WESTERN AUSTRALIAN

ASTRONOMY ALMANAC

INCLUDES FREE CD

The really useful guide to the wonders of the night sky

Highlights:

January 24	Lunar Occultation of Regulus
February 1	Venus in conjunction with Jupiter
February 2	Lunar Occultation of Antares
March	Venus close to Mercury
April 23	Lunar Occultation of Antares
July 11	Mars in conjunction with Saturn
July 14	Lunar Occultation of Antares
August 13	Venus in conjunction with Saturn
August 17	Partial lunar eclipse
September	Mercury, Venus and Mars close in evening twilight
October 4	Lunar Occultation of Antares
December 1	Venus in conjunction with Jupiter
December 29	Lunar Occultation of Jupiter
December 31	Mercury in conjunction with Jupiter

2008

Department of Environment and Conservation

PERTH OBSERVATORY

2008

JANUARY 2008

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		

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AUGUST 2008

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OCTOBER 2008

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NOVEMBER 2008

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DECEMBER 2008

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21	22	23	24	25	26	27 ●
28	29	30	31			

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

WESTERN AUSTRALIAN ASTRONOMY ALMANAC 2008

CONTENTS

Introduction	3
Getting Started	4
How To Use This Almanac	6
January	8
February	12
March	16
April	20
May	24
June	28
July	32
August	36
September	40
October	44
November	48
December	52
Special Events – Eclipses & Occultations	56
Solar System Information	60
Stars & Non-Stellar Objects	93
Background & General Information	97
Western Australian Places of Astronomical Interest	120

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'Astronomical Almanac for the Year 2008, 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.

'Astronomy and Astrophysics in the New Millennium', National Research Council USA, National Academy Press.

'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.

'Frequently Asked Questions About Calendars', 2005, Claus Tondering, http://www.tondering.dk/claus/calendar.html

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

'More Mathematical Astronomy Morsels', 2002, 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.

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

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

International Meteor Organization http://www.imo.net/

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

NASA National Space Science Data Center http://nssdc.gsfc.nasa.gov/planetary

Resolutions 5 and 6 adopted at IAU XXVIth General Assembly in Prague, on August 24, 2006. http://www.iau.org/Resolutions_at_GA-XXVI.340.0.html

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

Sky and Telescope magazine http://skyandtelescope.com/

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

US Geological Survey Planetary Nomenclature http://planetarynames.wr.usgs.gov/

ICE version 0.51, US Naval Observatory, Nautical Almanac Office

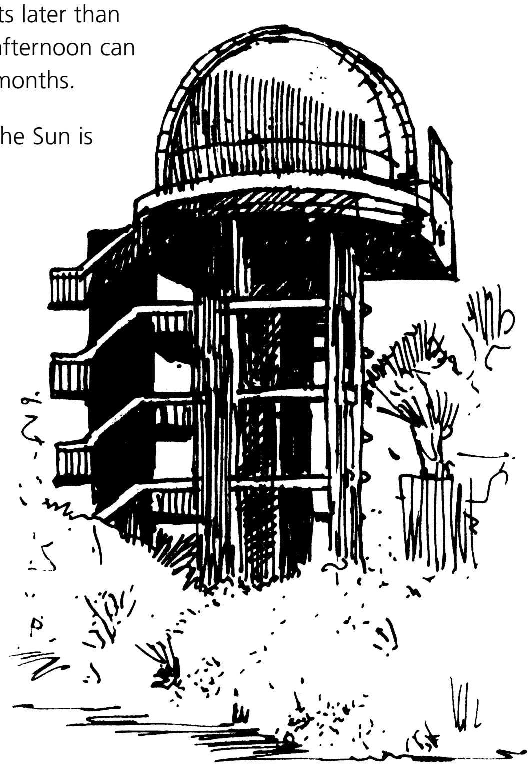
Sky Charts – Cartes du Ciel version 3 beta 0.1.2 by Patrick Chevalley

Starry Night Pro, version 5.0.2, Sienna Software Inc.

***Front Cover**: Hubble Space Telescope image of bright blue, newly formed stars that are blowing a cavity in the centre of a star-forming region in our galactic neighbour - the Small Magellanic Cloud – located about 200,000 light-years from the Solar System. Near the centre of the star-forming region, lies star cluster NGC 602. The high-energy radiation blazing out from the hot young stars is sculpting the inner edge of the outer portions of the nebula, slowly eroding it away and eating into the material beyond. The diffuse outer reaches of the nebula prevent the energetic outflows from streaming away from the cluster. Ridges of dust and gaseous filaments are seen towards the northwest (in the upper-left part of the image) and towards the southeast (in the lower right-hand corner). Elephant trunk-like dust pillars point towards the hot blue stars and are tell-tale signs of their eroding effect. In this region it is possible to trace how the star formation started at the centre of the cluster and propagated outward, with the youngest stars still forming today along the dust ridges. The width of the star forming region is about 200 light-years.*

Acknowledgement: NASA, ESA, and the Hubble Heritage Team (STScI/AURA) - ESA/Hubble Collaboration

Astronomy was once again prominent in the public arena in 2007 after the imposition of daylight saving in late 2006. Daylight saving exploits the fact that the Sun rises earlier and sets later than average during the months around, and during, the height of summer. A very long afternoon can be created if civil time is advanced by one hour (day light saving time) during these months.



However, this is only part of the story. A given time, such as noon – the time when the Sun is highest in the sky, is a local phenomenon and it is entirely impractical for each community to conduct their activities based on local time. As a consequence, the world is divided into time zones with each zone being (usually) one hour different to the one adjacent. Naturally, common sense comes into play and the boundaries for each zone are usually defined by state or regional boundaries in order minimise problems and maximise co-ordination of activities for people living in given region. Western Australia spans the longitude range 113° to 129° east of the Prime Meridian at Greenwich, England. This means that noon occurs from about 8.6 to 7.5 hours ahead of Greenwich, Consequently, the time zone for all of WA is 8 hours ahead of Greenwich and local time is the same as the zone time only at longitude 120°.

Given that the longitude for Perth is about 4° west of the 120th meridian means that the local noon is on average 16 minutes later than that expected for the time zone. This means that because of Perth's location it experiences an average of 16 minutes of daylight saving all year even without the formal imposition of daylight saving. The meridian of the Eastern Australian Standard Time is 150°, therefore given their locations the cities of Canberra, Hobart, Melbourne and Sydney have "natural daylight savings" of approximately, 3, 11, 20, and -5 minutes, respectively. Therefore, only Sydney, and to some extent Canberra, experiences a total shift of Sun position corresponding to one hour with day light saving.

The location of the Sun is actually more complicated. The motion of the Sun across the sky is not uniform owing to the elliptical orbit of the Earth and the tilt of the Earth's rotation axis with respect to its orbital axis. This means that, for example, local noon does not always occur at 1200 – it varies by about 16 minutes either early or late across the year at all locations. Astronomers have accurately calculated this change and call it the 'equation of time'. In the middle of November, December, January, February and March this shift is approximately 16, 4, -10, -15 and -10 minutes, respectively. This shift makes noon occur earlier in November, and in the middle of that month the effect of longitude and the equation of time cancel each other. However, from around the start of the year the equation of time adds to the longitude effect and makes the natural daylight saving experience at Perth extend to about 26 minutes in January and March, and to 31 minutes in mid February.

The imposition of daylight saving certainly caused Perth Observatory some issues, notably the times given in last year's Almanac and the rearrangement of our popular star viewing nights. It will be interesting to see what the voters of Western Australian have thought about this daylight saving trial at the referendum of 2009.

As with all years there is plenty to see in the night sky in 2008. In the month of September the three closest planets to Earth gather together in the eastern evening sky. On the evening of the September 2nd the crescent Moon is also located near this group of planets. Some people may call this a "lining up of the planets" but they don't really line up. Furthermore, this event is not a portent of doom (we've survived similar events – they recur about every 10 years), to the contrary, it presents a great astrophotography opportunity.

Mercury, Venus and Mars close in evening twilight – September

Several lunar occultations are visible in 2008. This is an event where the Moon, in the course of its orbit around the Earth, hides a distant object as it passes in front of it. Most of these lunar occultations involve the bright star *Antares*, and one with each of *Regulus* and Jupiter.

Lunar Occultation of* Regulus *Jan 24,* Antares *Feb 2, Apr 23, Jul 14 and Oct 4, and Jupiter, Dec 29

Remember to keep an eye to the sky. While this almanac will help you plan your observing sessions based on predicable phenomenon, the sky is full of wondrous unpredictable events that happen at any time.

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and Adjunct Associate Professor, Curtin University of Technology and James Cook University.

***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 the Section *Background and 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 the Section *Solar System Information*. Also note the way that astronomers write decimal angles – the symbol is always placed after its integer part, eg $\frac{1}{2}^{\circ}$ = 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, arcminutes and arcseconds should be used.

■ *Join an astronomy society*

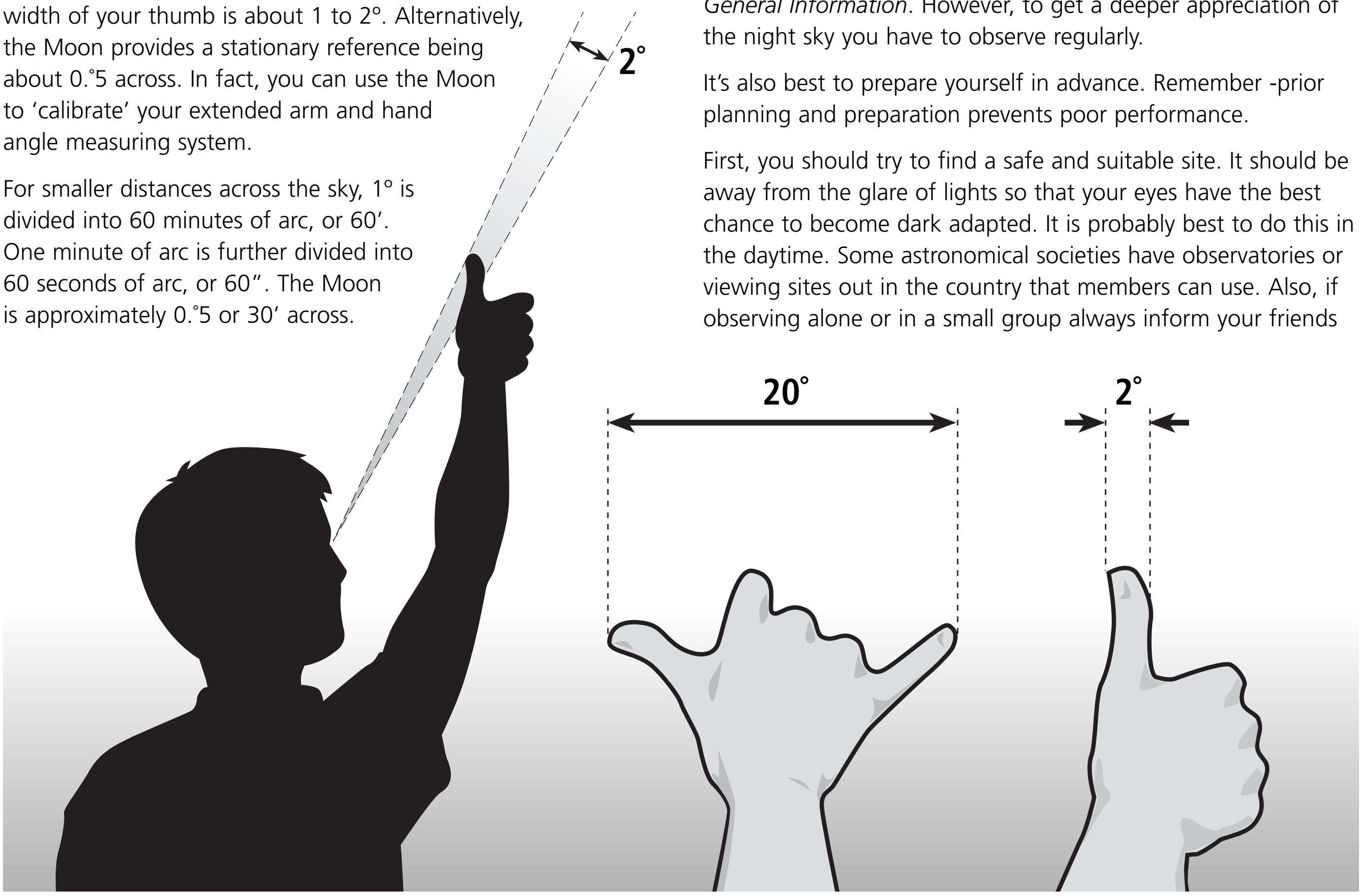
At an astronomy society you will meet a diverse range of people who have in common a great appreciation for and fascination with astronomy. The more established members are a great source of knowledge not only about the sky, but also instruments and observing sites. These societies can also provide enjoyable 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 the 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 the Section *Background and 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 are relatively inexpensive.

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.

