.300
May	29	03	04	21.2	+14	54	41	1.081	05	30	36.7	+25	16	08	0.303	07	01	37.9	+23	56	15	2.358	10	47	06.4	+09	04	24	5.315
May	30	03	10	44.3	+15	29	19	1.099	05	28	34.9	+25	02	28	0.300	07	04	22.6	+23	52	08	2.364	10	47	22.5	+09	02	35	5.331
May	31	03	17	19.0	+16	04	12	1.116	05	26	25.6	+24	48	12	0.298	07	07	07.1	+23	47	52	2.370	10	47	39.1	+09	00	42	5.347
Jun	1	03	24	05.4	+16	39	14	1.133	05	24	09.5	+24	33	22	0.296	07	09	51.4	+23	43	25	2.375	10	47	56.3	+08	58	46	5.363
Jun	2	03	31	03.8	+17	14	17	1.151	05	21	47.4	+24	17	59	0.294	07	12	35.5	+23	38	47	2.381	10	48	14.1	+08	56	47	5.378
Jun	3	03	38	14.5	+17	49	13	1.167	05	19	20.3	+24	02	06	0.292	07	15	19.3	+23	33	59	2.387	10	48	32.5	+08	54	44	5.394
Jun	4	03	45	37.5	+18	23	55	1.184	05	16	49.0	+23	45	45	0.291	07	18	03.0	+23	29	01	2.393	10	48	51.4	+08	52	37	5.410
Jun	5	03	53	13.0	+18	58	13	1.200	05	14	14.7	+23	29	01	0.290	07	20	46.3	+23	23	53	2.398	10	49	10.9	+08	50	27	5.425
Jun	6	04	01	01.0	+19	31	58	1.215	05	11	38.3	+23	11	57	0.289	07	23	29.5	+23	18	34	2.404	10	49	30.9	+08	48	14	5.441
Jun	7	04	09	01.6	+20	04	58	1.230	05	09	00.9	+22	54	36	0.289	07	26	12.4	+23	13	05	2.410	10	49	51.5	+08	45	58	5.457
Jun	8	04	17	14.6	+20	37	04	1.244	05	06	23.5	+22	37	05	0.289	07	28	55.1	+23	07	26	2.415	10	50	12.7	+08	43	38	5.472
Jun	9	04	25	39.8	+21	08	04	1.257	05	03	47.2	+22	19	26	0.289	07	31	37.6	+23	01	37	2.420	10	50	34.3	+08	41	15	5.488
Jun	10	04	34	16.7	+21	37	46	1.269	05	01	13.0	+22	01	46	0.290	07	34	19.8	+22	55	39	2.426	10	50	56.5	+08	38	49	5.504
Jun	11	04	43	04.9	+22	05	58	1.280	04	58	41.9	+21	44	10	0.291	07	37	01.7	+22	49	30	2.431	10	51	19.3	+08	36	19	5.519
Jun	12	04	52	03.5	+22	32	28	1.291	04	56	14.8	+21	26	42	0.292	07	39	43.4	+22	43	11	2.437	10	51	42.5	+08	33	46	5.535
Jun	13	05	01	11.8	+22	57	04	1.299	04	53	52.6	+21	09	27	0.293	07	42	24.9	+22	36	43	2.442	10	52	06.3	+08	31	11	5.550
Jun	14	05	10	28.7	+23	19	34	1.307	04	51	36.0	+20	52	31	0.295	07	45	06.1	+22	30	05	2.447	10	52	30.6	+08	28	32	5.565
Jun	15	05	19	52.8	+23	39	47	1.313	04	49	25.8	+20	35	59	0.297	07	47	47.0	+22	23	17	2.452	10	52	55.4	+08	25	49	5.581
Jun	16	05	29	22.9	+23	57	35	1.318	04	47	22.6	+20	19	54	0.300	07	50	27.7	+22	16	20	2.457	10	53	20.7	+08	23	04	5.596
Jun	17	05	38	57.3	+24	12	49	1.322	04	45	27.1	+20	04	21	0.302	07	53	08.1	+22	09	13	2.462	10	53	46.4	+08	20	16	5.611
Jun	18	05	48	34.7	+24	25	22	1.324	04	43	39.7	+19	49	24	0.305	07	55	48.2	+22	01	57	2.467	10	54	12.7	+08	17	25	5.626
Jun	19	05	58	13.2	+24	35	09	1.324	04	42	00.8	+19	35	05	0.308	07	58	28.1	+21	54	31	2.472	10	54	39.5	+08	14	30	5.642
Jun	20	06	07	51.2	+24	42	08	1.323	04	40	30.9	+19	21	29	0.312	08	01	07.6	+21	46	56	2.477	10	55	06.7	+08	11	33	5.657
Jun	21	06	17	27.2	+24	46	16	1.321	04	39	10.1	+19	08	37	0.316	08	03	46.9	+21	39	12	2.482	10	55	34.4	+08	08	33	5.672
Jun	22	06	26	59.6	+24	47	36	1.317	04	37	58.8	+18	56	31	0.319	08	06	25.9	+21	31	19	2.486	10	56	02.5	+08	05	30	5.686
Jun	23	06	36	27.0	+24	46	08	1.313	04	36	56.9	+18	45	14	0.324	08	09	04.6	+21	23	17	2.491	10	56	31.1	+08	02	24	5.701
Jun	24	06	45	48.1	+24	41	58	1.307	04	36	04.8	+18	34	45	0.328	08	11	43.0	+21	15	06	2.496	10	57	00.2	+07	59	16	5.716
Jun	25	06	55	01.7	+24	35	09	1.299	04	35	22.3	+18	25	06	0.333	08	14	21.1	+21	06	46	2.500	10	57	29.7	+07	56	05	5.731
Jun	26	07	04	06.9	+24	25	49	1.291	04	34	49.5	+18	16	18	0.337	08	16	58.9	+20	58	18	2.505	10	57	59.6	+07	52	50	5.745
Jun	27	07	13	02.8	+24	14	04	1.282	04	34	26.4	+18	08	20	0.342	08	19	36.4	+20	49	40	2.509	10	58	29.9	+07	49	34	5.760
Jun	28	07	21	48.7	+24	00	01	1.272	04	34	12.8	+18	01	12	0.347	08	22	13.5	+20	40	55	2.514	10	59	00.7	+07	46	14	5.774
Jun	29	07	30	24.0	+23	43	49	1.262	04	34	08.8	+17	54	53	0.353	08	24	50.4	+20	32	00	2.518	10	59	31.9	+07	42	52	5.788
Jun	30	07	38	48.3	+23	25	36	1.250	04	34	14.1	+17	49	23	0.358	08	27	27.0	+20	22	57	2.522	11	00	03.5	+07	39	28	5.803
Jul	1	07	47	01.3	+23	05	30	1.239	04	34	28.6	+17	44	40	0.364	08	30	03.2	+20	13	46	2.526	11	00	35.4	+07	36	01	5.817
Jul	2	07	55	02.7	+22	43	38	1.226	04	34	52.2	+17	40	44	0.370	08	32	39.2	+20	04	27	2.530	11	01	07.8	+07	32	31	5.831
Jul	3	08	02	52.5	+22	20	10	1.213	04	35	24.6	+17	37	33	0.376	08	35	14.8	+19	54	59	2.535	11	01	40.6	+07	28	59	5.844
Jul	4	08	10	30.5	+21	55	13	1.200	04	36	05.7	+17	35	04	0.382	08	37	50.1	+19	45	24	2.539	11	02	13.7	+07	25	25	5.858
Jul	5	08	17	56.6	+21	28	55	1.186	04	36	55.2	+17	33	17	0.388	08	40	25.2	+19	35	40	2.543	11	02	47.3	+07	21	48	5.872
Jul	6	08	25	11.1	+21	01	23	1.172	04	37	53.0	+17	32	10	0.394	08	42	59.9	+19	25	48	2.546	11	03	21.2	+07	18	09	5.886
Jul	7	08	32	13.8	+20	32	44	1.158	04	38	58.8	+17	31	40	0.400	08	45	34.4	+19	15	49	2.550	11	03	55.4	+07	14	27	5.899
Jul	8	08	39	04.9	+20	03	05	1.144	04	40	12.3	+17	31	46	0.407	08	48	08.5	+19	05	42	2.554	11	04	30.1	+07	10	43	5.912
Jul	9	08	45	44.5	+19	32	33	1.129	04	41	33.4	+17	32	25	0.414	08	50	42.4	+18	55	27	2.558	11	05	05.1	+07	06	57	5.926
Jul	10	08	52	12.7	+19	01	13	1.114	04	43	01.7	+17	33	36	0.420	08	53	15.9	+18	45	04	2.562	11	05	40.4	+07	03	09	5.939
Jul	11	08	58	29.6	+18	29	12	1.100	04	44	37.1	+17	35	16	0.427	08	55	49.2	+18	34	34	2.565	11	06	16.1	+06	59	18	5.952
Jul	12	09	04	35.3	+17	56	36	1.085	04	46	19.4	+17	37	23	0.434	08	58	22.2	+18	23	57	2.569	11	06	52.1	+06	55	25	5.964
Jul	13	09	10	29.9	+17	23	30	1.070	04	48	08.2	+17	39	55	0.441	09	00	54.9	+18	13	12	2.572	11	07	28.5	+06	51	30	5.977
Jul	14	09	16	13.6	+16	50	00	1.055	04	50	03.5	+17	42	50	0.448	09	03	27.3	+18	02	19	2.576	11	08	05.2	+06	47	33	5.990
Jul	15	09	21	46.3	+16	16	11	1.039	04	52	04.9	+17	46	07	0.455	09	05	59.4	+17	51	20	2.579	11	08	42.2	+06	43	33	6.002
Jul	16	09	27	08.2	+15	42	08	1.024	04	54	12.2	+17	49	43	0.462	09	08	31.3	+17	40	14	2.582	11	09	19.6	+06	39	32	6.015
Jul	17	09	32	19.2	+15	07	56	1.009	04	56	25.3	+17	53	36	0.469	09	11	02.8	+17	29	00	2.586	11	09	57.2	+06	35	28	6.027
Jul	18	09	37	19.5	+14	33	40	0.994	04	58	44.0	+17	57	44	0.477	09	13	34.1	+17	17	40	2.589	11	10	35.2	+06	31	23	6.039
Jul	19	09	42	08.9	+13	59	26	0.979	05	01	08.1	+18	02	06	0.484	09	16	05.1	+17	06	12	2.592	11	11	13.5	+06	27	15	6.051

PLANET POSITIONS (continued)

Note: positions refer to 0000 WAST

MTH	DAY	MERCURY RA h m s	MERCURY Declination ° ′ ″	MERCURY Dist. (AU)	VENUS RA h m s	VENUS Declination ° ′ ″	VENUS Dist. (AU)	MARS RA h m s	MARS Declination ° ′ ″	MARS Dist. (AU)	JUPITER RA h m s	JUPITER Declination ° ′ ″	JUPITER Dist. (AU)
Jul	20	09 46 47.4	+13 25 17	0.963	05 03 37.4	+18 06 40	0.491	09 18 35.8	+16 54 39	2.595	11 11 52.0	+06 23 06	6.063
Jul	21	09 51 15.0	+12 51 18	0.948	05 06 11.7	+18 11 23	0.499	09 21 06.2	+16 42 58	2.598	11 12 30.9	+06 18 54	6.074
Jul	22	09 55 31.6	+12 17 36	0.933	05 08 50.9	+18 16 15	0.506	09 23 36.3	+16 31 11	2.601	11 13 10.0	+06 14 41	6.086
Jul	23	09 59 37.0	+11 44 14	0.918	05 11 34.8	+18 21 13	0.514	09 26 06.2	+16 19 17	2.604	11 13 49.5	+06 10 26	6.097
Jul	24	10 03 31.1	+11 11 18	0.903	05 14 23.3	+18 26 17	0.521	09 28 35.7	+16 07 17	2.607	11 14 29.2	+06 06 09	6.108
Jul	25	10 07 13.6	+10 38 52	0.888	05 17 16.2	+18 31 24	0.529	09 31 05.0	+15 55 11	2.609	11 15 09.1	+06 01 50	6.119
Jul	26	10 10 44.3	+10 07 03	0.873	05 20 13.3	+18 36 32	0.536	09 33 34.0	+15 42 59	2.612	11 15 49.3	+05 57 29	6.130
Jul	27	10 14 02.9	+09 35 56	0.859	05 23 14.7	+18 41 41	0.544	09 36 02.8	+15 30 41	2.615	11 16 29.8	+05 53 07	6.141
Jul	28	10 17 09.2	+09 05 37	0.844	05 26 20.0	+18 46 50	0.551	09 38 31.3	+15 18 17	2.617	11 17 10.5	+05 48 43	6.151
Jul	29	10 20 02.7	+08 36 11	0.830	05 29 29.3	+18 51 55	0.559	09 40 59.5	+15 05 46	2.620	11 17 51.5	+05 44 18	6.162
Jul	30	10 22 43.0	+08 07 44	0.815	05 32 42.4	+18 56 57	0.567	09 43 27.4	+14 53 11	2.622	11 18 32.7	+05 39 51	6.172
Jul	31	10 25 09.8	+07 40 24	0.801	05 35 59.2	+19 01 54	0.574	09 45 55.1	+14 40 29	2.625	11 19 14.2	+05 35 22	6.182
Aug	1	10 27 22.4	+07 14 18	0.787	05 39 19.5	+19 06 44	0.582	09 48 22.6	+14 27 42	2.627	11 19 55.9	+05 30 52	6.192
Aug	2	10 29 20.6	+06 49 32	0.773	05 42 43.3	+19 11 27	0.590	09 50 49.8	+14 14 49	2.629	11 20 37.8	+05 26 20	6.202
Aug	3	10 31 03.6	+06 26 13	0.760	05 46 10.5	+19 16 01	0.598	09 53 16.7	+14 01 51	2.631	11 21 19.9	+05 21 47	6.211
Aug	4	10 32 31.0	+06 04 31	0.746	05 49 41.0	+19 20 24	0.606	09 55 43.4	+13 48 47	2.633	11 22 02.3	+05 17 13	6.221
Aug	5	10 33 42.2	+05 44 33	0.733	05 53 14.6	+19 24 37	0.613	09 58 10.0	+13 35 38	2.636	11 22 44.8	+05 12 36	6.230
Aug	6	10 34 36.6	+05 26 28	0.721	05 56 51.2	+19 28 36	0.621	10 00 36.2	+13 22 24	2.638	11 23 27.6	+05 07 59	6.239
Aug	7	10 35 13.6	+05 10 25	0.708	06 00 30.8	+19 32 22	0.629	10 03 02.3	+13 09 05	2.639	11 24 10.6	+05 03 20	6.248
Aug	8	10 35 32.8	+04 56 32	0.697	06 04 13.2	+19 35 54	0.637	10 05 28.1	+12 55 40	2.641	11 24 53.8	+04 58 40	6.257
Aug	9	10 35 33.7	+04 44 60	0.685	06 07 58.4	+19 39 10	0.645	10 07 53.8	+12 42 11	2.643	11 25 37.2	+04 53 58	6.265
Aug	10	10 35 15.8	+04 35 57	0.675	06 11 46.2	+19 42 09	0.652	10 10 19.2	+12 28 37	2.645	11 26 20.7	+04 49 15	6.274
Aug	11	10 34 38.9	+04 29 32	0.664	06 15 36.5	+19 44 51	0.660	10 12 44.5	+12 14 58	2.647	11 27 04.5	+04 44 31	6.282
Aug	12	10 33 43.0	+04 25 53	0.655	06 19 29.3	+19 47 14	0.668	10 15 09.5	+12 01 14	2.648	11 27 48.5	+04 39 46	6.290
Aug	13	10 32 28.0	+04 25 08	0.646	06 23 24.5	+19 49 18	0.676	10 17 34.4	+11 47 26	2.650	11 28 32.6	+04 34 59	6.298
Aug	14	10 30 54.3	+04 27 23	0.638	06 27 21.9	+19 51 02	0.684	10 19 59.0	+11 33 33	2.651	11 29 16.9	+04 30 11	6.305
Aug	15	10 29 02.5	+04 32 42	0.631	06 31 21.5	+19 52 25	0.691	10 22 23.5	+11 19 35	2.653	11 30 01.4	+04 25 22	6.313
Aug	16	10 26 53.6	+04 41 07	0.625	06 35 23.2	+19 53 27	0.699	10 24 47.8	+11 05 34	2.654	11 30 46.0	+04 20 32	6.320
Aug	17	10 24 28.8	+04 52 38	0.621	06 39 26.9	+19 54 06	0.707	10 27 11.9	+10 51 28	2.655	11 31 30.8	+04 15 41	6.327
Aug	18	10 21 50.0	+05 07 12	0.617	06 43 32.5	+19 54 23	0.715	10 29 35.9	+10 37 18	2.656	11 32 15.8	+04 10 49	6.334
Aug	19	10 18 59.2	+05 24 40	0.615	06 47 40.0	+19 54 16	0.723	10 31 59.6	+10 23 04	2.658	11 33 00.9	+04 05 55	6.341
Aug	20	10 15 59.1	+05 44 52	0.614	06 51 49.2	+19 53 44	0.730	10 34 23.2	+10 08 46	2.659	11 33 46.1	+04 01 01	6.347
Aug	21	10 12 52.7	+06 07 33	0.615	06 56 00.1	+19 52 48	0.738	10 36 46.7	+09 54 24	2.660	11 34 31.5	+03 56 06	6.353
Aug	22	10 09 43.3	+06 32 24	0.617	07 00 12.7	+19 51 27	0.746	10 39 10.0	+09 39 58	2.661	11 35 17.0	+03 51 10	6.360
Aug	23	10 06 34.5	+06 59 02	0.621	07 04 26.8	+19 49 40	0.754	10 41 33.1	+09 25 29	2.662	11 36 02.7	+03 46 13	6.366
Aug	24	10 03 30.4	+07 27 02	0.626	07 08 42.4	+19 47 27	0.761	10 43 56.1	+09 10 56	2.662	11 36 48.5	+03 41 16	6.371
Aug	25	10 00 34.8	+07 55 56	0.634	07 12 59.3	+19 44 47	0.769	10 46 18.9	+08 56 20	2.663	11 37 34.4	+03 36 17	6.377
Aug	26	09 57 51.7	+08 25 13	0.643	07 17 17.7	+19 41 40	0.777	10 48 41.6	+08 41 40	2.664	11 38 20.4	+03 31 18	6.382
Aug	27	09 55 25.0	+08 54 23	0.654	07 21 37.3	+19 38 05	0.785	10 51 04.2	+08 26 57	2.664	11 39 06.5	+03 26 18	6.387
Aug	28	09 53 18.4	+09 22 57	0.667	07 25 58.1	+19 34 03	0.792	10 53 26.7	+08 12 11	2.665	11 39 52.8	+03 21 17	6.392
Aug	29	09 51 35.0	+09 50 26	0.682	07 30 20.1	+19 29 32	0.800	10 55 49.0	+07 57 22	2.666	11 40 39.1	+03 16 16	6.397
Aug	30	09 50 17.7	+10 16 20	0.698	07 34 43.3	+19 24 33	0.808	10 58 11.2	+07 42 30	2.666	11 41 25.5	+03 11 14	6.402
Aug	31	09 49 29.0	+10 40 17	0.716	07 39 07.4	+19 19 06	0.815	11 00 33.3	+07 27 34	2.666	11 42 12.1	+03 06 11	6.406
Sep	1	09 49 10.7	+11 01 52	0.736	07 43 32.5	+19 13 09	0.823	11 02 55.4	+07 12 36	2.667	11 42 58.7	+03 01 08	6.410
Sep	2	09 49 24.1	+11 20 46	0.757	07 47 58.6	+19 06 43	0.831	11 05 17.3	+06 57 35	2.667	11 43 45.4	+02 56 04	6.414
Sep	3	09 50 10.2	+11 36 42	0.780	07 52 25.5	+18 59 47	0.838	11 07 39.2	+06 42 31	2.667	11 44 32.2	+02 50 60	6.418
Sep	4	09 51 29.2	+11 49 26	0.803	07 56 53.2	+18 52 22	0.846	11 10 01.0	+06 27 25	2.667	11 45 19.1	+02 45 55	6.421
Sep	5	09 53 21.1	+11 58 45	0.829	08 01 21.6	+18 44 27	0.854	11 12 22.7	+06 12 16	2.667	11 46 06.1	+02 40 50	6.425
Sep	6	09 55 45.2	+12 04 30	0.855	08 05 50.7	+18 36 02	0.861	11 14 44.3	+05 57 04	2.667	11 46 53.1	+02 35 44	6.428
Sep	7	09 58 40.5	+12 06 36	0.881	08 10 20.3	+18 27 08	0.869	11 17 05.9	+05 41 50	2.667	11 47 40.3	+02 30 38	6.431
Sep	8	10 02 05.8	+12 04 58	0.909	08 14 50.6	+18 17 44	0.876	11 19 27.5	+05 26 34	2.667	11 48 27.5	+02 25 31	6.433
Sep	9	10 05 59.2	+11 59 35	0.937	08 19 21.3	+18 07 49	0.884	11 21 49.0	+05 11 15	2.667	11 49 14.7	+02 20 24	6.436
Sep	10	10 10 19.0	+11 50 28	0.965	08 23 52.5	+17 57 25	0.891	11 24 10.5	+04 55 55	2.666	11 50 02.0	+02 15 17	6.438
Sep	11	10 15 03.0	+11 37 40	0.993	08 28 24.1	+17 46 32	0.899	11 26 32.0	+04 40 32	2.666	11 50 49.4	+02 10 09	6.440
Sep	12	10 20 08.9	+11 21 17	1.021	08 32 56.1	+17 35 08	0.906	11 28 53.4	+04 25 07	2.666	11 51 36.8	+02 05 01	6.442
Sep	13	10 25 34.3	+11 01 27	1.048	08 37 28.3	+17 23 15	0.914	11 31 14.8	+04 09 41	2.665	11 52 24.2	+01 59 53	6.444
Sep	14	10 31 16.8	+10 38 20	1.075	08 42 00.7	+17 10 53	0.921	11 33 36.2	+03 54 12	2.665	11 53 11.7	+01 54 45	6.445
Sep	15	10 37 13.9	+10 12 06	1.102	08 46 33.4	+16 58 02	0.929	11 35 57.5	+03 38 42	2.664	11 53 59.3	+01 49 36	6.447
Sep	16	10 43 23.4	+09 42 59	1.127	08 51 06.2	+16 44 41	0.936	11 38 18.9	+03 23 11	2.663	11 54 46.8	+01 44 28	6.448
Sep	17	10 49 43.1	+09 11 13	1.152	08 55 39.1	+16 30 52	0.943	11 40 40.3	+03 07 38	2.662	11 55 34.4	+01 39 19	6.449
Sep	18	10 56 10.9	+08 37 01	1.175	09 00 12.2	+16 16 35	0.951	11 43 01.7	+02 52 03	2.662	11 56 22.0	+01 34 10	6.449
Sep	19	11 02 44.9	+08 00 39	1.198	09 04 45.2	+16 01 49	0.958	11 45 23.0	+02 36 28	2.661	11 57 09.6	+01 29 02	6.450
Sep	20	11 09 23.4	+07 22 21	1.219	09 09 18.3	+15 46 35	0.965	11 47 44.4	+02 20 51	2.660	11 57 57.3	+01 23 53	6.450
Sep	21	11 16 05.1	+06 42 22	1.239	09 13 51.4	+15 30 54	0.972	11 50 05.8	+02 05 13	2.659	11 58 44.9	+01 18 45	6.450
Sep	22	11 22 48.6	+06 00 54	1.258	09 18 24.4	+15 14 45	0.980	11 52 27.3	+01 49 34	2.658	11 59 32.6	+01 13 36	6.450
Sep	23	11 29 32.9	+05 18 12	1.276	09 22 57.4	+14 58 09	0.987	11 54 48.8	+01 33 55	2.657	12 00 20.2	+01 08 28	6.449
Sep	24	11 36 17.0	+04 34 26	1.293	09 27 30.3	+14 41 07	0.994	11 57 10.3	+01 18 14	2.655	12 01 07.8	+01 03 19	6.449

PLANET POSITIONS (continued)

MTH	DAY	MERCURY							VENUS							MARS							JUPITER						
		RA			Declination			Dist.	RA			Declination			Dist.	RA			Declination			Dist.	RA			Declination			Dist.
		h	m	s	°	′	″	(AU)	h	m	s	°	′	″	(AU)	h	m	s	°	′	″	(AU)	h	m	s	°	′	″	(AU)
Sep	25	11	43	00.4	+03	49	49	1.308	09	32	03.0	+14	23	38	1.001	11	59	31.8	+01	02	33	2.654	12	01	55.5	+00	58	12	6.448
Sep	26	11	49	42.3	+03	04	30	1.322	09	36	35.7	+14	05	44	1.008	12	01	53.4	+00	46	52	2.653	12	02	43.1	+00	53	04	6.447
Sep	27	11	56	22.4	+02	18	40	1.335	09	41	08.3	+13	47	23	1.015	12	04	15.1	+00	31	09	2.651	12	03	30.7	+00	47	56	6.445
Sep	28	12	03	00.3	+01	32	26	1.347	09	45	40.7	+13	28	38	1.022	12	06	36.9	+00	15	27	2.650	12	04	18.2	+00	42	49	6.444
Sep	29	12	09	35.8	+00	45	55	1.358	09	50	12.9	+13	09	28	1.030	12	08	58.7	-00	00	17	2.648	12	05	05.8	+00	37	42	6.442
Sep	30	12	16	08.8	-00	00	44	1.368	09	54	45.0	+12	49	53	1.037	12	11	20.6	-00	15	60	2.647	12	05	53.3	+00	32	36	6.440
Oct	1	12	22	39.2	-00	47	26	1.377	09	59	17.0	+12	29	55	1.044	12	13	42.6	-00	31	44	2.645	12	06	40.8	+00	27	29	6.438
Oct	2	12	29	07.0	-01	34	07	1.386	10	03	48.7	+12	09	33	1.051	12	16	04.8	-00	47	27	2.643	12	07	28.3	+00	22	23	6.436
Oct	3	12	35	32.1	-02	20	39	1.393	10	08	20.2	+11	48	48	1.058	12	18	27.0	-01	03	11	2.642	12	08	15.7	+00	17	18	6.433
Oct	4	12	41	54.7	-03	07	01	1.399	10	12	51.6	+11	27	41	1.064	12	20	49.3	-01	18	55	2.640	12	09	03.1	+00	12	13	6.430
Oct	5	12	48	14.8	-03	53	07	1.405	10	17	22.7	+11	06	12	1.071	12	23	11.8	-01	34	38	2.638	12	09	50.4	+00	07	09	6.428
Oct	6	12	54	32.5	-04	38	54	1.409	10	21	53.6	+10	44	22	1.078	12	25	34.4	-01	50	22	2.636	12	10	37.7	+00	02	05	6.424
Oct	7	13	00	48.0	-05	24	19	1.414	10	26	24.4	+10	22	10	1.085	12	27	57.2	-02	06	05	2.634	12	11	24.9	-00	02	59	6.421
Oct	8	13	07	01.3	-06	09	19	1.417	10	30	54.9	+09	59	39	1.092	12	30	20.0	-02	21	47	2.632	12	12	12.0	-00	08	01	6.417
Oct	9	13	13	12.7	-06	53	53	1.419	10	35	25.2	+09	36	47	1.099	12	32	43.1	-02	37	29	2.629	12	12	59.1	-00	13	03	6.414
Oct	10	13	19	22.3	-07	37	56	1.421	10	39	55.3	+09	13	37	1.105	12	35	06.3	-02	53	10	2.627	12	13	46.1	-00	18	05	6.410
Oct	11	13	25	30.3	-08	21	28	1.423	10	44	25.2	+08	50	08	1.112	12	37	29.6	-03	08	51	2.625	12	14	33.1	-00	23	06	6.405
Oct	12	13	31	36.7	-09	04	27	1.423	10	48	54.9	+08	26	22	1.119	12	39	53.1	-03	24	31	2.623	12	15	19.9	-00	28	06	6.401
Oct	13	13	37	41.8	-09	46	51	1.424	10	53	24.4	+08	02	18	1.125	12	42	16.8	-03	40	10	2.620	12	16	06.7	-00	33	05	6.396
Oct	14	13	43	45.7	-10	28	37	1.423	10	57	53.7	+07	37	57	1.132	12	44	40.7	-03	55	47	2.618	12	16	53.4	-00	38	03	6.391
Oct	15	13	49	48.5	-11	09	45	1.422	11	02	22.8	+07	13	21	1.139	12	47	04.7	-04	11	24	2.615	12	17	39.9	-00	43	01	6.386
Oct	16	13	55	50.4	-11	50	14	1.420	11	06	51.8	+06	48	29	1.145	12	49	29.0	-04	26	59	2.612	12	18	26.4	-00	47	57	6.381
Oct	17	14	01	51.5	-12	30	01	1.418	11	11	20.6	+06	23	22	1.152	12	51	53.4	-04	42	33	2.610	12	19	12.8	-00	52	53	6.375
Oct	18	14	07	51.9	-13	09	05	1.415	11	15	49.3	+05	58	02	1.158	12	54	18.0	-04	58	05	2.607	12	19	59.0	-00	57	48	6.370
Oct	19	14	13	51.8	-13	47	26	1.412	11	20	17.9	+05	32	28	1.165	12	56	42.9	-05	13	36	2.604	12	20	45.2	-01	02	41	6.364
Oct	20	14	19	51.3	-14	25	02	1.408	11	24	46.3	+05	06	41	1.171	12	59	07.9	-05	29	05	2.601	12	21	31.2	-01	07	34	6.358
Oct	21	14	25	50.4	-15	01	51	1.404	11	29	14.7	+04	40	42	1.177	13	01	33.2	-05	44	32	2.598	12	22	17.0	-01	12	25	6.352
Oct	22	14	31	49.3	-15	37	53	1.399	11	33	43.1	+04	14	32	1.184	13	03	58.6	-05	59	57	2.595	12	23	02.8	-01	17	16	6.345
Oct	23	14	37	48.1	-16	13	07	1.394	11	38	11.4	+03	48	10	1.190	13	06	24.3	-06	15	20	2.592	12	23	48.4	-01	22	05	6.338
Oct	24	14	43	46.8	-16	47	30	1.388	11	42	39.7	+03	21	39	1.196	13	08	50.3	-06	30	41	2.589	12	24	33.9	-01	26	53	6.331
Oct	25	14	49	45.5	-17	21	02	1.381	11	47	08.0	+02	54	58	1.203	13	11	16.5	-06	45	60	2.586	12	25	19.2	-01	31	40	6.324
Oct	26	14	55	44.2	-17	53	42	1.374	11	51	36.4	+02	28	08	1.209	13	13	42.9	-07	01	16	2.583	12	26	04.4	-01	36	25	6.317
Oct	27	15	01	43.0	-18	25	29	1.367	11	56	04.9	+02	01	10	1.215	13	16	09.6	-07	16	30	2.579	12	26	49.4	-01	41	09	6.310
Oct	28	15	07	41.8	-18	56	20	1.359	12	00	33.4	+01	34	05	1.221	13	18	36.6	-07	31	42	2.576	12	27	34.2	-01	45	52	6.302
Oct	29	15	13	40.8	-19	26	16	1.351	12	05	02.1	+01	06	52	1.227	13	21	03.8	-07	46	51	2.573	12	28	18.9	-01	50	34	6.294
Oct	30	15	19	39.7	-19	55	14	1.342	12	09	31.0	+00	39	33	1.234	13	23	31.3	-08	01	57	2.569	12	29	03.4	-01	55	14	6.286
Oct	31	15	25	38.7	-20	23	14	1.332	12	14	00.0	+00	12	09	1.240	13	25	59.1	-08	16	60	2.566	12	29	47.8	-01	59	53	6.278
Nov	1	15	31	37.7	-20	50	14	1.322	12	18	29.3	-00	15	20	1.246	13	28	27.2	-08	32	00	2.562	12	30	31.9	-02	04	30	6.269
Nov	2	15	37	36.5	-21	16	12	1.312	12	22	58.8	-00	42	53	1.252	13	30	55.7	-08	46	58	2.558	12	31	15.9	-02	09	06	6.261
Nov	3	15	43	35.0	-21	41	08	1.301	12	27	28.6	-01	10	30	1.258	13	33	24.4	-09	01	52	2.555	12	31	59.7	-02	13	40	6.252
Nov	4	15	49	33.1	-22	04	59	1.289	12	31	58.7	-01	38	09	1.264	13	35	53.4	-09	16	43	2.551	12	32	43.3	-02	18	13	6.243
Nov	5	15	55	30.6	-22	27	44	1.277	12	36	29.2	-02	05	50	1.269	13	38	22.8	-09	31	31	2.547	12	33	26.7	-02	22	44	6.234
Nov	6	16	01	27.2	-22	49	21	1.264	12	40	60.0	-02	33	32	1.275	13	40	52.5	-09	46	15	2.543	12	34	09.9	-02	27	14	6.224
Nov	7	16	07	22.7	-23	09	50	1.251	12	45	31.2	-03	01	15	1.281	13	43	22.5	-10	00	55	2.539	12	34	52.8	-02	31	42	6.215
Nov	8	16	13	16.8	-23	29	09	1.237	12	50	02.8	-03	28	58	1.287	13	45	52.8	-10	15	32	2.535	12	35	35.6	-02	36	08	6.205
Nov	9	16	19	09.0	-23	47	15	1.223	12	54	34.9	-03	56	39	1.293	13	48	23.5	-10	30	05	2.531	12	36	18.1	-02	40	32	6.195
Nov	10	16	24	59.0	-24	04	07	1.208	12	59	07.5	-04	24	18	1.298	13	50	54.6	-10	44	34	2.527	12	37	00.4	-02	44	55	6.185
Nov	11	16	30	46.2	-24	19	44	1.192	13	03	40.6	-04	51	55	1.304	13	53	25.9	-10	58	59	2.523	12	37	42.5	-02	49	15	6.174
Nov	12	16	36	30.0	-24	34	04	1.176	13	08	14.2	-05	19	29	1.310	13	55	57.7	-11	13	20	2.519	12	38	24.3	-02	53	34	6.164
Nov	13	16	42	09.8	-24	47	05	1.160	13	12	48.4	-05	46	58	1.315	13	58	29.8	-11	27	37	2.515	12	39	05.8	-02	57	51	6.153
Nov	14	16	47	44.8	-24	58	45	1.142	13	17	23.2	-06	14	23	1.321	14	01	02.2	-11	41	49	2.510	12	39	47.1	-03	02	06	6.142
Nov	15	16	53	14.0	-25	09	04	1.124	13	21	58.6	-06	41	42	1.326	14	03	35.0	-11	55	56	2.506	12	40	28.2	-03	06	19	6.132
Nov	16	16	58	36.5	-25	17	59	1.106	13	26	34.7	-07	08	54	1.332	14	06	08.2	-12	09	59	2.501	12	41	08.9	-03	10	30	6.120
Nov	17	17	03	51.1	-25	25	30	1.087	13	31	11.5	-07	35	59	1.337	14	08	41.8	-12	23	57	2.497	12	41	49.4	-03	14	38	6.109
Nov	18	17	08	56.5	-25	31	34	1.067	13	35	48.9	-08	02	56	1.343	14	11	15.7	-12	37	49	2.492	12	42	29.6	-03	18	45	6.098
Nov	19	17	13	51.2	-25	36	10	1.047	13	40	27.2	-08	29	44	1.348	14	13	50.0	-12	51	37	2.488	12	43	09.6	-03	22	49	6.086
Nov	20	17	18	33.5	-25	39	17	1.026	13	45	06.2	-08	56	23	1.353	14	16	24.7	-13	05	20	2.483	12	43	49.2	-03	26	52	6.074
Nov	21	17	23	01.5	-25	40	54	1.004	13	49	46.0	-09	22	51	1.359	14	18	59.8	-13	18	57	2.478	12	44	28.5	-03	30	52	6.062
Nov	22	17	27	13.2	-25	40	60	0.983	13	54	26.7	-09	49	08	1.364	14	21	35.3	-13	32	29	2.474	12	45	07.5	-03	34	49	6.050
Nov	23	17	31	06.2	-25	39	33	0.961	13	59	08.3	-10	15	14	1.369	14	24	11.2	-13	45	55	2.469	12	45	46.2	-03	38	45	6.038
Nov	24	17	34	37.7	-25	36	33	0.938	14	03	50.7	-10	41	07	1.374	14	26	47.5	-13	59	16	2.464	12	46	24.6	-03	42	38	6.025
Nov	25	17	37	45.1	-25	31	59	0.915	14	08	34.1	-11	06	46	1.380	14	29	24.2	-14	12	31	2.459	12	47	02.7	-03	46	29	6.013
Nov	26	17	40	25.0	-25	25	49	0.892	14	13	18.4	-11	32	11	1.385	14	32	01.3	-14	25	40	2.454	12	47	40.4	-03	50	17	6.000
Nov	27	17	42	34.3	-25	18	03	0.869	14	18	03.8	-11	57	22	1.390	14	34	38.8	-14	38	43	2.449	12	48	17.8	-03	54	03	5.987
Nov	28	17	44	09.4	-25	08	39	0.847	14	22	50.1	-12	22	16	1.395	14	37	16.8	-14	51	40	2.444	12	48	54.9	-03	57	46	5.974
Nov	29	17	45	06.8	-24	57	36	0.824	14	27	37.5	-12	46	55	1.400	14	39	55.2	-15	04	30	2.439	12	49	31.6	-04	01	27	5.961
Nov	30	17	45	23.1	-24	44	52	0.803	14	32	25.9	-13	11	15	1.405	14	42	34.1	-15	17	15	2.434	12	50	08.0	-04	05	05	5.948

PLANET POSITIONS (continued)