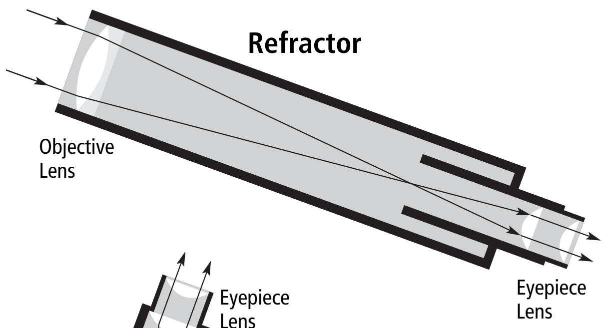
■ *Buying a telescope*

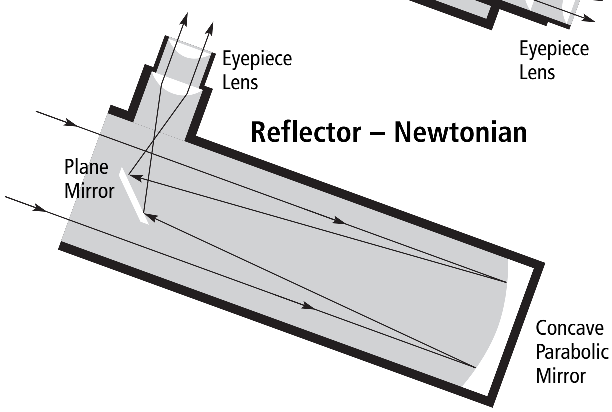
Eventually, if you've enjoyed doing all the things mentioned above you will probably want to buy your own telescope. Beware of any telescope that is advertised promoting its high magnification. These are probably built for a price, and not quality. It probably does have a high magnification, but what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

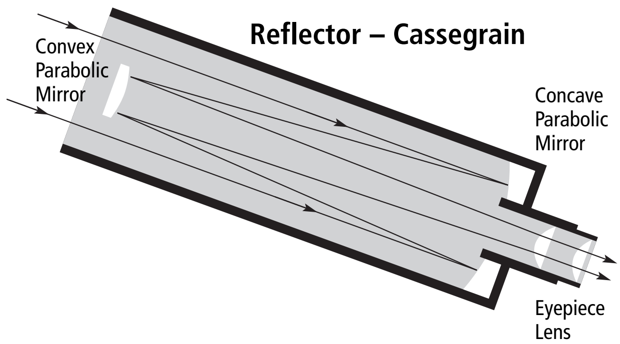
The subject of astronomical telescopes is quite large and only a very brief discussion is presented here. Telescopes come in three basic types:

- ***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

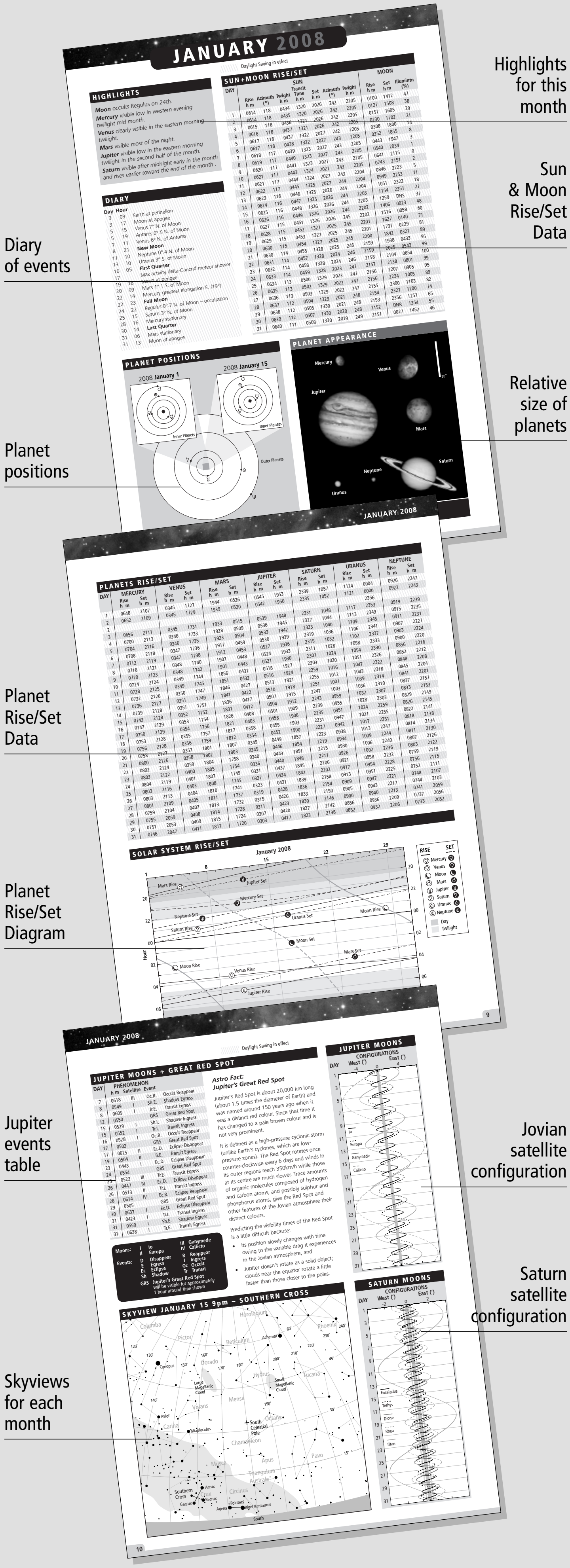
***The majority** of this almanac is dedicated to the provision of detailed information about what is to be seen and where it is located for each month. Following that is a section providing details about very rare and/or unusual events. Finally, the later sections provide background and reference information 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**. 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. The planets in the outer Solar System do not move very fast and only 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 Moonrise 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) = Co-ordinated Universal Time (UTC, the modern equivalent of Greenwich Mean Time) + 8 hours, unless noted otherwise. Daylight saving time is used from January 1 until March 30 02:00, and October 26 02:00 to December 31 in 2008. 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. This is just a consequence of the planet's and Earth's orbital motions. A chart graphically summarises the rise and set times of the Sun, Moon and planets over a given month. Daylight saving time is used in these charts for the January, February, March, November and December. 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 the Section *Background and General Information*. No information is supplied for Pluto as it is no longer classified as a planet (See Section *Solar System Information – Definition of the Planets in the Solar System*).

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, the Great Red Spot 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 the planets Jupiter and Saturn are also illustrated graphically. Note that in these charts the thicker lines indicate that the moon is closer to Earth than the planet. No corrections for daylight saving were made for these graphs given their scale.

The last component of the monthly sections – the *sky views* is one of the most useful. A *sky view* is a chart showing the planet or object of interest against the background of brighter stars. These are a great aid in assisting beginners find their way

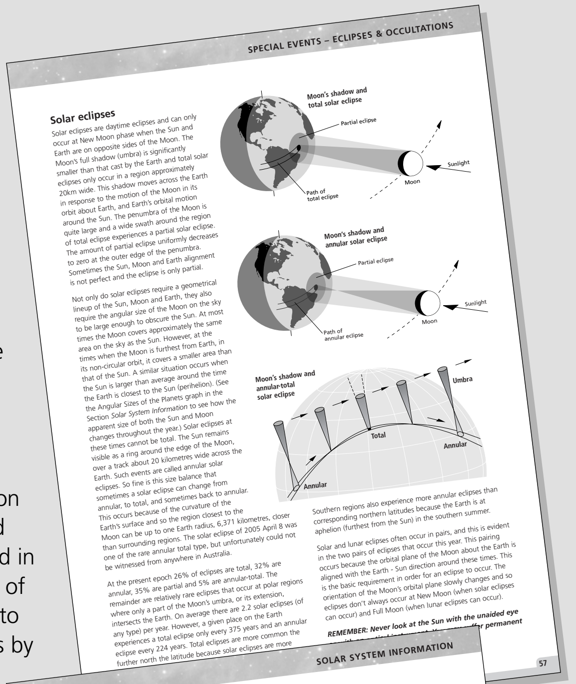


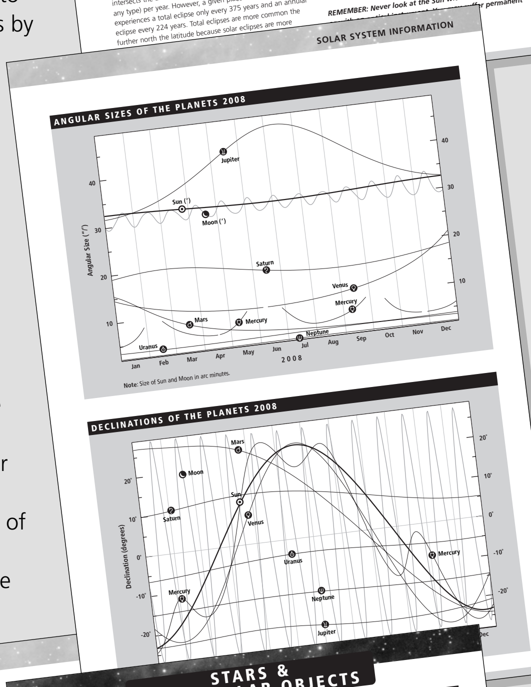
around the sky. Please note that the size of the Moon in these images is larger than it should be in order to aid clarity.

Additional Sections

Some of the more spectacular and/or rare celestial events are discussed in the **Special Events – Eclipses & 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 along with the constellation in which they are located. Note that these positions refer to 0000 WAST, which corresponds to 1600 UTC. 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, as well as some basic Moon information. More detailed graphs concerning the positions, sizes, brightness etc of the planets are also provided in order to assist the more experienced observers. An explanation of meteors and a list of bright meteor showers visible from the Southern Hemisphere are tabulated in order to assist identification of any conspicuous meteors. 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 included. Note that the brightness of comets is difficult to predict with any accuracy.

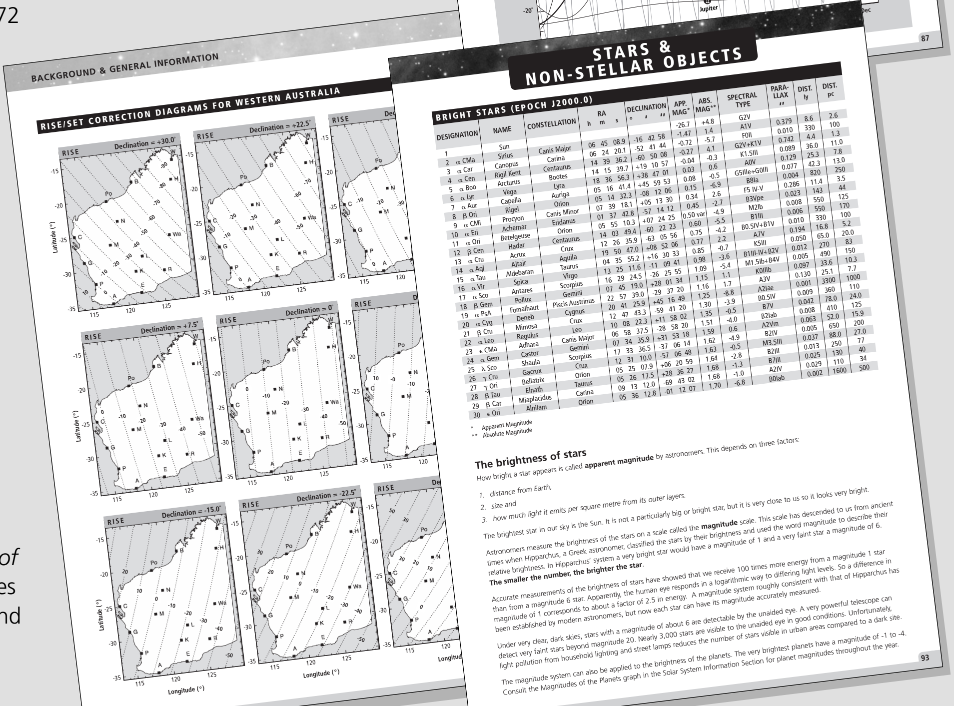




A detailed section with explanatory notes is contained in the **Stars and Non-Stellar Objects** Sections. You can’t view most of these objects with the unaided eye, but they are included as a reference for those interested and the more experienced observers. The parameters provided are the most up-to-date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

The penultimate section contains a range of **Background and 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. Also, a brief explanation of the astronomical and historical basis of our time keeping systems and terminology is outlined. 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 without using Julian day numbers!) Also note that astronomers have an unusual format for dates and times. Not only do they use a 24 hour clock, but 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*, the modern counterpart of AD). This system is also the international standard (ISO 8601). The next few pages 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.