Note: positions refer to 0000 WAST

MTH	DAY	MERCURY RA h m s	MERCURY Declination ° ′ ″	MERCURY Dist. (AU)	VENUS RA h m s	VENUS Declination ° ′ ″	VENUS Dist. (AU)	MARS RA h m s	MARS Declination ° ′ ″	MARS Dist. (AU)	JUPITER RA h m s	JUPITER Declination ° ′ ″	JUPITER Dist. (AU)
Dec	1	17 44 55.3	-24 30 26	0.782	14 37 15.5	-13 35 18	1.410	14 45 13.4	-15 29 52	2.428	12 50 44.0	-04 08 41	5.934
Dec	2	17 43 40.9	-24 14 16	0.762	14 42 06.1	-13 59 02	1.415	14 47 53.1	-15 42 24	2.423	12 51 19.6	-04 12 14	5.921
Dec	3	17 41 38.4	-23 56 21	0.743	14 46 57.8	-14 22 26	1.420	14 50 33.3	-15 54 48	2.418	12 51 54.9	-04 15 45	5.907
Dec	4	17 38 47.8	-23 36 43	0.726	14 51 50.7	-14 45 30	1.424	14 53 13.9	-16 07 06	2.412	12 52 29.8	-04 19 13	5.893
Dec	5	17 35 10.7	-23 15 25	0.711	14 56 44.7	-15 08 12	1.429	14 55 55.0	-16 19 17	2.407	12 53 04.3	-04 22 38	5.879
Dec	6	17 30 51.1	-22 52 36	0.699	15 01 39.9	-15 30 32	1.434	14 58 36.5	-16 31 20	2.402	12 53 38.4	-04 26 00	5.865
Dec	7	17 25 54.9	-22 28 31	0.689	15 06 36.2	-15 52 29	1.439	15 01 18.5	-16 43 17	2.396	12 54 12.1	-04 29 20	5.851
Dec	8	17 20 30.7	-22 03 31	0.682	15 11 33.7	-16 14 03	1.443	15 04 01.0	-16 55 06	2.391	12 54 45.4	-04 32 36	5.837
Dec	9	17 14 48.5	-21 38 06	0.679	15 16 32.4	-16 35 12	1.448	15 06 43.9	-17 06 47	2.385	12 55 18.3	-04 35 50	5.823
Dec	10	17 08 59.8	-21 12 51	0.678	15 21 32.3	-16 55 55	1.453	15 09 27.3	-17 18 21	2.379	12 55 50.8	-04 39 01	5.808
Dec	11	17 03 16.4	-20 48 28	0.681	15 26 33.4	-17 16 13	1.457	15 12 11.1	-17 29 47	2.374	12 56 22.8	-04 42 08	5.794
Dec	12	16 57 49.6	-20 25 37	0.687	15 31 35.6	-17 36 03	1.462	15 14 55.4	-17 41 05	2.368	12 56 54.4	-04 45 13	5.779
Dec	13	16 52 49.3	-20 04 57	0.696	15 36 39.0	-17 55 26	1.466	15 17 40.1	-17 52 16	2.362	12 57 25.5	-04 48 15	5.764
Dec	14	16 48 23.5	-19 47 01	0.707	15 41 43.6	-18 14 21	1.471	15 20 25.3	-18 03 17	2.356	12 57 56.2	-04 51 13	5.749
Dec	15	16 44 37.9	-19 32 12	0.721	15 46 49.4	-18 32 46	1.475	15 23 11.0	-18 14 11	2.351	12 58 26.4	-04 54 09	5.734
Dec	16	16 41 36.1	-19 20 45	0.737	15 51 56.3	-18 50 41	1.479	15 25 57.1	-18 24 56	2.345	12 58 56.2	-04 57 01	5.719
Dec	17	16 39 19.7	-19 12 44	0.755	15 57 04.4	-19 08 06	1.484	15 28 43.6	-18 35 33	2.339	12 59 25.5	-04 59 50	5.704
Dec	18	16 37 48.6	-19 08 05	0.774	16 02 13.6	-19 24 59	1.488	15 31 30.6	-18 46 00	2.333	12 59 54.3	-05 02 35	5.689
Dec	19	16 37 01.4	-19 06 39	0.794	16 07 23.9	-19 41 20	1.492	15 34 18.1	-18 56 19	2.327	13 00 22.6	-05 05 18	5.673
Dec	20	16 36 55.9	-19 08 10	0.816	16 12 35.3	-19 57 09	1.496	15 37 06.0	-19 06 29	2.321	13 00 50.4	-05 07 57	5.658
Dec	21	16 37 29.5	-19 12 20	0.837	16 17 47.8	-20 12 24	1.501	15 39 54.4	-19 16 30	2.315	13 01 17.7	-05 10 32	5.642
Dec	22	16 38 39.1	-19 18 50	0.860	16 23 01.4	-20 27 05	1.505	15 42 43.2	-19 26 22	2.308	13 01 44.5	-05 13 05	5.627
Dec	23	16 40 21.6	-19 27 19	0.882	16 28 16.0	-20 41 11	1.509	15 45 32.5	-19 36 05	2.302	13 02 10.8	-05 15 33	5.611
Dec	24	16 42 33.9	-19 37 29	0.904	16 33 31.6	-20 54 42	1.513	15 48 22.2	-19 45 38	2.296	13 02 36.6	-05 17 59	5.596
Dec	25	16 45 13.2	-19 49 00	0.926	16 38 48.2	-21 07 38	1.517	15 51 12.4	-19 55 02	2.290	13 03 01.9	-05 20 21	5.580
Dec	26	16 48 16.8	-20 01 36	0.948	16 44 05.8	-21 19 57	1.521	15 54 03.1	-20 04 16	2.284	13 03 26.6	-05 22 39	5.564
Dec	27	16 51 42.3	-20 14 59	0.970	16 49 24.3	-21 31 38	1.525	15 56 54.2	-20 13 20	2.277	13 03 50.8	-05 24 54	5.548
Dec	28	16 55 27.2	-20 28 57	0.992	16 54 43.8	-21 42 43	1.529	15 59 45.8	-20 22 15	2.271	13 04 14.5	-05 27 06	5.532
Dec	29	16 59 29.8	-20 43 15	1.012	17 00 04.0	-21 53 09	1.533	16 02 37.8	-20 30 59	2.264	13 04 37.6	-05 29 14	5.516
Dec	30	17 03 48.1	-20 57 43	1.033	17 05 25.1	-22 02 56	1.537	16 05 30.3	-20 39 33	2.258	13 05 00.1	-05 31 18	5.500
Dec	31	17 08 20.6	-21 12 10	1.053	17 10 47.0	-22 12 05	1.540	16 08 23.2	-20 47 58	2.252	13 05 22.1	-05 33 18	5.484

PLANET POSITIONS (continued)

Note: positions refer to 0000 WAST

MTH	DAY	SATURN RA h m s	SATURN Declination ° ′ ″	SATURN Dist. (AU)	URANUS RA h m s	URANUS Declination ° ′ ″	URANUS Dist. (AU)	NEPTUNE RA h m s	NEPTUNE Declination ° ′ ″	NEPTUNE Dist. (AU)	PLUTO RA h m s	PLUTO Declination ° ′ ″	PLUTO Dist. (AU)
Jan	1	06 41 44.3	+22 25 15	8.050	22 09 35.1	-12 08 32	20.663	20 56 30.9	-17 18 44	30.912	17 21 04.5	-14 29 23	31.650
Jan	2	06 41 23.0	+22 25 43	8.051	22 09 44.8	-12 07 37	20.676	20 56 39.1	-17 18 11	30.921	17 21 13.3	-14 29 31	31.645
Jan	3	06 41 01.6	+22 26 11	8.052	22 09 54.6	-12 06 41	20.689	20 56 47.3	-17 17 38	30.930	17 21 22.1	-14 29 39	31.639
Jan	4	06 40 40.3	+22 26 38	8.053	22 10 04.5	-12 05 44	20.701	20 56 55.6	-17 17 04	30.938	17 21 30.8	-14 29 47	31.633
Jan	5	06 40 19.1	+22 27 06	8.054	22 10 14.5	-12 04 47	20.714	20 57 03.9	-17 16 30	30.946	17 21 39.4	-14 29 54	31.626
Jan	6	06 39 57.9	+22 27 33	8.056	22 10 24.7	-12 03 49	20.726	20 57 12.3	-17 15 56	30.954	17 21 48.1	-14 30 01	31.620
Jan	7	06 39 36.8	+22 27 60	8.058	22 10 35.0	-12 02 51	20.738	20 57 20.7	-17 15 22	30.961	17 21 56.6	-14 30 08	31.613
Jan	8	06 39 15.8	+22 28 27	8.060	22 10 45.4	-12 01 51	20.750	20 57 29.2	-17 14 47	30.969	17 22 05.1	-14 30 14	31.605
Jan	9	06 38 54.8	+22 28 54	8.063	22 10 56.0	-12 00 52	20.762	20 57 37.8	-17 14 12	30.976	17 22 13.6	-14 30 20	31.598
Jan	10	06 38 34.0	+22 29 20	8.066	22 11 06.6	-11 59 51	20.773	20 57 46.4	-17 13 37	30.982	17 22 22.0	-14 30 26	31.590
Jan	11	06 38 13.3	+22 29 47	8.069	22 11 17.4	-11 58 50	20.785	20 57 55.0	-17 13 02	30.989	17 22 30.3	-14 30 31	31.582
Jan	12	06 37 52.7	+22 30 13	8.073	22 11 28.2	-11 57 48	20.796	20 58 03.7	-17 12 27	30.995	17 22 38.6	-14 30 36	31.574
Jan	13	06 37 32.3	+22 30 39	8.077	22 11 39.2	-11 56 46	20.807	20 58 12.4	-17 11 51	31.001	17 22 46.8	-14 30 41	31.565
Jan	14	06 37 12.0	+22 31 05	8.081	22 11 50.3	-11 55 43	20.817	20 58 21.2	-17 11 15	31.007	17 22 54.9	-14 30 45	31.557
Jan	15	06 36 51.8	+22 31 30	8.086	22 12 01.5	-11 54 39	20.827	20 58 30.0	-17 10 39	31.012	17 23 03.0	-14 30 49	31.548
Jan	16	06 36 31.9	+22 31 55	8.090	22 12 12.8	-11 53 35	20.838	20 58 38.9	-17 10 03	31.017	17 23 11.0	-14 30 53	31.538
Jan	17	06 36 12.1	+22 32 20	8.095	22 12 24.2	-11 52 30	20.848	20 58 47.8	-17 09 26	31.022	17 23 18.9	-14 30 56	31.529
Jan	18	06 35 52.5	+22 32 45	8.101	22 12 35.7	-11 51 25	20.857	20 58 56.7	-17 08 50	31.026	17 23 26.8	-14 30 59	31.519
Jan	19	06 35 33.2	+22 33 10	8.107	22 12 47.3	-11 50 19	20.867	20 59 05.7	-17 08 13	31.031	17 23 34.5	-14 31 01	31.509
Jan	20	06 35 14.1	+22 33 34	8.113	22 12 59.0	-11 49 13	20.876	20 59 14.6	-17 07 36	31.035	17 23 42.2	-14 31 04	31.499
Jan	21	06 34 55.2	+22 33 58	8.119	22 13 10.8	-11 48 06	20.885	20 59 23.6	-17 06 59	31.038	17 23 49.8	-14 31 06	31.489
Jan	22	06 34 36.5	+22 34 22	8.126	22 13 22.6	-11 46 59	20.893	20 59 32.7	-17 06 22	31.042	17 23 57.4	-14 31 07	31.478
Jan	23	06 34 18.1	+22 34 45	8.133	22 13 34.6	-11 45 51	20.902	20 59 41.7	-17 05 44	31.045	17 24 04.8	-14 31 08	31.467
Jan	24	06 34 00.0	+22 35 08	8.140	22 13 46.6	-11 44 43	20.910	20 59 50.8	-17 05 07	31.047	17 24 12.2	-14 31 09	31.456
Jan	25	06 33 42.2	+22 35 31	8.147	22 13 58.7	-11 43 34	20.918	20 59 59.9	-17 04 29	31.050	17 24 19.5	-14 31 10	31.445
Jan	26	06 33 24.6	+22 35 54	8.155	22 14 10.9	-11 42 25	20.926	21 00 09.0	-17 03 52	31.052	17 24 26.7	-14 31 10	31.434
Jan	27	06 33 07.4	+22 36 16	8.163	22 14 23.1	-11 41 16	20.933	21 00 18.1	-17 03 14	31.054	17 24 33.8	-14 31 10	31.422
Jan	28	06 32 50.4	+22 36 38	8.172	22 14 35.5	-11 40 06	20.940	21 00 27.3	-17 02 36	31.056	17 24 40.8	-14 31 10	31.410
Jan	29	06 32 33.8	+22 36 60	8.180	22 14 47.8	-11 38 56	20.947	21 00 36.4	-17 01 58	31.057	17 24 47.7	-14 31 09	31.398
Jan	30	06 32 17.5	+22 37 21	8.189	22 15 00.3	-11 37 45	20.954	21 00 45.5	-17 01 20	31.058	17 24 54.5	-14 31 08	31.386
Jan	31	06 32 01.5	+22 37 42	8.198	22 15 12.8	-11 36 34	20.960	21 00 54.7	-17 00 42	31.059	17 25 01.2	-14 31 07	31.373

PLANET POSITIONS (continued)

MTH	DAY	SATURN							URANUS							NEPTUNE							PLUTO						
		RA			Declination			Dist. (AU)	RA			Declination			Dist. (AU)	RA			Declination			Dist. (AU)	RA			Declination			Dist. (AU)
		h	m	s	°	′	″		h	m	s	°	′	″		h	m	s	°	′	″		h	m	s	°	′	″	
Feb	1	06	31	45.9	+22	38	03	8.207	22	15	25.3	-11	35	23	20.966	21	01	03.8	-17	00	04	31.059	17	25	07.8	-14	31	06	31.360
Feb	2	06	31	30.6	+22	38	23	8.217	22	15	38.0	-11	34	11	20.972	21	01	13.0	-16	59	26	31.060	17	25	14.3	-14	31	04	31.348
Feb	3	06	31	15.7	+22	38	43	8.227	22	15	50.6	-11	32	60	20.977	21	01	22.1	-16	58	48	31.059	17	25	20.8	-14	31	02	31.335
Feb	4	06	31	01.1	+22	39	03	8.237	22	16	03.3	-11	31	47	20.983	21	01	31.3	-16	58	10	31.059	17	25	27.1	-14	30	59	31.321
Feb	5	06	30	46.9	+22	39	22	8.248	22	16	16.1	-11	30	35	20.988	21	01	40.4	-16	57	32	31.058	17	25	33.3	-14	30	57	31.308
Feb	6	06	30	33.1	+22	39	41	8.258	22	16	28.9	-11	29	22	20.992	21	01	49.6	-16	56	54	31.057	17	25	39.4	-14	30	54	31.294
Feb	7	06	30	19.7	+22	40	00	8.269	22	16	41.8	-11	28	09	20.997	21	01	58.7	-16	56	16	31.056	17	25	45.4	-14	30	50	31.281
Feb	8	06	30	06.7	+22	40	19	8.280	22	16	54.7	-11	26	56	21.001	21	02	07.8	-16	55	38	31.055	17	25	51.3	-14	30	47	31.267
Feb	9	06	29	54.0	+22	40	37	8.291	22	17	07.6	-11	25	43	21.005	21	02	16.9	-16	55	00	31.053	17	25	57.0	-14	30	43	31.253
Feb	10	06	29	41.8	+22	40	55	8.303	22	17	20.5	-11	24	29	21.009	21	02	26.0	-16	54	22	31.051	17	26	02.7	-14	30	39	31.239
Feb	11	06	29	30.0	+22	41	12	8.315	22	17	33.5	-11	23	16	21.012	21	02	35.0	-16	53	44	31.048	17	26	08.2	-14	30	34	31.224
Feb	12	06	29	18.6	+22	41	29	8.327	22	17	46.6	-11	22	02	21.015	21	02	44.1	-16	53	07	31.045	17	26	13.7	-14	30	30	31.210
Feb	13	06	29	07.6	+22	41	46	8.339	22	17	59.6	-11	20	48	21.018	21	02	53.1	-16	52	29	31.042	17	26	19.0	-14	30	25	31.195
Feb	14	06	28	57.1	+22	42	03	8.351	22	18	12.7	-11	19	34	21.020	21	03	02.1	-16	51	51	31.039	17	26	24.2	-14	30	20	31.181
Feb	15	06	28	47.0	+22	42	19	8.364	22	18	25.8	-11	18	19	21.023	21	03	11.0	-16	51	14	31.036	17	26	29.3	-14	30	14	31.166
Feb	16	06	28	37.3	+22	42	35	8.377	22	18	38.9	-11	17	05	21.025	21	03	20.0	-16	50	36	31.032	17	26	34.3	-14	30	09	31.151
Feb	17	06	28	28.1	+22	42	51	8.390	22	18	52.0	-11	15	51	21.026	21	03	28.9	-16	49	59	31.028	17	26	39.1	-14	30	03	31.136
Feb	18	06	28	19.3	+22	43	06	8.403	22	19	05.1	-11	14	36	21.028	21	03	37.8	-16	49	21	31.023	17	26	43.8	-14	29	57	31.120
Feb	19	06	28	11.0	+22	43	21	8.416	22	19	18.3	-11	13	21	21.029	21	03	46.6	-16	48	44	31.019	17	26	48.4	-14	29	50	31.105
Feb	20	06	28	03.1	+22	43	35	8.430	22	19	31.4	-11	12	07	21.030	21	03	55.4	-16	48	07	31.014	17	26	52.9	-14	29	44	31.089
Feb	21	06	27	55.7	+22	43	50	8.443	22	19	44.5	-11	10	52	21.030	21	04	04.2	-16	47	30	31.008	17	26	57.3	-14	29	37	31.074
Feb	22	06	27	48.8	+22	44	04	8.457	22	19	57.7	-11	09	37	21.030	21	04	12.9	-16	46	54	31.003	17	27	01.5	-14	29	30	31.058
Feb	23	06	27	42.3	+22	44	17	8.471	22	20	10.8	-11	08	23	21.030	21	04	21.6	-16	46	17	30.997	17	27	05.6	-14	29	23	31.042
Feb	24	06	27	36.3	+22	44	31	8.485	22	20	24.0	-11	07	08	21.030	21	04	30.2	-16	45	41	30.991	17	27	09.6	-14	29	15	31.027
Feb	25	06	27	30.8	+22	44	44	8.500	22	20	37.1	-11	05	53	21.029	21	04	38.8	-16	45	04	30.985	17	27	13.4	-14	29	07	31.011
Feb	26	06	27	25.7	+22	44	57	8.514	22	20	50.2	-11	04	39	21.029	21	04	47.3	-16	44	28	30.978	17	27	17.1	-14	28	59	30.995
Feb	27	06	27	21.2	+22	45	09	8.529	22	21	03.3	-11	03	24	21.027	21	04	55.8	-16	43	52	30.971	17	27	20.7	-14	28	51	30.979
Feb	28	06	27	17.1	+22	45	21	8.544	22	21	16.4	-11	02	10	21.026	21	05	04.3	-16	43	17	30.964	17	27	24.2	-14	28	43	30.962
Feb	29	06	27	13.5	+22	45	33	8.559	22	21	29.5	-11	00	56	21.024	21	05	12.6	-16	42	41	30.957	17	27	27.5	-14	28	35	30.946
Mar	1	06	27	10.4	+22	45	44	8.574	22	21	42.5	-10	59	42	21.022	21	05	21.0	-16	42	06	30.949	17	27	30.7	-14	28	26	30.930
Mar	2	06	27	07.8	+22	45	55	8.589	22	21	55.5	-10	58	28	21.020	21	05	29.2	-16	41	31	30.941	17	27	33.8	-14	28	17	30.914
Mar	3	06	27	05.6	+22	46	06	8.604	22	22	08.5	-10	57	14	21.017	21	05	37.4	-16	40	56	30.933	17	27	36.7	-14	28	08	30.897
Mar	4	06	27	04.0	+22	46	16	8.619	22	22	21.5	-10	56	00	21.015	21	05	45.6	-16	40	22	30.924	17	27	39.5	-14	27	59	30.881
Mar	5	06	27	02.8	+22	46	27	8.635	22	22	34.4	-10	54	47	21.012	21	05	53.6	-16	39	48	30.916	17	27	42.2	-14	27	49	30.864
Mar	6	06	27	02.1	+22	46	36	8.650	22	22	47.3	-10	53	33	21.008	21	06	01.6	-16	39	14	30.907	17	27	44.7	-14	27	40	30.848
Mar	7	06	27	01.9	+22	46	46	8.666	22	23	00.1	-10	52	20	21.005	21	06	09.6	-16	38	40	30.898	17	27	47.1	-14	27	30	30.831
Mar	8	06	27	02.2	+22	46	55	8.682	22	23	13.0	-10	51	07	21.001	21	06	17.4	-16	38	07	30.888	17	27	49.3	-14	27	20	30.815
Mar	9	06	27	02.9	+22	47	04	8.698	22	23	25.7	-10	49	55	20.996	21	06	25.3	-16	37	34	30.879	17	27	51.5	-14	27	10	30.798
Mar	10	06	27	04.2	+22	47	12	8.714	22	23	38.5	-10	48	43	20.992	21	06	33.0	-16	37	01	30.869	17	27	53.4	-14	27	00	30.782
Mar	11	06	27	05.9	+22	47	20	8.730	22	23	51.1	-10	47	30	20.987	21	06	40.6	-16	36	28	30.859	17	27	55.3	-14	26	50	30.765
Mar	12	06	27	08.1	+22	47	28	8.746	22	24	03.8	-10	46	19	20.982	21	06	48.2	-16	35	56	30.849	17	27	57.0	-14	26	40	30.749
Mar	13	06	27	10.9	+22	47	35	8.762	22	24	16.3	-10	45	07	20.977	21	06	55.7	-16	35	24	30.838	17	27	58.6	-14	26	29	30.732
Mar	14	06	27	14.0	+22	47	42	8.778	22	24	28.8	-10	43	56	20.972	21	07	03.1	-16	34	53	30.827	17	28	00.1	-14	26	19	30.715
Mar	15	06	27	17.7	+22	47	49	8.795	22	24	41.3	-10	42	45	20.966	21	07	10.5	-16	34	21	30.816	17	28	01.4	-14	26	08	30.699
Mar	16	06	27	21.9	+22	47	56	8.811	22	24	53.7	-10	41	35	20.960	21	07	17.8	-16	33	50	30.805	17	28	02.5	-14	25	57	30.682
Mar	17	06	27	26.5	+22	48	02	8.827	22	25	06.0	-10	40	25	20.953	21	07	24.9	-16	33	20	30.794	17	28	03.6	-14	25	46	30.666
Mar	18	06	27	31.6	+22	48	08	8.844	22	25	18.3	-10	39	15	20.947	21	07	32.0	-16	32	50	30.782	17	28	04.5	-14	25	35	30.649
Mar	19	06	27	37.2	+22	48	13	8.860	22	25	30.5	-10	38	05	20.940	21	07	39.0	-16	32	20	30.770	17	28	05.2	-14	25	24	30.633
Mar	20	06	27	43.3	+22	48	18	8.877	22	25	42.6	-10	36	56	20.933	21	07	45.9	-16	31	50	30.758	17	28	05.9	-14	25	13	30.616
Mar	21	06	27	49.8	+22	48	23	8.893	22	25	54.7	-10	35	48	20.926	21	07	52.8	-16	31	21	30.746	17	28	06.3	-14	25	01	30.600
Mar	22	06	27	56.9	+22	48	27	8.910	22	26	06.7	-10	34	40	20.918	21	07	59.5	-16	30	53	30.733	17	28	06.7	-14	24	50	30.584
Mar	23	06	28	04.4	+22	48	31	8.927	22	26	18.6	-10	33	32	20.910	21	08	06.1	-16	30	24	30.721	17	28	06.9	-14	24	39	30.567
Mar	24	06	28	12.3	+22	48	34	8.943	22	26	30.4	-10	32	25	20.902	21	08	12.7	-16	29	56	30.708	17	28	07.0	-14	24	27	30.551
Mar	25	06	28	20.8	+22	48	38	8.960	22	26	42.1	-10	31	18	20.894	21	08	19.1	-16	29	29	30.695	17	28	06.9	-14	24	15	30.535
Mar	26	06	28	29.7	+22	48	41	8.977	22	26	53.8	-10	30	12	20.885	21	08	25.4	-16	29	02	30.682	17	28	06.7	-14	24	04	30.519
Mar	27	06	28	39.0	+22	48	43	8.993	22	27	05.3	-10	29	07	20.877	21	08	31.7	-16	28	35	30.668	17	28	06.4	-14	23	52	30.503
Mar	28	06	28	48.8	+22	48	45	9.010	22	27	16.8	-10	28	02	20.868	21	08	37.8	-16	28	09	30.655	17	28	05.9	-14	23	40	30.487
Mar	29	06	28	59.1	+22	48	47	9.026	22	27	28.2	-10	26	57	20.858	21	08	43.9	-16	27	43	30.641	17	28	05.3	-14	23	29	30.471
Mar	30	06	29	09.8	+22	48	48	9.043	22	27	39.4	-10	25	53	20.849	21	08	49.8	-16	27	18	30.627	17	28	04.6	-14	23	17	30.455
Mar	31	06	29	21.0	+22	48	49	9.060	22	27	50.6	-10	24	50	20.839	21	08	55.6	-16	26	53	30.613	17	28	03.8	-14	23	05	30.439
Apr	1	06	29	32.6	+22	48	49	9.076	22	28	01.7	-10	23	47	20.829	21	09	01.4	-16	26	29	30.599	17	28	02.8	-14	22	53	30.424
Apr	2	06	29	44.6	+22	48	49	9.093	22	28	12.7	-10	22	44	20.819	21	09	07.0	-16	26	05	30.585	17	28	01.6	-14	22	42	30.408
Apr	3	06	29	57.1	+22	48	49	9.109	22	28	23.5	-10	21	43	20.809	21	09	12.5	-16	25	41	30.570	17	28	00.4	-14	22	30	30.393
Apr	4	06	30	10.0	+22	48	48	9.126	22	28	34.3	-10	20	42	20.798	21	09	17.9	-16	25	18	30.555	17	27	59.0	-14	22	18	30.378
Apr	5	06	30	23.4	+22	48	47	9.142	22	28	44.9	-10	19	41	20.787	21	09	23.2	-16	24	56	30.541	17	27	57.5	-14	22	06	30.362
Apr	6	06	30	37.1	+22	48	46	9.159	22	28	55.5	-10	18	42	20.776	21	09	28.4	-16	24	34	30.526	17	27	55.9	-14	21	54	30.347
Apr	7	06	30	51.3	+22	48	44	9.175	22	29	05.9	-10	17	43	20.765	21	09	33.5	-16	24	12	30.511	17	27	54.1	-14	21	43	30.332

PLANET POSITIONS (continued)

Note: positions refer to 0000 WAST

MTH	DAY	SATURN RA h m s	SATURN Declination ° ′ ″	SATURN Dist. (AU)	URANUS RA h m s	URANUS Declination ° ′ ″	URANUS Dist. (AU)	NEPTUNE RA h m s	NEPTUNE Declination ° ′ ″	NEPTUNE Dist. (AU)	PLUTO RA h m s	PLUTO Declination ° ′ ″	PLUTO Dist. (AU)
Apr	8	06 31 05.9	+22 48 41	9.191	22 29 16.2	-10 16 44	20.754	21 09 38.4	-16 23 51	30.495	17 27 52.2	-14 21 31	30.318
Apr	9	06 31 20.9	+22 48 38	9.207	22 29 26.5	-10 15 46	20.742	21 09 43.3	-16 23 31	30.480	17 27 50.2	-14 21 19	30.303
Apr	10	06 31 36.3	+22 48 35	9.224	22 29 36.5	-10 14 49	20.730	21 09 48.0	-16 23 10	30.465	17 27 48.1	-14 21 07	30.288
Apr	11	06 31 52.1	+22 48 31	9.240	22 29 46.5	-10 13 53	20.718	21 09 52.6	-16 22 51	30.449	17 27 45.8	-14 20 56	30.274
Apr	12	06 32 08.4	+22 48 27	9.256	22 29 56.3	-10 12 57	20.706	21 09 57.1	-16 22 32	30.433	17 27 43.4	-14 20 44	30.260
Apr	13	06 32 25.0	+22 48 23	9.272	22 30 06.1	-10 12 03	20.694	21 10 01.5	-16 22 13	30.418	17 27 40.9	-14 20 33	30.246
Apr	14	06 32 42.0	+22 48 17	9.288	22 30 15.7	-10 11 08	20.681	21 10 05.7	-16 21 55	30.402	17 27 38.3	-14 20 21	30.232
Apr	15	06 32 59.4	+22 48 12	9.304	22 30 25.1	-10 10 15	20.669	21 10 09.9	-16 21 38	30.386	17 27 35.6	-14 20 10	30.218
Apr	16	06 33 17.2	+22 48 06	9.319	22 30 34.5	-10 09 22	20.656	21 10 13.9	-16 21 21	30.370	17 27 32.7	-14 19 58	30.204
Apr	17	06 33 35.4	+22 47 59	9.335	22 30 43.7	-10 08 31	20.642	21 10 17.8	-16 21 04	30.353	17 27 29.7	-14 19 47	30.191
Apr	18	06 33 54.0	+22 47 52	9.351	22 30 52.7	-10 07 40	20.629	21 10 21.6	-16 20 48	30.337	17 27 26.6	-14 19 35	30.177
Apr	19	06 34 12.9	+22 47 45	9.366	22 31 01.6	-10 06 49	20.616	21 10 25.2	-16 20 33	30.321	17 27 23.4	-14 19 24	30.164
Apr	20	06 34 32.2	+22 47 37	9.381	22 31 10.4	-10 05 60	20.602	21 10 28.7	-16 20 18	30.304	17 27 20.1	-14 19 13	30.151
Apr	21	06 34 51.9	+22 47 29	9.397	22 31 19.1	-10 05 11	20.588	21 10 32.1	-16 20 04	30.288	17 27 16.6	-14 19 02	30.139
Apr	22	06 35 11.9	+22 47 20	9.412	22 31 27.6	-10 04 24	20.575	21 10 35.4	-16 19 50	30.271	17 27 13.1	-14 18 51	30.126
Apr	23	06 35 32.3	+22 47 10	9.427	22 31 35.9	-10 03 37	20.560	21 10 38.5	-16 19 37	30.255	17 27 09.5	-14 18 41	30.114
Apr	24	06 35 53.0	+22 47 00	9.442	22 31 44.2	-10 02 51	20.546	21 10 41.6	-16 19 25	30.238	17 27 05.7	-14 18 30	30.102
Apr	25	06 36 14.1	+22 46 50	9.457	22 31 52.2	-10 02 05	20.532	21 10 44.4	-16 19 13	30.221	17 27 01.8	-14 18 19	30.090
Apr	26	06 36 35.6	+22 46 39	9.471	22 32 00.1	-10 01 21	20.517	21 10 47.2	-16 19 01	30.205	17 26 57.9	-14 18 09	30.078
Apr	27	06 36 57.3	+22 46 27	9.486	22 32 07.9	-10 00 38	20.503	21 10 49.8	-16 18 50	30.188	17 26 53.8	-14 17 58	30.066
Apr	28	06 37 19.4	+22 46 15	9.500	22 32 15.5	-09 59 55	20.488	21 10 52.3	-16 18 40	30.171	17 26 49.6	-14 17 48	30.055
Apr	29	06 37 41.8	+22 46 03	9.515	22 32 23.0	-09 59 14	20.473	21 10 54.7	-16 18 30	30.154	17 26 45.4	-14 17 38	30.044
Apr	30	06 38 04.6	+22 45 50	9.529	22 32 30.3	-09 58 33	20.458	21 10 57.0	-16 18 21	30.137	17 26 41.0	-14 17 28	30.033
May	1	06 38 27.6	+22 45 36	9.543	22 32 37.4	-09 57 54	20.443	21 10 59.1	-16 18 12	30.120	17 26 36.6	-14 17 19	30.022
May	2	06 38 51.0	+22 45 22	9.557	22 32 44.4	-09 57 15	20.428	21 11 01.1	-16 18 04	30.103	17 26 32.0	-14 17 09	30.012
May	3	06 39 14.6	+22 45 07	9.571	22 32 51.3	-09 56 37	20.412	21 11 02.9	-16 17 57	30.086	17 26 27.4	-14 16 59	30.001
May	4	06 39 38.6	+22 44 52	9.584	22 32 57.9	-09 56 00	20.397	21 11 04.7	-16 17 50	30.070	17 26 22.7	-14 16 50	29.991
May	5	06 40 02.9	+22 44 36	9.598	22 33 04.4	-09 55 24	20.381	21 11 06.3	-16 17 44	30.053	17 26 17.9	-14 16 41	29.981
May	6	06 40 27.4	+22 44 20	9.611	22 33 10.8	-09 54 49	20.366	21 11 07.7	-16 17 38	30.036	17 26 13.0	-14 16 32	29.972
May	7	06 40 52.2	+22 44 03	9.624	22 33 17.0	-09 54 15	20.350	21 11 09.1	-16 17 33	30.019	17 26 08.0	-14 16 23	29.963
May	8	06 41 17.4	+22 43 45	9.638	22 33 23.0	-09 53 42	20.334	21 11 10.3	-16 17 28	30.002	17 26 02.9	-14 16 15	29.953
May	9	06 41 42.8	+22 43 27	9.650	22 33 28.9	-09 53 10	20.318	21 11 11.4	-16 17 24	29.985	17 25 57.8	-14 16 06	29.945
May	10	06 42 08.4	+22 43 08	9.663	22 33 34.5	-09 52 39	20.302	21 11 12.3	-16 17 21	29.968	17 25 52.6	-14 15 58	29.936
May	11	06 42 34.4	+22 42 49	9.676	22 33 40.1	-09 52 09	20.286	21 11 13.1	-16 17 18	29.951	17 25 47.3	-14 15 50	29.928
May	12	06 43 00.6	+22 42 29	9.688	22 33 45.4	-09 51 40	20.270	21 11 13.8	-16 17 16	29.934	17 25 41.9	-14 15 42	29.920
May	13	06 43 27.1	+22 42 09	9.700	22 33 50.6	-09 51 12	20.254	21 11 14.4	-16 17 14	29.917	17 25 36.5	-14 15 34	29.912
May	14	06 43 53.8	+22 41 48	9.712	22 33 55.6	-09 50 45	20.237	21 11 14.8	-16 17 13	29.900	17 25 31.0	-14 15 27	29.904
May	15	06 44 20.8	+22 41 26	9.724	22 34 00.4	-09 50 19	20.221	21 11 15.1	-16 17 13	29.884	17 25 25.4	-14 15 19	29.897
May	16	06 44 48.0	+22 41 04	9.736	22 34 05.1	-09 49 54	20.205	21 11 15.2	-16 17 13	29.867	17 25 19.7	-14 15 12	29.890
May	17	06 45 15.5	+22 40 42	9.748	22 34 09.6	-09 49 30	20.188	21 11 15.3	-16 17 14	29.850	17 25 14.0	-14 15 05	29.883
May	18	06 45 43.2	+22 40 18	9.759	22 34 13.9	-09 49 07	20.172	21 11 15.2	-16 17 15	29.834	17 25 08.3	-14 14 59	29.876
May	19	06 46 11.1	+22 39 54	9.770	22 34 18.0	-09 48 45	20.155	21 11 14.9	-16 17 17	29.817	17 25 02.4	-14 14 52	29.870
May	20	06 46 39.3	+22 39 30	9.781	22 34 22.0	-09 48 24	20.138	21 11 14.6	-16 17 19	29.801	17 24 56.6	-14 14 46	29.864
May	21	06 47 07.7	+22 39 05	9.792	22 34 25.7	-09 48 05	20.122	21 11 14.1	-16 17 22	29.784	17 24 50.6	-14 14 40	29.858
May	22	06 47 36.3	+22 38 39	9.802	22 34 29.3	-09 47 46	20.105	21 11 13.5	-16 17 26	29.768	17 24 44.6	-14 14 34	29.853
May	23	06 48 05.1	+22 38 12	9.813	22 34 32.7	-09 47 29	20.088	21 11 12.7	-16 17 30	29.752	17 24 38.6	-14 14 29	29.848
May	24	06 48 34.1	+22 37 45	9.823	22 34 35.9	-09 47 12	20.072	21 11 11.8	-16 17 34	29.736	17 24 32.5	-14 14 24	29.843
May	25	06 49 03.3	+22 37 18	9.833	22 34 39.0	-09 46 57	20.055	21 11 10.8	-16 17 40	29.720	17 24 26.4	-14 14 19	29.838
May	26	06 49 32.8	+22 36 50	9.843	22 34 41.9	-09 46 42	20.038	21 11 09.7	-16 17 45	29.704	17 24 20.2	-14 14 14	29.834
May	27	06 50 02.4	+22 36 21	9.853	22 34 44.5	-09 46 29	20.022	21 11 08.5	-16 17 52	29.688	17 24 14.0	-14 14 10	29.830
May	28	06 50 32.1	+22 35 51	9.862	22 34 47.0	-09 46 17	20.005	21 11 07.1	-16 17 59	29.672	17 24 07.8	-14 14 05	29.826
May	29	06 51 02.1	+22 35 21	9.871	22 34 49.4	-09 46 06	19.988	21 11 05.6	-16 18 06	29.657	17 24 01.5	-14 14 01	29.822
May	30	06 51 32.3	+22 34 51	9.880	22 34 51.5	-09 45 56	19.971	21 11 04.0	-16 18 14	29.641	17 23 55.2	-14 13 58	29.819
May	31	06 52 02.6	+22 34 20	9.889	22 34 53.5	-09 45 47	19.955	21 11 02.2	-16 18 23	29.626	17 23 48.9	-14 13 54	29.816
Jun	1	06 52 33.1	+22 33 48	9.898	22 34 55.2	-09 45 39	19.938	21 11 00.3	-16 18 32	29.610	17 23 42.5	-14 13 51	29.813
Jun	2	06 53 03.7	+22 33 15	9.906	22 34 56.8	-09 45 32	19.921	21 10 58.3	-16 18 42	29.595	17 23 36.1	-14 13 48	29.811
Jun	3	06 53 34.5	+22 32 42	9.914	22 34 58.2	-09 45 26	19.905	21 10 56.2	-16 18 52	29.580	17 23 29.7	-14 13 46	29.809
Jun	4	06 54 05.4	+22 32 08	9.922	22 34 59.4	-09 45 22	19.888	21 10 54.0	-16 19 03	29.565	17 23 23.3	-14 13 43	29.807
Jun	5	06 54 36.5	+22 31 34	9.930	22 35 00.5	-09 45 18	19.872	21 10 51.7	-16 19 14	29.551	17 23 16.8	-14 13 41	29.806
Jun	6	06 55 07.8	+22 30 59	9.938	22 35 01.3	-09 45 16	19.855	21 10 49.2	-16 19 25	29.536	17 23 10.3	-14 13 39	29.804
Jun	7	06 55 39.2	+22 30 24	9.945	22 35 02.0	-09 45 14	19.839	21 10 46.6	-16 19 38	29.521	17 23 03.9	-14 13 38	29.803
Jun	8	06 56 10.7	+22 29 48	9.952	22 35 02.5	-09 45 14	19.822	21 10 43.9	-16 19 51	29.507	17 22 57.4	-14 13 37	29.803
Jun	9	06 56 42.3	+22 29 11	9.959	22 35 02.8	-09 45 15	19.806	21 10 41.1	-16 20 04	29.493	17 22 50.9	-14 13 36	29.802
Jun	10	06 57 14.1	+22 28 34	9.966	22 35 02.9	-09 45 17	19.790	21 10 38.2	-16 20 18	29.479	17 22 44.4	-14 13 35	29.802
Jun	11	06 57 46.0	+22 27 56	9.972	22 35 02.9	-09 45 20	19.773	21 10 35.1	-16 20 32	29.465	17 22 37.9	-14 13 35	29.802
Jun	12	06 58 18.0	+22 27 17	9.978	22 35 02.6	-09 45 24	19.757	21 10 32.0	-16 20 47	29.452	17 22 31.3	-14 13 35	29.803
Jun	13	06 58 50.2	+22 26 38	9.984	22 35 02.2	-09 45 29	19.741	21 10 28.7	-16 21 02	29.438	17 22 24.8	-14 13 35	29.804