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 2008

Daylight Saving in effect

HIGHLIGHTS

***Moon** occults Regulus on 24th.*

***Mercury** visible low in western evening twilight mid month.*

***Venus** clearly visible in the eastern morning twilight.*

***Mars** visible most of the night.*

***Jupiter** visible low in the eastern morning twilight in the second half of the month.*

***Saturn** visible after midnight early in the month and rises earlier toward the end of the month .*

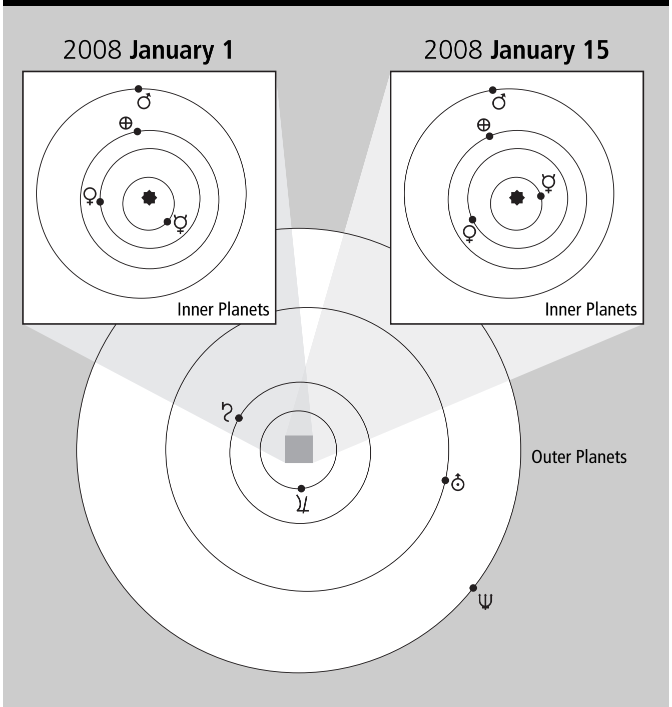
DIARY

Day	Hour	
3	09	Earth at perihelion
3	17	Moon at apogee
5	15	Venus 7° N. of Moon
5	19	*Antares* 0°.5 N. of Moon
7	11	Venus 6° N. of *Antares*
8	21	**New Moon**
11	10	Neptune 0°.4 N. of Moon
13	10	Uranus 3° S. of Moon
16	05	**First Quarter**
17		Max activity delta-Cancrid meteor shower
19	18	Moon at perigee
20	09	Mars 1°.1 S. of Moon
22	14	Mercury greatest elongation E. (19°)
22	23	**Full Moon**
24	22	*Regulus* 0°.7 N. of Moon – occultation
25	15	Saturn 3° N. of Moon
28	16	Mercury stationary
30	14	**Last Quarter**
31	06	Mars stationary
31	13	Moon at apogee

SUN+MOON RISE/SET

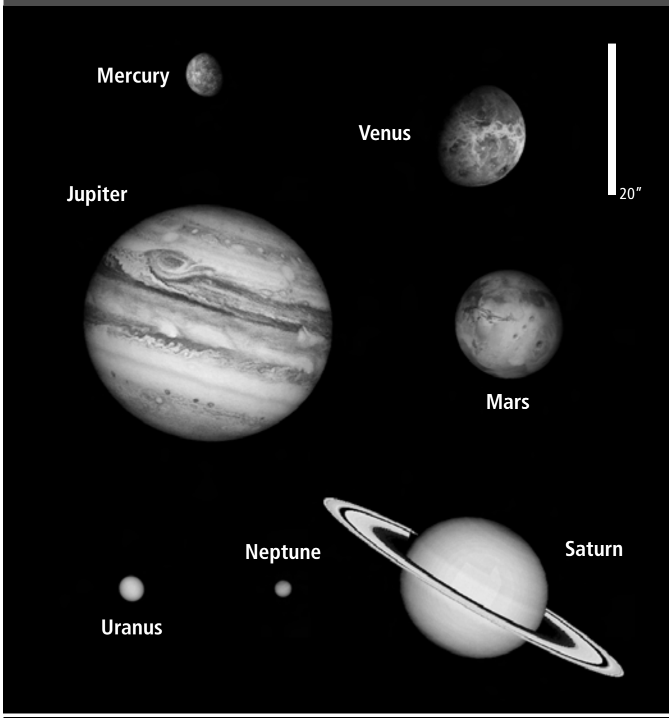
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn (%)
1	0614	118	0434	1320	2026	242	2205	0100	1412	47
2	0614	118	0435	1320	2026	242	2205	0127	1508	38
3	0615	118	0436	1321	2026	242	2205	0157	1605	29
4	0616	118	0437	1321	2026	242	2205	0230	1702	21
5	0617	118	0437	1322	2027	242	2205	0308	1800	14
6	0617	118	0438	1322	2027	243	2205	0352	1855	8
7	0618	117	0439	1323	2027	243	2205	0443	1947	3
8	0619	117	0440	1323	2027	243	2205	0540	2034	1
9	0620	117	0441	1323	2027	243	2205	0641	2115	0
10	0621	117	0443	1324	2027	243	2205	0743	2151	2
11	0621	117	0444	1324	2027	243	2204	0846	2223	5
12	0622	117	0445	1325	2027	244	2204	0949	2253	11
13	0623	116	0446	1325	2026	244	2204	1051	2322	18
14	0624	116	0447	1325	2026	244	2203	1154	2351	27
15	0625	116	0448	1326	2026	244	2203	1259	DNS	37
16	0626	116	0449	1326	2026	244	2202	1406	0023	48
17	0627	115	0451	1326	2026	245	2202	1516	0058	60
18	0628	115	0452	1327	2025	245	2201	1627	0140	71
19	0629	115	0453	1327	2025	245	2201	1737	0229	81
20	0630	115	0454	1327	2025	245	2200	1842	0327	89
21	0630	114	0455	1328	2025	246	2159	1938	0433	95
22	0631	114	0457	1328	2024	246	2159	2025	0543	99
23	0632	114	0458	1328	2024	246	2158	2104	0654	100
24	0633	114	0459	1328	2023	247	2157	2138	0801	99
25	0634	113	0500	1329	2023	247	2156	2207	0905	95
26	0635	113	0502	1329	2022	247	2156	2234	1005	89
27	0636	113	0503	1329	2022	247	2155	2300	1103	82
28	0637	112	0504	1329	2021	248	2154	2327	1200	74
29	0638	112	0505	1330	2021	248	2153	2356	1257	65
30	0639	112	0507	1330	2020	248	2152	DNR	1354	55
31	0640	111	0508	1330	2019	249	2151	0027	1452	46

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ⛢ Uranus
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

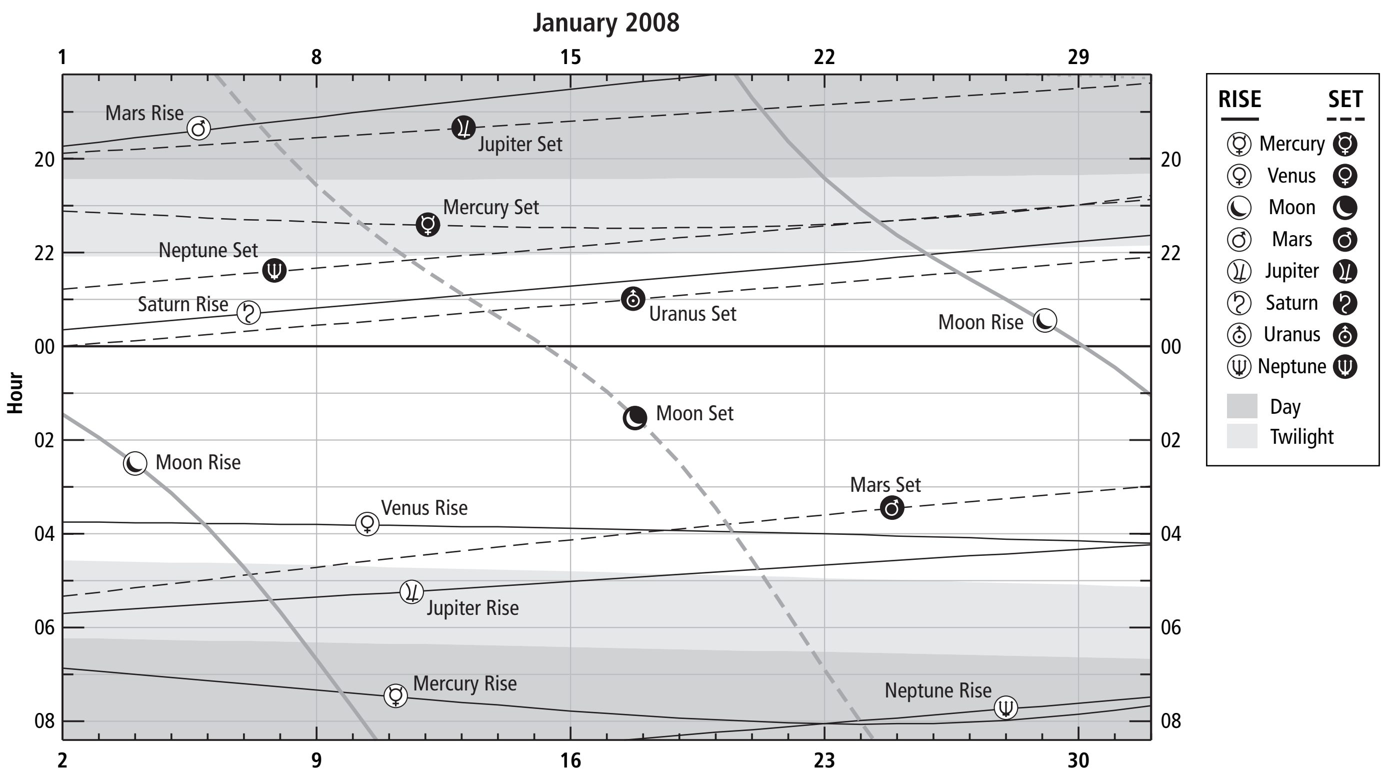


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY Rise h m	MERCURY Set h m	VENUS Rise h m	VENUS Set h m	MARS Rise h m	MARS Set h m	JUPITER Rise h m	JUPITER Set h m	SATURN Rise h m	SATURN Set h m	URANUS Rise h m	URANUS Set h m	NEPTUNE Rise h m	NEPTUNE Set h m
1	0648	2107	0345	1727	1944	0526	0545	1953	2339	1057	1124	0004	0926	2247
2	0652	2109	0345	1729	1939	0520	0542	1950	2335	1052	1121	0000	0922	2243
2												2356		
3	0656	2111	0345	1731	1933	0515	0539	1948	2331	1048	1117	2353	0919	2239
4	0700	2113	0346	1733	1928	0509	0536	1945	2327	1044	1113	2349	0915	2235
5	0704	2116	0346	1735	1923	0504	0533	1942	2323	1040	1109	2345	0911	2231
6	0708	2118	0347	1736	1917	0459	0530	1939	2319	1036	1106	2341	0907	2227
7	0712	2119	0347	1738	1912	0453	0527	1936	2315	1032	1102	2337	0903	2224
8	0716	2121	0348	1740	1907	0448	0524	1933	2311	1028	1058	2333	0900	2220
9	0720	2123	0348	1742	1901	0443	0521	1930	2307	1024	1054	2330	0856	2216
10	0724	2124	0349	1744	1856	0437	0518	1927	2303	1020	1051	2326	0852	2212
11	0728	2125	0349	1745	1851	0432	0516	1924	2259	1016	1047	2322	0848	2208
12	0732	2126	0350	1747	1846	0427	0513	1921	2255	1012	1043	2318	0845	2204
13	0736	2127	0351	1749	1841	0422	0510	1918	2251	1007	1039	2314	0841	2201
14	0739	2128	0351	1751	1836	0417	0507	1915	2247	1003	1036	2310	0837	2157
15	0743	2128	0352	1752	1831	0412	0504	1912	2243	0959	1032	2307	0833	2153
16	0747	2129	0353	1754	1826	0408	0501	1909	2239	0955	1028	2303	0829	2149
17	0750	2129	0354	1756	1821	0403	0458	1906	2235	0951	1024	2259	0826	2145
18	0753	2128	0355	1757	1817	0358	0455	1903	2231	0947	1021	2255	0822	2141
19	0756	2128	0356	1759	1812	0354	0452	1900	2227	0942	1017	2251	0818	2138
20	0758	2127	0357	1801	1807	0349	0449	1857	2223	0938	1013	2247	0814	2134
21	0800	2126	0358	1802	1803	0345	0446	1854	2219	0934	1009	2244	0811	2130
22	0802	2124	0359	1804	1758	0340	0443	1851	2215	0930	1006	2240	0807	2126
23	0803	2122	0400	1805	1754	0336	0440	1848	2211	0926	1002	2236	0803	2122
24	0804	2119	0401	1807	1749	0331	0437	1845	2206	0921	0958	2232	0759	2119
25	0803	2116	0403	1808	1745	0327	0434	1842	2202	0917	0954	2228	0756	2115
26	0803	2113	0404	1810	1741	0323	0431	1839	2158	0913	0951	2225	0752	2111
27	0801	2109	0405	1811	1737	0319	0428	1836	2154	0909	0947	2221	0748	2107
28	0759	2104	0407	1813	1732	0315	0426	1833	2150	0905	0943	2217	0744	2103
29	0755	2059	0408	1814	1728	0311	0423	1830	2146	0900	0940	2213	0741	2059
30	0751	2053	0409	1815	1724	0307	0420	1827	2142	0856	0936	2209	0737	2056
31	0746	2047	0411	1817	1720	0303	0417	1823	2138	0852	0932	2206	0733	2052

SOLAR SYSTEM RISE/SET



Daylight Saving in effect

JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Satellite	Event	
7	0618	III	Oc.R.	Occult Reappear
8	0549	I	Sh.E.	Shadow Egress
8	0605	I	Tr.E.	Transit Egress
12	0550		GRS	Great Red Spot
15	0529	I	Sh.I.	Shadow Ingress
15	0552	I	Tr.I.	Transit Ingress
16	0528	I	Oc.R.	Occult Reappear
17	0502		GRS	Great Red Spot
17	0625	II	Ec.D.	Eclipse Disappear
19	0504	II	Tr.E.	Transit Egress
23	0443	I	Ec.D.	Eclipse Disappear
24	0554		GRS	Great Red Spot
25	0522	III	Tr.E.	Transit Egress
26	0447	IV	Ec.D.	Eclipse Disappear
26	0513	II	Tr.I.	Transit Ingress
26	0614	IV	Ec.R.	Eclipse Reappear
29	0505		GRS	Great Red Spot
30	0637	I	Ec.D.	Eclipse Disappear
31	0423	I	Tr.I.	Transit Ingress
31	0559	I	Sh.E.	Shadow Egress
31	0638	I	Tr.E.	Transit Egress

Moons: I Io, II Europa, III Ganymede, 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

Astro Fact: Jupiter's Great Red Spot

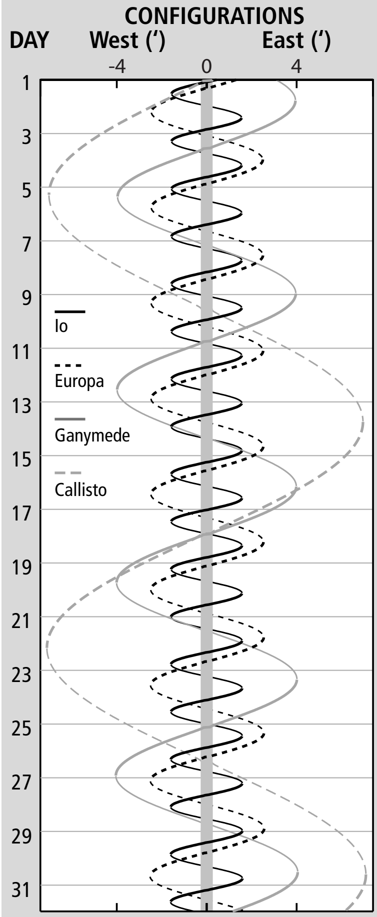
Jupiter's Red Spot is about 20,000 km long (about 1.5 times the diameter of Earth) and was named around 150 years ago when it was a distinct red colour. Since that time it has changed to a pale brown colour and is not very prominent.

It is defined as a high-pressure cyclonic storm (unlike Earth's cyclones, which are low-pressure zones). The Red Spot rotates once counter-clockwise every 6 days and winds in its outer regions reach 350km/h while those at its centre are much slower. Trace amounts of organic molecules composed of hydrogen and carbon atoms, and possibly sulphur and phosphorus atoms, give the Red Spot and other features of the Jovian atmosphere their distinct colours.

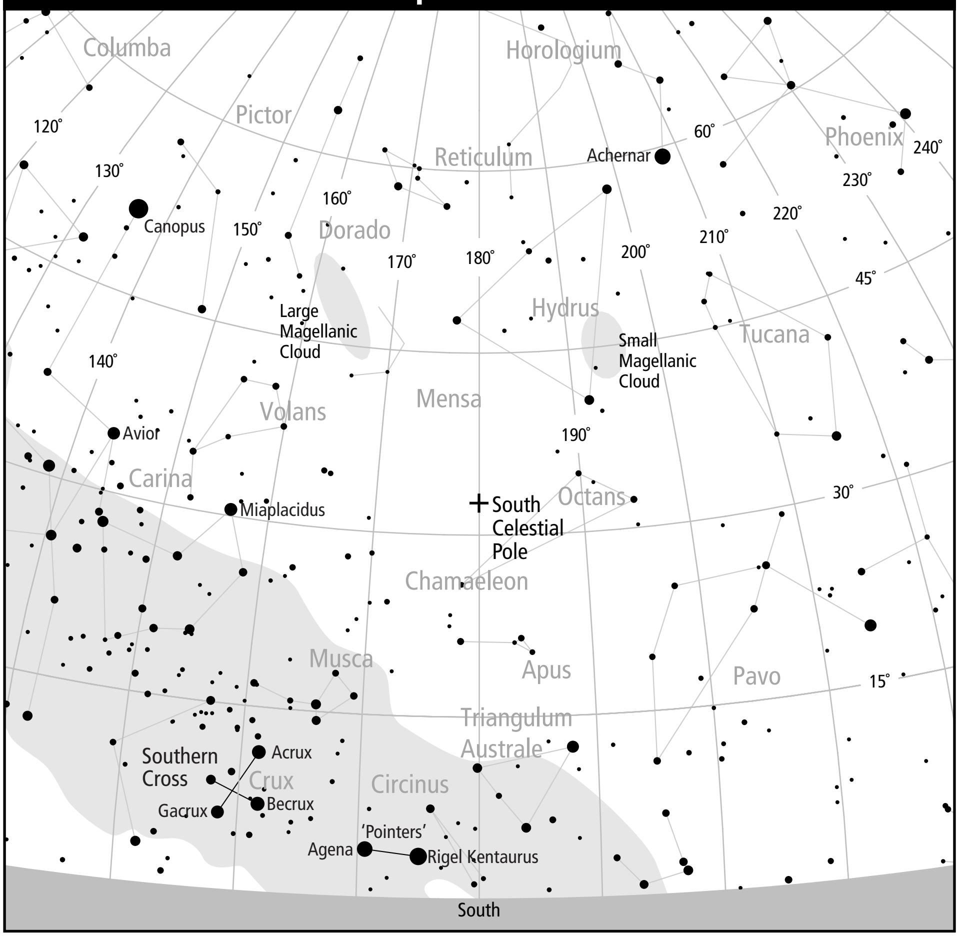
Predicting the visibility times of the Red Spot is a little difficult because:

- Its position slowly changes with time owing to the variable drag it experiences in the Jovian atmosphere, and
- Jupiter doesn't rotate as a solid object; clouds near the equator rotate a little faster than those closer to the poles.

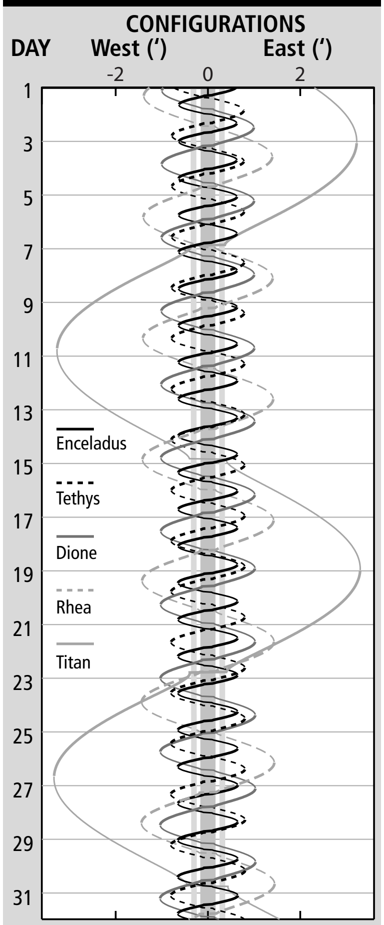
JUPITER MOONS



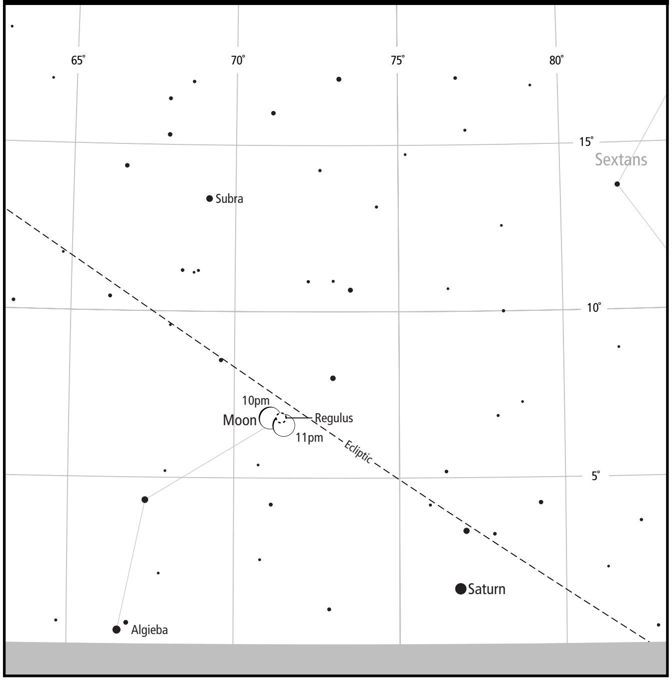
SKYVIEW JANUARY 15 9pm – SOUTHERN CROSS



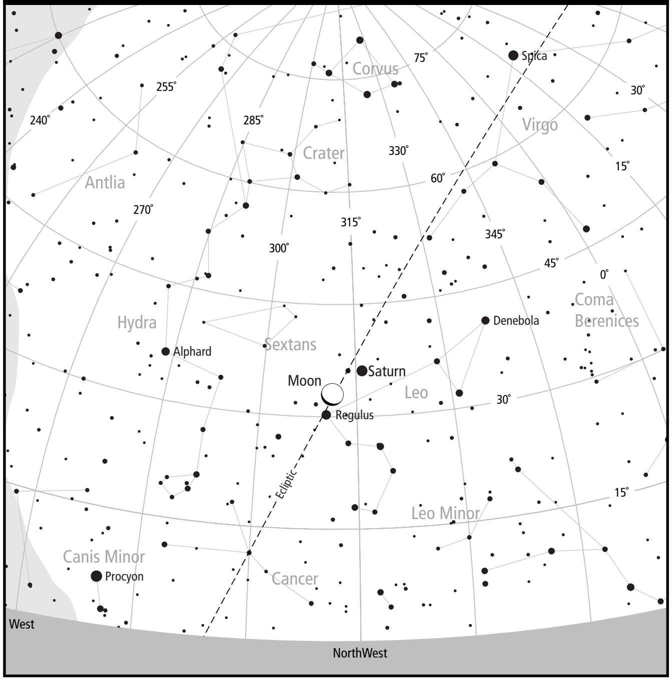
SATURN MOONS



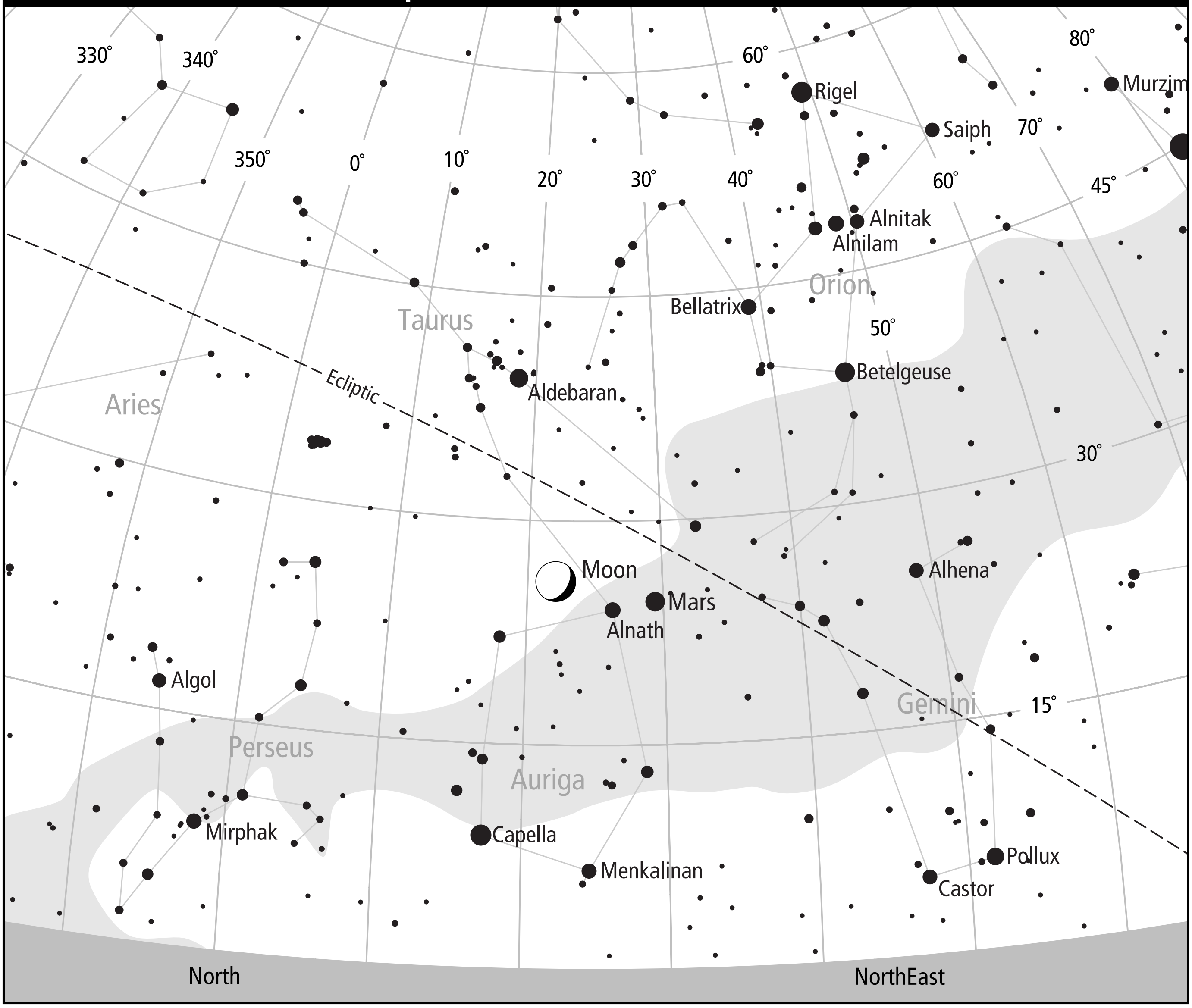
SKYVIEW 2008 JANUARY 24 10-11pm



SKYVIEW 2008 JANUARY 25 6am



SKYVIEW 2008 JANUARY 19 9pm



FEBRUARY 2008

Daylight Saving in effect

HIGHLIGHTS

Moon *occults Antares on the 2nd.*
Mercury *visible low in eastern morning twilight in the second half of month. Conjunction with Venus at end of month.*
Venus *clearly visible in the eastern morning twilight. Conjunction with Jupiter early in month.*
Mars *visible all evening, sets well after midnight.*
Jupiter *rises in the east before morning twilight.*
Saturn *visible most of night.*