PLANET POSITIONS (continued)

MTH	DAY	SATURN RA h m s	SATURN Declination ° ′ ″	SATURN Dist. (AU)	URANUS RA h m s	URANUS Declination ° ′ ″	URANUS Dist. (AU)	NEPTUNE RA h m s	NEPTUNE Declination ° ′ ″	NEPTUNE Dist. (AU)	PLUTO RA h m s	PLUTO Declination ° ′ ″	PLUTO Dist. (AU)
Jun	14	06 59 22.4	+22 25 58	9.990	22 35 01.6	-09 45 35	19.725	21 10 25.3	-16 21 18	29.425	17 22 18.3	-14 13 35	29.805
Jun	15	06 59 54.7	+22 25 18	9.996	22 35 00.8	-09 45 42	19.709	21 10 21.9	-16 21 34	29.412	17 22 11.8	-14 13 36	29.806
Jun	16	07 00 27.2	+22 24 37	10.001	22 34 59.8	-09 45 50	19.693	21 10 18.3	-16 21 50	29.399	17 22 05.3	-14 13 37	29.808
Jun	17	07 00 59.7	+22 23 56	10.006	22 34 58.7	-09 45 59	19.678	21 10 14.6	-16 22 07	29.386	17 21 58.8	-14 13 39	29.810
Jun	18	07 01 32.4	+22 23 14	10.011	22 34 57.4	-09 46 10	19.662	21 10 10.8	-16 22 25	29.373	17 21 52.4	-14 13 41	29.812
Jun	19	07 02 05.1	+22 22 31	10.016	22 34 55.8	-09 46 21	19.646	21 10 06.9	-16 22 43	29.361	17 21 45.9	-14 13 43	29.814
Jun	20	07 02 37.9	+22 21 48	10.020	22 34 54.2	-09 46 34	19.631	21 10 02.9	-16 23 02	29.349	17 21 39.5	-14 13 45	29.817
Jun	21	07 03 10.7	+22 21 04	10.024	22 34 52.3	-09 46 47	19.616	21 09 58.8	-16 23 20	29.337	17 21 33.1	-14 13 48	29.820
Jun	22	07 03 43.6	+22 20 20	10.028	22 34 50.2	-09 47 02	19.600	21 09 54.6	-16 23 40	29.325	17 21 26.7	-14 13 51	29.824
Jun	23	07 04 16.6	+22 19 35	10.032	22 34 48.0	-09 47 17	19.585	21 09 50.3	-16 23 59	29.314	17 21 20.3	-14 13 54	29.827
Jun	24	07 04 49.7	+22 18 50	10.035	22 34 45.6	-09 47 34	19.570	21 09 45.9	-16 24 20	29.302	17 21 14.0	-14 13 58	29.831
Jun	25	07 05 22.8	+22 18 04	10.039	22 34 43.0	-09 47 51	19.555	21 09 41.4	-16 24 40	29.291	17 21 07.7	-14 14 02	29.836
Jun	26	07 05 56.0	+22 17 17	10.042	22 34 40.3	-09 48 10	19.541	21 09 36.9	-16 25 01	29.280	17 21 01.4	-14 14 06	29.840
Jun	27	07 06 29.2	+22 16 30	10.045	22 34 37.4	-09 48 30	19.526	21 09 32.2	-16 25 22	29.270	17 20 55.2	-14 14 11	29.845
Jun	28	07 07 02.4	+22 15 42	10.047	22 34 34.3	-09 48 50	19.512	21 09 27.5	-16 25 44	29.259	17 20 49.0	-14 14 16	29.850
Jun	29	07 07 35.7	+22 14 54	10.049	22 34 31.0	-09 49 12	19.497	21 09 22.7	-16 26 06	29.249	17 20 42.9	-14 14 21	29.855
Jun	30	07 08 09.0	+22 14 06	10.051	22 34 27.6	-09 49 34	19.483	21 09 17.7	-16 26 29	29.239	17 20 36.7	-14 14 27	29.861
Jul	1	07 08 42.3	+22 13 16	10.053	22 34 24.0	-09 49 57	19.469	21 09 12.8	-16 26 51	29.229	17 20 30.7	-14 14 32	29.867
Jul	2	07 09 15.7	+22 12 27	10.055	22 34 20.3	-09 50 22	19.456	21 09 07.7	-16 27 14	29.220	17 20 24.7	-14 14 39	29.873
Jul	3	07 09 49.0	+22 11 37	10.056	22 34 16.4	-09 50 47	19.442	21 09 02.5	-16 27 38	29.211	17 20 18.7	-14 14 45	29.879
Jul	4	07 10 22.4	+22 10 46	10.057	22 34 12.3	-09 51 13	19.428	21 08 57.3	-16 28 02	29.202	17 20 12.8	-14 14 52	29.886
Jul	5	07 10 55.8	+22 09 55	10.058	22 34 08.1	-09 51 40	19.415	21 08 52.0	-16 28 26	29.193	17 20 06.9	-14 14 59	29.893
Jul	6	07 11 29.2	+22 09 03	10.059	22 34 03.7	-09 52 08	19.402	21 08 46.6	-16 28 50	29.184	17 20 01.1	-14 15 07	29.900
Jul	7	07 12 02.7	+22 08 11	10.059	22 33 59.1	-09 52 37	19.389	21 08 41.2	-16 29 15	29.176	17 19 55.4	-14 15 14	29.908
Jul	8	07 12 36.1	+22 07 19	10.060	22 33 54.4	-09 53 07	19.376	21 08 35.7	-16 29 40	29.168	17 19 49.7	-14 15 22	29.915
Jul	9	07 13 09.5	+22 06 26	10.059	22 33 49.6	-09 53 38	19.364	21 08 30.1	-16 30 05	29.160	17 19 44.0	-14 15 31	29.923
Jul	10	07 13 42.9	+22 05 32	10.059	22 33 44.6	-09 54 09	19.351	21 08 24.5	-16 30 30	29.153	17 19 38.5	-14 15 40	29.932
Jul	11	07 14 16.3	+22 04 39	10.059	22 33 39.4	-09 54 42	19.339	21 08 18.8	-16 30 56	29.146	17 19 33.0	-14 15 49	29.940
Jul	12	07 14 49.6	+22 03 44	10.058	22 33 34.1	-09 55 15	19.327	21 08 13.0	-16 31 22	29.139	17 19 27.5	-14 15 58	29.949
Jul	13	07 15 23.0	+22 02 50	10.057	22 33 28.7	-09 55 49	19.315	21 08 07.2	-16 31 48	29.132	17 19 22.2	-14 16 08	29.958
Jul	14	07 15 56.3	+22 01 54	10.056	22 33 23.1	-09 56 24	19.304	21 08 01.3	-16 32 15	29.126	17 19 16.9	-14 16 18	29.967
Jul	15	07 16 29.6	+22 00 59	10.054	22 33 17.3	-09 56 59	19.292	21 07 55.3	-16 32 42	29.119	17 19 11.6	-14 16 28	29.977
Jul	16	07 17 02.8	+22 00 03	10.052	22 33 11.5	-09 57 36	19.281	21 07 49.4	-16 33 08	29.113	17 19 06.5	-14 16 39	29.986
Jul	17	07 17 36.0	+21 59 07	10.050	22 33 05.4	-09 58 13	19.270	21 07 43.3	-16 33 36	29.108	17 19 01.4	-14 16 50	29.996
Jul	18	07 18 09.2	+21 58 10	10.048	22 32 59.3	-09 58 51	19.259	21 07 37.2	-16 34 03	29.103	17 18 56.5	-14 17 01	30.006
Jul	19	07 18 42.3	+21 57 13	10.046	22 32 53.0	-09 59 30	19.249	21 07 31.1	-16 34 30	29.097	17 18 51.6	-14 17 13	30.017
Jul	20	07 19 15.3	+21 56 16	10.043	22 32 46.6	-10 00 09	19.239	21 07 24.9	-16 34 58	29.093	17 18 46.7	-14 17 25	30.028
Jul	21	07 19 48.3	+21 55 18	10.040	22 32 40.1	-10 00 49	19.228	21 07 18.7	-16 35 26	29.088	17 18 42.0	-14 17 37	30.038
Jul	22	07 20 21.2	+21 54 20	10.037	22 32 33.4	-10 01 30	19.219	21 07 12.5	-16 35 54	29.084	17 18 37.4	-14 17 49	30.050
Jul	23	07 20 54.0	+21 53 22	10.034	22 32 26.6	-10 02 11	19.209	21 07 06.2	-16 36 22	29.080	17 18 32.8	-14 18 02	30.061
Jul	24	07 21 26.8	+21 52 23	10.030	22 32 19.7	-10 02 53	19.200	21 06 59.9	-16 36 50	29.076	17 18 28.4	-14 18 15	30.073
Jul	25	07 21 59.5	+21 51 24	10.026	22 32 12.7	-10 03 36	19.191	21 06 53.5	-16 37 19	29.073	17 18 24.0	-14 18 29	30.084
Jul	26	07 22 32.1	+21 50 25	10.022	22 32 05.6	-10 04 20	19.182	21 06 47.1	-16 37 47	29.070	17 18 19.7	-14 18 43	30.096
Jul	27	07 23 04.6	+21 49 26	10.018	22 31 58.3	-10 05 03	19.173	21 06 40.7	-16 38 16	29.067	17 18 15.6	-14 18 57	30.108
Jul	28	07 23 37.0	+21 48 26	10.013	22 31 51.0	-10 05 48	19.165	21 06 34.3	-16 38 44	29.065	17 18 11.5	-14 19 11	30.121
Jul	29	07 24 09.3	+21 47 26	10.008	22 31 43.5	-10 06 33	19.157	21 06 27.9	-16 39 13	29.063	17 18 07.5	-14 19 26	30.133
Jul	30	07 24 41.5	+21 46 26	10.003	22 31 36.0	-10 07 19	19.149	21 06 21.4	-16 39 42	29.061	17 18 03.6	-14 19 40	30.146
Jul	31	07 25 13.6	+21 45 26	9.998	22 31 28.3	-10 08 05	19.141	21 06 14.9	-16 40 11	29.059	17 17 59.9	-14 19 56	30.159
Aug	1	07 25 45.6	+21 44 25	9.993	22 31 20.6	-10 08 51	19.134	21 06 08.4	-16 40 40	29.058	17 17 56.2	-14 20 11	30.172
Aug	2	07 26 17.5	+21 43 25	9.987	22 31 12.7	-10 09 38	19.127	21 06 01.9	-16 41 08	29.057	17 17 52.6	-14 20 27	30.186
Aug	3	07 26 49.3	+21 42 24	9.981	22 31 04.8	-10 10 26	19.120	21 05 55.4	-16 41 37	29.056	17 17 49.2	-14 20 43	30.199
Aug	4	07 27 20.9	+21 41 23	9.975	22 30 56.8	-10 11 14	19.114	21 05 48.9	-16 42 06	29.055	17 17 45.8	-14 20 59	30.213
Aug	5	07 27 52.4	+21 40 22	9.969	22 30 48.7	-10 12 03	19.107	21 05 42.4	-16 42 35	29.055	17 17 42.6	-14 21 16	30.227
Aug	6	07 28 23.8	+21 39 20	9.962	22 30 40.5	-10 12 51	19.101	21 05 35.8	-16 43 04	29.055	17 17 39.4	-14 21 33	30.241
Aug	7	07 28 55.1	+21 38 19	9.955	22 30 32.2	-10 13 41	19.096	21 05 29.3	-16 43 33	29.056	17 17 36.4	-14 21 50	30.255
Aug	8	07 29 26.2	+21 37 18	9.948	22 30 23.9	-10 14 30	19.090	21 05 22.8	-16 44 02	29.057	17 17 33.5	-14 22 07	30.269
Aug	9	07 29 57.2	+21 36 16	9.941	22 30 15.5	-10 15 20	19.085	21 05 16.3	-16 44 31	29.058	17 17 30.7	-14 22 25	30.284
Aug	10	07 30 28.0	+21 35 14	9.934	22 30 07.0	-10 16 11	19.080	21 05 09.7	-16 44 60	29.059	17 17 28.0	-14 22 43	30.298
Aug	11	07 30 58.6	+21 34 13	9.926	22 29 58.5	-10 17 01	19.076	21 05 03.2	-16 45 28	29.061	17 17 25.5	-14 23 01	30.313
Aug	12	07 31 29.2	+21 33 11	9.918	22 29 49.9	-10 17 52	19.071	21 04 56.8	-16 45 57	29.062	17 17 23.0	-14 23 20	30.328
Aug	13	07 31 59.5	+21 32 09	9.910	22 29 41.2	-10 18 44	19.067	21 04 50.3	-16 46 26	29.065	17 17 20.7	-14 23 38	30.343
Aug	14	07 32 29.7	+21 31 08	9.902	22 29 32.5	-10 19 35	19.063	21 04 43.8	-16 46 54	29.067	17 17 18.5	-14 23 57	30.359
Aug	15	07 32 59.7	+21 30 06	9.893	22 29 23.7	-10 20 27	19.060	21 04 37.4	-16 47 22	29.070	17 17 16.4	-14 24 17	30.374
Aug	16	07 33 29.5	+21 29 04	9.884	22 29 14.9	-10 21 19	19.057	21 04 31.0	-16 47 51	29.073	17 17 14.5	-14 24 36	30.389
Aug	17	07 33 59.1	+21 28 02	9.875	22 29 06.1	-10 22 11	19.054	21 04 24.6	-16 48 19	29.076	17 17 12.6	-14 24 56	30.405
Aug	18	07 34 28.6	+21 27 01	9.866	22 28 57.2	-10 23 03	19.051	21 04 18.2	-16 48 47	29.080	17 17 10.9	-14 25 16	30.421
Aug	19	07 34 57.9	+21 25 59	9.857	22 28 48.2	-10 23 55	19.049	21 04 11.9	-16 49 15	29.084	17 17 09.3	-14 25 36	30.437

PLANET POSITIONS (continued)

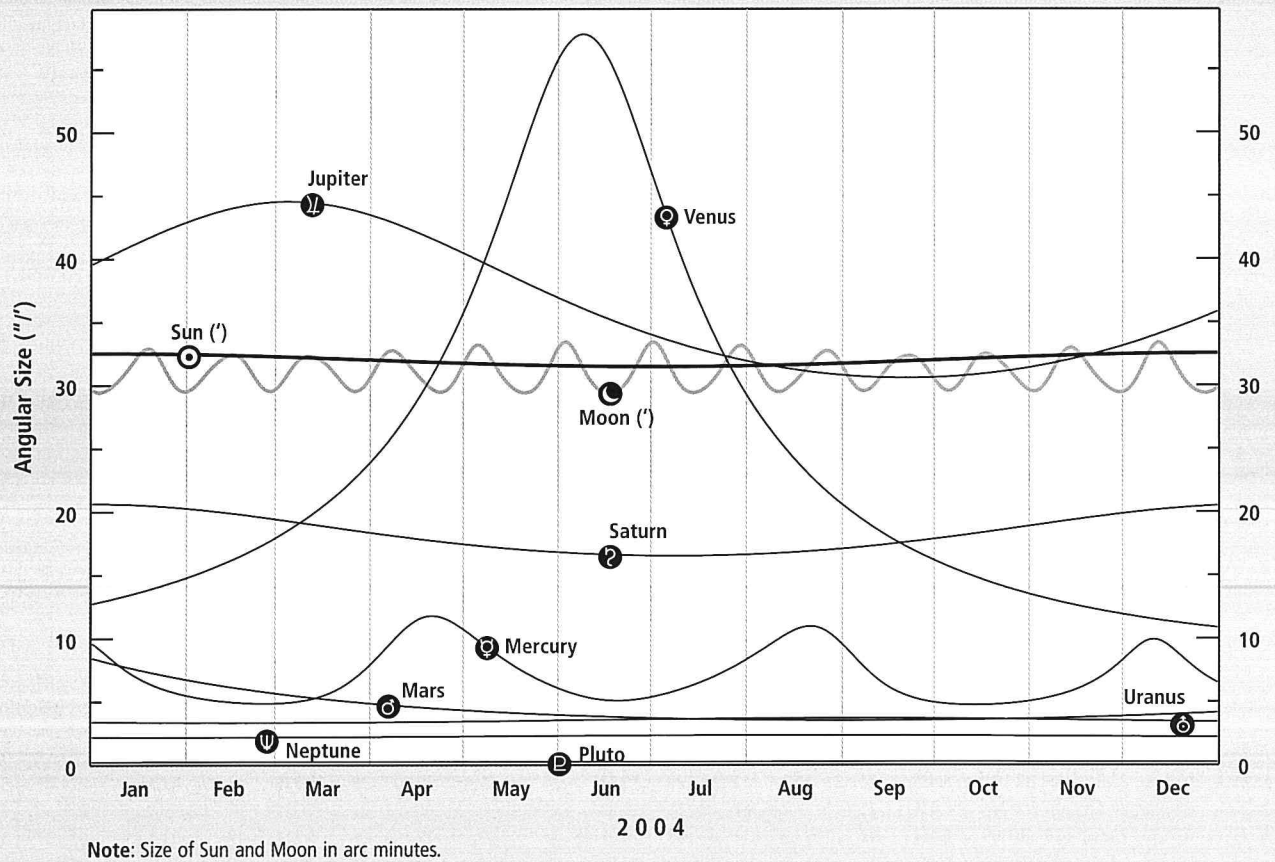
Note: positions refer to 0000 WAST

MTH	DAY	SATURN RA h m s	SATURN Declination ° ′ ″	SATURN Dist. (AU)	URANUS RA h m s	URANUS Declination ° ′ ″	URANUS Dist. (AU)	NEPTUNE RA h m s	NEPTUNE Declination ° ′ ″	NEPTUNE Dist. (AU)	PLUTO RA h m s	PLUTO Declination ° ′ ″	PLUTO Dist. (AU)
Aug	20	07 35 26.9	+21 24 58	9.847	22 28 39.3	-10 24 48	19.047	21 04 05.6	-16 49 42	29.088	17 17 07.8	-14 25 56	30.453
Aug	21	07 35 55.8	+21 23 57	9.838	22 28 30.3	-10 25 41	19.046	21 03 59.3	-16 50 10	29.093	17 17 06.5	-14 26 17	30.469
Aug	22	07 36 24.4	+21 22 56	9.828	22 28 21.3	-10 26 33	19.044	21 03 53.1	-16 50 37	29.097	17 17 05.3	-14 26 38	30.485
Aug	23	07 36 52.9	+21 21 55	9.818	22 28 12.3	-10 27 26	19.043	21 03 47.0	-16 51 04	29.103	17 17 04.2	-14 26 59	30.501
Aug	24	07 37 21.1	+21 20 54	9.807	22 28 03.2	-10 28 19	19.042	21 03 40.8	-16 51 31	29.108	17 17 03.3	-14 27 20	30.518
Aug	25	07 37 49.1	+21 19 53	9.797	22 27 54.2	-10 29 11	19.042	21 03 34.7	-16 51 58	29.114	17 17 02.4	-14 27 41	30.534
Aug	26	07 38 16.9	+21 18 53	9.786	22 27 45.1	-10 30 04	19.042	21 03 28.7	-16 52 25	29.119	17 17 01.7	-14 28 03	30.551
Aug	27	07 38 44.4	+21 17 53	9.775	22 27 36.0	-10 30 57	19.042	21 03 22.7	-16 52 51	29.126	17 17 01.2	-14 28 25	30.567
Aug	28	07 39 11.7	+21 16 53	9.764	22 27 27.0	-10 31 50	19.042	21 03 16.7	-16 53 17	29.132	17 17 00.7	-14 28 47	30.584
Aug	29	07 39 38.8	+21 15 54	9.753	22 27 17.9	-10 32 42	19.043	21 03 10.9	-16 53 43	29.139	17 17 00.4	-14 29 09	30.601
Aug	30	07 40 05.7	+21 14 54	9.741	22 27 08.8	-10 33 35	19.044	21 03 05.0	-16 54 08	29.146	17 17 00.2	-14 29 31	30.617
Aug	31	07 40 32.3	+21 13 55	9.730	22 26 59.8	-10 34 27	19.045	21 02 59.3	-16 54 33	29.153	17 17 00.2	-14 29 54	30.634
Sep	1	07 40 58.6	+21 12 56	9.718	22 26 50.7	-10 35 19	19.047	21 02 53.5	-16 54 58	29.161	17 17 00.3	-14 30 17	30.651
Sep	2	07 41 24.7	+21 11 58	9.706	22 26 41.7	-10 36 11	19.049	21 02 47.9	-16 55 23	29.168	17 17 00.5	-14 30 40	30.668
Sep	3	07 41 50.6	+21 11 00	9.694	22 26 32.7	-10 37 03	19.051	21 02 42.3	-16 55 48	29.177	17 17 00.8	-14 31 03	30.685
Sep	4	07 42 16.2	+21 10 02	9.681	22 26 23.7	-10 37 55	19.053	21 02 36.8	-16 56 12	29.185	17 17 01.3	-14 31 26	30.702
Sep	5	07 42 41.5	+21 09 05	9.669	22 26 14.8	-10 38 46	19.056	21 02 31.4	-16 56 35	29.193	17 17 01.9	-14 31 49	30.719
Sep	6	07 43 06.6	+21 08 08	9.656	22 26 05.8	-10 39 37	19.059	21 02 26.0	-16 56 59	29.202	17 17 02.7	-14 32 13	30.736
Sep	7	07 43 31.3	+21 07 12	9.644	22 25 56.9	-10 40 28	19.062	21 02 20.7	-16 57 22	29.211	17 17 03.5	-14 32 37	30.754
Sep	8	07 43 55.8	+21 06 16	9.631	22 25 48.1	-10 41 19	19.066	21 02 15.4	-16 57 45	29.221	17 17 04.5	-14 33 01	30.771
Sep	9	07 44 20.0	+21 05 21	9.617	22 25 39.3	-10 42 09	19.070	21 02 10.3	-16 58 08	29.230	17 17 05.7	-14 33 25	30.788
Sep	10	07 44 44.0	+21 04 26	9.604	22 25 30.5	-10 42 59	19.074	21 02 05.2	-16 58 30	29.240	17 17 06.9	-14 33 49	30.805
Sep	11	07 45 07.6	+21 03 31	9.591	22 25 21.8	-10 43 49	19.079	21 02 00.2	-16 58 51	29.250	17 17 08.4	-14 34 13	30.822
Sep	12	07 45 30.9	+21 02 37	9.577	22 25 13.1	-10 44 38	19.084	21 01 55.3	-16 59 13	29.261	17 17 09.9	-14 34 37	30.840
Sep	13	07 45 53.9	+21 01 44	9.563	22 25 04.5	-10 45 27	19.089	21 01 50.5	-16 59 34	29.271	17 17 11.6	-14 35 02	30.857
Sep	14	07 46 16.6	+21 00 51	9.550	22 24 56.0	-10 46 15	19.094	21 01 45.8	-16 59 55	29.282	17 17 13.4	-14 35 26	30.874
Sep	15	07 46 39.0	+20 59 59	9.536	22 24 47.5	-10 47 03	19.100	21 01 41.2	-17 00 15	29.293	17 17 15.3	-14 35 51	30.891
Sep	16	07 47 01.1	+20 59 07	9.521	22 24 39.1	-10 47 51	19.106	21 01 36.6	-17 00 35	29.304	17 17 17.4	-14 36 16	30.909
Sep	17	07 47 22.8	+20 58 17	9.507	22 24 30.8	-10 48 38	19.112	21 01 32.2	-17 00 54	29.316	17 17 19.6	-14 36 41	30.926
Sep	18	07 47 44.3	+20 57 26	9.493	22 24 22.5	-10 49 24	19.119	21 01 27.8	-17 01 13	29.328	17 17 21.9	-14 37 06	30.943
Sep	19	07 48 05.4	+20 56 37	9.478	22 24 14.3	-10 50 10	19.126	21 01 23.5	-17 01 32	29.339	17 17 24.4	-14 37 31	30.960
Sep	20	07 48 26.1	+20 55 48	9.464	22 24 06.3	-10 50 56	19.133	21 01 19.4	-17 01 50	29.352	17 17 27.0	-14 37 56	30.977
Sep	21	07 48 46.5	+20 54 60	9.449	22 23 58.3	-10 51 41	19.140	21 01 15.3	-17 02 08	29.364	17 17 29.7	-14 38 21	30.994
Sep	22	07 49 06.6	+20 54 12	9.434	22 23 50.3	-10 52 25	19.148	21 01 11.4	-17 02 25	29.376	17 17 32.6	-14 38 46	31.011
Sep	23	07 49 26.3	+20 53 26	9.419	22 23 42.5	-10 53 09	19.156	21 01 07.5	-17 02 42	29.389	17 17 35.6	-14 39 12	31.028
Sep	24	07 49 45.7	+20 52 40	9.404	22 23 34.8	-10 53 52	19.164	21 01 03.8	-17 02 58	29.402	17 17 38.7	-14 39 37	31.045
Sep	25	07 50 04.7	+20 51 55	9.389	22 23 27.2	-10 54 34	19.172	21 01 00.2	-17 03 14	29.415	17 17 41.9	-14 40 02	31.062
Sep	26	07 50 23.4	+20 51 11	9.373	22 23 19.7	-10 55 16	19.181	21 00 56.6	-17 03 30	29.429	17 17 45.3	-14 40 28	31.078
Sep	27	07 50 41.7	+20 50 27	9.358	22 23 12.2	-10 55 57	19.190	21 00 53.2	-17 03 45	29.442	17 17 48.8	-14 40 53	31.095
Sep	28	07 50 59.6	+20 49 45	9.343	22 23 04.9	-10 56 38	19.199	21 00 49.9	-17 03 59	29.456	17 17 52.4	-14 41 19	31.112
Sep	29	07 51 17.2	+20 49 03	9.327	22 22 57.7	-10 57 18	19.209	21 00 46.7	-17 04 13	29.470	17 17 56.2	-14 41 45	31.128
Sep	30	07 51 34.3	+20 48 22	9.311	22 22 50.7	-10 57 57	19.218	21 00 43.7	-17 04 27	29.484	17 18 00.0	-14 42 10	31.145
Oct	1	07 51 51.1	+20 47 42	9.296	22 22 43.7	-10 58 35	19.228	21 00 40.7	-17 04 40	29.498	17 18 04.0	-14 42 36	31.161
Oct	2	07 52 07.6	+20 47 03	9.280	22 22 36.9	-10 59 13	19.239	21 00 37.9	-17 04 52	29.512	17 18 08.1	-14 43 01	31.177
Oct	3	07 52 23.6	+20 46 25	9.264	22 22 30.1	-10 59 50	19.249	21 00 35.1	-17 05 04	29.527	17 18 12.4	-14 43 27	31.193
Oct	4	07 52 39.3	+20 45 48	9.248	22 22 23.6	-11 00 26	19.260	21 00 32.5	-17 05 16	29.542	17 18 16.8	-14 43 53	31.209
Oct	5	07 52 54.5	+20 45 12	9.232	22 22 17.1	-11 01 01	19.271	21 00 30.0	-17 05 27	29.557	17 18 21.2	-14 44 18	31.225
Oct	6	07 53 09.4	+20 44 37	9.216	22 22 10.8	-11 01 35	19.282	21 00 27.7	-17 05 37	29.572	17 18 25.8	-14 44 44	31.241
Oct	7	07 53 23.8	+20 44 03	9.200	22 22 04.6	-11 02 09	19.293	21 00 25.4	-17 05 47	29.587	17 18 30.6	-14 45 10	31.257
Oct	8	07 53 37.9	+20 43 30	9.183	22 21 58.5	-11 02 42	19.305	21 00 23.3	-17 05 57	29.602	17 18 35.4	-14 45 35	31.273
Oct	9	07 53 51.5	+20 42 57	9.167	22 21 52.6	-11 03 14	19.317	21 00 21.3	-17 06 06	29.617	17 18 40.4	-14 46 01	31.288
Oct	10	07 54 04.8	+20 42 26	9.151	22 21 46.8	-11 03 45	19.329	21 00 19.5	-17 06 14	29.633	17 18 45.5	-14 46 26	31.303
Oct	11	07 54 17.6	+20 41 57	9.134	22 21 41.2	-11 04 15	19.341	21 00 17.7	-17 06 22	29.649	17 18 50.6	-14 46 52	31.319
Oct	12	07 54 29.9	+20 41 28	9.118	22 21 35.7	-11 04 45	19.354	21 00 16.1	-17 06 29	29.664	17 18 56.0	-14 47 17	31.334
Oct	13	07 54 41.9	+20 41 00	9.102	22 21 30.4	-11 05 13	19.366	21 00 14.6	-17 06 36	29.680	17 19 01.4	-14 47 43	31.349
Oct	14	07 54 53.4	+20 40 34	9.085	22 21 25.3	-11 05 41	19.379	21 00 13.3	-17 06 42	29.696	17 19 06.9	-14 48 08	31.363
Oct	15	07 55 04.5	+20 40 08	9.069	22 21 20.2	-11 06 08	19.392	21 00 12.1	-17 06 48	29.713	17 19 12.6	-14 48 33	31.378
Oct	16	07 55 15.2	+20 39 44	9.052	22 21 15.4	-11 06 33	19.406	21 00 11.0	-17 06 53	29.729	17 19 18.3	-14 48 58	31.393
Oct	17	07 55 25.4	+20 39 21	9.036	22 21 10.7	-11 06 58	19.419	21 00 10.0	-17 06 58	29.745	17 19 24.2	-14 49 24	31.407
Oct	18	07 55 35.2	+20 38 59	9.019	22 21 06.2	-11 07 22	19.433	21 00 09.2	-17 07 02	29.762	17 19 30.1	-14 49 49	31.421
Oct	19	07 55 44.5	+20 38 38	9.002	22 21 01.8	-11 07 45	19.447	21 00 08.5	-17 07 05	29.778	17 19 36.2	-14 50 14	31.435
Oct	20	07 55 53.4	+20 38 19	8.986	22 20 57.6	-11 08 06	19.461	21 00 08.0	-17 07 08	29.795	17 19 42.4	-14 50 39	31.449
Oct	21	07 56 01.9	+20 38 01	8.969	22 20 53.6	-11 08 27	19.475	21 00 07.6	-17 07 10	29.811	17 19 48.7	-14 51 03	31.463
Oct	22	07 56 09.8	+20 37 44	8.953	22 20 49.7	-11 08 47	19.489	21 00 07.3	-17 07 12	29.828	17 19 55.1	-14 51 28	31.476
Oct	23	07 56 17.4	+20 37 28	8.936	22 20 46.1	-11 09 06	19.504	21 00 07.1	-17 07 13	29.845	17 20 01.5	-14 51 53	31.490
Oct	24	07 56 24.5	+20 37 14	8.920	22 20 42.6	-11 09 24	19.519	21 00 07.1	-17 07 14	29.862	17 20 08.1	-14 52 17	31.503
Oct	25	07 56 31.1	+20 37 00	8.903	22 20 39.2	-11 09 40	19.533	21 00 07.2	-17 07 14	29.879	17 20 14.8	-14 52 42	31.516

PLANET POSITIONS (continued)

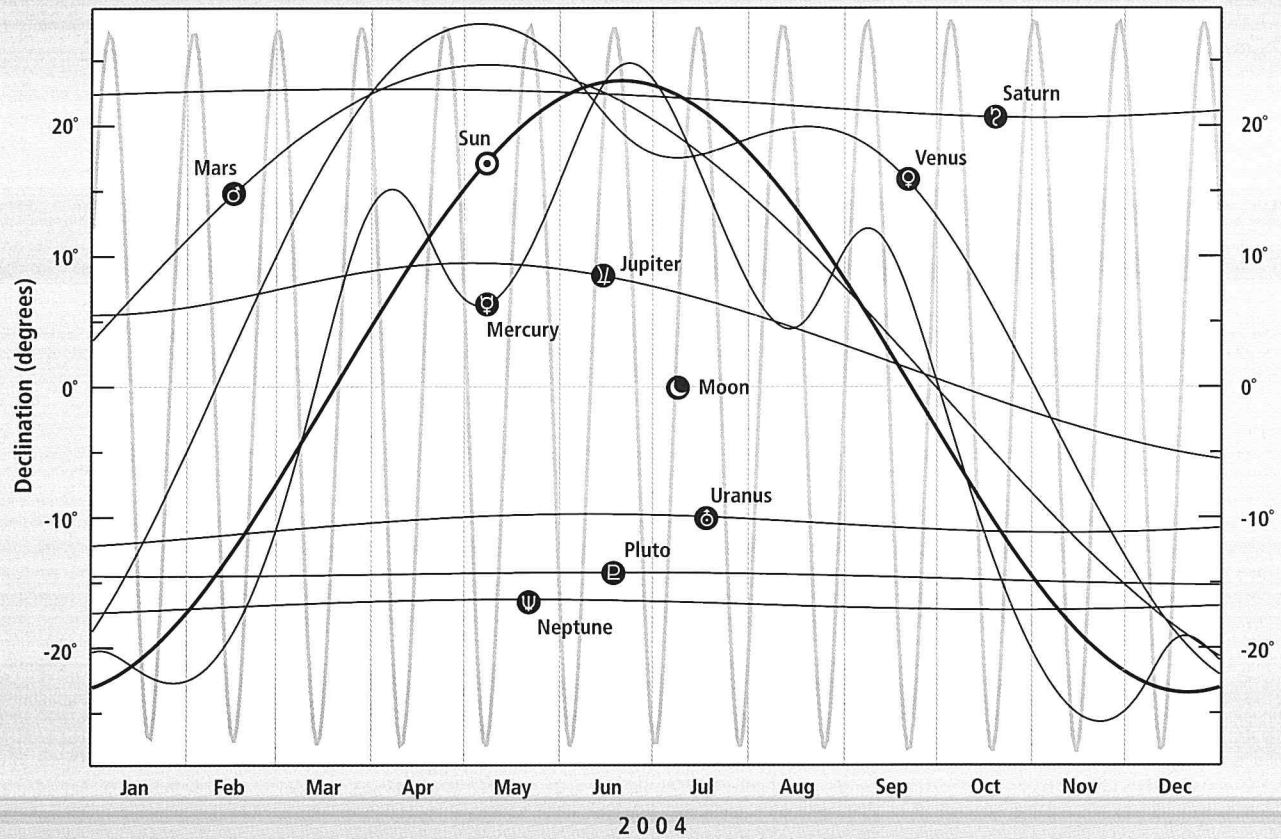
MTH	DAY	SATURN RA h m s	SATURN Declination ° ′ ″	SATURN Dist. (AU)	URANUS RA h m s	URANUS Declination ° ′ ″	URANUS Dist. (AU)	NEPTUNE RA h m s	NEPTUNE Declination ° ′ ″	NEPTUNE Dist. (AU)	PLUTO RA h m s	PLUTO Declination ° ′ ″	PLUTO Dist. (AU)
Oct	26	07 56 37.3	+20 36 48	8.887	22 20 36.1	-11 09 56	19.548	21 00 07.5	-17 07 13	29.896	17 20 21.6	-14 53 06	31.528
Oct	27	07 56 43.0	+20 36 38	8.871	22 20 33.1	-11 10 11	19.564	21 00 07.9	-17 07 12	29.913	17 20 28.4	-14 53 30	31.541
Oct	28	07 56 48.3	+20 36 28	8.854	22 20 30.3	-11 10 24	19.579	21 00 08.4	-17 07 10	29.930	17 20 35.4	-14 53 54	31.553
Oct	29	07 56 53.1	+20 36 20	8.838	22 20 27.7	-11 10 37	19.594	21 00 09.1	-17 07 08	29.947	17 20 42.4	-14 54 18	31.565
Oct	30	07 56 57.4	+20 36 14	8.822	22 20 25.2	-11 10 49	19.610	21 00 09.9	-17 07 05	29.964	17 20 49.6	-14 54 41	31.577
Oct	31	07 57 01.3	+20 36 08	8.805	22 20 23.0	-11 10 59	19.626	21 00 10.8	-17 07 02	29.981	17 20 56.8	-14 55 05	31.589
Nov	1	07 57 04.7	+20 36 04	8.789	22 20 20.9	-11 11 09	19.641	21 00 11.9	-17 06 58	29.998	17 21 04.1	-14 55 28	31.601
Nov	2	07 57 07.6	+20 36 01	8.773	22 20 19.0	-11 11 17	19.657	21 00 13.1	-17 06 53	30.016	17 21 11.5	-14 55 52	31.612
Nov	3	07 57 10.1	+20 35 60	8.757	22 20 17.3	-11 11 24	19.673	21 00 14.4	-17 06 48	30.033	17 21 19.0	-14 56 15	31.623
Nov	4	07 57 12.1	+20 35 59	8.741	22 20 15.8	-11 11 30	19.690	21 00 15.9	-17 06 42	30.050	17 21 26.6	-14 56 38	31.634
Nov	5	07 57 13.6	+20 36 00	8.725	22 20 14.5	-11 11 35	19.706	21 00 17.5	-17 06 36	30.067	17 21 34.2	-14 57 01	31.645
Nov	6	07 57 14.7	+20 36 03	8.709	22 20 13.4	-11 11 40	19.722	21 00 19.3	-17 06 29	30.084	17 21 41.9	-14 57 23	31.655
Nov	7	07 57 15.3	+20 36 07	8.693	22 20 12.4	-11 11 42	19.739	21 00 21.2	-17 06 21	30.102	17 21 49.7	-14 57 46	31.665
Nov	8	07 57 15.4	+20 36 12	8.678	22 20 11.7	-11 11 44	19.755	21 00 23.2	-17 06 13	30.119	17 21 57.6	-14 58 08	31.675
Nov	9	07 57 15.0	+20 36 18	8.662	22 20 11.1	-11 11 45	19.772	21 00 25.4	-17 06 05	30.136	17 22 05.5	-14 58 30	31.685
Nov	10	07 57 14.2	+20 36 26	8.647	22 20 10.8	-11 11 45	19.789	21 00 27.7	-17 05 56	30.153	17 22 13.5	-14 58 52	31.694
Nov	11	07 57 12.8	+20 36 36	8.631	22 20 10.6	-11 11 43	19.806	21 00 30.1	-17 05 46	30.170	17 22 21.6	-14 59 14	31.704
Nov	12	07 57 11.0	+20 36 46	8.616	22 20 10.7	-11 11 40	19.822	21 00 32.7	-17 05 36	30.187	17 22 29.8	-14 59 35	31.713
Nov	13	07 57 08.8	+20 36 58	8.601	22 20 10.9	-11 11 37	19.839	21 00 35.4	-17 05 25	30.204	17 22 38.0	-14 59 56	31.721
Nov	14	07 57 06.0	+20 37 11	8.586	22 20 11.3	-11 11 32	19.856	21 00 38.2	-17 05 13	30.221	17 22 46.3	-15 00 17	31.730
Nov	15	07 57 02.8	+20 37 26	8.571	22 20 11.9	-11 11 26	19.873	21 00 41.2	-17 05 01	30.238	17 22 54.6	-15 00 38	31.738
Nov	16	07 56 59.2	+20 37 42	8.556	22 20 12.7	-11 11 19	19.891	21 00 44.3	-17 04 49	30.255	17 23 03.0	-15 00 59	31.746
Nov	17	07 56 55.0	+20 37 59	8.542	22 20 13.7	-11 11 11	19.908	21 00 47.5	-17 04 36	30.272	17 23 11.5	-15 01 19	31.754
Nov	18	07 56 50.4	+20 38 17	8.527	22 20 14.9	-11 11 01	19.925	21 00 50.9	-17 04 22	30.289	17 23 20.0	-15 01 39	31.761
Nov	19	07 56 45.3	+20 38 37	8.513	22 20 16.3	-11 10 51	19.942	21 00 54.4	-17 04 08	30.306	17 23 28.6	-15 01 59	31.768
Nov	20	07 56 39.8	+20 38 58	8.499	22 20 17.9	-11 10 39	19.959	21 00 58.0	-17 03 53	30.322	17 23 37.2	-15 02 19	31.775
Nov	21	07 56 33.8	+20 39 21	8.485	22 20 19.7	-11 10 27	19.977	21 01 01.8	-17 03 38	30.339	17 23 45.9	-15 02 39	31.782
Nov	22	07 56 27.4	+20 39 44	8.471	22 20 21.7	-11 10 13	19.994	21 01 05.7	-17 03 22	30.355	17 23 54.6	-15 02 58	31.788
Nov	23	07 56 20.5	+20 40 09	8.457	22 20 23.9	-11 09 58	20.011	21 01 09.7	-17 03 05	30.371	17 24 03.3	-15 03 17	31.795
Nov	24	07 56 13.2	+20 40 35	8.444	22 20 26.3	-11 09 42	20.028	21 01 13.8	-17 02 48	30.388	17 24 12.2	-15 03 36	31.800
Nov	25	07 56 05.4	+20 41 03	8.430	22 20 28.8	-11 09 25	20.046	21 01 18.1	-17 02 31	30.404	17 24 21.0	-15 03 54	31.806
Nov	26	07 55 57.2	+20 41 31	8.417	22 20 31.6	-11 09 07	20.063	21 01 22.4	-17 02 13	30.420	17 24 29.9	-15 04 12	31.811
Nov	27	07 55 48.5	+20 42 01	8.404	22 20 34.5	-11 08 48	20.080	21 01 26.9	-17 01 54	30.436	17 24 38.8	-15 04 30	31.816
Nov	28	07 55 39.5	+20 42 32	8.391	22 20 37.7	-11 08 27	20.097	21 01 31.6	-17 01 35	30.452	17 24 47.8	-15 04 48	31.821
Nov	29	07 55 29.9	+20 43 04	8.379	22 20 41.0	-11 08 06	20.115	21 01 36.3	-17 01 16	30.467	17 24 56.8	-15 05 05	31.826
Nov	30	07 55 20.0	+20 43 38	8.366	22 20 44.5	-11 07 43	20.132	21 01 41.2	-17 00 55	30.483	17 25 05.8	-15 05 23	31.830
Dec	1	07 55 09.6	+20 44 12	8.354	22 20 48.2	-11 07 20	20.149	21 01 46.2	-17 00 35	30.498	17 25 14.8	-15 05 40	31.834
Dec	2	07 54 58.9	+20 44 48	8.342	22 20 52.1	-11 06 55	20.166	21 01 51.3	-17 00 14	30.514	17 25 23.9	-15 05 56	31.837
Dec	3	07 54 47.7	+20 45 24	8.330	22 20 56.2	-11 06 29	20.183	21 01 56.5	-16 59 52	30.529	17 25 33.0	-15 06 13	31.841
Dec	4	07 54 36.1	+20 46 02	8.319	22 21 00.5	-11 06 03	20.200	21 02 01.8	-16 59 30	30.544	17 25 42.1	-15 06 29	31.844
Dec	5	07 54 24.1	+20 46 41	8.307	22 21 05.0	-11 05 35	20.217	21 02 07.2	-16 59 07	30.559	17 25 51.3	-15 06 44	31.847
Dec	6	07 54 11.7	+20 47 20	8.296	22 21 09.6	-11 05 06	20.234	21 02 12.8	-16 58 44	30.574	17 26 00.5	-15 07 00	31.849
Dec	7	07 53 58.9	+20 48 01	8.285	22 21 14.4	-11 04 36	20.251	21 02 18.5	-16 58 21	30.588	17 26 09.7	-15 07 15	31.851
Dec	8	07 53 45.8	+20 48 43	8.275	22 21 19.5	-11 04 05	20.268	21 02 24.3	-16 57 57	30.603	17 26 18.9	-15 07 30	31.853
Dec	9	07 53 32.2	+20 49 26	8.264	22 21 24.7	-11 03 33	20.285	21 02 30.1	-16 57 32	30.617	17 26 28.1	-15 07 45	31.855
Dec	10	07 53 18.3	+20 50 10	8.254	22 21 30.0	-11 02 60	20.302	21 02 36.1	-16 57 07	30.631	17 26 37.3	-15 07 59	31.856
Dec	11	07 53 04.0	+20 50 54	8.244	22 21 35.6	-11 02 26	20.318	21 02 42.2	-16 56 42	30.645	17 26 46.5	-15 08 13	31.857
Dec	12	07 52 49.4	+20 51 40	8.235	22 21 41.3	-11 01 51	20.335	21 02 48.5	-16 56 16	30.659	17 26 55.8	-15 08 27	31.858
Dec	13	07 52 34.4	+20 52 26	8.225	22 21 47.3	-11 01 15	20.351	21 02 54.8	-16 55 49	30.672	17 27 05.0	-15 08 41	31.859
Dec	14	07 52 19.1	+20 53 14	8.216	22 21 53.4	-11 00 38	20.368	21 03 01.2	-16 55 23	30.686	17 27 14.3	-15 08 54	31.859
Dec	15	07 52 03.4	+20 54 02	8.207	22 21 59.6	-10 59 59	20.384	21 03 07.7	-16 54 55	30.699	17 27 23.5	-15 09 07	31.859
Dec	16	07 51 47.5	+20 54 51	8.198	22 22 06.1	-10 59 20	20.400	21 03 14.3	-16 54 28	30.712	17 27 32.7	-15 09 19	31.858
Dec	17	07 51 31.2	+20 55 40	8.190	22 22 12.7	-10 58 40	20.416	21 03 21.0	-16 53 60	30.725	17 27 42.0	-15 09 31	31.858
Dec	18	07 51 14.6	+20 56 30	8.182	22 22 19.5	-10 57 59	20.432	21 03 27.8	-16 53 31	30.737	17 27 51.2	-15 09 43	31.857
Dec	19	07 50 57.7	+20 57 21	8.174	22 22 26.5	-10 57 17	20.448	21 03 34.7	-16 53 02	30.750	17 28 00.4	-15 09 55	31.855
Dec	20	07 50 40.6	+20 58 13	8.167	22 22 33.6	-10 56 34	20.463	21 03 41.7	-16 52 33	30.762	17 28 09.6	-15 10 06	31.854
Dec	21	07 50 23.1	+20 59 05	8.159	22 22 40.9	-10 55 50	20.479	21 03 48.8	-16 52 03	30.774	17 28 18.8	-15 10 17	31.852
Dec	22	07 50 05.4	+20 59 58	8.152	22 22 48.3	-10 55 06	20.494	21 03 55.9	-16 51 33	30.785	17 28 28.0	-15 10 28	31.850
Dec	23	07 49 47.5	+21 00 52	8.146	22 22 55.9	-10 54 20	20.510	21 04 03.2	-16 51 02	30.797	17 28 37.1	-15 10 39	31.848
Dec	24	07 49 29.3	+21 01 46	8.139	22 23 03.7	-10 53 33	20.525	21 04 10.5	-16 50 31	30.808	17 28 46.3	-15 10 49	31.845
Dec	25	07 49 10.8	+21 02 40	8.133	22 23 11.6	-10 52 46	20.540	21 04 17.9	-16 50 00	30.819	17 28 55.4	-15 10 58	31.842
Dec	26	07 48 52.2	+21 03 35	8.128	22 23 19.7	-10 51 58	20.555	21 04 25.4	-16 49 29	30.830	17 29 04.4	-15 11 08	31.839
Dec	27	07 48 33.3	+21 04 30	8.122	22 23 27.9	-10 51 08	20.569	21 04 33.0	-16 48 57	30.841	17 29 13.5	-15 11 17	31.835
Dec	28	07 48 14.2	+21 05 26	8.117	22 23 36.3	-10 50 18	20.584	21 04 40.6	-16 48 24	30.851	17 29 22.5	-15 11 26	31.831
Dec	29	07 47 54.9	+21 06 22	8.112	22 23 44.8	-10 49 27	20.598	21 04 48.3	-16 47 52	30.861	17 29 31.5	-15 11 34	31.827
Dec	30	07 47 35.5	+21 07 19	8.107	22 23 53.5	-10 48 36	20.612	21 04 56.1	-16 47 19	30.871	17 29 40.5	-15 11 43	31.823
Dec	31	07 47 15.8	+21 08 15	8.103	22 24 02.3	-10 47 43	20.627	21 05 04.0	-16 46 45	30.881	17 29 49.4	-15 11 50	31.818

ANGULAR SIZES OF THE PLANETS 2004

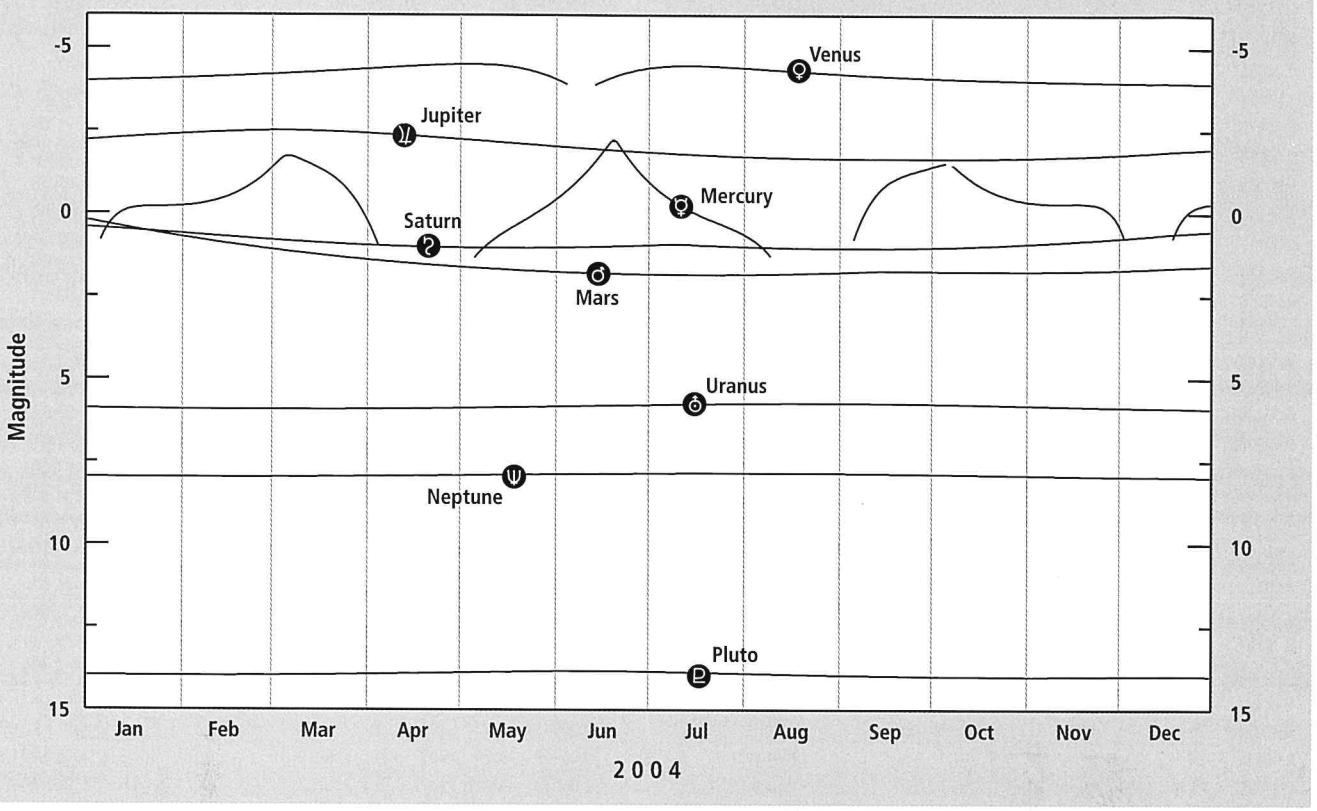


Note: Size of Sun and Moon in arc minutes.

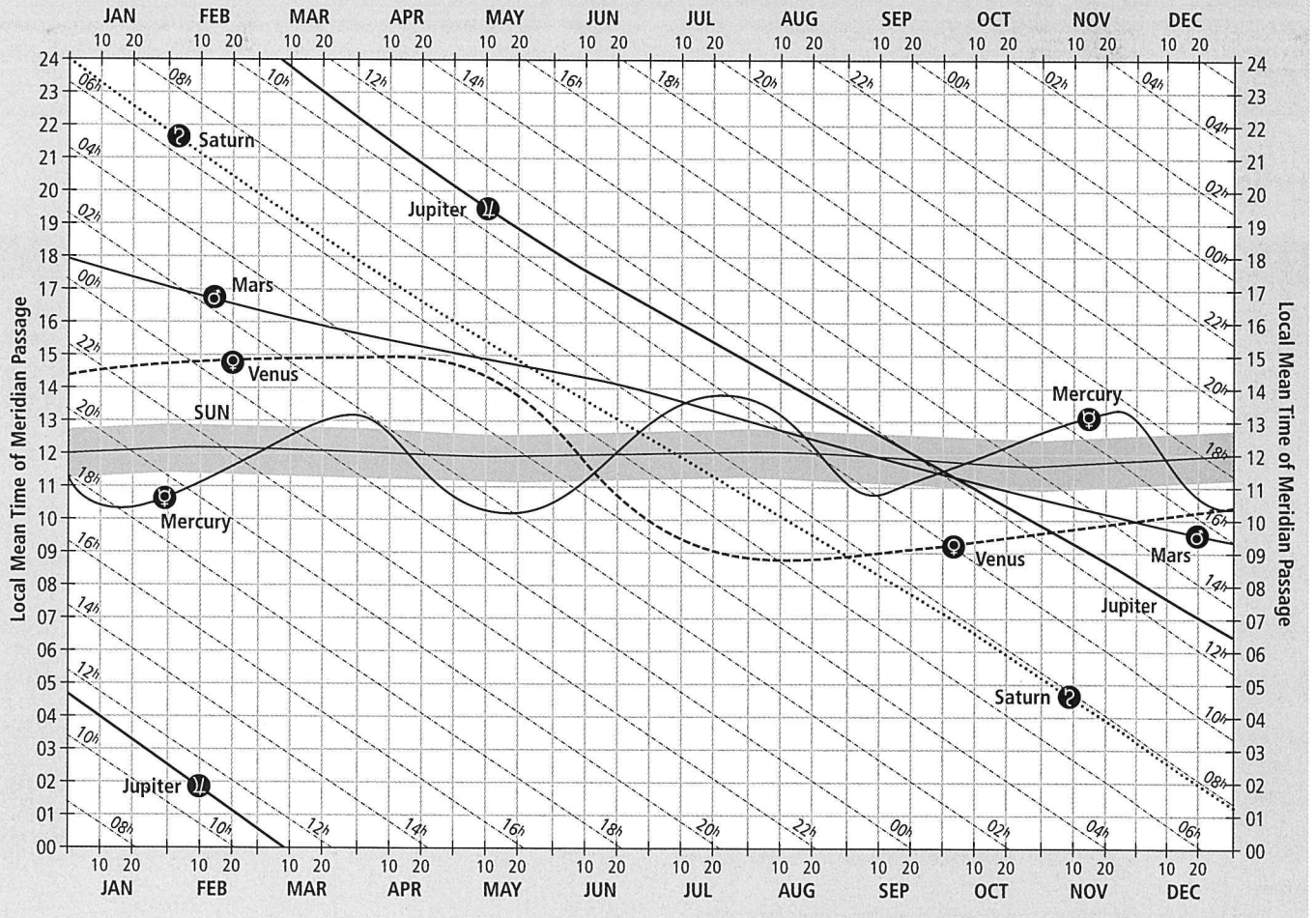
DECLINATIONS OF THE PLANETS 2004



MAGNITUDES OF THE PLANETS 2004



MERIDIAN TRANSIT OF PLANETS 2004



CLOSE APPROACHES BY ASTEROIDS

DISTANCE (AU)	(LD)	DATE (TT) Year	Mnth	Day	DESIGNATION Permanent	Provisional
0.00056*	0.2	2003	Sep	27.96		2003 SQ222
0.00072	0.3	1994	Dec	09.79		1994 XM1
0.00079	0.3	2002	Dec	11.35		2002 XV90
0.00080	0.3	2002	Jun	14.09		2002 MN
0.00099	0.4	1993	May	20.86		1993 KA2
0.00108	0.4	2003	Sep	19.24		2003 SW130
0.00113	0.4	1994	Mar	15.72		1994 ES1
0.00114	0.4	1991	Jan	18.72		1991 BA
0.00188	0.7	2003	Oct	12.07		2003 UM3
0.00205+	0.8	2001	Jan	15.85		2001 BA16
0.00221	0.9	2003	Apr	29.27		2003 HW10
0.00282	1.1	2002	Mar	31.15		2002 GQ
0.00289++	1.1	1995	Mar	27.15		1995 FF
0.00303	1.2	1996	May	19.69		1996 JA1
0.00306**	1.2	1991	Dec	05.39		1991 VG
0.00311	1.2	2002	Mar	08.04		2002 EM7
0.00321	1.2	2002	Feb	08.80		2002 CB26
0.00331	1.3	2003	Jun	01.22		2003 LW2
0.00332	1.3	2000	Jun	02.90		2000 LG6
0.00352	1.4	2002	Aug	18.33		2002 NY40
0.00362	1.4	2003	Mar	03.26		2003 DW10
0.00367	1.4	2003	Mar	05.85		2003 DY15
0.00380	1.5	1999	May	06.14		2000 SG344
0.00457	1.8	1989	Mar	22.90	(4581) Asclepius	1989 FC
0.00484	1.9	2001	Nov	29.33		2001 WM15
0.00486	1.9	1994	Nov	24.85		1994 WR12
0.00495	1.9	2000	Dec	22.29		2000 YA
0.00495	1.9	1937	Oct	30.71	Hermes	1937 UB
0.00500	1.9	1995	Oct	17.20		1995 UB
0.00510	2.0	2002	Oct	02.08		2002 TY59
0.00526	2.0	2003	Aug	27.39		2003 QB30
0.00528	2.0	2001	Nov	20.86		2001 WJ4
0.00529	2.0	2002	Oct	01.25		2002 TX55
0.00539	2.1	1998	Jun	08.24		1998 KY26
0.00557	2.1	2002	Jan	07.32		2001 YB5
0.00595	2.3	2001	Feb	23.06		2001 DZ76
0.00628	2.4	2001	Oct	21.36		2001 UP
0.00642	2.5	2001	Oct	08.65		2001 TB
0.00656	2.5	2002	Feb	05.47		2002 CA26
0.00664	2.6	2002	Oct	05.50		2002 TZ66
0.00670	2.6	1993	Oct	18.80		1993 UA
0.00679	2.6	1999	Feb	04.08		1999 CQ2
0.00690	2.7	1994	Apr	12.10		1994 GV
0.00709	2.7	2003	Sept	27.19		2003 SR84
0.00710	2.7	1993	May	17.90		1993 KA
0.00710	2.7	1997	Oct	26.20		1997 UA11
0.00736	2.8	1997	Feb	09.78		1997 CD17
0.00740	2.8	2003	Oct	27.30		2003 UT55
0.00775	3.0	1976	Oct	20.70	(2340) Hathor	1976 UA
0.00792	3.0	2003	Sept	16.67		2003 SL36
0.00822	3.2	2002	Apr	06.16		2002 FD6
0.00872	3.4	2003	Apr	03.76		2003 GG21
0.00879	3.4	1999	Mar	12.86		1999 FR5
0.00892	3.4	2001	Dec	15.15		2001 YN2
0.00898	3.5	2001	Aug	15.48		2001 QE71
0.00904	3.5	2000	Dec	29.35		2001 AV43
0.00909	3.5	2003	Sep	30.70		2003 SM215
0.00930	3.6	2003	Jun	20.27		2003 ME1
0.00931	3.6	2003	Mar	22.36		2003 FY6
0.00932	3.6	2003	Apr	27.75		2003 JX2
0.00947	3.6	2003	Sep	17.01		2003 RU11
0.00983	3.8	2001	Feb	26.72		2001 EC
0.00984	3.8	1988	Sep	29.09		1988 TA
0.00998	3.8	2003	May	28.29		2003 LH

Notes:

* This approach is to about 84000 km.

** 1991 VG may be a returning piece of man-made space debris.

\+ Closest approach to the Moon was 0.0013 AU on 1995 Mar. 27.0.

++ Closest approach to the Moon was 0.00053 AU on 2001 Jan. 15.80.

AU Astronomical distance Unit: 1.0 AU is roughly the average distance between the Earth and the Sun (= 149,597,870 km).

LD Lunar Distance unit: 1.0 LD is the average distance from the Earth to the Moon (about 0.00257 AU = 384,400 km).

CLOSE APPROACHES BY HISTORIC COMETS

COMET NAME	Designation	DATE Year	Mnth	Day	DISTANCE (AU)	(LD)	COMET NAME	Designation	DATE Year	Mnth	Day	DISTANCE (AU)	(LD)
Comet of 1491	C/1491 B1	1491	Feb	20.00	0.0094	3.7*	Comet of 1472	C/1471 Y1	1472	Jan	22.90	0.0690	26.9*
Lexell	D/1770 L1	1770	Jul	01.70	0.0151	5.9	Comet of 400	C/ 400 F1	400	Mar	31.10	0.0767	29.8*
Tempel-Tuttle	55P/1366 U1	1366	Oct	26.40	0.0229	8.9	LINEAR	P/2000 G1	1921	Mar	09.90	0.0775	30.1
IRAS-Araki-Alcock	C/1983 H1	1983	May	11.50	0.0313	12.2	Comet of 1556	C/1556 D1	1556	Mar	13.00	0.0835	32.5*
Halley	1P/ 837 F1	837	Apr	10.50	0.0334	13.0	Schweizer	C/1853 G1	1853	Apr	29.10	0.0839	32.7
Biela	3D/1805 V1	1805	Dec	09.90	0.0366	14.2	Bouvard-Herschel	C/1797 P1	1797	Aug	16.50	0.0879	34.2
Comet of 1743	C/1743 C1	1743	Feb	08.90	0.0390	15.2	Halley	1P/ 374 E1	374	Apr	01.90	0.0884	34.4
Pons-Winnecke	7P	1927	Jun	26.80	0.0394	15.3	Halley	1P/ 607 H1	607	Apr	19.20	0.0898	34.9
Comet of 1014	C/1014 C1	1014	Feb	24.90	0.0407	15.8*	Comet of 568	C/ 568 O1	568	Sep	25.70	0.0918	35.7*
Comet of 1702	C/1702 H1	1702	Apr	20.20	0.0437	17.0	Messier	C/1763 S1	1763	Sep	23.70	0.0934	36.3
Comet of 1132	C/1132 T1	1132	Oct	07.20	0.0447	17.4*	Tempel	C/1864 N1	1864	Aug	08.40	0.0964	37.5
Comet of 1351	C/1351 W1	1351	Nov	29.40	0.0479	18.6*	Machholz 2	141P	1905	Jan	05.20	0.0968	37.7
Comet of 1345	C/1345 O1	1345	Jul	31.90	0.0485	18.9*	LINEAR	P/2000 G1	2000	Mar	04.70	0.0974	37.9
Comet of 1499	C/1499 Q1	1499	Aug	17.10	0.0588	22.9*	Schmidt	C/1862 N1	1862	Jul	04.60	0.0982	38.2
Schwassmann-Wachmann 3	73P/1930 J1	1930	May	31.70	0.0617	24.0	Comet of 390	C/ 390 Q1	390	Aug	18.90	0.1002	39.0*
Sugano-Saigusa-Fujikawa	C/1983 J1	1983	Jun	12.80	0.0628	24.4	Hyakutake	C/1996 B2	1996	Mar	25.30	0.1018	39.6
Comet of 1080	C/1080 P1	1080	Aug	05.70	0.0641	24.9*	Seki	C/1961 T1	1961	Nov	15.20	0.1019	39.7
Great comet	C/1760 A1	1760	Jan	08.20	0.0681	26.5							

Notes:

* Distance is uncertain because comet's orbit is relatively poorly determined.

FUTURE KNOWN CLOSEST ENCOUNTERS

DESIGNATION		DATE			DISTANCE	
Permanent	Provisional	Year	Month	Day (UT)	(AU)	(LD)
EXPECTED CLOSE ENCOUNTERS 2004-2005 (time order)						
	2001 SY269	2004	Mar	18.32	0.02676	10.3
	2001 US16	2004	May	08.23	0.02860	11.0
25143		2004	Jun	26.83	0.01290	5.0
	1999 MN	2004	Jul	11.06	0.01737	6.7
(4179) Toutatis		2004	Sep	29.57	0.01036	4.0
	1992 UY4	2005	Aug	08.38	0.04038	15.5
	1999 RQ36	2005	Sept	20.45	0.03313	12.7
TWENTY FUTURE KNOWN CLOSEST ENCOUNTERS (ranked by distance)						
	2001 WN5	2028	Jun	26.23	0.00167	0.6
	2003 MK4	2110	Jan	04.41	0.00181	0.7
	1998 OX4	2148	Jan	22.14	0.00200	0.8
	2000 WO107	2140	Dec	01.83	0.00234	0.9
	1999 AN10	2027	Aug	07.29	0.00265	1.0
35396		2136	Oct	28.49	0.00276	1.1
	1998 MZ	2116	Nov	27.00	0.00292	1.1
	2003 QC10	2066	Sep	24.86	0.00340	1.3
	1999 RQ36	2080	Sep	23.21	0.00358	1.4
	2001 GQ2	2100	Apr	27.68	0.00398	1.5
	2002 CU11	2080	Aug	31.02	0.00419	1.6
	1999 RQ36	2060	Sep	23.02	0.00503	1.9
	2003 MK4	2032	Jan	03.96	0.00507	2.0
	2002 NN4	2130	Jun	07.77	0.00517	2.0
	1999 RQ36	2158	Sep	25.47	0.00551	2.1
	2002 AW	2103	Oct	06.99	0.00562	2.2
(2340) Hathor		2086	Oct	21.67	0.00597	2.3
	1999 VP11	2086	Oct	22.41	0.00603	2.3
35396		2028	Oct	26.28	0.00624	2.4
	2000 TU28	2121	Apr	14.29	0.00649	2.5

METEOR SHOWERS visible from the Southern Hemisphere

SHOWER NAME	DURATION	MAX. ACTIVITY DATE	MAX COUNT PER HOUR	RADIANT		
				RA. (h m)	Dec. (°)	Size (°)
Delta Cancrids	Jan 01 - Jan 24	Jan 17	4	08 40	+20	5 - 10
Alpha Centaurids	Jan 28 - Feb 21	Feb 07	20	14 00	-59	4
Delta Leonids	Feb 15 - Mar 10	Feb 25	2	11 12	+16	5
Gamma Normids	Feb 25 - Mar 22	Mar 13	8	16 36	-51	5
Virginids	Jan 25 - Apr 15	Mar 24	5	13 00	-04	10 - 15
Eta Aquarids	Apr 19 - May 28	May 04	30	22 24	-02	4
Sagittarids	Apr 15 - Jul 15	May 19	5	16 28	-22	10 - 15
Pegasids	Jul 07 - Jul 13	Jul 09	3	22 40	+15	5
Piscis Austrinids	Jul 15 - Aug 10	Jul 27	5	22 44	-30	10 - 15
Delta Aquarids S.	Jul12 - Aug19	Jul 28	20	22 36	-16	5
Alpha Capricornids	Jul 03 - Aug 15	Jul 29	4	20 28	-10	8
Iota Aquarids S.	Jul 25 - Aug 15	Aug 04	2	22 16	-15	2
Delta Aquarids N.	Jul 15 - Aug 25	Aug 08	4	22 20	-05	5
Iota Aquarids N.	Aug 11 - Aug 31	Aug 19	3	21 48	-06	5
Piscids	Sep 01 - Sep 30	Sep 19	3	00 20	-01	5
Epsilon Geminids	Oct 14 - Oct 27	Oct 18	2	06 48	+27	5
Orionids	Oct 02 - Nov 07	Oct 22	25	06 20	+16	20
Southern Taurids	Oct 01 - Nov 25	Nov 05	5	03 28	+13	5 - 10
Northern Taurids	Oct 01 - Nov 25	Nov 12	5	03 52	+22	5 - 10
Leonids	Nov 14 - Nov 21	Nov 17	varies to 1000+	10 12	+22	5
Alpha Monocerotids	Nov 15 - Nov 25	Nov 21	variable	07 48	+01	5
Chi Orionids	Nov 26 - Dec 15	Dec 01	3	05 28	+23	8
Phoenicids	Nov 28 - Dec 9	Dec 05	variable	01 12	-53	5
Puppid Velids	Dec 01 - Dec 15	Dec 07	10	08 12	-45	10
Monocerotids (Dec.)	Nov 27 - Dec 17	Dec 09	3	06 40	+08	5
Sigma Hydrids	Dec 03 - Dec 15	Dec 11	2	08 28	+02	5
Geminids	Dec 07 - Dec17	Dec 14	120	07 28	+33	5
Coma Berenicids	Dec 12 - Jan 23	Dec 19	5	11 40	+25	5

Geocentric positions of comets

Ephemerides are provided for known comets with V brighter than 10 and Declination less than +30°. Comets C/LINEAR (2002 T7) and C/NEAT (2001 Q4) may brighten to 1st magnitude and become visible to the naked eye. However, comet brightnesses are notoriously unpredictable!

GEOCENTRIC POSITIONS OF COMETS 2004

Note: positions refer to 0000 WAST

DATE Mnth	Day	RA h	m	DECLINATION °	′	V	r (AU)	Δ (AU)
2P/Encke								
Jan	1	17	12.7	-24	21	7.5	0.34	0.94
Jan	4	17	26.1	-25	42	7.8	0.36	1.04
Jan	7	17	41.5	-26	41	8.1	0.40	1.14
Jan	10	17	57.7	-27	20	8.3	0.44	1.22
Jan	13	18	13.8	-27	44	8.6	0.49	1.30
Jan	16	18	29.3	-27	55	8.8	0.55	1.37
Jan	19	18	44.0	-27	56	9.1	0.60	1.44
Jan	22	18	58.0	-27	49	9.4	0.66	1.51
Jan	25	19	11.1	-27	37	9.6	0.71	1.57
Jan	28	19	23.4	-27	20	9.9	0.77	1.62
C/NEAT (2001 Q4)								
Jan	1	23	16.7	-75	01	9.3	2.33	2.62
Jan	6	23	10.6	-74	02	9.1	2.27	2.58
Jan	11	23	06.8	-73	03	9.0	2.21	2.54
Jan	16	23	04.9	-72	07	8.8	2.15	2.50
Jan	21	23	04.5	-71	12	8.6	2.08	2.45
Jan	26	23	05.4	-70	21	8.5	2.02	2.39
Jan	31	23	07.4	-69	32	8.3	1.96	2.33
Feb	5	23	10.3	-68	47	8.1	1.90	2.27
Feb	10	23	14.1	-68	06	7.9	1.84	2.20
Feb	15	23	18.7	-67	30	7.6	1.77	2.12
Feb	20	23	24.1	-66	57	7.4	1.71	2.04
Feb	25	23	30.4	-66	29	7.1	1.65	1.95
Mar	1	23	37.5	-66	06	6.9	1.59	1.85
Mar	6	23	45.5	-65	49	6.6	1.53	1.75
Mar	11	23	54.7	-65	37	6.3	1.47	1.65
Mar	16	00	05.4	-65	31	5.9	1.41	1.53
Mar	21	00	17.9	-65	30	5.6	1.35	1.42
Mar	26	00	33.0	-65	36	5.2	1.30	1.29
Mar	31	00	51.6	-65	46	4.8	1.25	1.16
Apr	5	01	15.4	-65	58	4.3	1.20	1.03
Apr	10	01	46.7	-66	03	3.9	1.15	0.90
Apr	15	02	29.2	-65	42	3.3	1.10	0.76
Apr	20	03	26.5	-64	08	2.8	1.07	0.63
Apr	21	03	39.9	-63	33	2.6	1.06	0.60
Apr	22	03	53.8	-62	49	2.5	1.05	0.57
Apr	23	04	08.2	-61	56	2.4	1.04	0.55
Apr	24	04	23.1	-60	52	2.3	1.04	0.52
Apr	25	04	38.3	-59	36	2.1	1.03	0.50
Apr	26	04	53.7	-58	04	2.0	1.02	0.48
Apr	27	05	09.2	-56	16	1.9	1.02	0.45
Apr	28	05	24.6	-54	09	1.7	1.01	0.43
Apr	29	05	39.9	-51	42	1.6	1.01	0.41
Apr	30	05	54.8	-48	52	1.5	1.00	0.39
May	1	06	09.3	-45	38	1.4	1.00	0.37
May	2	06	23.4	-41	60	1.3	0.99	0.36
May	3	06	36.8	-37	57	1.2	0.99	0.35
May	4	06	49.7	-33	31	1.1	0.99	0.34
May	5	07	01.9	-28	44	1.0	0.98	0.33
May	6	07	13.4	-23	42	1.0	0.98	0.32
May	7	07	24.2	-18	31	0.9	0.98	0.32
May	8	07	34.4	-13	17	0.9	0.97	0.32
May	9	07	44.0	-08	07	0.9	0.97	0.33
May	10	07	53.0	-03	07	1.0	0.97	0.33
May	11	08	01.4	+01	37	1.0	0.97	0.34
May	12	08	09.3	+06	03	1.1	0.96	0.36
May	13	08	16.6	+10	09	1.2	0.96	0.37
May	14	08	23.5	+13	54	1.3	0.96	0.39
May	15	08	30.0	+17	18	1.4	0.96	0.41
May	16	08	36.0	+20	23	1.5	0.96	0.43
May	17	08	41.7	+23	11	1.6	0.96	0.45
May	18	08	47.1	+25	42	1.7	0.96	0.47
May	19	08	52.1	+27	58	1.8	0.96	0.50
May	20	08	56.8	+30	02	1.9	0.96	0.52
C/LINEAR (2002 T7)								
Jan	1	01	12.9	+26	17	8.4	2.13	1.63
Jan	6	01	00.9	+24	28	8.3	2.06	1.67
Jan	11	00	50.7	+22	45	8.2	1.99	1.71
Jan	16	00	42.2	+21	11	8.1	1.92	1.76
Jan	21	00	35.0	+19	46	7.9	1.84	1.81
Jan	26	00	29.1	+18	30	7.8	1.77	1.85
Jan	31	00	24.2	+17	22	7.7	1.70	1.89
Feb	5	00	20.1	+16	22	7.5	1.62	1.93
Feb	10	00	16.6	+15	28	7.4	1.55	1.96
Feb	15	00	13.8	+14	39	7.2	1.47	1.99
Feb	20	00	11.4	+13	56	7.0	1.39	2.01
Feb	25	00	09.3	+13	16	6.7	1.32	2.02
Mar	1	00	07.4	+12	39	6.5	1.24	2.02
Mar	6	00	05.7	+12	04	6.2	1.16	2.01
Mar	11	00	04.1	+11	30	5.8	1.08	1.98
Mar	16	00	02.4	+10	55	5.5	1.01	1.95
Mar	21	00	00.7	+10	19	5.1	0.93	1.90
Mar	26	23	58.9	+09	40	4.7	0.86	1.83
Mar	31	23	57.0	+08	57	4.2	0.79	1.75
Apr	5	23	55.1	+08	08	3.7	0.73	1.65
Apr	10	23	53.4	+07	11	3.3	0.68	1.53
Apr	15	23	52.3	+06	04	2.8	0.64	1.39
Apr	20	23	52.5	+04	45	2.4	0.62	1.23
Apr	25	23	55.4	+03	11	2.0	0.62	1.05
Apr	30	00	02.9	+01	14	1.7	0.63	0.87
May	1	00	05.2	+00	47	1.6	0.64	0.83
May	2	00	07.9	+00	18	1.6	0.64	0.79
May	3	00	11.1	-00	12	1.5	0.65	0.75
May	4	00	14.7	-00	46	1.4	0.66	0.71
May	5	00	18.9	-01	21	1.4	0.66	0.67
May	6	00	23.8	-02	00	1.3	0.67	0.64
May	7	00	29.4	-02	43	1.2	0.68	0.60
May	8	00	35.9	-03	29	1.1	0.69	0.56
May	9	00	43.6	-04	21	1.1	0.70	0.52
May	10	00	52.5	-05	19	1.0	0.71	0.49
May	11	01	03.1	-06	24	0.9	0.72	0.45
May	12	01	15.5	-07	36	0.8	0.73	0.42
May	13	01	30.3	-08	57	0.7	0.75	0.39
May	14	01	47.8	-10	28	0.6	0.76	0.36
May	15	02	08.7	-12	07	0.5	0.77	0.33
May	16	02	33.5	-13	54	0.4	0.78	0.31
May	17	03	02.4	-15	42	0.3	0.80	0.29
May	18	03	35.4	-17	23	0.3	0.81	0.27
May	19	04	11.7	-18	48	0.3	0.82	0.27
May	20	04	49.7	-19	45	0.3	0.84	0.27
May	21	05	27.4	-20	10	0.5	0.85	0.27
May	22	06	02.9	-20	04	0.6	0.86	0.28
May	23	06	34.8	-19	35	0.8	0.88	0.30
May	24	07	02.6	-18	52	1.0	0.89	0.32
May	25	07	26.4	-18	01	1.3	0.91	0.35