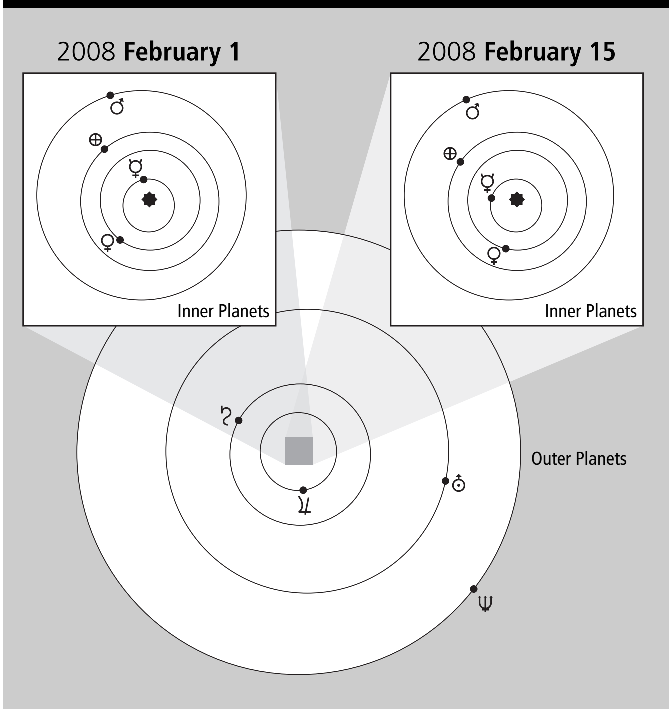
DIARY

Day	Hour	
1	22	Venus 0°.6 N. of Jupiter
2	01	*Antares* 0°.6 N. of Moon - occultation
4	15	Jupiter 4° N. of Moon
4	21	Venus 4° N. of Moon
7		Max activity alpha-Centaurid meteor shwr
7	03	Mercury in inferior conjunction
7	13	**New Moon**
8		Max act. of alpha-Centaurid meteor shwr
9	19	Uranus 3° S. of Moon
11	11	Neptune in conjunction with Sun
14	10	Moon at perigee
14	13	**First Quarter**
16	17	Mars 1°.6 S. of Moon
19	01	Mercury stationary
21	09	*Regulus* 0°.7 N. of Moon
21	13	**Full Moon**
21	21	Saturn 3° N. of Moon
24	19	Saturn at opposition
25		Max activity of delta-Leonid meteor shwr
26	12	Mercury 1°.3 N. of Venus
28	10	Moon at apogee
29		Leap day
29	11	**Last Quarter**
29	12	*Antares* 0°.6 N. of Moon

SUN+MOON RISE/SET

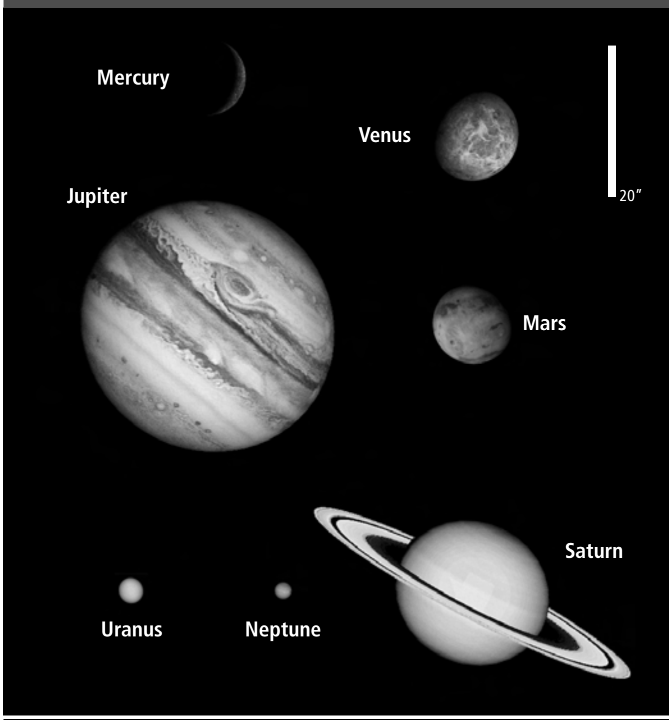
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn (%)
1	0641	111	0509	1330	2019	249	2150	0103	1549	37
2	0642	111	0510	1330	2018	249	2149	0145	1646	28
3	0643	110	0512	1330	2017	250	2148	0233	1739	20
4	0644	110	0513	1330	2017	250	2147	0328	1828	13
5	0645	110	0514	1331	2016	250	2146	0427	1911	7
6	0646	109	0515	1331	2015	251	2145	0530	1949	3
7	0646	109	0517	1331	2014	251	2144	0634	2024	0
8	0647	109	0518	1331	2014	252	2143	0738	2055	0
9	0648	108	0519	1331	2013	252	2142	0842	2125	3
10	0649	108	0520	1331	2012	252	2141	0946	2154	7
11	0650	107	0521	1331	2011	253	2140	1051	2225	14
12	0651	107	0523	1331	2010	253	2138	1158	2259	23
13	0652	107	0524	1331	2009	254	2137	1307	2338	34
14	0653	106	0525	1331	2008	254	2136	1417	DNS	45
15	0654	106	0526	1331	2007	254	2135	1527	0024	56
16	0654	105	0527	1331	2006	255	2134	1632	0118	67
17	0655	105	0528	1331	2005	255	2132	1730	0220	77
18	0656	105	0529	1331	2004	256	2131	1819	0327	86
19	0657	104	0531	1331	2003	256	2130	1900	0436	93
20	0658	104	0532	1330	2002	256	2128	1935	0543	98
21	0659	103	0533	1330	2001	257	2127	2006	0648	100
22	0700	103	0534	1330	2000	257	2126	2034	0750	100
23	0700	103	0535	1330	1959	258	2125	2100	0849	98
24	0701	102	0536	1330	1958	258	2123	2127	0947	93
25	0702	102	0537	1330	1957	259	2122	2155	1044	88
26	0703	101	0538	1330	1956	259	2121	2226	1142	80
27	0704	101	0539	1329	1955	259	2119	2300	1239	72
28	0704	100	0540	1329	1954	260	2118	2339	1337	64
29	0705	100	0541	1329	1952	260	2117	DNR	1434	54

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ⛢ Uranus
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

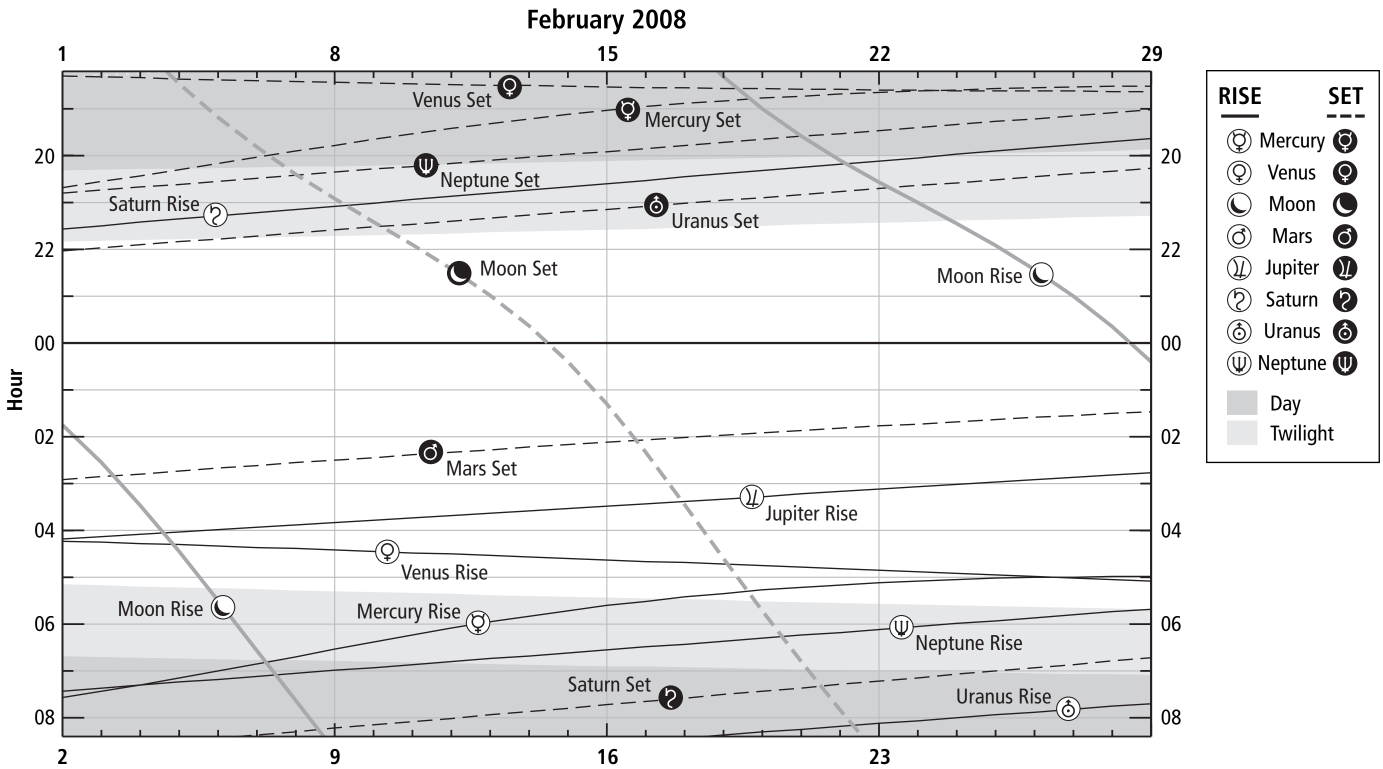


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY Rise h m	MERCURY Set h m	VENUS Rise h m	VENUS Set h m	MARS Rise h m	MARS Set h m	JUPITER Rise h m	JUPITER Set h m	SATURN Rise h m	SATURN Set h m	URANUS Rise h m	URANUS Set h m	NEPTUNE Rise h m	NEPTUNE Set h m
1	0740	2041	0412	1818	1716	0259	0414	1820	2134	0848	0929	2202	0729	2048
2	0734	2033	0414	1819	1712	0255	0411	1817	2130	0843	0925	2158	0726	2044
3	0726	2026	0415	1820	1709	0251	0408	1814	2125	0839	0921	2154	0722	2040
4	0718	2018	0417	1822	1705	0248	0405	1811	2121	0835	0917	2150	0718	2037
5	0709	2010	0418	1823	1701	0244	0402	1808	2117	0831	0914	2147	0714	2033
6	0700	2002	0420	1824	1658	0240	0359	1805	2113	0826	0910	2143	0711	2029
7	0651	1954	0422	1825	1654	0237	0356	1802	2109	0822	0906	2139	0707	2025
8	0642	1947	0423	1826	1650	0233	0353	1759	2105	0818	0903	2135	0703	2021
9	0632	1939	0425	1827	1647	0230	0350	1756	2101	0813	0859	2131	0659	2017
10	0623	1932	0427	1828	1643	0227	0347	1753	2056	0809	0855	2128	0656	2014
11	0614	1925	0429	1829	1640	0223	0344	1750	2052	0805	0852	2124	0652	2010
12	0605	1919	0430	1830	1637	0220	0341	1746	2048	0801	0848	2120	0648	2006
13	0557	1913	0432	1830	1633	0217	0338	1743	2044	0756	0844	2116	0644	2002
14	0550	1907	0434	1831	1630	0213	0335	1740	2040	0752	0841	2112	0641	1958
15	0543	1902	0436	1832	1627	0210	0332	1737	2036	0748	0837	2109	0637	1955
16	0536	1857	0438	1833	1624	0207	0329	1734	2032	0743	0833	2105	0633	1951
17	0531	1853	0440	1833	1621	0204	0326	1731	2027	0739	0829	2101	0629	1947
18	0525	1850	0441	1834	1617	0201	0323	1728	2023	0735	0826	2057	0626	1943
19	0521	1846	0443	1834	1614	0158	0320	1724	2019	0730	0822	2054	0622	1939
20	0516	1844	0445	1835	1611	0155	0317	1721	2015	0726	0818	2050	0618	1935
21	0513	1841	0447	1835	1608	0152	0313	1718	2011	0722	0815	2046	0614	1932
22	0510	1839	0449	1836	1605	0149	0310	1715	2007	0717	0811	2042	0611	1928
23	0507	1837	0451	1836	1603	0146	0307	1712	2003	0713	0807	2038	0607	1924
24	0505	1836	0453	1837	1600	0144	0304	1709	1958	0709	0804	2035	0603	1920
25	0503	1834	0455	1837	1557	0141	0301	1705	1954	0704	0800	2031	0559	1916
26	0501	1833	0457	1837	1554	0138	0258	1702	1950	0700	0756	2027	0556	1913
27	0500	1832	0459	1837	1551	0135	0255	1659	1946	0656	0753	2023	0552	1909
28	0500	1831	0501	1838	1548	0133	0252	1656	1942	0652	0749	2020	0548	1905
29	0459	1831	0503	1838	1546	0130	0249	1652	1938	0647	0745	2016	0544	1901