GEOCENTRIC POSITIONS OF COMETS 2004 (continued)

DATE Mnth	Day	RA h	m	DECLINATION °	′	V	r (AU)	Δ (AU)
May	26	07	46.5	-17	08	1.5	0.92	0.37
May	27	08	03.5	-16	17	1.7	0.94	0.40
May	28	08	18.0	-15	28	2.0	0.95	0.44
May	29	08	30.3	-14	44	2.2	0.97	0.47
May	30	08	40.9	-14	03	2.4	0.98	0.50
May	31	08	50.0	-13	26	2.6	1.00	0.54
Jun	1	08	58.0	-12	52	2.8	1.01	0.57
Jun	2	09	05.0	-12	22	3.0	1.03	0.61
Jun	3	09	11.3	-11	54	3.2	1.04	0.65
Jun	4	09	16.8	-11	29	3.4	1.06	0.68
Jun	5	09	21.8	-11	07	3.6	1.07	0.72
Jun	6	09	26.2	-10	46	3.8	1.09	0.76
Jun	7	09	30.3	-10	27	3.9	1.10	0.79
Jun	8	09	34.0	-10	10	4.1	1.12	0.83
Jun	9	09	37.4	-09	54	4.2	1.13	0.87
Jun	10	09	40.5	-09	40	4.4	1.15	0.91
Jun	11	09	43.5	-09	27	4.5	1.16	0.94
Jun	12	09	46.2	-09	14	4.7	1.18	0.98
Jun	13	09	48.7	-09	03	4.8	1.19	1.02
Jun	14	09	51.0	-08	53	4.9	1.21	1.05
Jun	19	10	01.0	-08	12	5.6	1.29	1.24
Jun	24	10	08.9	-07	46	6.1	1.37	1.42
Jun	29	10	15.5	-07	28	6.6	1.44	1.59
Jul	4	10	21.3	-07	19	7.0	1.52	1.76
Jul	9	10	26.5	-07	14	7.5	1.59	1.92
Jul	14	10	31.3	-07	14	7.8	1.67	2.08
Jul	19	10	35.8	-07	18	8.2	1.74	2.24
Jul	24	10	40.1	-07	25	8.5	1.82	2.38
Jul	29	10	44.2	-07	35	8.8	1.89	2.52
Aug	3	10	48.1	-07	46	9.1	1.96	2.66
Aug	8	10	51.9	-07	60	9.3	2.04	2.79
Aug	13	10	55.6	-08	15	9.6	2.11	2.91
Aug	18	10	59.2	-08	32	9.8	2.18	3.02
Aug	23	11	02.7	-08	50	10.0	2.25	3.13
C/LINEAR (2003 K4)								
Apr	11	20	15.0	+25	02	10.5	2.90	3.02
Apr	14	20	14.7	+25	46	10.4	2.87	2.95
Apr	17	20	14.1	+26	32	10.3	2.84	2.87
Apr	20	20	13.3	+27	20	10.2	2.80	2.80
Apr	23	20	12.2	+28	11	10.1	2.77	2.72
Apr	26	20	10.7	+29	03	10.0	2.73	2.64
Apr	29	20	08.9	+29	58	9.9	2.70	2.57
May	2	20	06.6	+30	56	9.7	2.66	2.49
Jul	25	14	17.8	+31	34	6.6	1.66	1.50
Jul	28	14	08.5	+29	27	6.5	1.63	1.53
Jul	31	14	00.1	+27	21	6.5	1.59	1.56
Aug	3	13	52.7	+25	17	6.4	1.56	1.59
Aug	6	13	46.0	+23	17	6.4	1.52	1.62
Aug	9	13	40.0	+21	19	6.3	1.49	1.65
Aug	12	13	34.7	+19	26	6.3	1.46	1.69
Aug	15	13	29.9	+17	36	6.2	1.42	1.72
Aug	18	13	25.5	+15	49	6.2	1.39	1.76
Aug	21	13	21.6	+14	06	6.1	1.36	1.79
Aug	24	13	18.0	+12	26	6.0	1.33	1.82
Aug	27	13	14.7	+10	50	6.0	1.30	1.85
Aug	30	13	11.6	+09	17	5.9	1.27	1.88
Sep	2	13	08.8	+07	46	5.9	1.24	1.91
Sep	5	13	06.1	+06	17	5.8	1.21	1.94
Sep	8	13	03.6	+04	51	5.7	1.19	1.96
Sep	11	13	01.2	+03	26	5.7	1.16	1.98
Sep	14	12	59.0	+02	03	5.6	1.14	2.00
Sep	17	12	56.8	+00	42	5.5	1.12	2.01
Sep	20	12	54.6	-00	39	5.5	1.10	2.03

DATE Mnth	Day	RA h	m	DECLINATION °	′	V	r (AU)	Δ (AU)
Sep	23	12	52.5	-01	59	5.4	1.08	2.04
Sep	26	12	50.4	-03	18	5.3	1.07	2.04
Sep	29	12	48.4	-04	37	5.3	1.06	2.04
Oct	2	12	46.3	-05	56	5.2	1.04	2.04
Oct	5	12	44.2	-07	15	5.2	1.04	2.03
Oct	8	12	42.1	-08	35	5.2	1.03	2.02
Oct	11	12	40.0	-09	56	5.1	1.02	2.01
Oct	14	12	37.8	-11	18	5.1	1.02	1.99
Oct	17	12	35.5	-12	42	5.1	1.02	1.97
Oct	20	12	33.1	-14	08	5.1	1.03	1.94
Oct	23	12	30.6	-15	36	5.1	1.03	1.92
Oct	26	12	28.0	-17	07	5.1	1.04	1.88
Oct	29	12	25.3	-18	41	5.1	1.05	1.85
Nov	1	12	22.3	-20	19	5.1	1.07	1.81
Nov	4	12	19.1	-22	01	5.1	1.08	1.77
Nov	7	12	15.6	-23	48	5.1	1.10	1.73
Nov	10	12	11.8	-25	40	5.1	1.12	1.68
Nov	13	12	07.5	-27	38	5.1	1.14	1.63
Nov	16	12	02.7	-29	43	5.2	1.16	1.59
Nov	19	11	57.3	-31	55	5.2	1.19	1.54
Nov	22	11	51.0	-34	14	5.2	1.21	1.49
Nov	25	11	43.7	-36	41	5.2	1.24	1.44
Nov	28	11	35.1	-39	16	5.3	1.27	1.39
Dec	1	11	25.0	-41	58	5.3	1.30	1.35
Dec	4	11	12.9	-44	47	5.3	1.33	1.31
Dec	7	10	58.2	-47	39	5.4	1.36	1.27
Dec	10	10	40.4	-50	32	5.4	1.39	1.23
Dec	13	10	18.7	-53	19	5.4	1.42	1.20
Dec	16	09	52.5	-55	54	5.5	1.45	1.18
Dec	19	09	21.1	-58	05	5.6	1.49	1.16
Dec	22	08	44.9	-59	41	5.6	1.52	1.15
Dec	25	08	05.1	-60	32	5.7	1.55	1.15
Dec	28	07	24.1	-60	30	5.8	1.59	1.16
Dec	31	06	44.7	-59	38	6.0	1.62	1.17
C/Tabur (2003 T3)								
Feb	6	22	23.7	-16	01	10.0	1.87	2.80
Feb	11	22	32.1	-13	48	9.9	1.83	2.77
Feb	16	22	40.5	-11	32	9.7	1.79	2.75
Feb	21	22	49.1	-09	12	9.6	1.76	2.73
Feb	26	22	57.8	-06	49	9.5	1.72	2.70
Mar	2	23	06.6	-04	21	9.4	1.69	2.67
Mar	7	23	15.6	-01	50	9.3	1.65	2.64
Mar	12	23	24.8	+00	45	9.2	1.63	2.61

Legend:

RA and DECLINATION — Astrometric right ascension and declination of target (J2000.0). Corrected for light-time. These positions refer to the geocentre. However, none of these comets get very close to Earth and the effects of parallax are less than the quoted level of precision.

V — Comet's approximate apparent visual total magnitude

r — Apparent heliocentric range

Δ — Apparent range

BRIGHT STARS (EPOCH J2000.0)

	DESIGNATION	NAME	CONSTELLATION	RA hh	RA mm	RA ss	DECLINATION °	DECLINATION ′	DECLINATION ″	APP. MAG*	ABS. MAG**	SPECTRAL TYPE	PARA-LLAX ″	DIST. ly	DIST. pc
1		Sun								-26.7	+4.8	G2V			
2	α CMa	Sirius	Canis Major	06	45	08.9	-16	42	58	-1.47	1.4	A1V	0.379	8.6	2.6
3	α Car	Canopus	Carina	06	24	20.1	-52	41	44	-0.72	-5.7	FOII	0.010	330	100
4	α Cen	Rigil Kent	Centaurus	14	39	36.2	-60	50	08	-0.27	4.1	G2V+K1V	0.742	4.4	1.3
5	α Boo	Arcturus	Bootes	14	15	39.7	+19	10	57	-0.04	-0.3	K1.5III	0.089	36.0	11.0
6	α Lyr	Vega	Lyra	18	36	56.3	+38	47	01	0.03	0.6	A0V	0.129	25.3	7.8
7	α Aur	Capella	Auriga	05	16	41.4	+45	59	53	0.08	-0.5	G5IIIe+G0III	0.077	42.3	13.0
8	β Ori	Rigel	Orion	05	14	32.3	-08	12	06	0.12	-6.9	B8Ia	0.004	820	250
9	α CMi	Procyon	Canis Minor	07	39	18.1	+05	13	30	0.34	2.6	F5 IV-V	0.286	11.4	3.5
10	α Eri	Achenar	Eridanus	01	37	42.8	-57	14	12	0.50	-2.7	B3Vpe	0.023	143	44
11	α Ori	Betelgeuse	Orion	05	55	10.3	+07	24	25	0.58	-4.9	M2Ib	0.008	550	125
12	β Cen	Hadar	Centaurus	14	03	49.4	-60	22	23	0.60	-5.5	B1III	0.006	550	170
13	α Aql	Altair	Aquila	19	50	47.0	+08	52	06	0.77	2.2	A7V	0.194	16.8	5.2
14	α Cru	Acrux	Crux	12	26	35.9	-63	05	56	0.77	-4.2	B0.5IV+B1V	0.010	330	100
15	α Tau	Aldebaran	Taurus	04	35	55.2	+16	30	33	0.85	-0.7	K5III	0.050	65.0	20.0
16	α Vir	Spica	Virgo	13	25	11.6	-11	09	41	1.04	-3.6	B1III-IV+B2V	0.012	270	83
17	α Sco	Antares	Scorpius	16	29	24.5	-26	25	55	1.09	-5.4	M1.5Ib+B4V	0.005	650	200
18	β Gem	Pollux	Gemini	07	45	19.0	+28	01	34	1.15	1.1	K0IIIb	0.097	33.6	10.3
19	α PsA	Formalhaut	Piscis Austrinus	22	57	39.0	-29	37	20	1.16	1.7	A3V	0.130	25.1	7.7
20	α Cyg	Deneb	Cygnus	20	41	25.9	+45	16	49	1.25	-8.8	A2Iae	0.001	3300	1000
21	β Cru	Mimosa	Crux	12	47	43.3	-59	41	20	1.30	-3.9	B0.5IV	0.009	360	110
22	α Leo	Regulus	Leo	10	08	22.3	+11	58	02	1.35	-0.5	B7V	0.042	78.0	24.0
23	ϵ CMa	Adhara	Canis Major	06	58	37.5	-28	58	20	1.51	-4.0	B2Iab	0.008	410	125
24	α Gem	Castor	Gemini	07	34	35.9	+31	53	18	1.59	0.6	A2Vm	0.063	52.0	15.9
25	λ Sco	Shaula	Scorpius	17	33	36.5	-37	06	14	1.62	-4.9	B2IV	0.005	650	200
26	γ Cru	Gacrux	Crux	12	31	10.0	-57	06	48	1.63	-0.5	M3.5III	0.037	88.0	27.0
27	γ Ori	Bellatrix	Orion	05	25	07.9	+06	20	59	1.64	-2.8	B2III	0.013	250	77
28	β Tau	Alnath	Taurus	05	26	17.5	+28	36	27	1.68	-1.3	B7III	0.025	130	40
29	β Car	Miaplacidus	Carina	09	13	12.0	-69	43	02	1.70	-1.0	A2IV	0.029	110	34
30	ϵ Ori	Alnilam	Orion	05	36	12.8	-01	12	07	1.70	-6.8	B0Iab	0.002	1600	500

* Apparent Magnitude
** Absolute Magnitude

The brightness of stars

How bright a star appears is called. by astronomers, its **apparent magnitude**. This depends on three factors:

1. *distance from Earth,*
2. *size and*
3. *how much light it emits per square metre from its outer layers.*

The brightest star in the sky is our Sun. It is not a particularly big or bright star, but it is the nearest star to us.

Astronomers measure the brightness of the stars on a scale called the **magnitude** scale. This scale has descended to us from ancient times when Hipparchus, a Greek astronomer, classified the stars by their brightness and used the word magnitude to describe their relative brightness. In Hipparchus' system a very bright star would have a magnitude of 1 and a very faint star a magnitude of 6. **The smaller the number, the brighter the star**.

Accurate measurements of the brightness of stars have showed that a magnitude 1 star emits 100 times more energy than a magnitude 6 star. Apparently, the human eye responds in a logarithmic way to differing light levels. So a difference in magnitude of 1 corresponds to about a factor of 2.5 in energy. A magnitude system roughly consistent with that of Hipparchus has been established by modern astronomers, but now each star can have its magnitude accurately measured.

Using the magnitude system a very powerful telescope can detect very faint stars beyond magnitude 20. Under very clear, dark skies, stars with a magnitude of about 6 are detectable by the unaided eye. Nearly 3,000 stars are visible to the unaided eye in good conditions. The very brightest planets have a magnitude of -1 to -4. Unfortunately, light pollution from household lighting and street lamps reduces the number of stars visible in urban areas compared to a dark site.

CLOSE STARS (EPOCH J2000.0)

	DESIGNATION	NAME	CONSTELLATION	RA hh mm ss	DEC. ° ′ ″	APP. MAG*	ABS. MAG**	SPECTRAL TYPE	PARA-LLAX ″	PROPER MOTION ″/year	DIST. ly	DIST. pc
1		Sun				-27	4.8	G2 V				
2	α Cen C	Proxima Cen	Centaurus	14 29 42.9	-62 40 46	11.05	15.49	M5.5Ve	0.772	3.85	4.22	1.30
	α Cen A	Rigil Kentaurus	Centaurus	14 39 36.5	-60 50 02	-0.01	4.34	G2V	0.742	3.71	4.39	1.35
	α Cen B	Rigil Kentaurus	Centaurus	14 39 35.1	-60 50 14	1.33	5.68	K1V	0.742	3.73	4.39	1.35
3		Barnard's Star	Ophiuchus	17 57 48.5	+04 41 36	9.54	13.24	M4Ve	0.549	10.37	5.94	1.82
4	G045-020	Wolf 359	Leo	10 56 29.0	+07 00 52	13.54	16.68	M5.5	0.425	4.71	7.67	2.35
5		Lalande 21185	Ursa Major	11 03 20.2	+35 58 12	7.49	10.46	M2V	0.392	4.81	8.32	2.55
6	α CMa A	Sirius A	Canis Major	06 45 08.9	-16 42 58	-1.47	1.42	A1V	0.379	1.34	8.60	2.64
	α CMa B	Sirius B	Canis Major	06 45 08.9	-16 43 06	8.44	11.33	DA	0.379	1.33	8.60	2.64
7	L 726-8 A	BL Cet	Cetus	01 39 01.5	-17 57 02	12.57	15.43	M5.5V:e	0.374	3.37	8.72	2.67
	L 726-8 B	UV Cet	Cetus	01 39 01.5	-17 57 04	12.52	15.42	M5.5e	0.381	3.37	8.56	2.62
8		Ross 154	Sagittarius	18 49 49.4	-23 50 10	10.95	13.58	M3.5	0.336	0.67	9.70	2.98
9		Ross 248	Andromeda	23 41 55.2	+44 10 38	12.28	14.77	M5	0.315	1.62	10.3	3.17
10	ϵ Eri	Epsilon Eridani	Eridanus	03 32 55.8	-09 27 30	3.73	6.19	K2 V	0.311	0.98	10.5	3.22
11	Gl 887	Lacaille 9352	Piscis Austrinus	23 05 52.0	-35 51 11	7.34	9.75	M0.5	0.304	6.90	10.7	3.29
12	G010-050	Ross 128	Virgo	11 47 44.4	+00 48 16	11.08	13.47	M4	0.300	1.36	10.9	3.33
13	G156-031 A	L 789-6 A	Aquarius	22 38 33.8	-15 18 03	13.3	15.69	M5.5	0.300	3.24	10.9	3.33
	G156-031 B	L 789-6 B	Aquarius	22 38 33.8	-15 18 03	13.3	15.69	M5	0.300	3.24	10.9	3.33
	G156-031 C	L 789-6 C	Aquarius	22 38 37.3	-15 17 07	14.0	16.34	M7	0.294	3.25	11.1	3.40
14	α CMi A	Procyon A	Canis Minor	07 39 18.1	+05 13 30	0.34	2.62	F5IV-V	0.286	1.26	11.4	3.50
	α CMi B	Procyon B	Canis Minor	07 39 19.7	+05 15 25	10.7	12.98	-	0.286	1.25	11.4	3.50
15	Gl 820 A	61 Cygni A	Cygnus	21 06 53.9	+38 44 58	5.21	7.50	K5V	0.287	5.28	11.4	3.48
	Gl 820 B	61 Cygni B	Cygnus	21 06 55.3	+38 44 31	6.03	8.30	K7V	0.285	5.17	11.4	3.51
16	Gl 725 A	Struve 2398 A	Draco	18 42 46.7	+59 37 49	8.91	11.15	M3V	0.280	2.24	11.6	3.57
	Gl 725 B	Struve 2398 B	Draco	18 42 46.9	+59 37 37	9.69	11.96	M3.5	0.284	2.31	11.5	3.52
17	BD +43°44	Groombridge 34 A	Andromeda	00 18 22.9	+44 01 23	8.09	10.33	M1.5V	0.280	2.92	11.6	3.57
		Groombridge 34 B	Andromeda	00 18 25.8	+44 01 38	11.04	13.28	M3.5	0.280	2.93	11.6	3.57
18	ϵ Ind A	Gl 845 A	Indus	22 03 21.6	-56 47 10	4.69	6.89	K4V	0.276	4.70	11.8	3.62
	ϵ Ind B	Gl 845 B	Indus	22 03 21.6	-56 47 10	-	-	T2.5	0.276	4.70	11.8	3.62
19	G51-15	GJ 1111	Cancer	08 29 49.5	+26 46 32	14.81	17.01	M6	0.276	1.27	11.8	3.62
20	τ Cet	Gl 71	Cetus	01 44 04.1	-15 56 15	3.50	5.69	G8V	0.274	1.92	11.9	3.65
21	L 725-32	YZ Ceti	Cetus	01 12 30.6	-16 59 56	11.6	13.75	M4.5	0.269	1.37	12.1	3.72
22	BD +5°1668	Luyten's Star	Canis Minor	07 27 24.5	+05 13 33	9.89	11.99	M3.5	0.263	3.74	12.4	3.80
23	Gl 191	Kapteyn's Star	Pictor	05 11 40.6	-45 01 06	8.89	10.92	M1	0.255	8.66	12.8	3.92
24	Gl 825	Lacaille 8760	Microscopium	21 17 15.3	-38 52 02	6.68	8.70	K7	0.253	3.45	12.9	3.95
25	L 372-58	GJ 1061	Horologium	03 35 59.6	-44 30 46	13.03	14.87	M5.5	0.233	0.83	14.0	4.29

* Apparent Magnitude
** Absolute Magnitude

Star names

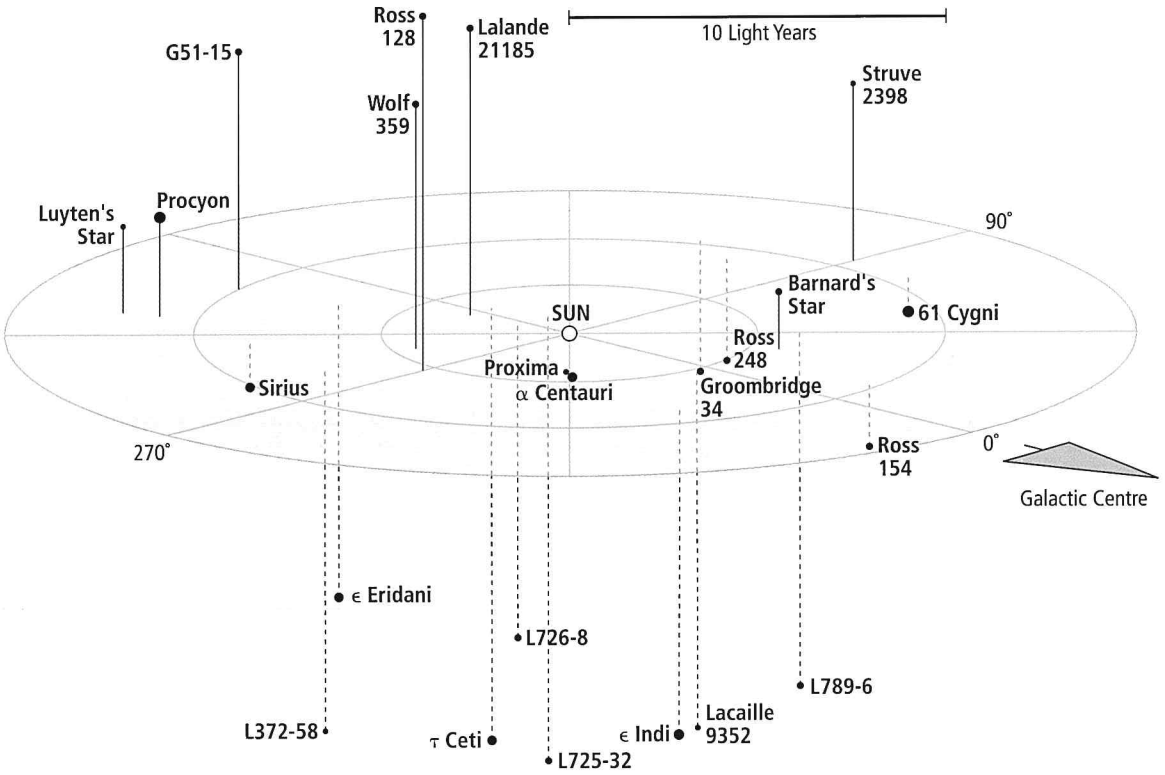
Many of the brighter stars were named in ancient times. Usually, the name referred to its place or association in its constellation. About 1,000 years ago Arab scholars kept the science of astronomy progressing and many star names are derived from their work.

In 1603, Johannes Bayer published an accurate atlas of the stars and constellations. He utilised a new system to name the stars within a constellation. The brightest star in a constellation was designated α (alpha), and the next brightest was β (beta), and so on through the Greek alphabet (see section: ***Background & General Information***). Unfortunately, Bayer was not rigorous in the application of this system and so there are anomalies such as α Orionis (Betelgeuse) being fainter than β Orionis (Rigel).

Some of the fainter stars (but still visible to the unaided eye) are often referred to by their Flamsteed number. John Flamsteed (1646-1719) compiled a star catalogue which was published in 1725, six years after his death. In this catalogue, called the *Historia Coelestis Britannica*, Flamsteed assigned numbers to the stars within each constellation according to the stars' right ascensions. For example, the brightest star in the constellation Taurus is Aldebaran (*the follower* – in 'corrupted' Arabic), also designated α Tauri in Bayer's system and 87 Tauri according to Flamsteed's work.

Many stars have been catalogued and named in a variety of astronomical research programmes. Most names are now based on the position (right ascension and declination) of the star in the sky. Other naming systems are derived from the details of the observing equipment and how it has mapped the sky. Other names are based solely on the star's sequence in a published catalogue. For example, Aldebaran is also BD +16 629 in the Bonner Durchmusterung (Bonn Survey), BS 1457 in the Yale Bright Star Catalog, HD 29139 in the Henry Draper Catalog of stellar spectra, SAO 94027 in the Smithsonian Astrophysical Observatory Catalog, and HIP 21421 in the Hipparcos Catalogue of accurate star positions.

Diagram showing stars closest to the Solar System.



Spectral classes of main sequence stars

Stars are classified according to the temperature of their photosphere (the observable "surface" of the star). Most stars are powered by thermonuclear reactions in their interiors. Middle aged stars produce energy (light) by converting hydrogen to helium. Such stars are said to be on the Main Sequence.

Class	Colour	Representative Temperature	Representative Mass	Representative Radius	Representative density	Some Stars of this Type
O	Blue	50,000K	40	18	0.01	None visible to the naked eye
B	Blue	30,000K	7	4	0.2	Achernar, Rigel, Acrux
A	White	10,000K	2	2	0.6	Sirius, Fomalhaut, Canopus
F	White-Yellow	7,000K	1.5	1.2	1.1	Procyon
G	Yellow	6,000K	1	1	1.6	Sun
K	Orange	5,000K	0.7	0.7	2.4	Arcturus, Aldebaran, Pollux
M	Red	3,500K	0.2	0.3	10.0	Betelgeuse, Antares

***Note**: At these temperatures, degrees Kelvin (K) is approximated equal to the same number of degrees Celsius. Typical star masses and typical star radii are given for each spectral class. These two figures are expressed relative to the Sun's mass (1.99 x 10^{30} kg) and the Sun's radius (6.96 x 10^{5} km). Average density is given in grams/cm^3; for comparison, water has a density of 1 gram/cm^3.*

NON-STELLAR OBJECTS (EPOCH J2000.0)

NAME	RA hh mm	DEC. ° ′	SIZE	CONST.	TYPE	MAG.	DESCRIPTION
NGC 55	00 15.1	-39 13	30 x 63	Scl	Spiral galaxy	8.2	A bright galaxy in the Sculptor Group
NGC 104	00 24.1	-72 05	31	Tuc	Globular cluster	4.0	47 Tucanae, one of the finest globular clusters
NGC 224	**00 42.8**	**+41 16**	**186 x70**	**And**	**Spiral galaxy**	**4.5**	**M31, The 'Andromeda Galaxy'**
NGC 253	00 47.5	-25 17	26 x 6	Scl	Spiral galaxy	7.1	'Silver Coin' galaxy. Large, bright edge-on spiral
SMC	00 52.7	-72 49	300	Tuc	Galaxy	2.2	Small Magellanic Cloud. Visible to unaided eye from dark sky
Pleiades	03 47.0	+24 07	110	Tau	Open cluster	1.5	M45 or 'Seven Sisters'. Naked eye cluster, the brighter stars mag. 2
Hyades	04 26.9	+15 52	330	Tau	Open cluster	0.8	A naked eye, W' shaped cluster. 28 stars, the brighter mag. 3 and 4

NON-STELLAR OBJECTS (continued)

NAME	RA hh mm	DEC. ° ′	SIZE	CONST.	TYPE	MAG.	DESCRIPTION
LMC	05 23.6	-69 45	600	Dor	Galaxy	0.1	Large Magellanic Cloud. Visible to unaided eye from dark sky
NGC 1976	05 35.3	-05 23	90 x 60	Ori	Gaseous nebula	5.0	M42, 'Orion Nebula', emission and reflection nebula
NGC 2070	05 38.7	-69 06	30 x 20	Dor	Emission nebula	7.2	30 Doradus, 'Tarantula Nebula', bright complex looped structure
NGC 2169	06 08.5	+13 58	7	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	5.1	M35, 200 stars, magnitude range 9 to 16, no central concentration
NGC 2244	06 32.3	+04 52	24	Men	Open cluster	4.8	Rich cluster of 100 stars, with nebulosity (Rosette Nebula)
NGC 2264	06 41.1	+09 53	20	Men	Open cluster	3.9	40 stars, large brightness range, involved in nebulosity (Cone Nebula)
NGC 2287	06 46.9	-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	30	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	3.5	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 10.4	-49 10	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 40.4	+19 40	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 42.6	-48 07	7	Vel	Open cluster	4.6	40 stars 6th magnitude and fainter
NGC 2808	09 12.0	-64 52	15	Car	Globular cluster	6.2	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 07.0	-40 26	0.5	Vel	Planetary nebula	9.9	The 'Eight Burst Nebula', ring and disk, 10th magnitude central star
IC 2602	10 43.3	-64 20	50	Car	Open cluster	1.6	Rich in stars, strong central concentration, brightest stars mag. 3
NGC 3372	10 44.3	-59 53		Car	Emission nebula	varies	The 'Eta Carinae Nebula', very bright, prominent dark lanes
NGC 3532	11 06.6	-58 44	55	Car	Open cluster	3.0	Rich and large, slight central concentration, 150 stars 7 to 12th magnitude
NGC 3766	11 36.2	-61 38	12	Cen	Open cluster	5.3	Rich cluster, 100 stars magnitude range 7 to 12th
NGC 4755	12 53.8	-60 22	10	Cru	Open cluster	5.2	The 'Jewel Box', rich in stars, large brightness range
NGC 4945	13 05.4	-49 28	23 x 6	Cen	Spiral galaxy	8.2	Large edge on spiral, good field, another small galaxy in same field
NGC 5128	13 25.5	-43 01	31 x 23	Cen	Galaxy	7.0	'Centaurus A', bright sphere crossed by dark lane, radio source
NGC 5139	13 26.8	-47 29	36	Cen	Globular cluster	3.7	Omega Centauri, one of the finest globular clusters
NGC 5272	13 42.2	+28 23	16	CVn	Globular cluster	6.2	M3, large bright globular cluster, brightens rapidly towards the middle
NGC 5281	13 46.5	-62 55	4	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	20	Ser	Globular cluster	5.6	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	Nor	Open cluster	5.4	40 stars, moderate brightness range, slight central concentration
NGC 6121	16 23.6	-26 32	26	Sco	Globular cluster	5.6	M4, conspicuous globular near Antares, one of the nearest
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**	**17**	**Her**	**Globular cluster**	**5.8**	**M13, the 'Great Hercules Cluster', showpiece of northern skies**
NGC 6231	16 54.2	-41 50	14	Sco	Open cluster	2.6	A few stars with strong central concentration. Brightest stars mag. 5
NGC 6405	17 40.1	-32 13	20	Sco	Open cluster	4.2	M6, the 'Butterfly Cluster', 80 stars, large brightness range
NGC 6397	17 40.7	-53 40	26	Ara	Globular cluster	5.7	Loose, scattered structure, one of the nearest of the globulars
NGC 6475	17 53.9	-34 49	80	Sco	Open cluster	4.5	M7, 80 stars brighter than 1 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 02.4	-23 02	28	Sgr	Gaseous nebula	6.3	M20, 'Trifid Nebula', emission and reflection nebulosity cut by dark lanes
NGC 6523	18 03.6	-24 23	45 x 30	Sgr	Emission nebula	5.8	M8, 'Lagoon', densest section known as the 'Hourglass', dark lane
NGC 6611	18 18.8	-13 47	7	Ser	Open cluster	6.0	M16, 100 bright and faint stars in the 'Eagle Nebula'
IC 4725	18 31.9	-19 15	29	Sgr	Open cluster	6.2	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	14	Set	Open cluster	5.8	M11, the 'Wild Duck Cluster', rich and compact open cluster
NGC 7009	21 04.2	-11 22	0.5	Aqr	Planetary nebula	12.8	The 'Saturn Nebula', ring structure in a larger and fainter halo
NGC 7078	21 30.0	+12 10	12	Peg	Globular cluster	6.2	M15, bright, irregularly shaped, well resolved into faint stars
NGC 7293	22 29.6	-20 50	13	Aqr	Planetary nebula	13.5	The 'Helix Nebula', ring structure in a larger and fainter disk

The data in **bold** denotes objects that are difficult to view from southern parts of WA.

Astronomy on the Internet

There are many Internet sites available for aspiring amateur astronomers, most of which are very user friendly, and full of information. The following list of sites has been found to be quite useful. Users are reminded that the Internet sites are constantly changing so access to sites can change without notice, while new sites are becoming available all the time. This is a small list – each of the sites mentioned will have links to more related sites.

Perth Observatory

http://www.wa.gov.au/perthobs

- ***Astronomy News***: Updated regularly, this section contains the weekly night sky column, plus notification of current phenomena and topical events.
- ***Astronomy Information***: This gives information (small images) of planets, comets, stars etc. All of this information is taken from the Perth Observatory Project Kit.
- ***Tours***: Details of services for the public. For availability, contact Perth Observatory. Daytime guided tours and evening star viewing available.
- ***Current Phenomena***: Programs of specific interest (Galileo, Hubble Space Telescope, eclipses etc) are given links from here. Also Sun and Moon rise/set times for Perth.
- ***Links***: This section links the user to all areas of astronomical interest.

NASA Homepage

http://www.nasa.gov/NASA homepage.html

This is a good starting place for many NASA projects – especially current missions. When a shuttle mission is in orbit, this will give a link to the current shuttle home page, with associated projects and experiments.

Astronomy Images

http://wfpc2.jpl.nasa.gov

Images from the Hubble Space telescope.

Hubble Space Telescope

http://oposite.stsci.edu/pubinfo/

The Hubble Space Telescope is managed through the Space Telescope Science Institute in Baltimore. Many HST images are available, even those several years old.

Sky and Telescope Magazine

http://www.skypub.com/

This magazine is the premier astronomy magazine for amateur astronomers. Sky Publishing put out a weekly update of all astronomical events in non-technical language along with summaries of press releases. The site can also provide some basic astronomical information.

Sun

http://sohowww.nascom.nasa.gov/data/realtime-images.html

Current real time Sun images, including animated GIFs of solar flares. Also information about auroras.

Sunrise/set times

http://www.auslig.gov.au/geodesy/astro/astro.htm

Type in your latitude, longitude and Time Zone for astronomical phenomena at any place – interactive.

Moon Phases

http://sunearth.gsfc.nasa.2ov/eclipse/phase/phases.2001-2100.htm

Dates and times for moon phases (in UT: WAST = UT + 8hrs).

Eclipses

http://sunearth.gsfc.nasa.gov/eclipse

Provides a wealth of information concerning both solar and lunar eclipses.

Current Almanac

http://skyandtelescope.com/observing/almanac

Can be set for your location. Sun and Moon, rise and set times, planet visibility, plus Space Station viewing times are available at this site.

Planets

http://www.seds.org/nineplanets/nineplanets

Latest Information on all the planets – an excellent site.

Solar System Conditions

http://www.spaceweather.com

Current state of the solar winds, plus aurora predictions and asteroid approaches.

ISS, Iridium Satellites, Satellites

http://www.heavens-above.com

Input your specific site, and bookmark for your location. This gives passages of all satellites, or ISS (International Space Station), or the Iridium satellite flashes visible from your site, with specific times.

Weather

http://www.bom.gov.au/weather/wa

Weather maps and predictions, wind forecasts, charts and current conditions.

Constellations

Constellations are a relatively arbitrary grouping of stars in the sky. They are arbitrary in the sense that the stars are not necessarily related in any way, or even close to one another, they just lie in the same direction in the sky. Also, in ancient times some stars were grouped together in a constellation because they were reminiscent of the outline, or rough shape, of an animal, object, or a mythological being. Different cultures most times defined different constellations for the same grouping of stars, but sometimes they were quite similar. Identifying a constellation by eye is sometimes just a matter of 'joining the dots' defined by the stars and using some imagination. Some constellations are not easily identified in this way as the relationship of stars to object is abstract or obscure.

Some of the constellations are descended from catalogues created by the ancient Greeks around 2,000 years ago. The most influential of these catalogues is the Almagest by Ptolemy of Alexandria (CE 73 - 151) in which he mentions 48 constellations that were visible from the Northern Hemisphere. Naturally, these constellations descended from earlier Egyptian and Mesopotamian cultures.

This catalogue had an influence lasting nearly 1,200 years and was the foundation of the astronomy accomplished by Arabic and Medieval scholars. In fact, the title Almagest is a corruption of the Arabic, Al-mijisti , which roughly translates to 'the Magnificent' – such was this culture's appreciation of its scholarly importance.

A little more than half of the constellations in use today originated from ancient times. The others were defined by European astronomers and cartographers as the Southern Hemisphere began to be explored in the 16th Century. The most notable of these astronomers was Nicolas Louis de Lacaille (1713-1762). After an observing expedition to South Africa, he named 14 new constellations in the uncharted parts of southern sky. The constellations he defined represented equipment (mostly scientific) in use at that time.

In 1930 the International Astronomical Union (the organisation of professional astronomers) fixed the names and boundaries of the constellations. They defined 88 constellations in all, covering the entire sky (see table below). They generally follow the patterns of the most common constellations defined in earlier times. Strict definitions were required because prior to that date mapmakers and astronomers could define constellations as they pleased. Sometimes this was undertaken in order to obtain favour from a patron.