SOLAR SYSTEM RISE/SET



Daylight Saving in effect

JUPITER MOONS + GREAT RED SPOT

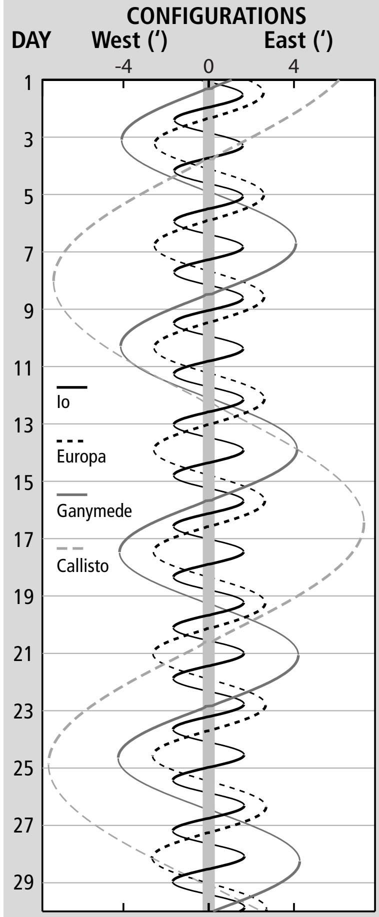
DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event	DAY	PHENOMENON h m	Sat.	Event
1	0414	III	Sh.I.	7	0539	I	Sh.I.	12	0607	IV	Oc.D.	22	0510		GRS
2	0640	II	Sh.I.	7	0623	I	Tr.I.	12	0648		GRS	22	0646	I	Ec.D.
3	0417		GRS	8	0600	I	Oc.R.	15	0419		GRS	23	0355	I	Sh.I.
4	0457	II	Oc.R.	10	0508		GRS	15	0453	I	Ec.D.	23	0452	I	Tr.I.
5	0557		GRS	12	0436	III	Oc.R.	16	0415	I	Sh.E.	23	0608	I	Sh.E.
								16	0507	I	Tr.E.	24	0429	I	Oc.R.
								17	0559		GRS	24	0650		GRS
								18	0600	II	Ec.D.	26	0615	III	Ec.D.
								19	0511	III	Ec.R.	27	0344	II	Sh.I.
								19	0557	III	Oc.D.	27	0422		GRS
								20	0331		GRS	27	0546	II	Tr.I.
								20	0349	II	Sh.E.	27	0624	II	Sh.E.
								20	0542	II	Tr.E.	29	0451	IV	Oc.R.
								20	0547	IV	Sh.I.	29	0601		GRS

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

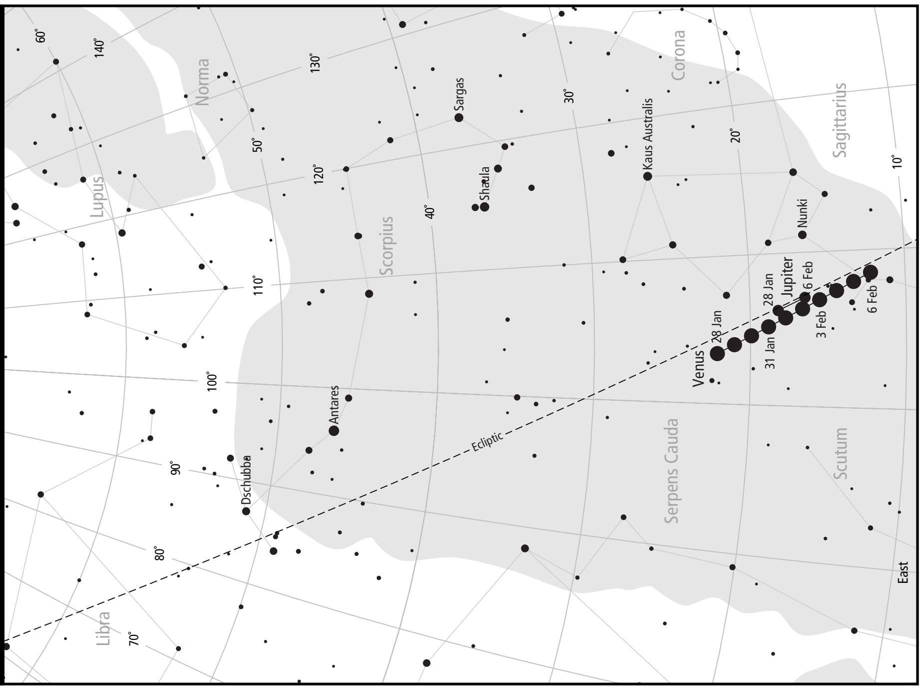
Events: D Disappear; E Egress; Ec Eclipse; Sh Shadow; R Reappear; I Ingress; Oc Occult; Tr Transit