The table also provides the Latin 'genitive' case of the constellation names. This case is often referred to as the possessive case, as that is the most similar English language case comparison. It expresses possession, origin, source, etc. and in Latin grammar is shown by inflection of nouns, pronouns, and adjectives. With respect to the constellations, this case is used to show that the location of a star, or other object, lies within the boundaries of a constellation. For example, the brightest star in Taurus, Aldebaran, becomes α Tauri.

Culmination occurs when the mid point of a constellation is highest in the sky around midnight.

CONSTELLATIONS

DESIGNATION	GENITIVE	ABBREV.	CULMINATION	MEANING
Andromeda	Andromedae	And	Nov 23	The Princess of Ethiopia
Antlia	Antliae	Ant	Apr 10	The Air Pump
Apus	Apodis	Aps	Jul 05	The Bird of Paradise
Aquarius	Aquarii	Aqr	Oct 09	The Water Bearer
Aquila	Aquilae	Aql	Aug 30	The Eagle
Ara	Arae	Ara	Jul 25	The Altar
Aries	Arietis	Ari	Dec 14	The Ram
Auriga	Aurigae	Aur	Feb 04	The Charioteer
Bootes	Bootis	Boo	Jun 16	The Bear Driver
Caelum	Caeli	Cae	Jan 15	The Sculptor's Chisel
Camelopardus	Camelopardi	Cam	Feb 06	The Giraffe
Cancer	Cancri	Cnc	Mar 16	The Crab
Canes Venatici	Canum Venaticorum	CVn	May 22	The Hunting Dogs
Canis Major	Canis Majoris	CMa	Feb 16	The Greater Dog
Canis Minor	Canis Minoris	CMi	Feb 28	The Lesser Dog
Capricornus	Capricorni	Cap	Sep 22	The Sea Goat
Carina	Carinae	Car	Mar 17	The Keel (of Argo Navis)
Cassiopeia	Cassiopeiae	Cas	Nov 23	The Queen of Ethiopia
Centaurus	Centauri	Cen	May 14	The Centaur
Cepheus	Cephei	Cep	Nov 13	The King of Ethiopia
Cetus	Ceti	Cet	Nov 29	The Sea Monster (Whale)
Chamaeleon	Chamaeleontis	Cha	Apr15	The Chameleon
Circinus	Circini	Cir	Jun 14	The Compasses
Columba	Columbae	Col	Feb 01	Noah's Dove
Coma Berenices	Cornae Berenices	Corn	May 17	The Hair of Berenice
Corona Australis	Coronae Australis	CrA	Aug 14	The Southern Crown

CONSTELLATIONS (continued)

DESIGNATION	GENITIVE	ABBREV.	CULMINATION	MEANING
Corona Borealis	Coronae Borealis	CrB	Jul 03	The Northern Crown
Corvus	Corvi	Crv	May 12	The Crow
Crater	Crateris	Crt	Apr 26	The Cup
Crux	Crucis	Cru	May 12	The (Southern) Cross
Cygnus	Cygni	Cyg	Sep 13	The Swan
Delphinus	Delphini	Del	Sep 14	The Dolphin (Porpoise)
Dorado	Doradus	Dor	Jan 31	The Swordfish
Draco	Draconis	Dra	Jul 08	The Dragon
Equuleus	Equulei	Equ	Sep 22	The Foal
Eridanus	Eridani	Eri	Dec 25	The River
Fornax	Fornacis	For	Dec 17	The Laboratory Furnace
Gemini	Geminorum	Gem	Feb 19	The Twins
Grus	Gruis	Gru	Oct 12	The Crane
Hercules	Herculis	Her	Jul 28	Hercules (the hero)
Horologium	Horologii	Hor	Dec 25	The Pendulum Clock
Hydra	Hydrae	Hya	Apr 29	The Water Snake
Hydrus	Hydri	Hyi	Dec 10	The Southern Water Snake
Indus	Indi	Ind	Sep 26	The American Indian
Lacerta	Lacertae	Lac	Oct 12	The Lizard
Leo	Leonis	Leo	Apr 15	The Lion
Leo Minor	Leonis Minoris	LMi	Apr 09	The Lion Cub
Lepus	Leporis	Lep	Jan 28	The Hare
Libra	Librae	Lib	Jun 23	The Scales
Lupus	Lupi	Lup	Jun 23	The Wolf
Lynx	Lyncis	Lyn	Mar 05	The Lynx
Lyra	Lyrae	Lyr	Aug18	The Harp
Mensa	Mensae	Men	Jan 28	The Table Mountain
Microscopium	Microscopii	Mic	Sep, 18	The Microscope
Monoceros	Monocerotis	Mon	Feb 19	The Unicorn
Musca	Muscae	Mus	May 14	The Fly
Norma	Normae	Nor	Jul 03	The Carpenter's Square
Octans	Octantis	Oct	Circum	The Octant
Ophiuchus	Ophiuchi	Oph	Jul 26	The Serpent Bearer
Orion	Orionis	Ori	Jan 27	The Hunter
Pavo	Pavonis	Pav	Aug 29	The Peacock
Pegasus	Pegasi	Peg	Oct 16	The Winged Horse
Perseus	Persei	Per	Dec 22	Perseus (the hero)
Phoenix	Phoenicis	Phe	Nov 18	The Phoenix
Pictor	Pictoris	Pic	Jan 30	The Painter's Easel
Pisces	Piscium	Psc	Nov 11	The Fishes
Piscis Austrinus	Piscis Austrini	PsA	Oct 09	The Southern Fish
Puppis	Puppis	Pup	Feb 22	The Stern (of Argo Navis)
Pyxis	Pyxidis	Pyx	Mar 21	The Compass (of Argo Navis)
Reticulum	Reticuli	Ret	Jan 03	The Net
Sagitta	Sagittae	Sge	Aug 30	The Arrow
Sagittarius	Sagittarii	Sgr	Aug 21	The Archer
Scorpius	Scorpii	Sco	Jul 18	The Scorpion
Sculptor	Sculptoris	Scl	Nov 10	The Sculptor's Workshop
Scutum	Scuti	Sct	Aug 15	The Shield
Serpens	Serpentis	Ser	Jul 21	The Serpent
Sextans	Sextantis	Sex	Apr 08	The Sextant
Taurus	Tauri	Tau	Jan 14	The Bull
Telescopium	Telescopii	Tel	Aug 24	The Telescope
Triangulum	Trianguli	Tri	Dec 07	The Triangle
Triangulum Australe	Trianguli Australis	TrA	Jul 07	The The Southern Triangle
Tucana	Tucanae	Tuc	Nov 01	The Toucan
Ursa Major	Ursae Majoris	UMa	Apr 25	The Great Bear
Ursa Minor	Ursae Minoris	Umi	Jun 27	The Bear Cub
Vela	Velorum	Vel	Mar 30	The Sail (of Argo Navis)
Virgo	Virginis	Vir	May 26	The Virgin
Volans	Volantis	Vol	Mar 04	The Flying Fish
Vulpecula	Vulpeculae	Vul	Sep 08	The Fox

GREEK ALPHABET

Α	α	Alpha
Β	β	Beta
Γ	γ	Gamma
Δ	δ	Delta
Ε	ε	Epsilon
Ζ	ζ	Zeta
Η	η	Eta
Θ	θ	Theta
Ι	ι	Iota
Κ	κ	Kappa
Λ	λ	Lambda
Μ	μ	Mu
Ν	ν	Nu
Ξ	ξ	Xi
Ο	ο	Omicron
Π	π	Pi
Ρ	ρ	Rho
Σ	σ	Sigma
Τ	τ	Tau
Υ	υ	Upsilon
Φ	φ	Phi
Χ	χ	Chi
Ψ	ψ	Psi
Ω	ω	Omega

CALENDAR WITH JULIAN DATE AND DAY NUMBERS

DAY OF MONTH	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000
1	Thu	1	5.5	Sun	32	36.5	Mon	61	65.5	Thu	92	96.5	Sat	122	126.5	Tue	153	157.5
2	Fri	2	6.5	Mon	33	37.5	Tue	62	66.5	Fri	93	97.5	Sun	123	127.5	Wed	154	158.5
3	Sat	3	7.5	Tue	34	38.5	Wed	63	67.5	Sat	94	98.5	Mon	124	128.5	Thu	155	159.5
4	Sun	4	8.5	Wed	35	39.5	Thu	64	68.5	Sun	95	99.5	Tue	125	129.5	Fri	156	160.5
5	Mon	5	9.5	Thu	36	40.5	Fri	65	69.5	Mon	96	100.5	Wed	126	130.5	Sat	157	161.5
6	Tue	6	10.5	Fri	37	41.5	Sat	66	70.5	Tue	97	101.5	Thu	127	131.5	Sun	158	162.5
7	Wed	7	11.5	Sat	38	42.5	Sun	67	71.5	Wed	98	102.5	Fri	128	132.5	Mon	159	163.5
8	Thu	8	12.5	Sun	39	43.5	Mon	68	72.5	Thu	99	103.5	Sat	129	133.5	Tue	160	164.5
9	Fri	9	13.5	Mon	40	44.5	Tue	69	73.5	Fri	100	104.5	Sun	130	134.5	Wed	161	165.5
10	Sat	10	14.5	Tue	41	45.5	Wed	70	74.5	Sat	101	105.5	Mon	131	135.5	Thu	162	166.5
11	Sun	11	15.5	Wed	42	46.5	Thu	71	75.5	Sun	102	106.5	Tue	132	136.5	Fri	163	167.5
12	Mon	12	16.5	Thu	43	47.5	Fri	72	76.5	Mon	103	107.5	Wed	133	137.5	Sat	164	168.5
13	Tue	13	17.5	Fri	44	48.5	Sat	73	77.5	Tue	104	108.5	Thu	134	138.5	Sun	165	169.5
14	Wed	14	18.5	Sat	45	49.5	Sun	74	78.5	Wed	105	109.5	Fri	135	139.5	Mon	166	170.5
15	Thu	15	19.5	Sun	46	50.5	Mon	75	79.5	Thu	106	110.5	Sat	136	140.5	Tue	167	171.5
16	Fri	16	20.5	Mon	47	51.5	Tue	76	80.5	Fri	107	111.5	Sun	137	141.5	Wed	168	172.5
17	Sat	17	21.5	Tue	48	52.5	Wed	77	81.5	Sat	108	112.5	Mon	138	142.5	Thu	169	173.5
18	Sun	18	22.5	Wed	49	53.5	Thu	78	82.5	Sun	109	113.5	Tue	139	143.5	Fri	170	174.5
19	Mon	19	23.5	Thu	50	54.5	Fri	79	83.5	Mon	110	114.5	Wed	140	144.5	Sat	171	175.5
20	Tue	20	24.5	Fri	51	55.5	Sat	80	84.5	Tue	111	115.5	Thu	141	145.5	Sun	172	176.5
21	Wed	21	25.5	Sat	52	56.5	Sun	81	85.5	Wed	112	116.5	Fri	142	146.5	Mon	173	177.5
22	Thu	22	26.5	Sun	53	57.5	Mon	82	86.5	Thu	113	117.5	Sat	143	147.5	Tue	174	178.5
23	Fri	23	27.5	Mon	54	58.5	Tue	83	87.5	Fri	114	118.5	Sun	144	148.5	Wed	175	179.5
24	Sat	24	28.5	Tue	55	59.5	Wed	84	88.5	Sat	115	119.5	Mon	145	149.5	Thu	176	180.5
25	Sun	25	29.5	Wed	56	60.5	Thu	85	89.5	Sun	116	120.5	Tue	146	150.5	Fri	177	181.5
26	Mon	26	30.5	Thu	57	61.5	Fri	86	90.5	Mon	117	121.5	Wed	147	151.5	Sat	178	182.5
27	Tue	27	31.5	Fri	58	62.5	Sat	87	91.5	Tue	118	122.5	Thu	148	152.5	Sun	179	183.5
28	Wed	28	32.5	Sat	59	63.5	Sun	88	92.5	Wed	119	123.5	Fri	149	153.5	Mon	180	184.5
29	Thu	29	33.5	Sun	60	64.5	Mon	89	93.5	Thu	120	124.5	Sat	150	154.5	Tue	181	185.5
30	Fri	30	34.5				Tue	90	94.5	Fri	121	125.5	Sun	151	155.5	Wed	182	186.5
31	Sat	31	35.5				Wed	91	95.5				Mon	152	156.5			

DAY OF MONTH	JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000	Day of: Week	Year	Julian Date -2,453,000
1	Thu	183	187.5	Sun	214	218.5	Wed	245	249.5	Fri	275	279.5	Mon	306	310.5	Wed	336	340.5
2	Fri	184	188.5	Mon	215	219.5	Thu	246	250.5	Sat	276	280.5	Tue	307	311.5	Thu	337	341.5
3	Sat	185	189.5	Tue	216	220.5	Fri	247	251.5	Sun	277	281.5	Wed	308	312.5	Fri	338	342.5
4	Sun	186	190.5	Wed	217	221.5	Sat	248	252.5	Mon	278	282.5	Thu	309	313.5	Sat	339	343.5
5	Mon	187	191.5	Thu	218	222.5	Sun	249	253.5	Tue	279	283.5	Fri	310	314.5	Sun	340	344.5
6	Tue	188	192.5	Fri	219	223.5	Mon	250	254.5	Wed	280	284.5	Sat	311	315.5	Mon	341	345.5
7	Wed	189	193.5	Sat	220	224.5	Tue	251	255.5	Thu	281	285.5	Sun	312	316.5	Tue	342	346.5
8	Thu	190	194.5	Sun	221	225.5	Wed	252	256.5	Fri	282	286.5	Mon	313	317.5	Wed	343	347.5
9	Fri	191	195.5	Mon	222	226.5	Thu	253	257.5	Sat	283	287.5	Tue	314	318.5	Thu	344	348.5
10	Sat	192	196.5	Tue	223	227.5	Fri	254	258.5	Sun	284	288.5	Wed	315	319.5	Fri	345	349.5
11	Sun	193	197.5	Wed	224	228.5	Sat	255	259.5	Mon	285	289.5	Thu	316	320.5	Sat	346	350.5
12	Mon	194	198.5	Thu	225	229.5	Sun	256	260.5	Tue	286	290.5	Fri	317	321.5	Sun	347	351.5
13	Tue	195	199.5	Fri	226	230.5	Mon	257	261.5	Wed	287	291.5	Sat	318	322.5	Mon	348	352.5
14	Wed	196	200.5	Sat	227	231.5	Tue	258	262.5	Thu	288	292.5	Sun	319	323.5	Tue	349	353.5
15	Thu	197	201.5	Sun	228	232.5	Wed	259	263.5	Fri	289	293.5	Mon	320	324.5	Wed	350	354.5
16	Fri	198	202.5	Mon	229	233.5	Thu	260	264.5	Sat	290	294.5	Tue	321	325.5	Thu	351	355.5
17	Sat	199	203.5	Tue	230	234.5	Fri	261	265.5	Sun	291	295.5	Wed	322	326.5	Fri	352	356.5
18	Sun	200	204.5	Wed	231	235.5	Sat	262	266.5	Mon	292	296.5	Thu	323	327.5	Sat	353	357.5
19	Mon	201	205.5	Thu	232	236.5	Sun	263	267.5	Tue	293	297.5	Fri	324	328.5	Sun	354	358.5
20	Tue	202	206.5	Fri	233	237.5	Mon	264	268.5	Wed	294	298.5	Sat	325	329.5	Mon	355	359.5
21	Wed	203	207.5	Sat	234	238.5	Tue	265	269.5	Thu	295	299.5	Sun	326	330.5	Tue	356	360.5
22	Thu	204	208.5	Sun	235	239.5	Wed	266	270.5	Fri	296	300.5	Mon	327	331.5	Wed	357	361.5
23	Fri	205	209.5	Mon	236	240.5	Thu	267	271.5	Sat	297	301.5	Tue	328	332.5	Thu	358	362.5
24	Sat	206	210.5	Tue	237	241.5	Fri	268	272.5	Sun	298	302.5	Wed	329	333.5	Fri	359	363.5
25	Sun	207	211.5	Wed	238	242.5	Sat	269	273.5	Mon	299	303.5	Thu	330	334.5	Sat	360	364.5
26	Mon	208	212.5	Thu	239	243.5	Sun	270	274.5	Tue	300	304.5	Fri	331	335.5	Sun	361	365.5
27	Tue	209	213.5	Fri	240	244.5	Mon	271	275.5	Wed	301	305.5	Sat	332	336.5	Mon	362	366.5
28	Wed	210	214.5	Sat	241	245.5	Tue	272	276.5	Thu	302	306.5	Sun	333	337.5	Tue	363	367.5
29	Thu	211	215.5	Sun	242	246.5	Wed	273	277.5	Fri	303	307.5	Mon	334	338.5	Wed	364	368.5
30	Fri	212	216.5	Mon	243	247.5	Thu	274	278.5	Sat	304	308.5	Tue	335	339.5	Thu	365	369.5
31	Sat	213	217.5	Tue	244	248.5				Sun	305	309.5				Fri	366	370.5

CHRONOLOGICAL CYCLES (2004)

Dominical Letter	DC	A letter that corresponds to the day upon which the first Sunday (and every subsequent Sunday) of the year falls. For example, A=Sunday Jan 1st, B=Sunday Jan 2nd, C= Sunday Jan 3rd etc. This system was developed in Roman times and assists constructing the ecclesiastical calendar for any year.
Epact	8	The 'age' of the Moon, the number of days since new moon, diminished by one day, on January 1 in the Gregorian ecclesiastical lunar cycles.
Golden Number (Lunar Cycle)	X	Year within a 19-year cycle after moon phases repeat (approximately) on the same calendar day.
Julian Period (year of)	6717	Number of Julian years from Julian Day 0.
Roman Indiction	12	Year within a 15-year cycle based on a Roman taxation cycle. (This, in turn, was based on the maximum length of Roman military service, at the end of which taxation had to be finalised.)
Solar Cycle	25	Year within a 28-year cycle after which weekdays and calendar dates repeat in the Julian Calendar.

ERAS (2004)

ERA NAME	YEAR	BEGINS
Byzantine	7513	Sep 14
Chinese (Gui-Weu)	(4641)	Jan 22
Diocletian	1721	Sep 11
Grecian (Seleucidae)	2311	Sep 14 (or Oct 14)
GREGORIAN	**2004**	**Jan 1**
Indian (Saka)	1926	Mar 21
Islamic (Hegira)*	1425	Feb 21
Japanese	2664	Jan 1
Jewish (A.M)*	5765	Sep 15
Nabonassar	2753	Apr 22
Roman (A.U.C.)	2757	Jan 14

* Year begins at sunset.

All dates are given in terms of the Gregorian calendar in which 2004 January 14 corresponds to 2004 January 1 of the Julian Calendar.

RELIGIOUS CALENDAR (2004)

EVENT	DATE
Epiphany	Jan 6
Ash Wednesday	Feb 25
Palm Sunday	Apr 4
Good Friday	Apr 9
Easter Day	Apr 11
Ascension Day	May 20
Whit Sunday - Pentecost	May 30
Trinity Sunday	Jun 6
First Sunday in Advent	Nov 28
Christmas Day (Saturday)	Dec 25
First Day of Passover (Pesach)	Apr 6
Feast of Weeks (Shavuot)	May 26
Jewish New Year (tabular) (Rosh Hashanah)	Sep 16
Day of Atonement (Yom Kippur)	Sep 25
First Day of Tabernacles (Succoth)	Sep 30
Islamic New Year (tabular)	Feb 22
First Day of Ramadan (tabular)	Oct 15

The Jewish and Islamic dates above are tabular dates, which begin at sunset on the previous evening and end at sunset on the date tabulated. In practice, the dates of Islamic fasts and festivals are determined by an actual sighting of the appropriate New Moon.

HOURS	01	02	03	04	05	06	07	08	09	10	11	12
FRACTION OF A DAY:	0.042	0.083	0.125	0.167	0.208	0.250	0.292	0.333	0.375	0.417	0.458	0.500

HOURS	13	14	15	16	17	18	19	20	21	22	23	24
FRACTION OF A DAY:	0.542	0.583	0.625	0.667	0.708	0.750	0.792	0.833	0.875	0.917	0.958	1.000

Rise Set Corrections

Most of the rise and set times quoted in this Almanac are correct for WA's population centre and state capital, Perth. The maps provided here will assist making corrections for observations at other locations around the state.

Meteorological and local topography affect the actual time of an object's rise or set. These affects vary from place to place and in general add an uncertainty of about two minutes to these times.

How to make a correction

1. Find the relevant rise or set time at Perth for the date you require,
2. Find the declination of the object on that date,
3. Fnd the rise or set map for the object's declination, or the two maps that bracket the declination, and
4. Estimate your location on the maps,
5. Estimate the correction from the map, or maps.

If you use two maps you will need to estimate the correction for both maps, then interpolate (estimate an intermediate value given the objects declination as a proportion between the map declinations) between these two values to obtain the overall correction.

An example:

The sun rise time at Leonora on 2004 Dec 21 (the December Solstice of 2004).

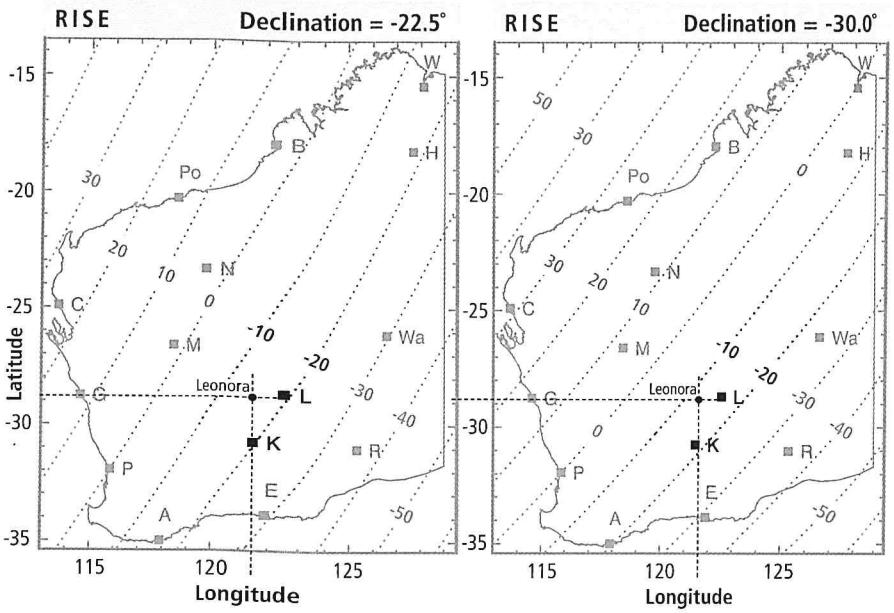
1 The sunrise time at Perth on that date is 0507 WAST (from December Sun and Moon rise and set table, see section: *December*).

2. The declination of the Sun on that date is -23° 26' 19" = -(23+26/60+19/3600)° = -23.°44 (from Sun position table, section: *Solar System Information*).
3. Leonora is approximately NW of the line joining Kalgoorlie and Laverton, or, latitude = -28.9 degrees and longitude = 121.33 degrees E.
4. Use the rise maps, with declinations –22.°5 and –30.°0. From the rise correction maps the corrections are –16 minutes and –13 minutes, respectively.
5. Interpolate between maps: -23.°44 is 0.°94 from –22.°5 toward –30.°0. So we must add 0.94/7.5 of the difference between the estimates, from the estimate at –22.°5.

   The interpolation 'correction' = 0.94/7.5 * (-13+16) minutes, is approximately 0 minutes (any fraction of 2 minutes is negligible for these purposes).

   Total correction is –16 minutes (at declination = –22.°5) + interpolation (=0 minutes) = -16 minutes.

Sun rise time at Leonora
= Sun rise time at Perth + correction = 0507 WAST –16 minutes = 0451 WAST.



Notes for maps

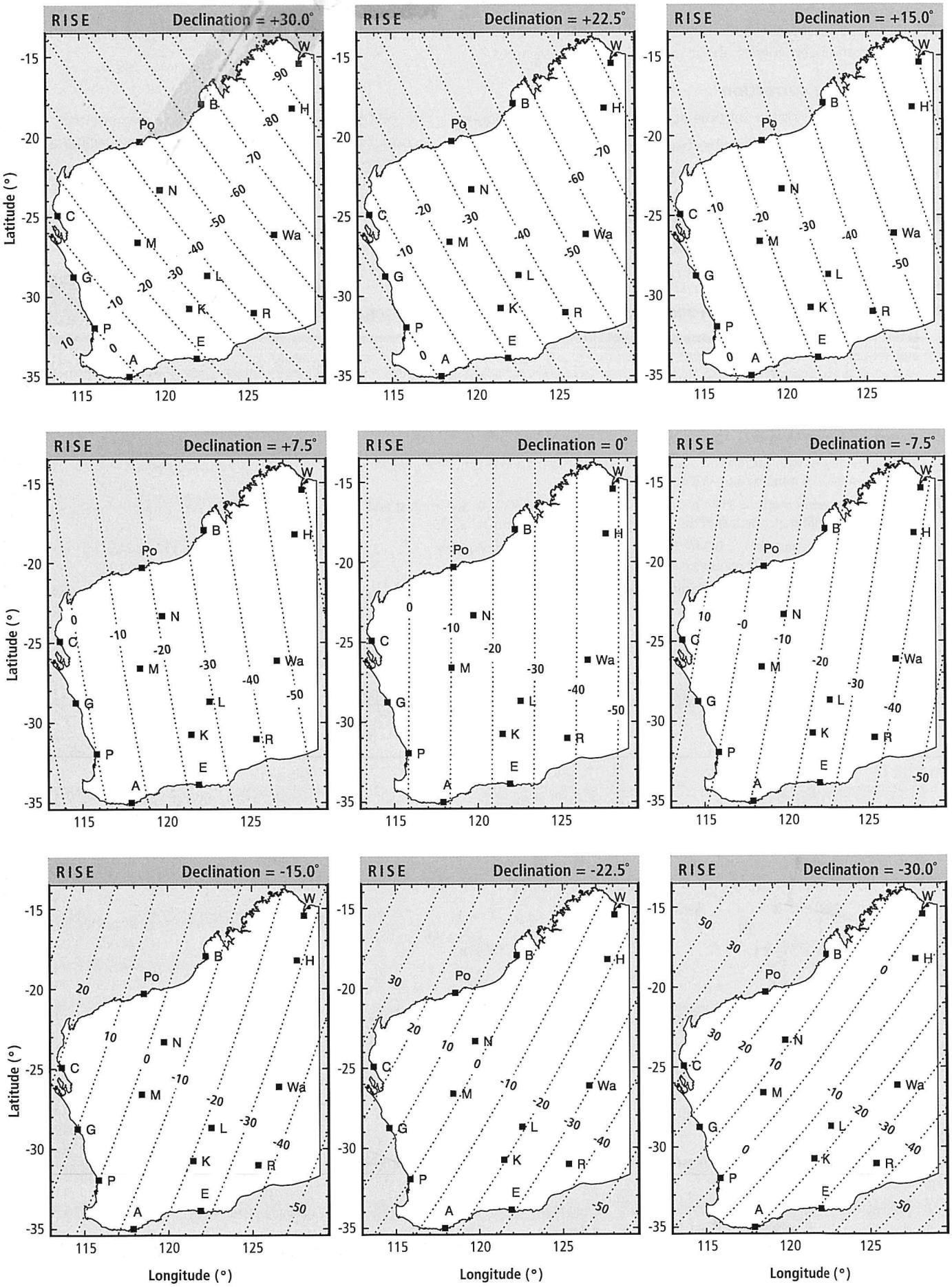
All corrections are the number of minutes to be added to the rise or set time at Perth. The cities and towns indicated are:

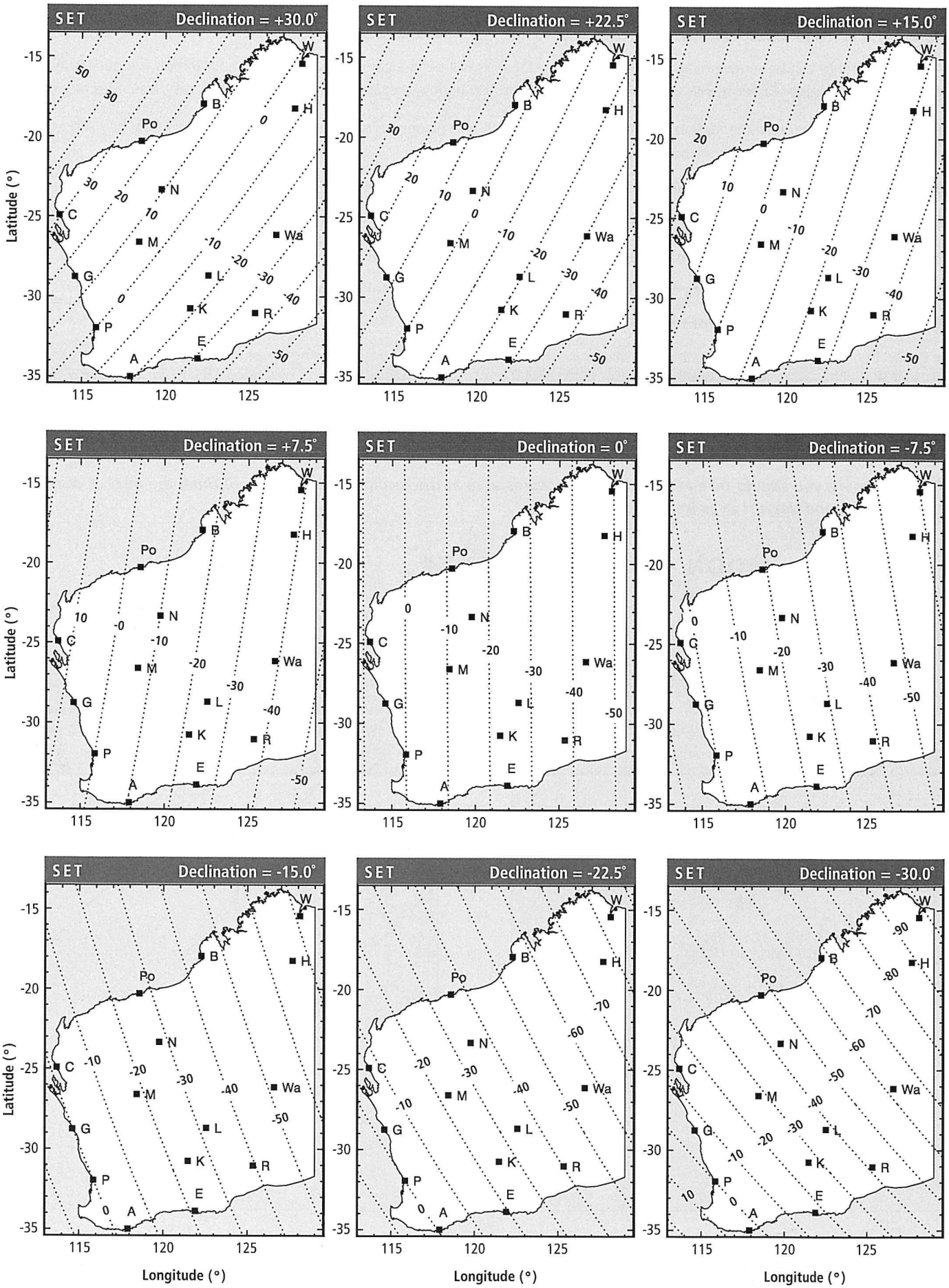
A	Albany	B	Broome	C	Carnarvon	E	Esperance
G	Geraldton	H	Halls Creek	K	Kalgoorlie	L	Laverton
M	Meekatharra	N	Newman	P	Perth	Po	Port Hedland
R	Rawlinna	Wa	Warburton Community			W	Wyndham

COORDINATES AROUND WA

LOCATION	Latitude (° South)	Longitude (° East)
Albany	35.018	117.884
Augusta	34.312	115.159
Bickley (Perth Observatory)	32.017	116.133
Bridgetown	33.958	116.141
Broome	17.962	122.236
Bunbury	33.340	115.642
Carnarvon	24.890	113.660
Christmas Island	10.483	105.623
Cocos (Keeling) Islands	12.166	96.823
Denmark	34.972	117.357
Derby	17.303	123.629
Esperance	33.866	121.888
Eucla	31.675	128.883
Fitzroy Crossing	18.178	125.591
Fremantle	32.056	115.746
Geraldton	28.779	114.614
Giles Meteorological Station	18.227	127.668
Joondalup	31.745	115.766
Kalgoorlie	30.749	121.466
Karratha	20.731	116.857
Kellerberrin	31.632	117.708
Kojonup	33.838	117.152
Lake Grace	33.089	118.405
Laverton	28.623	122.401
Mandurah	32.529	115.723
Marble Bar	21.172	119.746
Meekatharra	26.591	118.497
Moora	30.638	116.010
Mount Magnet	28.062	117.848
Narrogin	32.936	117.178
Newman	23.358	119.730
Norseman	32.196	121.778
North am	31.647	116.669
Onslow	21.688	115.135
Pemberton	34.446	116.036
Perth	31.952	115.859
Port Hedland	20.310	118.601
Rawlinna	30.776	125.440
Rockingham	32.281	115.727
South ern Cross	31.227	119.327
Tom Price	22.694	117.793
Warburton Community	26.132	126.571
Wilun a	26.595	120.225
Wynd ham	15.486	128.120
Yamp Sound	16.129	123.656

RISE/SET CORRECTION DIAGRAMS FOR WESTERN AUSTRALIA




SET Declination = +30.0°
SET Declination = +22.5°
SET Declination = +15.0°
SET Declination = +7.5°
SET Declination = 0°
SET Declination = -7.5°
SET Declination = -15.0°
SET Declination = -22.5°
SET Declination = -30.0°
Latitude (°)
Longitude (°)
-15
-20
-25
-30
-35
115
120
125
A Albany
B Broome
C Carnarvon
E Esperance
G Geraldton
H Halls Creek
K Kalgoorlie
L Laverton
M Meekatharra
N Newman
P Perth
Po Port Hedland
R Rawlinna
W Wyndham
Wa Warburton Community

Astrophotography

Astrophotography can be a rewarding and challenging hobby. You will need a camera that is firmly mounted on a tripod or the like. You can also eliminate vibration with a remote switch, which is also handy to control the long time exposures sometimes required.

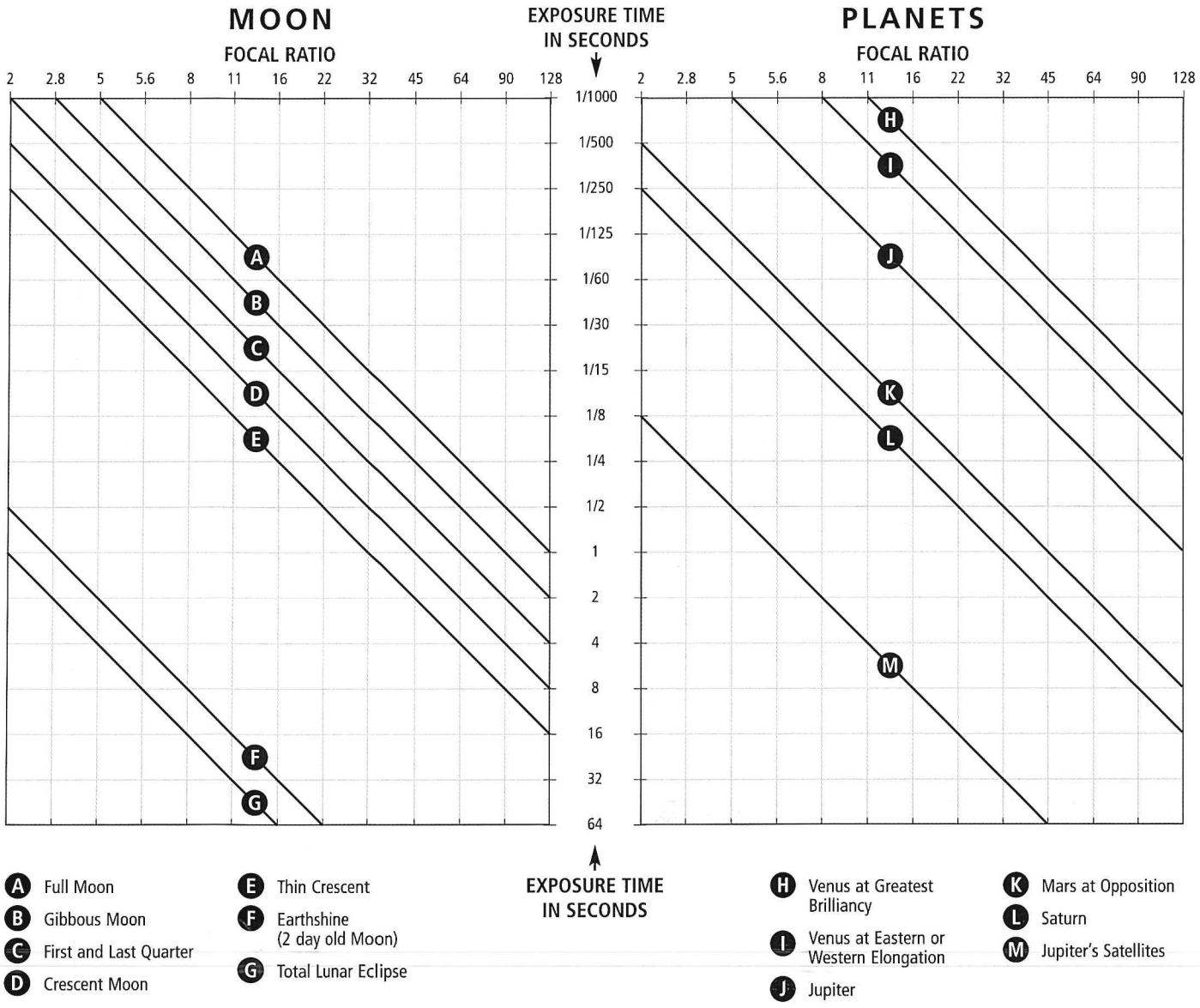
The graphs show the recommended exposure times for the Moon and planets using 100 ISO film. They should only be used as a guide because many factors influence the exposure time.

To select the correct exposure time:

1. **Select your system's focal ratio along the horizontal axis,**
2. **Find the intersection with the exposure line of the Moon or planet required,**
3. **Follow a horizontal line across to find the intersection with the vertical axis for the exposure time, and**
4. **Correct the exposure time for the speed of your film.**

FILM SPEED	MULTIPLY BY	FILM SPEED	DIVIDE BY	FILM SPEED	DIVIDE BY
32 ISO	4	200 ISO	2	800 ISO	8
64 ISO	2	400 ISO	4	1600 ISO	16

For best results you should take at least three exposures, one at the recommended exposure time, the next at one half the exposure, and the last at twice the exposure time.



- **A** Full Moon
- **B** Gibbous Moon
- **C** First and Last Quarter
- **D** Crescent Moon
- **E** Thin Crescent
- **F** Earthshine (2 day old Moon)
- **G** Total Lunar Eclipse
- **H** Venus at Greatest Brilliancy
- **I** Venus at Eastern or Western Elongation
- **J** Jupiter
- **K** Mars at Opposition
- **L** Saturn
- **M** Jupiter's Satellites

ASTRONOMY AND ASTROPHYSICS DEFINITIONS

A

aberration: the apparent angular displacement of the observed position of a celestial object from its geometric position, caused by the finite velocity of light in combination with the motions of the observer and of the observed object.

aberration, annual: the component of stellar aberration resulting from the motion of the Earth about the Sun.

aberration, diurnal: the component of stellar aberration resulting from the observer's diurnal motion about the centre of the Earth.

aberration, planetary: the apparent angular displacement of the observed position of a celestial body produced by motion of the observer and the actual motion of the observed object.

aberration, stellar: the apparent angular displacement of the observed position of a celestial body resulting from the motion of the observer. Stellar aberration is divided into diurnal, annual, and secular components.

accretion, accretion disk: Astronomical objects as diverse as protostars and active galaxies may derive their energy from the gravitational power released by the infall, or accretion, of material onto a central object. The combined effects of gravity and rotation often force the accreting material into an orbiting accretion disk.

active galaxy: Certain galaxies emit far more energy than can be accounted for by their stars alone. The central regions of these galaxies harbour a compact, solar-system-sized object capable of outshining the rest of the galaxy by a factor of 100. The ultimate energy source for active galaxies may be the accretion of matter onto a supermassive black hole. Active galaxies can emit strongly across the entire electromagnetic spectrum, from radio waves to gamma rays. See quasar.

active optics: A technique to reduce the effects of slowly varying forces, such as gravitational deflections and temperature drifts, that can distort a mirror on time scales of minutes to hours, resulting in imperfect images.

adaptive optics: A set of techniques to adjust the mirrors of telescopes on time scales of hundredths of a second to correct for distortions in astronomical images due to turbulence in Earth's atmosphere.

arcminute: A unit of angle corresponding to 1/60th of a degree. The full moon is 30 arcminutes in diameter.

arcsecond: A unit of angle corresponding to 1/3600th of a degree; 1/60th of an arcminute. An arcsecond is approximately the size of a five cent coin viewed from a distance of 1 kilometre.

altitude: the angular distance of a celestial body above or below the horizon, measured along the great circle passing through the body and the zenith. Altitude is 90° minus zenith distance.

anomaly: angular measurement of a body in its orbit from its perihelion.

aphelion: the point in a planetary orbit that is at the greatest distance from the Sun.

apogee: the point at which a body in orbit around the Earth reaches its farthest distance from the Earth. Apogee is sometimes used with reference to the apparent orbit of the Sun around the Earth.

apparent place: the position on a celestial sphere, centred at the Earth, determined by removing from the directly observed position of a celestial body the effects that depend on the topocentric location of the observer; i.e., refraction, diurnal aberration and geocentric (diurnal) parallax. Thus, the position at which the object would actually be seen from the centre of the Earth, displaced by planetary aberration (except the diurnal part and referred to the true equator and equinox.

apparent solar time: the measure of time based on the diurnal motion of the true Sun. The rate of diurnal motion undergoes seasonal variation because of the obliquity of the ecliptic and because of the eccentricity of the Earth's orbit. Additional small variations result from irregularities in the rotation of the Earth on its axis.

array: There are two examples of arrays in common use in astronomy:
(1) A group, or array, of telescopes can be combined to simulate a single large telescope, kilometres or even thousands of kilometres across.
(2) Astronomical instruments have recently been fabricated using new electronic components called detector arrays or charge-coupled devices (CCDs) that consist of thousands of individual detectors constructed on centimetre-sized wafers of silicon, or other materials.

aspect: the apparent position of any of the planets or the Moon relative to the Sun, as seen from Earth.

astrometric ephemeris: an ephemeris of a solar system body in which the tabulated positions are essentially comparable to catalogue mean places of stars at a standard epoch.

astrometry: The branch of astronomy concerned with measuring the positions of celestial objects. Advances in technology may soon permit a 1,000-fold improvement in the measurement of positions, and thus in astronomers' ability to determine distances to stars and galaxies. See parallax.

astronomical co-ordinates: the longitude and latitude of a point on Earth relative to the geoid. These co-ordinates are influenced by local gravity anomalies.

astronomical unit (a.u.): the radius of a circular orbit in which a body of negligible mass, and free of perturbations, would revolve around the Sun in $2\pi/k$ days, where k is the Gaussian gravitational constant. This is slightly less than the semimajor axis of the Earth's orbit. Its value is approximately 1.496×10^8 km.

azimuth: the angular distance measured clockwise along the horizon from a specified reference point (usually north) to the intersection with the great circle drawn from the zenith through a body on the celestial sphere. Similar to compass bearing.

B

baseline: The separation between telescopes in an interferometer. The largest baseline determines the finest detail that can be discerned with an interferometer.

Big Bang: Most astronomers believe that the universe began in a giant explosion called the Big Bang about 14 billion years ago. Starting from an initial state of extremely high density, the universe has been expanding and cooling ever since. Some of the most fundamental observed properties of the universe, including the abundance of light elements such as helium and lithium and the recession of galaxies, can be accounted for by modern theories of the Big Bang.

black hole: A region in space where the density of matter is so extreme, and the resultant pull of gravity so strong, that not even light can escape. Black holes are probably the end point in the evolution of some types of stars and are probably located at the centres of some active galaxies and quasars.

blackbody radiation: A glowing object emits radiation in a quantity and at wavelengths that depend on the temperature of the object. For example, a poker placed in a hot fire first glows red-hot, then yellow-hot, then finally white-hot. This radiation is called thermal or blackbody radiation.

brown dwarf: A star-like object that contains less than about 0.08 the mass of the Sun and is thus too small to ignite nuclear fuels and become a normal star. Brown dwarfs emit small amounts of infrared radiation due to the slow release of gravitational energy and may be a component of dark matter.

C

calendar: a system of reckoning time in which days are enumerated according to their position in cyclic patterns.

Catalogue Equinox: the intersection of the hour circle of zero right ascension of a star catalogue with the celestial equator.

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

Celestial Pole: either of the two points projected onto the celestial sphere by the extension of the Earth's axis of rotation to infinity.

celestial sphere: an imaginary sphere of arbitrary radius upon which celestial bodies may be considered to be located. As circumstances require, the celestial sphere may be centred at the observer, at the Earth's centre, or at any other location.

charge-coupled device, or CCD: An electronic detector used for lowlight-level imaging and astronomical observations. CCDs were developed by NASA for use in the Hubble Space Telescope and the Galileo probe to Jupiter and are now widely used on ground-based telescopes. See also array.

conjunction: the phenomenon in which two bodies have the same apparent celestial longitude or right ascension as viewed from a third body. Conjunctions are usually tabulated as geocentric phenomena. For Mercury and Venus, geocentric inferior conjunction occurs when the planet is between the Earth and Sun, and superior conjunction occurs when the Sun is between the planet and Earth.

constellation: a grouping of stars, usually with pictorial or mythical associations, that serves to identify an area of the celestial sphere. Also, one of the precisely defined areas of the celestial sphere, associated with a grouping of stars, that the International Astronomical Union has designated as a constellation,

co-ordinated Universal Time (UTC): the time scale available from broadcast time signals. UTC differs from TAI (see International Atomic Time) by an integral number of seconds; it is maintained within ±0.90 second of UTI (see Universal Time) by the introduction of one second steps (leap seconds).

cosmic microwave background (CMB) radiation: The radiation left over from the Big Bang explosion at the beginning of the universe. As the universe expanded, the temperature of the fireball cooled to its present level of 2.7 degrees above absolute zero (2.7 K). Blackbody radiation from the cosmic background is observed at radio, millimetre, and submillimetre wavelengths.

cosmic rays: Protons and nuclei of heavy atoms that are accelerated to high energies in the magnetic field of our galaxy and that can be studied directly from Earth or from satellites.

culmination: passage of a celestial object across the observer's meridian; also called meridian passage. More precisely, culmination is the passage through the point of greatest altitude in the diurnal path. Upper culmination (also called "culmination above pole" for circumpolar stars and the Moon) or transit is the crossing closer to the observer's zenith. Lower culmination (also called "culmination below pole" for circumpolar stars and the Moon) is the crossing farther from the zenith.

D

dark energy: An as yet unknown form of energy that pervades the universe. Its presence was inferred from the discovery that the expansion of the universe is accelerating, and these observations suggest that about 70 percent of the total density of matter plus energy is in this form. Such an acceleration is predicted if the cosmological constant that Einstein included in his General Theory of Relativity were non-zero.

dark matter: Approximately 80 percent of the matter in the universe may so far have escaped direct detection. The presence of this unseen matter has been inferred from motions of stars and gas in galaxies, and of galaxies in clusters of galaxies. Candidates for the missing mass include brown dwarf stars and exotic subatomic particles. Dark matter was called "missing mass" for many years. However, because it is the light, not the mass, that is missing, astronomers have given up this terminology.

day: an interval of 86,400 SI seconds (see second, Systeme International), unless otherwise indicated.

Declination: angular distance on the celestial sphere north or south of the celestial equator. It is measured along the hour circle passing through the celestial object. Declination is usually given in combination with right ascension or hour angle. It can be considered the celestial analogue of latitude on Earth.

diffraction limit: The finest detail that can be discerned with a telescope. The physical principle of diffraction limits this level of detail to a value proportional to the wavelength of the light observed divided by the diameter of the telescope.

direct motion: for orbital motion in the solar system, motion that is counter clockwise in the orbit as seen from the north pole of the ecliptic; for an object observed on the celestial sphere, motion that is from west to east, resulting from the relative motion of the object and the Earth.

diurnal motion: the apparent daily motion caused by the Earth's rotation, of celestial bodies across the sky from east to west.

Dynamical Time: the family of time scales introduced in 1984 to replace ephemeris time as the independent argument of dynamical theories and ephemerides.

E

eccentricity: a parameter (usually for orbits) that specifies the extent to which an ellipse departs from circularity. For a circle, eccentricity = 0. Most of the planets and their satellites have low eccentricity. Many comets, and some asteroids and planetary satellites have very eccentric orbits, with eccentricity approaching 1.

eclipse: the obscuration of a celestial body caused by its passage through the shadow cast by another body.

eclipse, annular: a solar eclipse (see eclipse, solar) in which the solar disk is never completely covered but is seen as an annulus or ring at maximum eclipse. An annular eclipse occurs when the apparent disk of the Moon is smaller than that of the Sun.

eclipse, lunar: an eclipse in which the Moon passes through the shadow cast by the Earth. The eclipse may be total (the Moon passing completely through the Earth's umbra), partial (the Moon passing partially through the Earth's umbra at maximum eclipse), or intersectic penumbral (the Moon passing only through the Earth's penumbra).

eclipse, solar: an eclipse in which the Earth passes through the shadow cast by the Moon. It may be total (observer in the Moon's umbra), partial (observer in the Moon's penumbra), or annular.

ecliptic: the mean plane of the Earth's orbit around the Sun. It is also the path of the Sun against the background stars.

elements, orbital: parameters that specify the position and motion of a body in orbit.

electromagnetic spectrum: Radiation can be represented as electric and magnetic fields vibrating with a characteristic wavelength or frequency. Long wavelengths (low frequencies) correspond to radio radiation; intermediate wavelengths, to millimetre and infra-red radiation; short wavelengths (high frequencies), to visible and ultraviolet light; and extremely short wavelengths, to x-rays and gamma rays. Most astronomical observations measure some form of electromagnetic radiation.

elongation, greatest: the instants when the geocentric angular distances of Mercury and Venus from the Sun are at a maximum.

elongation (planetary): the geocentric angle between a planet and the Sun, measured in the plane of the planet, Earth and Sun. Planetary elongations are measured from 0° to 180° east or west of the Sun.

elongation (satellite): the geocentric angle between a satellite and its primary, measured in the plane of the satellite, planet and Earth. Satellite elongations are measured from 0° east or west of the planet.

ephemeris: a tabulation of the positions of a celestial object in an orderly sequence for a number of dates.

Ephemeris Time (ET): the time scale used prior to 1984 as the independent variable in gravitational theories of the solar system. In 1984, ET was replaced by dynamical time.

epoch: an arbitrary fixed instant of time or date used as a chronological reference point for calendars (see calendar), celestial reference systems, star catalogues, or orbital motions.

equation of time: the hour angle of the true Sun minus the hour angle of the fictitious mean sun; alternatively, apparent solar time minus mean solar time.

equator: the great circle on the surface of a body formed by the intersection of the surface with the plane passing through the centre of the body perpendicular to the axis of rotation. (See celestial equator.)

equinox: either of the two points on the celestial sphere at which the ecliptic intersects the celestial equator; also, the time at which the Sun passes through either of these intersection points; i.e., when the apparent longitude of the Sun is 0° or 180°.

era: a system of chronological notation reckoned from a given date.

expansion of the universe: The tendency of every part of the universe to move away from every other part due to the initial impetus of the Big Bang; also known as the Hubble expansion, after the American astronomer Edwin Hubble, whose observations of receding galaxies led to scientists' current understanding of the expanding universe. See redshift.

extragalactic: Objects outside our galaxy, more than about 50,000 light-years away, are referred to as extragalactic.

F

fictitious mean sun: an imaginary body introduced to define mean solar time; essentially the name of a mathematical formula that defined mean solar time. This concept is no longer used in high precision work.

G

galaxy: An isolated grouping of tens to hundreds of billions of stars ranging in size from 5,000 to 150,000 light-years across. Spiral galaxies like our own Milky Way are flattened disks of stars and often contain large amounts of gas out of which new stars can form. Elliptical galaxies are shaped more like footballs and are usually devoid of significant quantities of gas.

gamma-ray astronomy: The study of astronomical objects using the most energetic form of electromagnetic radiation.

gegenschein: faint nebulous light about 20° across near the ecliptic and opposite the Sun, best seen in September and October. Also called counterglow.

General Relativity: Einstein's theory of gravity in which the gravity is the curved geometry of space and time.

geocentric: with reference to, or pertaining to, the centre of the Earth.

geocentric co-ordinates: the latitude and longitude of a point on the Earth's surface relative to the centre of the Earth; also, celestial co-ordinates given with respect to the centre of the Earth.

geoid: an equipotential surface that coincides with mean sea level in the open ocean. On land it is the level surface that would be assumed by water in an imaginary network of frictionless channels connected to the ocean.

geometric position: the geocentric position of an object on the celestial sphere referred to the true equator and equinox, but without the displacement due to planetary aberration.

gravitational lens: A consequence of Einstein's General Relativity Theory is that the path of light rays can be bent by the presence of matter. Astronomers have observed that the light from a distant galaxy or quasar can be 'lensed' by the matter in an intervening galaxy to form multiple and often distorted images of the background object.

Gregorian calendar: the calendar introduced by Pope Gregory XIII in 1582 to replace the Julian calendar; the calendar now used as the civil calendar in most countries. Every year when the end year is exactly divisible by four is a leap year, except for centurial years, which must be exactly divisible by 400 to be leap years. Thus, 2000 is a leap year, but 1900 and 2100 are not leap years.

H

halo (of a galaxy): The roughly spherical distribution of dark matter and thinly scattered stars, star clusters, and gas that surround a spiral galaxy.

height: elevation above ground or distance upwards from a given level (especially sea level) to a fixed point. (See altitude.)

heliocentric: with reference to, or pertaining to, the centre of the Sun.

helioseismology: The study of the internal vibrations of the Sun. In a manner analogous to terrestrial seismology, helioseismology can reveal important information about the Sun's internal condition.

horizon: a plane perpendicular to the line from an observer to the zenith. The great circle formed by the intersection of the celestial sphere with a plane perpendicular to the line from an observer to the zenith is called the astronomical horizon.

horizontal parallax: the difference between the topocentric and geocentric positions of an object, when the object is on the astronomical horizon.

hour angle: angular distance on the celestial sphere measured westward along the celestial equator from the meridian to the hour circle that passes through a celestial object.

hour circle: a great circle on the celestial sphere that passes through the celestial poles and is therefore perpendicular to the celestial equator.

Hubble Space Telescope (HST): A 2.4-m-diameter space telescope designed to study visible, ultraviolet, and infrared radiation; the first of NASA's Great Observatories.

Hydrogen: The most abundant element in the universe. It can be observed at a variety of wavelengths, including 21-cm radio, infrared, visible, and ultraviolet wavelengths, and in a variety of forms, including atoms (HI) and molecular (H_2) and ionised (HII) forms.

I

inclination: the angle between two planes or their poles; usually the angle between an orbital plane and a reference plane; one of the standard orbital elements that specifies the orientation of an orbit.

infra-red astronomy: The study of astronomical objects using intermediate-wavelength radiation to which the atmosphere is mostly opaque and the human eye insensitive. Humans sense infra-red energy as heat. The infra-red part of the electromagnetic spectrum generally corresponds to radiation with wavelengths from 1 mm to 1,000 mm. Objects with temperatures around room temperature, or lower, emit most of their radiation in the infrared.

interferometer, interferometry: A spatial interferometer combines beams of light from different telescopes to synthesise the aperture of a single large telescope; see array. Spatial interferometry is the main technique used by astronomers to map sources at high resolution and to measure their positions with high precision. A different form of interferometer can be used on a single telescope to break up the light into its constituent colours; see spectroscopy.

International Atomic Time (TAI): the continuous scale resulting from analyses by the Bureau International des Poids et Mesures of atomic time standards in many countries. The fundamental unit of TAI is the SI second, and the epoch is 1958 January 1.

invariable plane: the plane through the centre of mass of the solar system perpendicular to the angular momentum vector of the solar system.

irradiation: an optical effect of contrast that makes bright objects viewed against a dark background appear to be larger than they really are.

J

Julian calendar: the calendar introduced by Julius Caesar in 46 B.C. to replace the Roman calendar. In the Julian calendar a common year is defined to comprise 365 days, and every fourth year is a leap year comprising 366 days. The Julian calendar was superseded by the Gregorian calendar.

Julian date (JD): the interval of time in days and fraction of a day since 4713 B.C. January 1800 and 1, Greenwich noon, Julian proleptic calendar. In precise work the timescale, e.g., dynamical time or Universal Time, should be specified. This system facilitates easy calculation of the time interval between two events.

Julian date, modified (MJD): the Julian date minus 2400000.5.

Julian day number: the integral part of the Julian date.

L

latitude, celestial: angular distance on the celestial sphere measured north or south of the ecliptic along the great circle passing through the poles of the ecliptic and the celestial object.

latitude, terrestrial: angular distance on the Earth measured north or south of the equator along the meridian of a geographic location.

leap second: a second added between 60 seconds and 0 seconds at the announced times to keep UTC within 0s.90 of UT1 Generally, leap seconds are added at the end of June or December.

librations: variations in the orientation of the Moon's surface with respect to an observer on the Earth. Physical librations are due to variations in the orientation of the Moon's rotational axis in inertial space. The much larger optical librations are due to variations in the rate of the Moon's orbital motion, the obliquity of the Moon's equator to its orbital plane, and the diurnal changes of geometric perspective of an observer on the Earth's surface.

light-time: the interval of time required for light to travel from a celestial body to the Earth. During this interval the motion of the body in space causes an angular displacement of its apparent place from its geometric place.

light pollution: The emission of stray light or glare from lighting fixtures in manners that counter the purpose of the light (which is to light what is below); also known as the waste of money and energy in the form of electric light, usually meant in the form of outdoor night lighting. Such light trespass can cause severe safety problems for motorists, pedestrians, and cyclists at night from lighting that shines onto streets and highways and footpaths from poorly-designed or poorly-mounted lighting. Such glare also imposes on privacy, by shining brightly into private residences at night and into backyards where adults and children are trying to observe the night sky. It also restricts our view of the night sky – a part of our world's natural and cultural heritage. While most people have accepted bad lighting and glare without question and assumed that nothing could be done about it, dedicated groups of volunteers around the world are now showing that effective laws and guidelines can be instated at the local and regional levels of government (and in planning and engineering offices). This can mean that proper outdoor night lighting can be a norm so that everybody benefits - car drivers, sleeping residents, government budgets, and skygazers alike. Laws limiting light pollution are already in existence in the Czech Republic and certain regions of the USA.

light-year: A unit of astronomical distance equal to the distance light travels in a year: about 10,000,000,000,000 km. The nearest star is 4 light-years away. The center of our galaxy is about 25,000 light-years away. The closest galaxy is about 180,000 light-years away.

limb: the apparent edge of the Sun, Moon, or a planet or any other celestial body with a detectable disk.

local sidereal time: the local hour angle of a catalogue equinox.

longitude, celestial: angular distance on the celestial sphere measured eastward along the ecliptic from the dynamical equinox to the great circle passing through the poles of the ecliptic and the celestial object.

longitude, terrestrial: angular distance measured along the Earth's equator from the Greenwich meridian to the meridian of a geographic location.

luminosity class: distinctions among stars of the same spectral class. (See spectral types or classes).

lunar phases: cyclically recurring apparent forms of the Moon. New moon, first quarter, full moon and last quarter are defined as the times at which the excess of the apparent celestial longitude of the Moon over that of the Sun is 0°, 90°, 180° and 270° respectively.

lunation: the period of time between two consecutive new moons.

M

Magellanic Clouds, Large and Small: The two closest galaxies to our own Milky Way, located about 180,000 light-years away and visible only from the Southern Hemisphere. A bright supernova, SN1987A, was observed in the Large Magellanic Cloud in 1987.

magnetohydrodynamics: The study of the motion of gases in the presence of magnetic fields.

magnitude, stellar: a measure on a logarithmic scale of the brightness of a celestial object considered as a point source. Fainter stars have numerically larger magnitudes. The brightest stars, excluding the Sun, are about magnitude 0; the faintest star visible to the unaided eye is about magnitude 6. A star of magnitude 15 is one-millionth as bright as the half dozen brightest stars of magnitude 0. Stars as faint as magnitude 28 can be seen with powerful terrestrial or spacebourne telescopes.

magnitude of a lunar eclipse: the fraction of the lunar diameter obscured by the shadow of the Earth at the greatest phase of a lunar eclipse, measured along the common diameter.

magnitude of a solar eclipse: the fraction of the solar diameter obscured by the Moon at the greatest phase of a solar eclipse, measured along the common diameter.

massive compact halo object (MACHO): An object of roughly stellar mass in the halo of our galaxy that is too faint to be detected by its own emission. MACHOs are indirectly detected via gravitational microlensing of more distant stars.

mean anomaly: in undisturbed elliptic motion, the product of the mean motion of an orbiting body and the interval of time since the body passed pericentre. Thus, the mean anomaly is the angle from pericentre of a hypothetical body moving with a constant angular speed that is equal to the mean motion.

mean distance: the semimajor axis of an elliptic orbit.

mean equator and equinox: the celestial reference system determined by ignoring small variations of short period in the motions of the celestial equator. Thus, the mean equator and equinox are affected only by precession. Positions in star catalogues are normally referred to the mean catalogue equator and equinox of a standard epoch.

mean motion: in undisturbed elliptic motion, the constant angular speed required for a body to complete one revolution in an orbit of a specified semimajor axis.

mean place: the geocentric position, referred to the mean equator and equinox of a standard epoch, of an object on the celestial sphere centred at the Sun. A mean place is determined by removing from the directly observed position the effects of refraction, parallax geocentric and stellar parallax, and stellar aberration, and by referring the co-ordinates to the mean equator and equinox of a standard epoch.

mean solar time: a measure of time based conceptually on the diurnal motion of the fictitious mean sun, under the assumption that the Earth's rate of rotation is constant.

meridian: a great circle passing through the celestial poles and through the zenith of any location on Earth. For planetary observations a meridian is half the great circle passing through the planet's poles and through any location on the planet.

microlensing: Gravitational lensing due to a stellar mass object. This lensing phenomenon is called microlensing because the mass of the lens is so small compared with that of a galaxy. Microlensing of distant stars by intervening faint stars can reveal planets in orbit around the lensing star.

Milky Way: Our Sun is located in the Milky Way Galaxy, a spiral galaxy consisting of some 100,000,000,000 stars spread in a disk more than 80,000 light-years across and hundreds of light-years thick. The central disk of the Milky Way is the wide path of faint light that stretches across the night sky.

month: the period of one complete synodic or sidereal revolution of the Moon around the Earth; also, a calendrical unit that approximates the period of revolution.

moonrise, moonset: the times at which the apparent upper limb of the Moon is on the astronomical horizon; i.e., when the true zenith distance, referred to the centre of the Earth, of the central point of the disk is $90° 34' + s - \pi$, where s is the Moon's semi-diameter, π is the horizontal parallax, and 34' is the adopted value of horizontal refraction.

N

nadir: the point on the celestial sphere diametrically opposite to the zenith.

neutrino: One of a family of subatomic particles with little or no mass. These particles are generated in nuclear reactions on Earth, in the centers of stars, and during supernova explosions and can give unique information about these energetic processes. Because neutrinos interact only weakly with matter, they are difficult to detect.

node: either of the points on the celestial sphere at which the plane of an orbit intersects a reference plane. The position of a node is one of the standard orbital elements used to specify the orientation of an orbit.

nucleosynthesis: The process by which heavy elements such as helium, carbon, nitrogen, and iron are formed out of the fusion of lighter elements, such as hydrogen, during the normal evolution of stars, during supernova explosions, and in the Big Bang.

nutation: the short-period oscillations in the motion of the pole of rotation of a freely rotating body that is undergoing torque from external gravitational forces. Nutation of the Earth's pole is discussed in terms of components in obliquity and longitude.

O

obliquity: in general, the angle between the equatorial and orbital planes of a body or, equivalently, between the rotational and orbital poles. For the Earth the obliquity of the ecliptic is the angle between the planes of the equator and the ecliptic.

occultation: the obscuration of one celestial body by another of greater apparent diameter; especially the passage of the Moon in front of a star or planet, or the disappearance of a satellite behind the disk of its primary. If the primary source of illumination of a reflecting body is cut off by the occultation, the phenomenon is also called an eclipse. The occultation of the Sun by the Moon is a solar eclipse.

opposition: a configuration of the Sun, Earth and a planet in which the apparent geocentric longitude of the planet differs by 180° from the apparent geocentric longitude of the Sun.

optical astronomy: The study of astronomical objects using light waves with wavelengths from about 1 to 0.3 mm. The human eye is sensitive to most of these wavelengths. See electromagnetic spectrum.

orbit: the path in space followed by a celestial body.

P

parallax: the difference in apparent direction of an object as seen from two different locations; conversely, the angle at the object that is subtended by the line joining two designated points. Geocentric (diurnal) parallax is the difference in direction between a topocentric observation and a hypothetical geocentric observation. Heliocentric or annual parallax is the difference between hypothetical geocentric and heliocentric observations; it is the angle subtended at the observed object by the semimajor axis of the Earth's orbit.

parsec: the distance at which one astronomical unit subtends an angle of one second of arc; equivalently, the distance to an object having an annual parallax of one second of arc. Its value is 3.086×10^{13} km, or 3.27 light years.

penumbra: the portion of a shadow in which light from an extended source is partially but not completely cut off by an intervening body; the area of partial shadow surrounding the umbra.

pericentre: the point in an orbit that is nearest to the centre of force.

perigee: the point at which a body in orbit around the Earth most closely approaches the Earth. Perigee is sometimes used with reference to the apparent orbit of the Sun around the Earth.

perihelion: the point at which a body in orbit around the Sun most closely approaches the Sun.

period: the interval of time required to complete one revolution in an orbit or one cycle of a periodic phenomenon, such as a cycle of phases.

phase: the ratio of the illuminated area of the apparent disk of a celestial body to the area of the entire apparent disk taken as a circle. For the Moon, phase designations (see lunar phases) are defined by specific configurations of the Sun, Earth and Moon. For eclipses, phase designations (total, partial, penumbral, etc.) provide general descriptions of the phenomena. More generally, for use with oddly shaped bodies, phase might be defined as 0.5(1 + cos (phase angle)).

phase angle: the angle measured at the centre of an illuminated body between the light source and the observer.

photometry: a measurement of the intensity of light usually specified for a specific frequency range.

planetocentric co-ordinates: co-ordinates for general use, where the z-axis is the mean axis of rotation, the x-axis is the intersection of the planetary equator (normal to the z-axis through the centre of mass) and an arbitrary prime meridian, and the y-axis completes a right-hand co-ordinate system. Longitude of a point is measured positive to the prime meridian as defined by rotational elements. Latitude of a point is the angle between the planetary equator and a line to the centre of mass. The radius is measured from the centre of mass to the surface point.

planetographic co-ordinates: co-ordinates for cartographic purposes dependent on an equipotential surface as a reference surface. Longitude of a point is measured in the direction opposite to the rotation (positive to the west for direct rotation) from the cartographic position of the prime meridian defined by a clearly observable surface feature. Latitude of a point is the angle between the planetary equator (normal to the z-axis and through the centre of mass) and normal to the reference surface at the point. The height of a point is specified as the distance above a point with the same longitude and latitude on the reference surface.

polar motion: the irregularly varying motion of the Earth's pole of rotation with respect to the Earth's crust.

precession: the uniformly progressing motion of the pole of rotation of a freely rotating body undergoing torque from external gravitational forces. In the case of the Earth, the component of precession caused by the Sun and Moon acting on the Earth's equatorial bulge is called lunisolar precession; the component caused by the action of the planets is called planetary precession. The sum of lunisolar and planetary precession is called general precession.

proper motion: the projection onto the celestial sphere of the space motion of a star relative to the solar system; thus, the transverse component of the space motion of a star with respect to the solar system. Proper motion is usually tabulated in star catalogues as changes in right ascension and declination per year or century.

protogalaxy: Galaxies are thought to have formed fairly early in the history of the universe, by the collapse of giant clouds of gas. During this process, a first generation of stars formed.

protoplanetary or protostellar disk: A disk of gas and dust surrounding a young star or protostar out of which planets may form.

protostar: The earliest phase in the evolution of a star, in which most of its energy comes from the infall of material, or accretion, onto the growing star. A protostellar disk probably forms around the star at this time.

Q

quadrature: a configuration in which two celestial bodies have apparent longitudes that differ by 90° as viewed from a third body. Quadratures are usually tabulated with respect to the Sun as viewed from the centre of the Earth.

quasar: An extremely compact, luminous source of energy found in the cores of certain galaxies. A quasar may outshine its parent galaxy by a factor of 1,000 yet be no larger than our own solar system. The accretion of gas onto a supermassive black hole probably powers the quasar. Active galaxies are probably less luminous and less distant versions of quasars.

R

radial velocity: the rate of change of the distance to an object.

radio astronomy: The study of astronomical objects using radio waves with wavelengths generally longer than 0.5 to 1 mm. See electromagnetic spectrum.

redshift: Radiation from an approaching object is shifted to higher frequencies (to the blue), while radiation from a receding object is shifted to lower frequencies (to the red). A similar effect raises the pitch of an ambulance siren as it approaches. The expansion of the universe makes objects recede so that the light from distant galaxies is redshifted. The redshift is parameterised by z, where the wavelength shift is given by the factor (1 + z) times the wavelength.

refraction, astronomical: the change in direction of travel (bending) of a light ray as it passes obliquely through the atmosphere. As a result of refraction the observed altitude of a celestial object is greater than its geometric altitude. The amount of refraction depends on the altitude of the object and on atmospheric conditions.

resolution: Spatial resolution describes the ability of an instrument to separate features at small details; see diffraction limit and interferometer.

retrograde motion: for orbital motion in the solar system, motion that is clockwise in the orbit as seen from the north pole of the ecliptic; for an object observed on the celestial sphere, motion that is from east to west, resulting from the relative motion of the object and the Earth.

Right Ascension: angular distance on the celestial sphere measured eastward along the celestial equator from the equinox to the hour circle passing through the celestial object. Right ascension is usually given in combination with declination. It can be considered the celestial analogue of longitude on Earth.

S

second, Systeme International (SI): the duration of 9,192,631,770 cycles of radiation corresponding to the transition between two hyperfine levels of the ground state of caesium 133.

selenocentric: with reference to, or pertaining to, the centre of the Moon.

semidiameter: the angle at the observer subtended by the equatorial radius of the Sun, Moon or a planet.

semi-major axis: half the length of the major axis of an ellipse; a standard element used to describe an elliptical orbit.

sidereal day: the time interval between two consecutive transits of the catalogue equinox (Right Ascension 0h for a specific catalogue). A slightly inaccurate definition is the time interval between two consecutive transits of a given star.

sidereal hour angle: angular distance on the celestial sphere measured westward along the celestial equator from the catalogue equinox to the hour circle passing through the celestial object. It is equal to 360° minus right ascension in degrees.

sidereal time: the measure of time defined by the apparent diurnal motion of the catalogue equinox; hence, a measure of the rotation of the Earth with respect to the stars rather than the Sun.

solstice: either of the two points on the ecliptic at which the apparent longitude of the Sun is 90° or 270°; also, the time at which the Sun is at either point.

spectral resolution: describes the ability of an instrument to discern small shifts in wavelength; see spectroscopy.

spectroscopy: A technique whereby the light from astronomical objects is broken up into its constituent colours. Radiation from the different chemical elements that make up an object can be distinguished, giving information about the abundances of these elements and their physical state.

spectral types or classes: catagorisation of stars according to their spectra, primarily due to differing temperatures of the stellar atmosphere. From hottest to coolest, the spectral types are O, B, A, F, G, K and M.

standard epoch: a date and time that specifies the reference system to which celestial co-ordinates are referred. Prior to 1984 co-ordinates of star catalogues were commonly referred to the mean equator and equinox of the beginning of a Besselian year. Beginning with 1984 the Julian year has been used, as denoted by the prefix J, e.g., J2000.0.

starburst galaxy: Certain galaxies, particularly those perturbed by a close encounter or collision with another galaxy, often form stars at a rate hundreds of times greater than that evident in our galaxy. Such galaxies are bright sources of infrared radiation.

stationary point (of a planet): the position at which the rate of change of the apparent right ascension of a planet is momentarily zero.

submillimetre radiation: Electromagnetic radiation with wavelengths between about 0.1 and 1 mm intermediate between radio and infrared radiation.

sunrise, sunset: the times at which the apparent upper limb of the Sun is on the astronomical horizon; i.e., when the true zenith distance, referred to the centre of the Earth, of the central point of the disk is 90° 50′, based on adopted values of 34′ for horizontal refraction and 16′ for the Sun's semidiameter.

Sunyaev-Zeldovich effect: An astrophysical effect whereby the distribution of wavelengths of radiation seen through the gas in a distant cluster of galaxies is subtly modified. Measurement of this effect can be used to determine the distance to the cluster.

supermassive black hole: A black hole that is much more massive than the Sun. Supermassive black holes with masses exceeding a million solar masses are found in the nuclei of most galaxies.

supernova: A star that, due to accretion of matter from a companion star or exhaustion of its own fuel supply, can no longer support itself against its own weight and thus collapses, throwing off its outer layers in a burst of energy that outshines an entire galaxy. In 1987 a star in the Large Magellanic Cloud was observed as a dramatic supernova called Supernova 1987A.

surface brightness (of a planet): the visual magnitude of an average square arc-second area of the illuminated portion of the apparent disk.

synodic period: for planets, the mean interval of time between successive conjunctions of a pair of planets, as observed from the Sun; for satellites, the mean interval between successive conjunctions of a satellite with the Sun, as observed from the satellite's primary.

T

Terrestrial Time (TT): the independent argument for apparent geocentric ephemerides, known in this publication 1984 - 2000 as Terrestrial Dynamical Time (TDT). At 1977 January 1d00h00m00s TAI, the value of TT was exactly 1977 January 1d0003725. The unit of TT is 86 400 SI seconds at mean sea level. For practical purposes TT = TAI + 32s184.

terminator: the boundary between the illuminated and dark areas of the apparent disk of the Moon, a planet or a planetary satellite

topocentric: with reference to, or pertaining to, a point on the surface of the Earth.

transit: the passage of the apparent centre of the disk of a celestial object across a meridian; also, the passage of one celestial body in front of another of greater apparent diameter (e.g., the passage of Mercury or Venus across the Sun or Jupiter's satellites across its disk); however, the passage of the Moon in front of the larger apparent Sun is called an annular eclipse. The passage of a body's shadow across another body is called a shadow transit; however, the passage of the Moon's shadow across the Earth is called a solar eclipse.

true anomaly: the angle, measured at the focus nearest the pericentre of an elliptical orbit, between the pericentre and the radius vector from the focus to the orbiting body; one of the standard orbital elements.

true equator and equinox: the celestial co-ordinate system determined by the instantaneous positions of the celestial equator and ecliptic. The motion of this system is due to the progressive effect of precession and the short-term, periodic variations of nutation.

twilight: the interval of time preceding sunrise and following sunset (see sunrise, sunset) during which the sky is partially illuminated. Civil twilight comprises the interval when the zenith distance, referred to the centre of the Earth, of the central point of the Sun's disk is between 90° 50′ and 96°, nautical twilight comprises the interval from 96° to 102°, and astronomical twilight comprises the interval from 102° to 108°.

U

ultraviolet astronomy: The study of astronomical objects using short-wavelength radiation, from 0.3 mm to 0.01 mm (10 nm), to which the atmosphere is opaque and the human eye insensitive. See electromagnetic spectrum.

umbra: the portion of a shadow cone in which none of the light from an extended light source (ignoring refraction) can be observed.

Universal Time (UT): a measure of time that conforms, within a close approximation, to the mean diurnal motion of the Sun and serves as the basis of all civil timekeeping. UT is formally defined by a mathematical formula as a function of sidereal time. Thus, UT is determined from observations of the diurnal motions of the stars. The time scale is determined directly from such observations is designated U0; it is slightly dependent on the place of observation. When UTO is corrected for the shift in longitude of the observing station caused by polar motion, the time scale UT1 is obtained. Whenever the designation UT is used in this volume, UT1 is implied.

V

vernal equinox: the ascending node of the ecliptic on the celestial sphere; also, the time at which the apparent longitude of the Sun is 0°.

vertical: the apparent direction of gravity at the point of observation (normal to the plane of a free level surface).