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

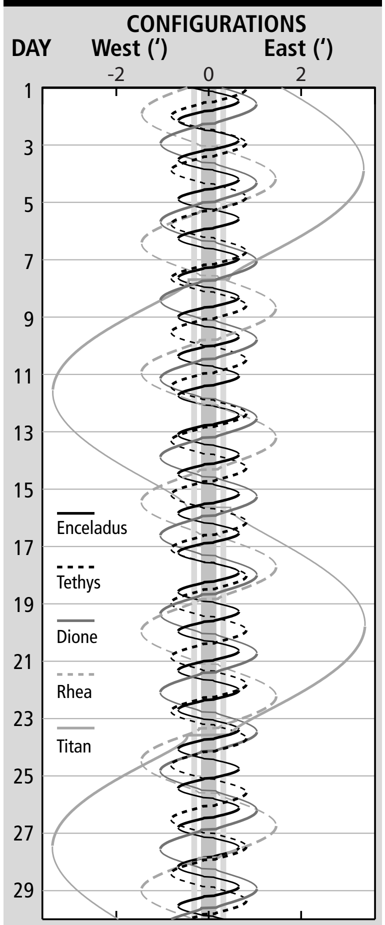
JUPITER MOONS



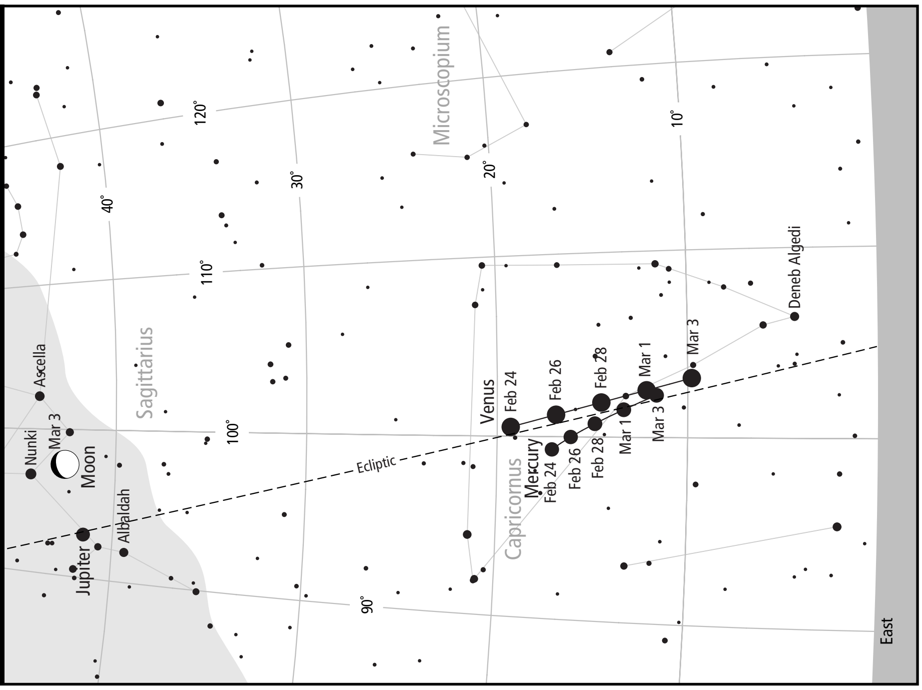
SKYVIEW 2008 JAN 28 - FEB 6 6am



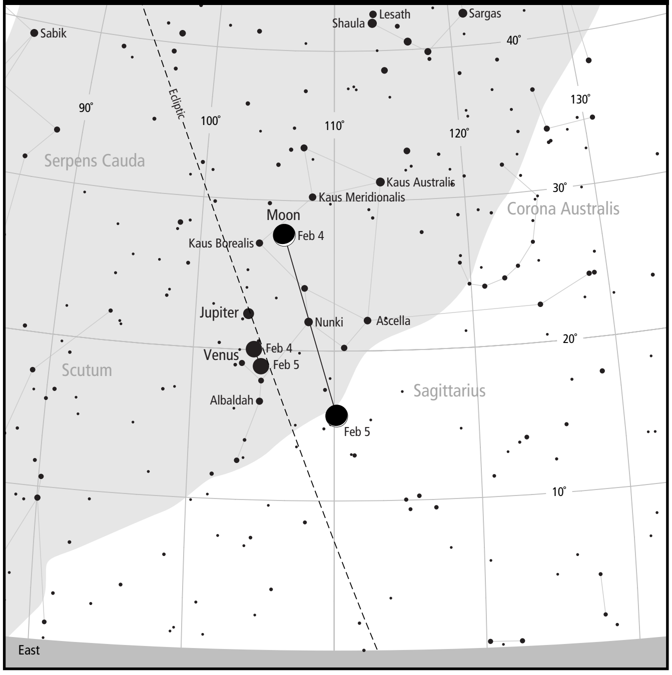
SATURN MOONS



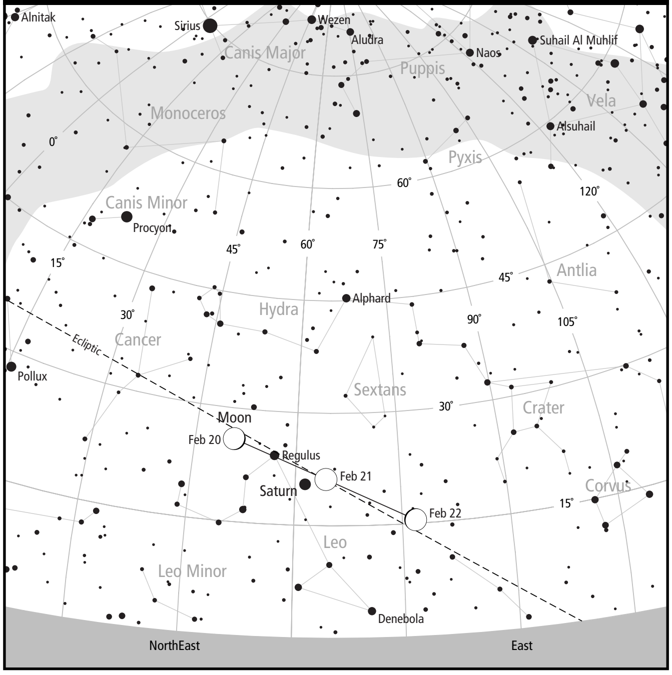
SKYVIEW 2008 FEB 24 - MAR 3 6.30am



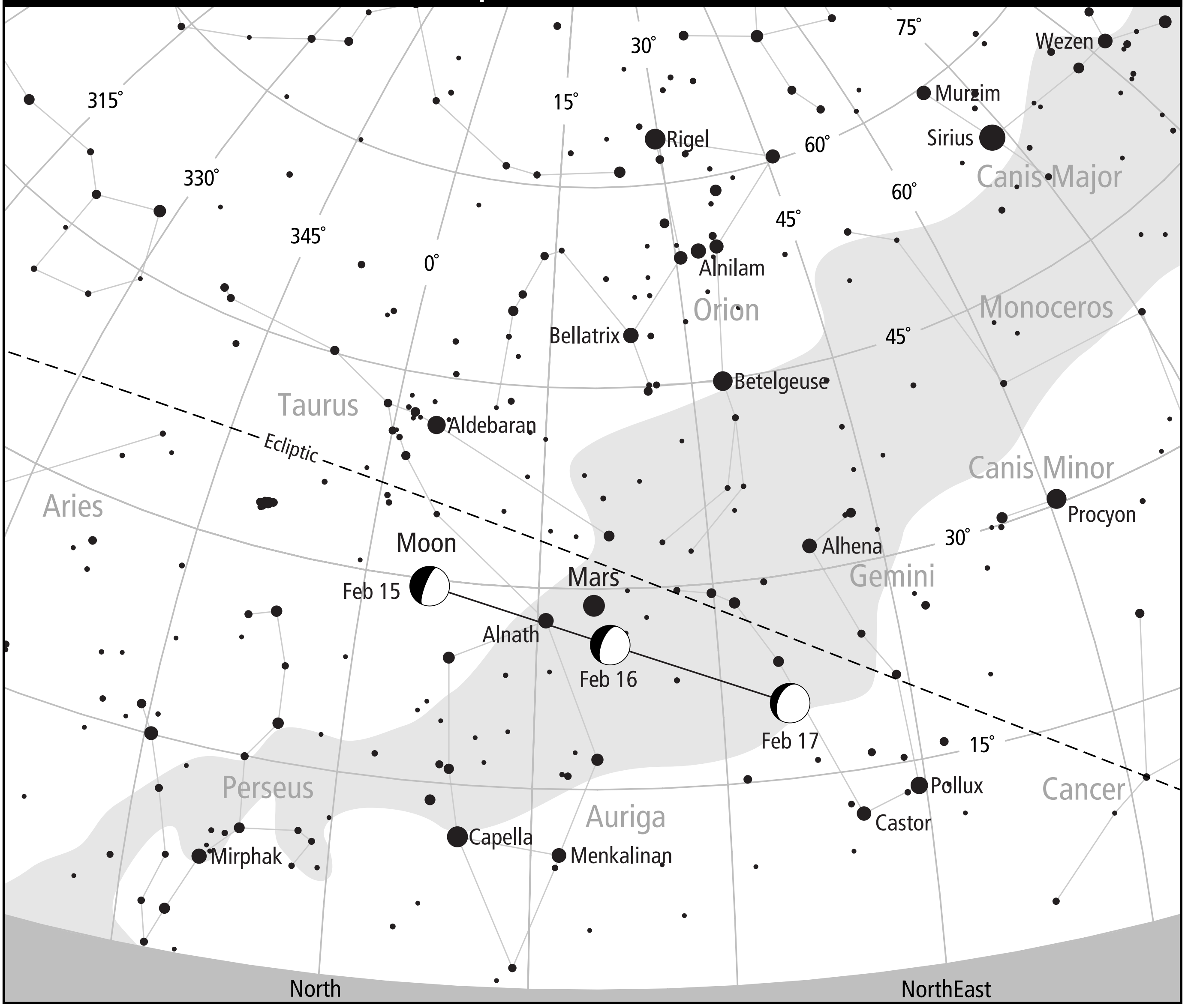
SKYVIEW 2008 FEBRUARY 4-5 6am



SKYVIEW 2008 FEBRUARY 20-22 10pm



SKYVIEW 2008 FEBRUARY 15-17 8pm



MARCH 2008

Daylight Saving in effect

HIGHLIGHTS

***Mercury** visible low in eastern morning twilight most of month. Close to Venus all month.*

***Venus** visible low in eastern morning twilight most of month. Close to Mercury all month.*

***Mars** visible all evening.*

***Jupiter** visible after midnight and near overhead at sunrise.*

***Saturn** visible all night early in month.*

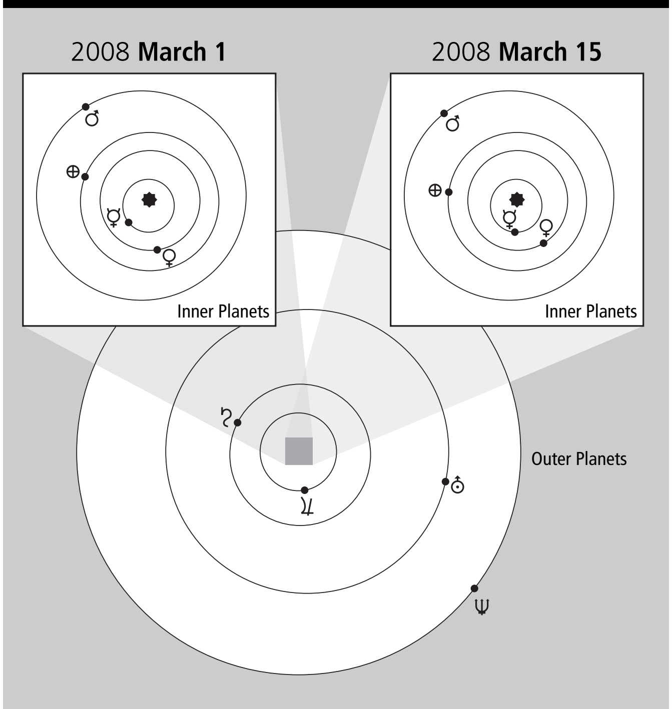
DIARY

Day	Hour	
3	10	Jupiter 4° N. of Moon
3	20	Mercury greatest elongation W. (27°)
5	23	Mercury 0°.2 N. of Moon
6	04	Venus 0°.2 S. of Moon
6	07	Neptune 0°.2 N. of Moon
7	05	Venus 0°.6 S. of Neptune
8	02	**New Moon**
9	05	Uranus in conjunction with Sun
9	12	Mercury 0°.9 S. of Neptune
13		Maximum activity of gamma-Normid meteor shower
14	20	**First Quarter**
15	12	Mars 1°.7 S. of Moon
19	17	*Regulus* 0°.8 N. of Moon
20	00	Saturn 3° N. of Moon
20	15	Equinox
22	04	**Full Moon**
23	19	Mercury 1°.0 S. of Venus
27	05	Moon at apogee
27	19	*Antares* 0°.5 N. of Moon
30	06	**Last Quarter**
31	01	Jupiter 3° N. of Moon

SUN+MOON RISE/SET

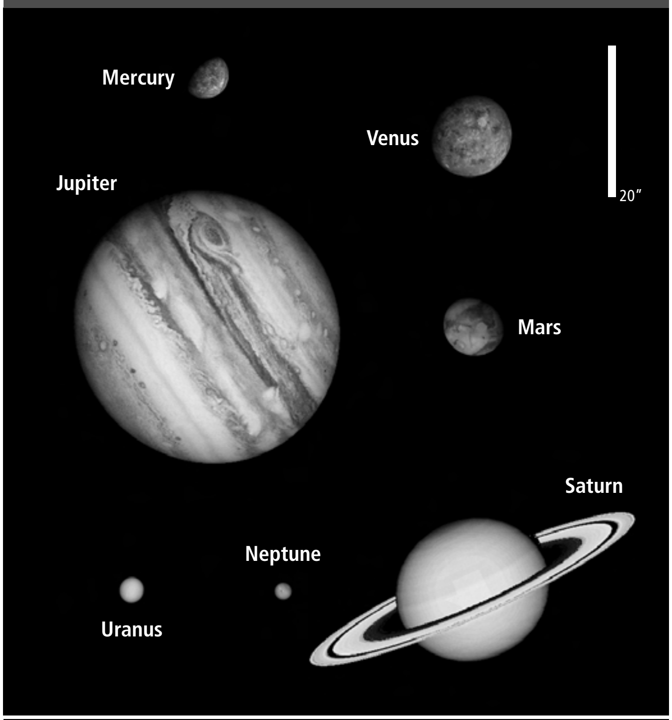
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn (%)
1	0706	99	0542	1329	1951	261	2115	0024	1528	45
2	0707	99	0543	1329	1950	261	2114	0115	1619	35
3	0708	99	0544	1329	1949	262	2112	0212	1704	26
4	0708	98	0545	1328	1948	262	2111	0313	1744	18
5	0709	98	0546	1328	1947	263	2110	0417	1820	11
6	0710	97	0547	1328	1945	263	2108	0521	1853	5
7	0711	97	0548	1328	1944	264	2107	0626	1924	1
8	0711	96	0548	1327	1943	264	2106	0731	1954	0
9	0712	96	0549	1327	1942	264	2104	0837	2025	1
10	0713	95	0550	1327	1940	265	2103	0946	2059	5
11	0714	95	0551	1327	1939	265	2101	1056	2138	12
12	0714	94	0552	1326	1938	266	2100	1208	2222	20
13	0715	94	0553	1326	1937	266	2059	1319	2314	30
14	0716	93	0554	1326	1935	267	2057	1426	DNS	41
15	0716	93	0554	1326	1934	267	2056	1525	0014	53
16	0717	93	0555	1325	1933	268	2055	1616	0119	64
17	0718	92	0556	1325	1932	268	2053	1659	0226	74
18	0719	92	0557	1325	1930	269	2052	1735	0333	83
19	0719	91	0558	1324	1929	269	2050	1807	0437	90
20	0720	91	0558	1324	1928	270	2049	1835	0538	95
21	0721	90	0559	1324	1926	270	2048	1902	0638	99
22	0721	90	0600	1323	1925	271	2046	1928	0736	100
23	0722	89	0601	1323	1924	271	2045	1956	0833	99
24	0723	89	0601	1323	1923	271	2044	2025	0930	96
25	0723	88	0602	1323	1921	272	2042	2058	1028	92
26	0724	88	0603	1322	1920	272	2041	2135	1126	86
27	0725	87	0603	1322	1919	273	2040	2218	1224	79
28	0725	87	0604	1322	1917	273	2039	2306	1319	71
29	0726	86	0605	1221	1916	274	2037	2300	1410	62
30	0627	86	0506	1221	1815	274	1936	2358	1357	53
31	0627	86	0506	1221	1814	275	1935	DNR	1438	43

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ⛢ Uranus
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

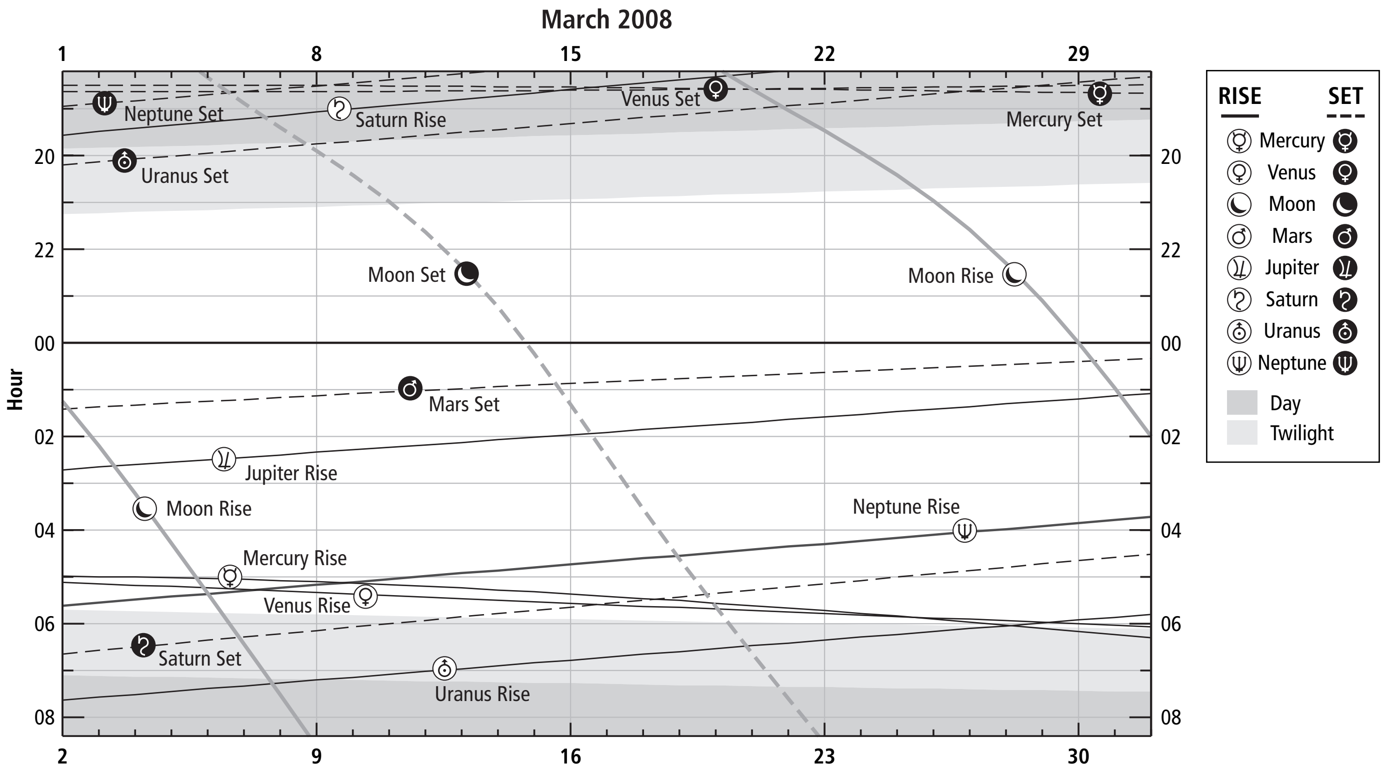


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY Rise h m	MERCURY Set h m	VENUS Rise h m	VENUS Set h m	MARS Rise h m	MARS Set h m	JUPITER Rise h m	JUPITER Set h m	SATURN Rise h m	SATURN Set h m	URANUS Rise h m	URANUS Set h m	NEPTUNE Rise h m	NEPTUNE Set h m
1	0459	1830	0505	1838	1543	0128	0246	1649	1934	0643	0742	2012	0541	1857
2	0459	1830	0507	1838	1540	0125	0243	1646	1929	0639	0738	2008	0537	1853
3	0500	1830	0509	1838	1538	0122	0239	1643	1925	0634	0734	2004	0533	1850
4	0500	1830	0511	1838	1535	0120	0236	1640	1921	0630	0731	2001	0529	1846
5	0501	1830	0512	1838	1533	0117	0233	1636	1917	0626	0727	1957	0525	1842
6	0502	1830	0514	1838	1530	0115	0230	1633	1913	0621	0723	1953	0522	1838
7	0503	1830	0516	1838	1528	0113	0227	1630	1909	0617	0720	1949	0518	1834
8	0505	1830	0518	1838	1525	0110	0224	1626	1904	0613	0716	1945	0514	1831
9	0506	1830	0520	1838	1523	0108	0220	1623	1900	0609	0712	1942	0510	1827
10	0508	1831	0522	1838	1520	0105	0217	1620	1856	0604	0709	1938	0507	1823
11	0510	1831	0524	1837	1518	0103	0214	1617	1852	0600	0705	1934	0503	1819
12	0512	1831	0526	1837	1515	0101	0211	1613	1848	0556	0701	1930	0459	1815
13	0514	1832	0528	1837	1513	0059	0208	1610	1844	0551	0658	1927	0455	1811
14	0517	1832	0530	1837	1510	0056	0204	1607	1840	0547	0654	1923	0452	1808
15	0519	1832	0532	1836	1508	0054	0201	1603	1835	0543	0650	1919	0448	1804
16	0522	1833	0534	1836	1506	0052	0158	1600	1831	0539	0647	1915	0444	1800
17	0525	1833	0536	1836	1503	0050	0155	1556	1827	0534	0643	1911	0440	1756
18	0528	1834	0538	1835	1501	0048	0151	1553	1823	0530	0639	1908	0436	1752
19	0530	1834	0539	1835	1459	0046	0148	1550	1819	0526	0636	1904	0433	1748
20	0534	1835	0541	1835	1457	0044	0145	1546	1815	0521	0632	1900	0429	1745
21	0537	1835	0543	1834	1454	0042	0142	1543	1811	0517	0628	1856	0425	1741
22	0540	1835	0545	1834	1452	0040	0138	1540	1807	0513	0625	1853	0421	1737
23	0543	1836	0547	1833	1450	0038	0135	1536	1802	0509	0621	1849	0418	1733
24	0547	1836	0549	1833	1448	0036	0132	1533	1758	0505	0617	1845	0414	1729
25	0550	1837	0551	1832	1445	0034	0128	1529	1754	0500	0614	1841	0410	1725
26	0554	1838	0553	1832	1443	0032	0125	1526	1750	0456	0610	1837	0406	1722
27	0558	1838	0554	1831	1441	0030	0122	1522	1746	0452	0606	1834	0402	1718
28	0602	1839	0556	1831	1439	0028	0118	1519	1742	0448	0603	1830	0359	1714
29	0606	1839	0558	1830	1437	0026	0115	1515	1738	0443	0559	1826	0355	1710
30	0510	1740	0500	1730	1334	0024	0112	1412	1634	0539	0455	1722	0251	1606
30						2322								
31	0514	1740	0502	1729	1332	2322	0008	1408	1630	0335	0452	1719	0247	1602