W

week: an arbitrary period of days, usually seven days; approximately equal to the number of days counted between the four phases of the Moon.

X

x-ray astronomy: The study of astronomical objects using x-rays with wavelengths shorter than about 10 nm, to which the atmosphere is opaque. X-rays are emitted by extremely energetic objects that have temperatures of millions of degrees. See electromagnetic spectrum.

Y

year: a period of time based on the orbit of the Earth around the Sun. The calendar year (see Gregorian calendar) is an approximation to the tropical year. The anomalistic year is the mean interval between successive passages of the Earth through perihelion. The sidereal year is the mean period of revolution with respect to the background stars.

year, tropical: the period of one complete revolution of the mean longitude of the Sun with respect to the dynamical equinox.

Z

zenith: in general, the point directly overhead on the celestial sphere. The astronomical zenith is the extension to infinity of a plumb line. The geocentric zenith is defined by the line from the centre of the Earth through the observer. The geodetic zenith is the normal to the geodetic ellipsoid at the observer's location.

zenith distance: angular distance on the celestial sphere measured along the great circle from the zenith to the celestial object. Zenith distance is 90° minus altitude.

zodiacal light: a nebulous light seen in the cast before twilight and in the west after twilight. It is triangular in shape along the ecliptic with the base on the horizon and its apex at varying altitudes. It is best seen in middle latitudes on spring evenings and autumn mornings.

What was that?

Attention seekers in the night sky

One of the ways Perth Observatory serves the public of Western Australia is by answering enquiries. A lot of these involve interpreting people's naked-eye observations of something in the sky. Hopefully, reading this section will stimulate an awareness of what is visible in the night sky as well facilitating an increase in observing skills so that anyone can make scientifically meaningful observations. More details concerning some of the objects discussed here, and their visibility, can be found elsewhere in this Almanac.

Most careful and detailed observations of apparently unusual objects are explicable by known phenomena. When given thorough (but time consuming) examination, less than 2% of allegedly unusual observations remain "unidentified". Just because they are unidentified does not mean they are evidence of extraterrestrials, or their technology! The late Professor Carl Sagan once said "extraordinary claims require extraordinary evidence".

The following objects are the subject of most enquiries.

Venus

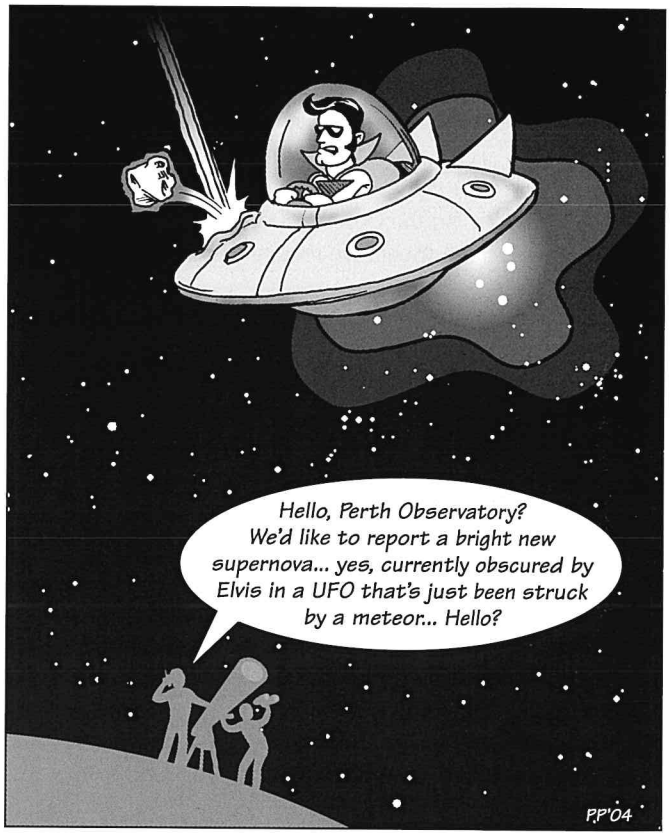
Venus is the brightest star-like object in the sky. It can appear as an 'evening star' as well as a 'morning star' – it just depends on its and Earth's positions in their respective orbits around the Sun. Venus orbits closer to the Sun than Earth, so it is only visible up to about three hours after sunset or before sunrise – it can never be visible around midnight (except in polar regions). Consult the monthly sections for information on the visibility of this planet (and other planets).

Shooting stars or meteors

Shooting stars are the glow of energy released as small particles about the size of a grain of sand "crash" into Earth's upper atmosphere. Very bright meteors are called fireballs or bolides. Sometimes they are so bright they can even be observed in the daytime, and sometimes a sonic boom can be heard as they break the sound barrier when they plough through the atmosphere. At certain times of the year the Earth passes through a cloud of comet debris and the number of meteors substantially increases (see meteor showers in the *Solar System Information* Section). Some meteors are the debris from collisions between asteroids.

Satellites

Satellites are generally visible for a few hours after sunset and a few hours before sunrise as they reflect sunlight off their highly reflective outer surfaces. Around midnight low-Earth orbiting satellites (the majority) are not visible because they are in Earth's shadow. Most satellites are launched in a roughly West to East orbit as this has the lowest fuel requirements. This is also the trajectory of most of the space junk that glows on re-entry into the atmosphere. Space junk re-entries have orbits essentially parallel with the ground so they last for a longer duration and can be viewed along a long path across the Earth. Weather and reconnaissance satellites can orbit North to South (or vice versa) in order to get a longer duration view of the Earth. Iridium communication satellites have one highly reflecting surface and when the geometry is favourable we can observe a slow flash of light that builds up to a maximum in about 5 seconds, and then fades over a similar time. About one of these flashes is visible from any location on the Earth every night, and about once per month a flash about ten times brighter than Venus provides a spectacular sight. Information about the visibility of satellites can be found in the Astronomy on the Internet sub-section.



Clouds

Clouds can partially obscure the Moon, planets and aircraft thus giving the impression of changing lights or a halo effect. Beams of light moving through the sky, or circles of light on the under side of clouds result from searchlights operated on the ground (usually to promote some entertainment activity). High-altitude aircraft can also leave a trail of water vapour called a contrail.

Refraction (the bending of light) through ice crystals or water droplets high in the atmosphere can create halos and coronae (coloured clouds) near the Sun or Moon.

Pranks

Some people make artificial "UFOs". One of the Observatory staff has actually recovered one after tracking it. Such "UFOs" may have the appearance of either a solitary light, or a string of lights moving in unison across the night sky. This prank can be very dangerous because of the fire and aviation hazards involved.

Recording your observations

A **Sighting Report Form** is provided on the following page, and an explanation of its contents is given in order to assist the recording of scientifically useful observations.

The first thing of note about the Sighting Report Form is its rather non-specific nature. That is, with only minor modification it could be adapted for other uses such as bird watching, rock hunting etc. You are encouraged to modify it for your specific use.

An important point to remember is: record your own observations as soon as possible after the event. Try not to be influenced by those who may have accompanied you. Instead, get them to complete their own Sighting Report Forms. We don't all observe things in the same way, so multiple individual reports of a sighting will provide a more accurate description of the event. Also, try to be objective about your observations. This can be difficult because a spectacular or sudden event can evoke a variety of emotions.

The section concerning the Observer Details is rather obvious, but we do need these should we require to contact you.

The Sighting Details section has many parts, but please try to be brief as well accurate with your report.

The date and time are important details. Don't forget to look at your watch or a clock as soon as possible after the sighting (this is probably inappropriate during the sighting). Local time (appropriate to your time zone) should be recorded to the nearest minute. Try to be fairly precise with your location. It is acceptable to record this in relative terms such as "100 metres west of Fremantle Railway Station", "in my backyard", etc. Observatory staff can always determine the location more accurately later if need be. Also, note the sky conditions as best you can. Conditions other than clear, dark skies can really limit the quality of the observation or distort an otherwise commonplace event such as the motion of an aeroplane. Next, record your method of observation.

Some sightings are over in an instant, but try to determine the duration. It's probably inopportune to look at your watch during a sighting, but you could try to count the seconds using some mental (or voiced) counting method like – "One (thousand and), two (thousand and), three (thousand and) ..." Beware, most people are notoriously unreliable at guessing time intervals after a particularly startling event. Some phenomena have sound associated with them so report anything that you hear.

The trajectory, or path across the sky, or the location of a stationary event, is important data. The altitude above the horizon and the compass bearing where you first detected the object are the first things to note. The horizon has an altitude of 0 degrees (assuming any surrounding hills and valleys are of insignificant size), while straight overhead (the zenith) is at altitude 90 degrees. One way to estimate altitude is by spreading out your hand and holding it out at arm's length. The span between the tips of your thumb and little finger is approximately 20 degrees. Compass bearings start at 0 degrees for due North, and progress to 90 degrees for due East, 180 degrees for due South, 270 degrees for due East, and 360 degrees (reset back to 0 degrees) for the full circle around to due North.

A compass will give you an accurate bearing and the difference between true North and Magnetic North is generally negligible in this context. If you can't determine the altitude and bearing at the time, then work them out at a later time providing you remember these quantities with respect to the scene around you, eg "above the South-side neighbour's highest tree when I was standing on my front door step". Apply the same principles for the altitude and bearing when the object was last seen. Record if it disappeared below the horizon. Note the requirement for direction to be expressed in angular format. Actual distance measurements are extremely unreliable for objects in the sky because there are few, if any, distance markers on which to base your estimate. Sketch the trajectory if you can, and try to indicate altitude and compass bearing.

Try to estimate the angular size of the object. For comparison the Moon is 1/2 degree in diameter and a finger width at arm's length from your eye is about 1 to 2 degrees wide. Also note any colour (and whether you are colour blind!). Record the structure of the object: was it a star-like point, did it fragment, etc?

Your observation will have greater credibility if it is confirmed by another independent observer (who should complete a separate Sighting Report Form) or by use of another observing method such as photography.

Finally, record anything you think is relevant concerning the sighting or your particular observation.

Please feel free to copy the Sighting Report Form as many times as you need. Take them with you on your holidays, give them to your friends who live on (say) a remote cattle station or to your police officer sister-in-law etc. It is unlikely you will discover a new phenomenon unknown to science, but not impossible! One type of object you may sight quite often is a bright meteor. Your observation may assist in recovering any piece that reaches the ground. This extraterrestrial material is scientifically valuable as it gives clues on such matters as the formation of Solar System.

If you complete a Sighting Report Form please read the first part of this article. You will probably be able to identify what you observed. Then, if appropriate, please mail (or fax) your report to the address on the Sighting Report Form. If you think your sighting is of immediate interest please ring the number on the Sighting Report Form and relay the information you have just recorded. (Observatory staff will attempt to answer the telephone at night but sometimes they are too busy with observing duties).

In summary, the use of the Sighting Report Form should not only assist you as an observer but should also aid Observatory staff in interpreting your sighting. Finally, it's important to just enjoy viewing the night sky – its beauty has entranced humankind for untold millennia.

You can obtain a PDF of the Sighting Report from Perth Observatory's website at **www.wa.gov.au/perthobs**

Perth Observatory Sighting Report Form

PERTH OBSERVATORY

OBSERVER DETAILS

Name: _____

Address: _____

Telephone: _____ Fax: _____ Email: _____

SIGHTING DETAILS

Date: _____ Time: _____

Location: _____

Sky Conditions (eg. clear, 1/2 moon, 1/3 cloud, raining etc): _____

Method of Observation (eg. naked eye, binoculars etc): _____

Duration: _____

Sound: _____

	Altitude angle	Compass Bearing
Direction when first seen:		
Direction when last seen:		

Trajectory sketch:

Apparent Angular Size (eg. Full Moon is 1/2 degree):

Colour:

Structure (eg. point-like, streak, fragments):

Confirmation (other observer, video, etc):

Other Comments:

Send to: **Sighting Report, Perth Observatory, 337 Walnut Rd, Bickley 6076, WA**
Telephone: (08) 9293 8255 Fax: (08) 9293 8138

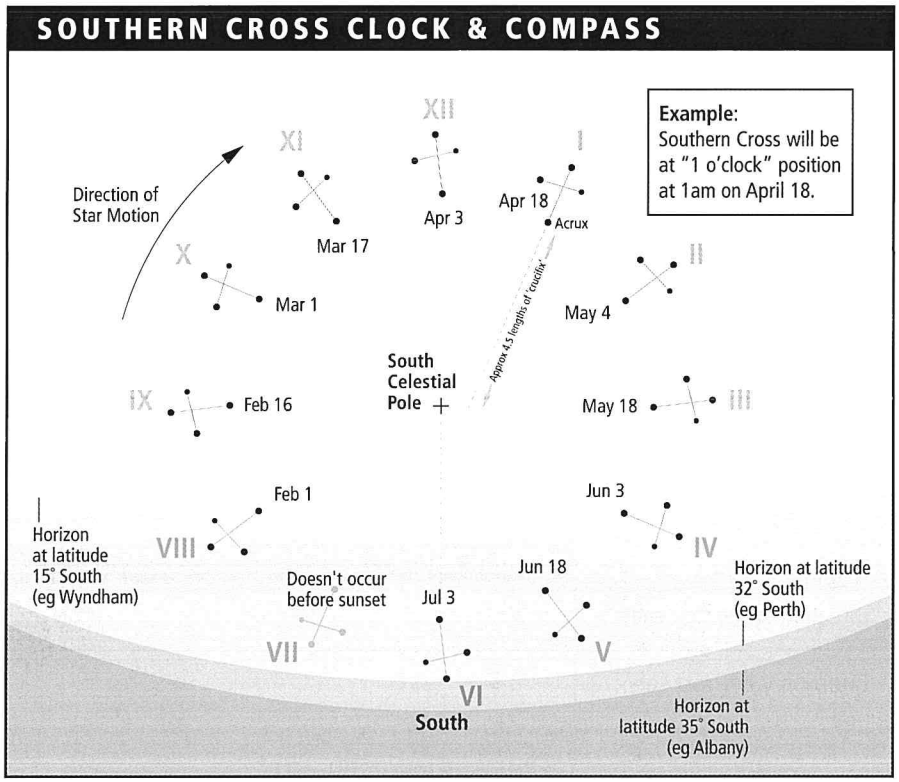
What's the time? – How to estimate the time using the Southern Cross

The Southern Cross (Crux) is one of the most prominent constellations in the sky. Its formal boundaries give it the least area on the sky, but because it contains four first magnitude stars it is the brightest (per unit area). It is also one of the most easily identified constellations – just join the dots and the pattern resembles a crucifix – just as its name suggests. However, it is sometimes frustrating to locate - especially on summer evenings. This is a pleasant time to view the stars but Crux is low on the horizon (except for locations further south than about 40° latitude) and easily obscured by foreground objects, or it may actually have set and be located below the horizon.

Earth rotates once per day, and at night this manifests itself in the general East to West motion of the stars. Toward the South Celestial Pole (the projection of the Earth's rotation axis on the sky, see Southern Cross diagram) the stars appear to move in circles around this point.

For most locations in Australia the stars of the Southern Cross are sufficiently close to the South Celestial Pole that they move in an obvious circular arc through the night. This motion is somewhat reminiscent of the motion of the hour hand of a clock, and the Southern Cross diagram assists in the estimation of local time based on the orientation of the Southern Cross.

The Southern Cross diagram indicates the orientation of the constellation at hourly interval around a clock face. The date for which the local time is the same as that indicated by the orientation of the Southern Cross is located next to the hour labels. Note: the dates are approximate and have an uncertainty of about one day.



For a given 'Southern Cross hour configuration' the local time will be one hour earlier every 15.5 days after the date given with the hour on the diagram. For example, the Southern Cross will have the XII hour configuration on May 04 (31 days after that on the diagram) when the local time is 10pm (two hours earlier).

A convenient time for many people to observe the stars is around 8pm. The following table gives the date of each 'Southern Cross hour configuration' at that time.

HOUR	DATE	HOUR	DATE	HOUR	DATE
I	Jul 02	V	Nov 01	IX	Mar 03
II	Aug 02	VI	Dec 02	X	Apr 02
III	Sep 01	VII	Jan 01	XI	May 01
IV	Oct 02	VIII	Feb 01	XII	Jun 02

Using the information in the diagram or table, and knowing the date, you can calculate the local time from the orientation of the Southern Cross.

Note: The dates listed here are relevant for observers located at the longitude of Perth. Observers at other locations will have to make a correction to take into account the effect of longitude. The easiest way to make these corrections is to consult the rise or set correction graphs for declination 0° (they correct for longitude only - which is appropriate for this situation as we are not dealing with rise or set times). To the 'times' represented by the orientation of the Southern Cross you must ADD the correction at your location, in order to estimate the local time at your location. For example, around April 03 the 'Southern Cross time' is hour XII for Perth observers at midnight local time. For Leonora, the rise/set correction graphs for declination 0° indicate a correction of –23 minutes needs to be applied. Therefore, on April 03 it is 1137 pm (2337 WAST) when the Southern Cross is oriented at its most upright (hour XII) as viewed from Leonora.

Finding South

At all times, the long axis of the Southern Cross points approximately to the South Celestial Pole. In order to find the South Celestial Pole project an imaginary line along the Cross's long axis, 4½ times its length, away from the bottom of the crucifix (as indicated on the Southern Cross time diagram). The bottom of the cross is defined by the star Acrux, the star in Southern Cross time diagram closest to the South Celestial Pole, independent of the orientation of the Southern Cross. Note that there is no bright star at this point. (The star Polaris is close to the North Celestial Pole, but is not visible from the Southern Hemisphere.) The geographic South Pole lies directly below the South Celestial Pole on the horizon.

Note: You risk injury if you walk through the countryside at night. Do so only in emergency situations. It is better to orient yourself by finding South, then select a landmark, and travel in the daytime using the landmark as a direction reference.

WESTERN AUSTRALIAN PLACES OF ASTRONOMICAL INTEREST

OBSERVATORIES

Perth Observatory

founded 1896

Perth Observatory is the oldest continuously operating astronomical observatory in Australia. For over 100 years it has served the state of Western Australia by its provision of information and educational services, as well as conducting international-standard astronomical research. It is situated in the locality of Bickley in the Darling Range. This site is adequate for astronomical research, yet it is only 25 km east of the city and conveniently close for the public to attend its educational activities.

As part of the Observatory public education programme, several telescopes with apertures ranging from 20 to 40cm (10" to 16") are used to show night visitors the splendors of the southern skies. These nights are very popular so booking is essential. Alternatively, we can bring portable telescopes to your site for an Astronomy Field Night in order to show you the stars. Observatory staff regularly conduct many astronomy talks and lectures. A museum has been established to inform visitors about the history of the Observatory and to educate them in the science of astronomy.

The Observatory also has a well-equipped shop that sells a variety of astronomy-based educational material and gifts.

Star viewing nights
Times vary during the year. No sessions May-September inclusive – Bookings essential. Session lasts approximately 1.5 hours.

Daytime Guided Tours
10am, 12.30pm, or by appointment – Bookings essential.
1st Sunday of the month 2pm, no booking required.

Astronomy Field Nights
Observatory staff take portable telescopes to your site in order to show you the stars. Booking is essential.

Costs
All services attract charges, contact the Observatory for details.

Phone: (08) 9293 8255
Fax: (08) 9293 8138
Information Line: (08) 9293 8109
Website: www.wa.gov.au/perthobs
Email: perthobs@calm.wa.gov.au

Pingelly Heights Observatory

(Astro Ventures)

The observatory is just one and a half hours drive from the Perth Metropolitan area. Follow the Brookton Highway from Kelmscott to Brookton then turn south for Pingelly. The property is named *'SUNARISE'* Lot 11 Pingelly Heights (off Aldersyde Road) Pingelly.

Astro Ventures caters especially for: primary and secondary schools, youth groups, community organisations, private parties and others on request.

For prices, further information and ticket reservations:

Phone: (08) 9887 0088 or 0407 380 922
Fax: (08) 9887 0207
Address: Astro Ventures, PO Box 512, Pingelly, WA 6308
Website: http://www.westnet.com.au/astroventures
Email: astroventures@westnet.com.au

Southern Cross Cosmos Centre

The Southern Cross Cosmos Centre is a commercial observatory situated about an hours drive north of Perth, and is co-sited with the Australian International Gravitational Observatory, a research establishment run by the University of Western Australia. The SCCC has seven telescopes including one of West Australia's biggest, the 25 inch Obsession. The other instruments include two 8 inch Schmidt Cassegrains, two 12 inch LX200 computer controlled SC's, a 14 inch Celestron SC and a 16 inch Meade Newtonian. Binoculars will be available for patrons to use plus live video of the Moon and planets when appropriate.

The observatory is open each Friday and Saturday from October to April, (inclusive) with the evenings running from 7.30pm to 10.00pm. Other evenings are available on request but minimum charges apply. Bookings are essential and can be made by contacting ***Astro Nights***.

Phone: (08) 9307 1353
Website: www.sccc.asn.au
Email: sccc@arach.net.au

Stargate Observatory

Hyden, Western Australia

Stargate Observatory is an exciting new tourism venture that is now open in Hyden, away from the city lights and pollution (350km from Perth). Hyden's clear, dark skies provide the perfect place for telescopic viewing and orientation to our beautiful southern skies. The Stargate Observatory is situated approximately 2km from Wave Rock on the East Hyden Bin Road. It is only a short drive from the resort and other accommodation in Hyden.

There are two primary telescopes available for public viewing, an 8" Meade Schmidt Cassegrain and a 16" Meade Starfinder Equatorial. Binoculars are also available.

Our building may also be of interest as it was built using the rendered straw bale building technique.

Tours
Tours commence at 7:30pm from April until October and at 8:00pm November until March. Tours are conducted nightly (weather permitting) except for four nights each month during the full moon. Each tour runs for approximately 2.5 hours and will include a brief slide show and usage of the telescopes and binoculars. A light supper will be provided and is included in the price. It will consist of fresh, farm-baked goodies. Tea, coffee and cold drinks will also be provided.

Bookings are necessary and can be made on-line or by phone. Discounts apply for seniors, YHA members and groups of more than ten. All our facilities have disabled access.

Phone: (08) 9880 7049
Fax: (08) 9880 7029
Address: PO Box 24 Hyden WA 6359
Website: www.stargate-observatory.com.au
Email: info@stargate-observatory.com.au

AMATEUR ASTRONOMICAL SOCIETIES & ASSOCIATED GROUPS

Astronomical Society of WA

Formed in 1950, ASWA offers members monthly meetings (8 pm 2nd Mondays except January) with guest speakers, classes 7 pm preceding the meeting, monthly Club Nights (7 – 10 pm 4th Mondays except January). Monthly - dark sky site viewing, lunar study and viewing, astrophotography and planetary nights, loan instruments, extensive lending library, a bi-monthly Journal with international and Society news, free members only email newsgroup, AstroCamps at least twice yearly at very dark sky sites. ASWA strives to promote and popularise astronomy as both a modern-day science and an exciting and rewarding hobby. Where possible speakers and viewing nights for schools and community groups. Meetings and Club Nights are held at South Perth Bridge Club, cnr Barker Rd & Brittain St, Como.

Fees

Ordinary Member: $20 nomination $50 subscription
Associate Member: $15 nomination $30 subscription
Junior Member (<18): $15 nomination $20 subscription
Approx. 20% discount for Country Members

Phone: (08) 9299 6347
Address: PO Box 421, Subiaco WA 6008
Website: http://aswa.info
Email: aswa@aswa.info

Astronomical Group of Western Australia (AGWA)

AGWA was formed to provide activity and networking for amateur astronomers and people interested in the wonders of the night sky, with or without their own telescopes. Activities throughout the year include: Field trips, seminars by noted astronomers, workshops and special events and an Annual Astro-Fest. The group meets at 7pm on the first Tuesday of every month at 159A Scarborough Beach Rd, Mt Hawthorn. Everybody is welcome to attend the meetings. AGWA is proudly sponsored by Binocular, Telescope and Optical World.

Phone: (08) 9201 0895
Address: 159A Scarborough Beach Rd, Mt Hawthorn WA 6016

Astronomical Society of the South West (Inc)

Membership is open to anyone interested in basic astronomy. Observing nights at their observatory south of Bunbury on the two Fridays before the new moon. There is an active junior group that meets twice monthly. Astronomy camps in good cottage accommodation are held during the year at dark sky sites. Other observing at nearby dark sky sites occurs on an informal basis. A six evening's astronomy course for beginners is conducted each year in March/April. Nights for the general public are held during school holidays on three occasions through the year. Community groups are welcome to book for special nights.

Phone: (08) 9721 1586
Address: PO Box 1100, Bunbury, WA 6231
Website: www.assw.org.au
Email: mail@assw.org.au

Murdoch Astronomical Society

The MAS is an active body based at Murdoch University. Membership is open to the general public and no prior knowledge of astronomy is required. Meetings are conducted each month at the observatory on campus and may consist of guest speakers, slide shows or observation reports. A small library is available to members. A telescope-making group has been meeting regularly in recent years. Other activities include regular camps with ASWA and the ASSW, an annual public night usually held around February/March and observing nights on request from school and community groups. The society owns 440mm, 300mm, 200mm and 150mm telescopes for member's use. Fees: $30 per year.

Address: c/- Murdoch Uni, School of Science and Engineering, Murdoch WA 6150
Website: wwwscience.murdoch.edu.au/interest/mas/
Email: mas@science.murdoch.edu.au

Perth Observatory Volunteer Group Inc.

Perth Observatory is keen to get the public more involved in its activities. One way to directly participate and assist is to join our volunteer. This programme has been running since 1996. Currently about 30 people assist the Observatory in its activities and contribute the equivalent of one extra full-time staff member. Recently, the Observatory's volunteer group has become incorporated with the aim to obtain funding from external sources in order to further their work.

Furthermore, the fine activities and achievements of the Volunteers group were formally recognised in 2001 with the award of $1,000 by the National Australia Bank CommunityLink Programme. Only 109 of the 2,703 nominations (Australia-wide) won awards, and the Perth Observatory Volunteers Group was the only **highly recommended** winner in the Recreation category. They were also awarded a $3,600 International Year of the Volunteer grant from the Commonwealth Department of Family and Community. Apparently 17,000 organisations applied; 2,835 were successful and only 263 of those successful were based in WA. Most notably, they were also awarded a $15,000 grant from the Lotteries Commission Gordon Reid fund in order obtain equipment that would assist integrate disabled people into The Observatory's Star Viewing Night programme.

Current projects involve:

- assisting permanent staff with the public star viewing sessions,
- archiving and preserving historical documents
- rearranging the library, inputting the library database onto computer
- assisting at open days.

Those interested should send a written application to the Perth Observatory Director and volunteer coordinator, Dr James Biggs. The applicant should outline:

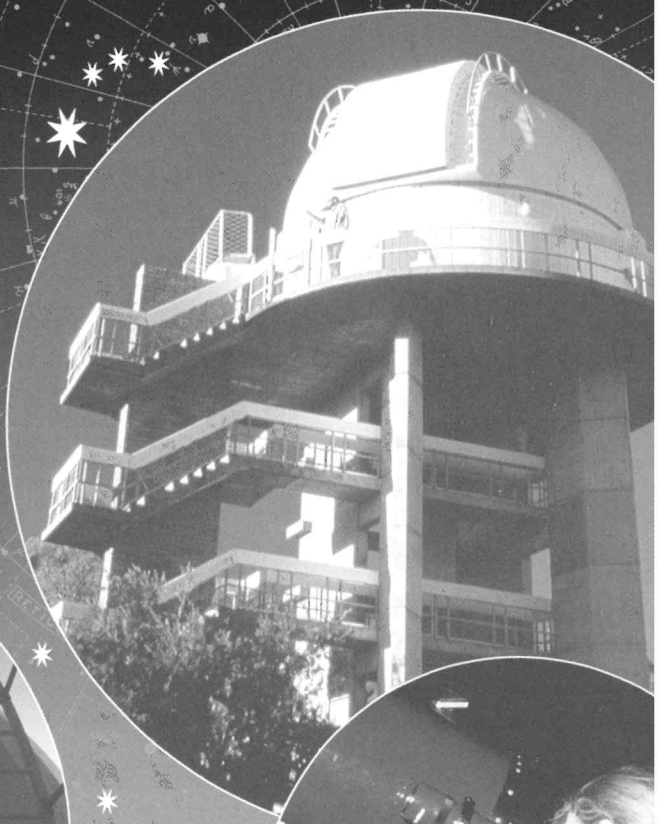
- why they wish to become part of the program,
- what skills, qualifications or experience they possess,
- what realistic amount of time they can contribute, and
- anything else that they think is relevant.

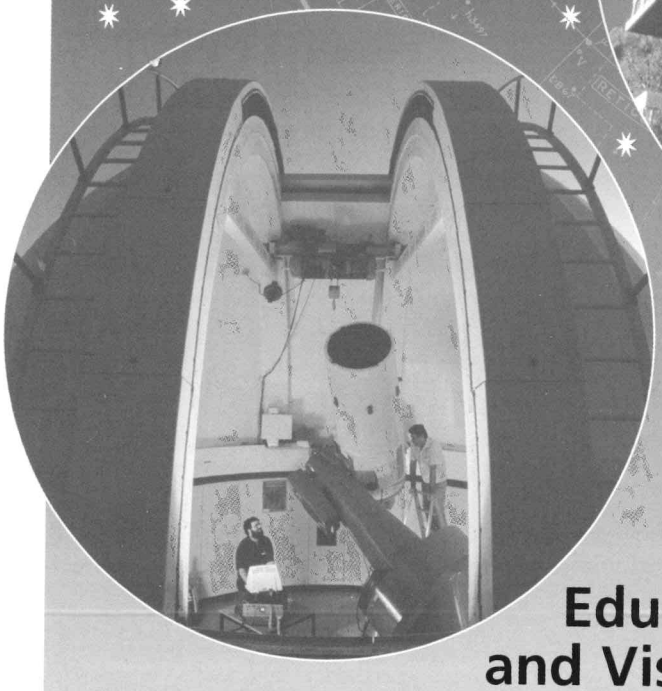
Please note that the qualification requirement is not really very stringent - what is really important is simply the desire to assist the Perth Observatory. Interviews are conducted with applicants shortlisted from their written applications around September most years. Vast astronomical knowledge is not required as successful applicants are trained for the project (or projects) in which they wish to participate. Furthermore, ongoing training is provided at the monthly volunteer group meeting and as required.

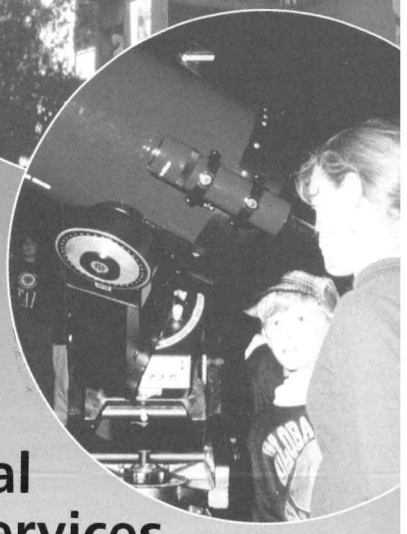
PERTH OBSERVATORY

Australia's oldest continuously operational Astronomical Observatory

Established 1896







Educational and Visitor Services

Star viewing, guided tours, astronomy field nights, lectures, talks, workshops and educational resources.

Astronomical Information

Up-to-date information concerning astronomical issues and events, for the public, media, business and legal profession.

Research

Monitoring the brightness and positions of galaxies, stars, comets, asteroids and gravitational lensing events. Searching for supernovae and near-Earth objects. Computer simulations of astronomical systems. Astronomical site testing.



PERTH OBSERVATORY

Phone 9293 8255 (office hours), fax 9293 8138
or visit **www.wa.gov.au/perthobs**

GOVERNMENT OF WESTERN AUSTRALIA

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

WESTERN AUSTRALIAN

ASTRONOMY ALMANAC

Inside this almanac you'll find a wealth of astronomical information, all designed and tabulated for use right here in Western Australia!

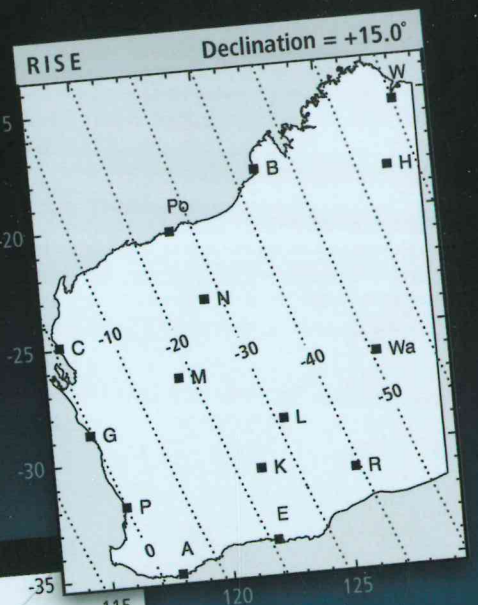
Monthly sections:

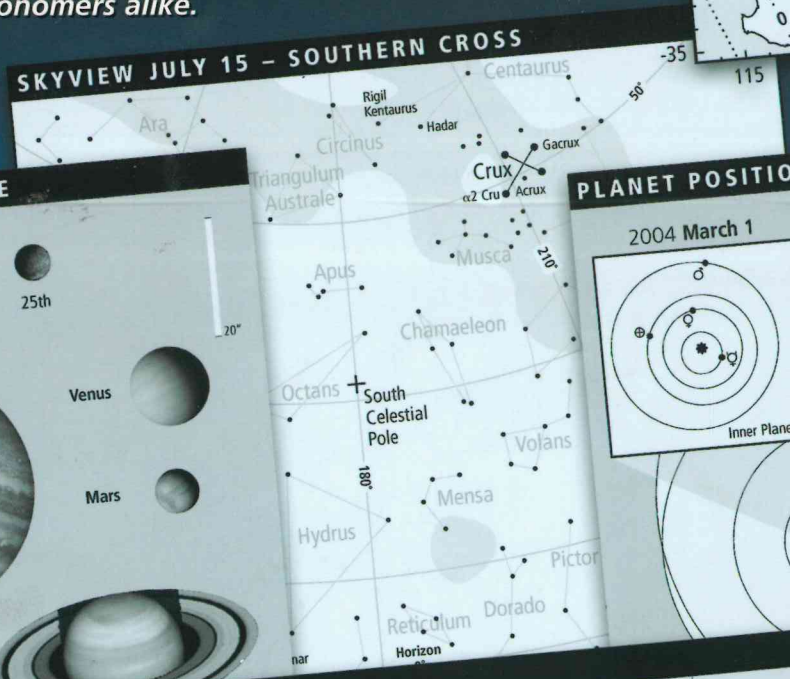
Highlights and Events Diary
Sun, Moon and Planet Rise/Set Data
Planet Appearance and Relative Sizes
Jupiter Events and Satellite Configuration Data • Skyviews

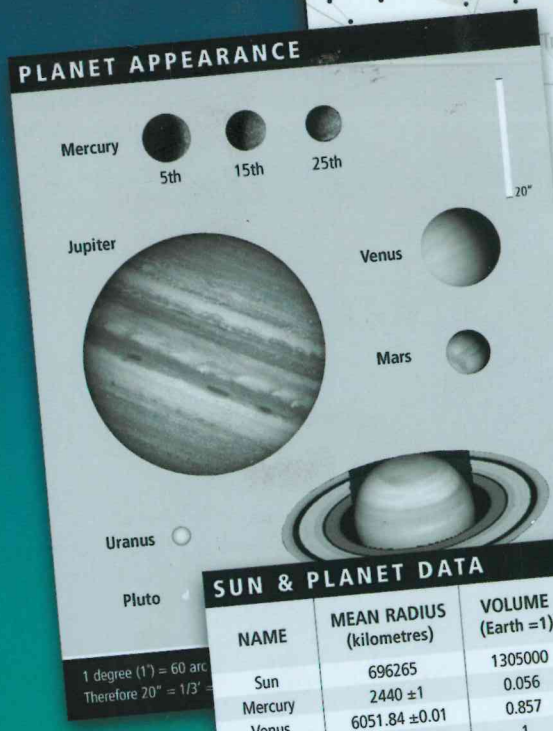
Supplementary sections include:

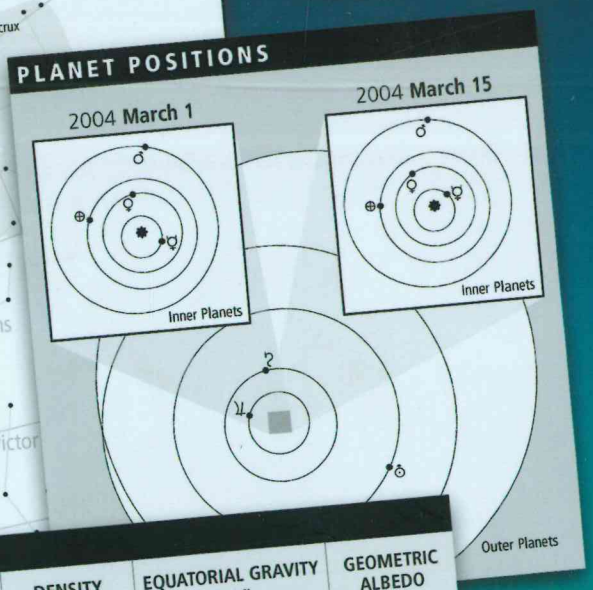
Solar System Information • Stars & Non-Stellar Objects
Background & General Information

This almanac is a useful resource for all budding and experienced astronomers alike.









SUN & PLANET DATA

NAME	MEAN RADIUS (kilometres)	VOLUME (Earth =1)	FLATTENING (Earth =1)	MASS (x 10^{23} kg)	DENSITY (g/cm³)	EQUATORIAL GRAVITY (m/s²)	GEOMETRIC ALBEDO
Sun	696265	1305000		19890850	1.407		
Mercury	2440 ±1	0.056	0	3.302	5.427	3.701	0.106
Venus	6051.84 ±0.01	0.857	0	48.685	5.204	8.87	0.65
Earth	6371.01 ±0.02	1	0.00335364	59.736	5.515	9.780327	0.367
Mars	3389.92 ±0.04	0.151	0.006476	6.4185	3.9335 ±0.0004	3.69	0.15
	69911 ±6	1321	0.064874	18986	1.326	23.12 ±0.01	0.52
			0.097962	5684.6	0.6873	8.96 ±0.01	0.47
					1.318	8.69 ±0.01	0.51
							0.41

2004

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