SOLAR SYSTEM RISE/SET



Daylight Saving in effect

JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Sat.	Event
1	0322	III	Tr.E.
1	0548	I	Sh.I.
1	0651	I	Tr.I.
2	0308	I	Ec.D.
2	0627	I	Oc.R.
3	0333		GRS
3	0335	I	Tr.E.
5	0512		GRS
5	0619	II	Sh.I.
7	0525	II	Oc.R.
7	0652		GRS

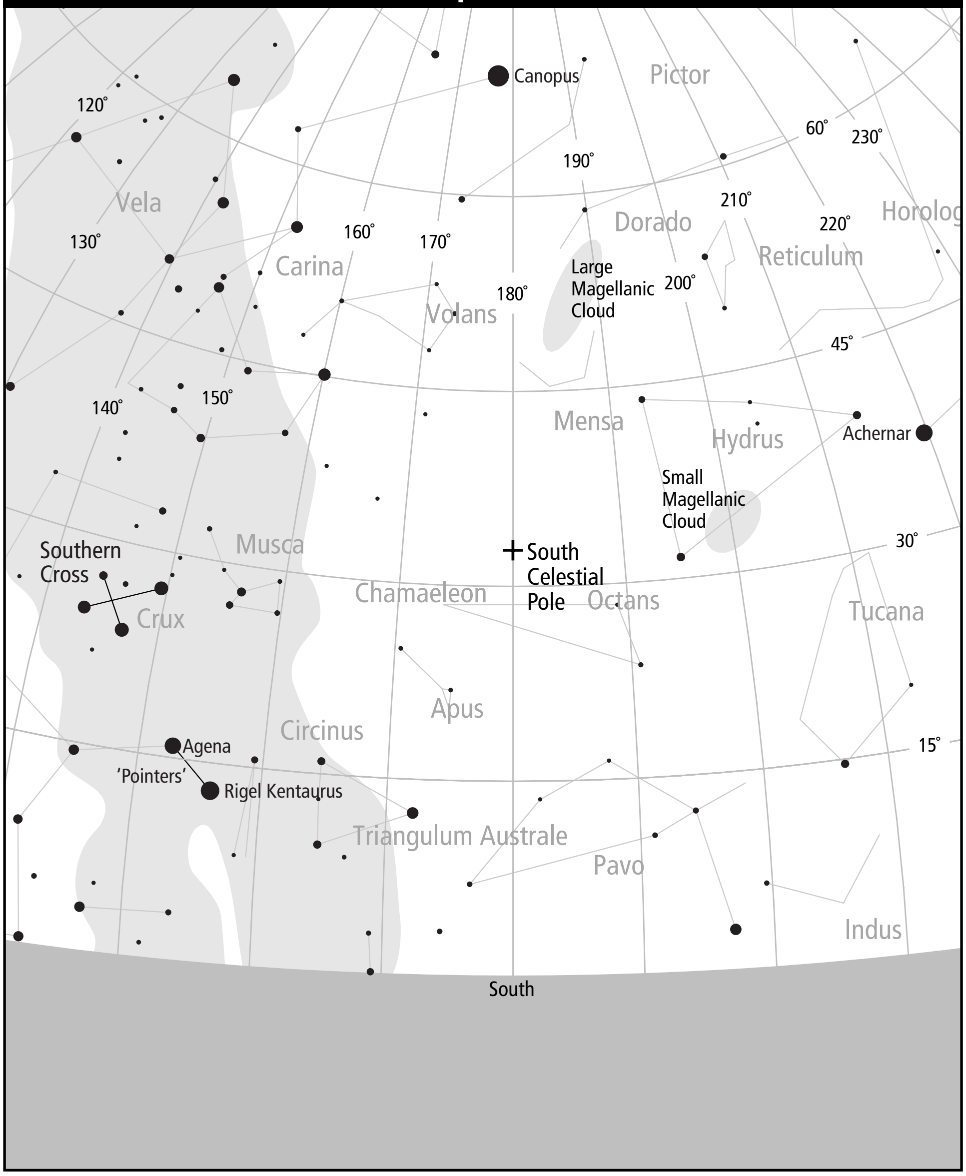
DAY	PHENOMENON h m	Sat.	Event
8	0244		GRS
8	0301	III	Sh.E.
8	0435	III	Tr.I.
9	0502	I	Ec.D.
10	0318	I	Tr.I.
10	0423		GRS
10	0424	I	Sh.E.
10	0532	I	Tr.E.
11	0254	I	Oc.R.
12	0603		GRS
14	0302	II	Ec.D.

DAY	PHENOMENON h m	Sat.	Event
15	0334		GRS
15	0404	III	Sh.I.
15	0700	III	Sh.E.
16	0314	II	Tr.E.
16	0655	I	Ec.D.
17	0404	I	Sh.I.
17	0513		GRS
17	0515	I	Tr.I.
17	0618	I	Sh.E.
18	0451	I	Oc.R.
19	0159	I	Tr.E.
19	0208	III	Oc.R.
19	0653		GRS
20	0245		GRS
21	0537	II	Ec.D.
22	0424		GRS
23	0312	II	Tr.I.
23	0325	II	Sh.E.
23	0554	II	Tr.E.
24	0558	I	Sh.I.

DAY	PHENOMENON h m	Sat.	Event
24	0604		GRS
24	0711	I	Tr.I.
25	0155		GRS
25	0317	I	Ec.D.
25	0510	IV	Tr.I.
25	0647	I	Oc.R.
26	0140	I	Tr.I.
26	0240	I	Sh.E.
26	0309	III	Oc.D.
26	0355	I	Tr.E.
26	0617	III	Oc.R.
27	0335		GRS
29	0514		GRS
30	0220	II	Sh.I.
30	0450	II	Tr.I.
30	0459	II	Sh.E.
31	0553		GRS

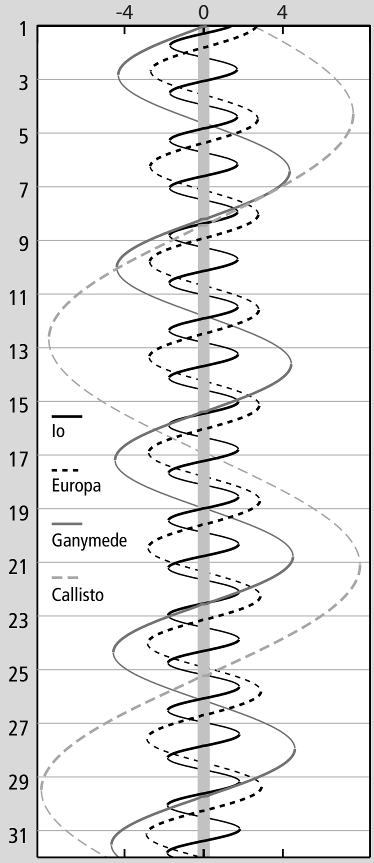
Moons: I Io, II Europa, III Ganymede, IV Callisto
Events: D Disappear, E Egress, Ec Eclipse, Sh Shadow, R Reappear, I Ingress, Oc Occult, Tr Transit
GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

SKYVIEW 2008 MARCH 15 8pm



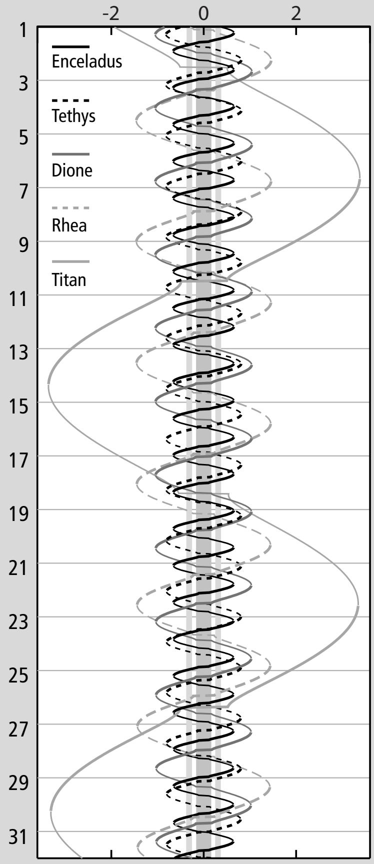
JUPITER MOONS

CONFIGURATIONS
DAY West (') East (')

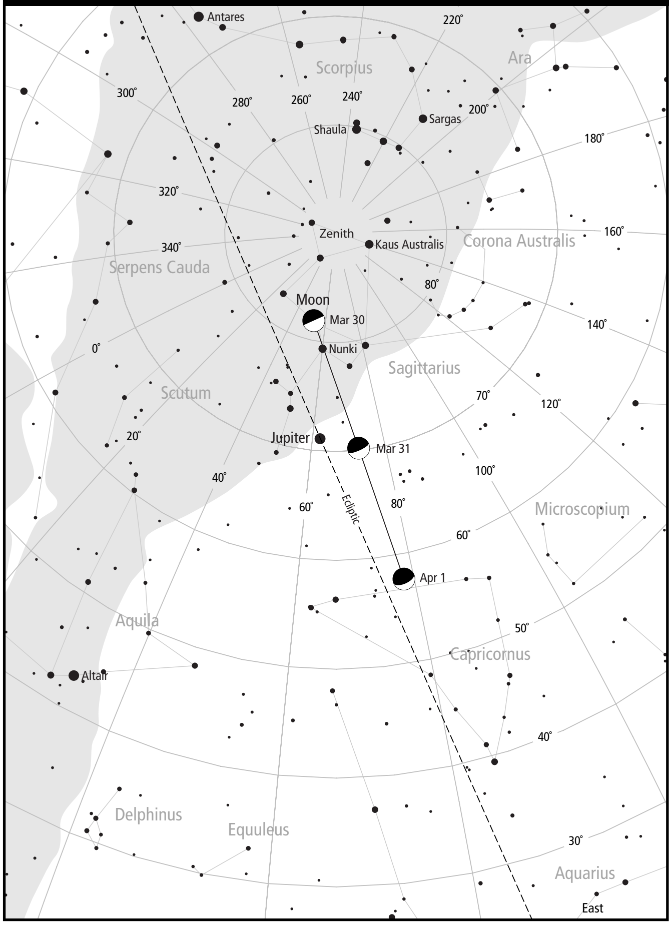


SATURN MOONS

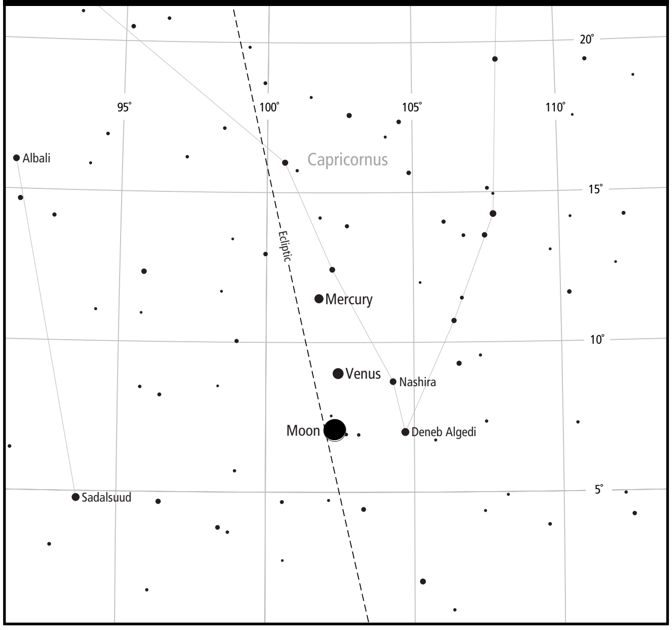
CONFIGURATIONS
DAY West (') East (')



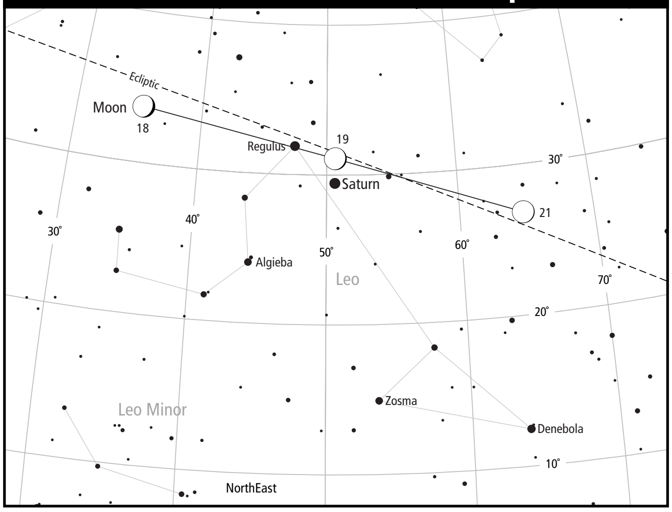
SKYVIEW 2008 MAR 30 - APR 1 6am



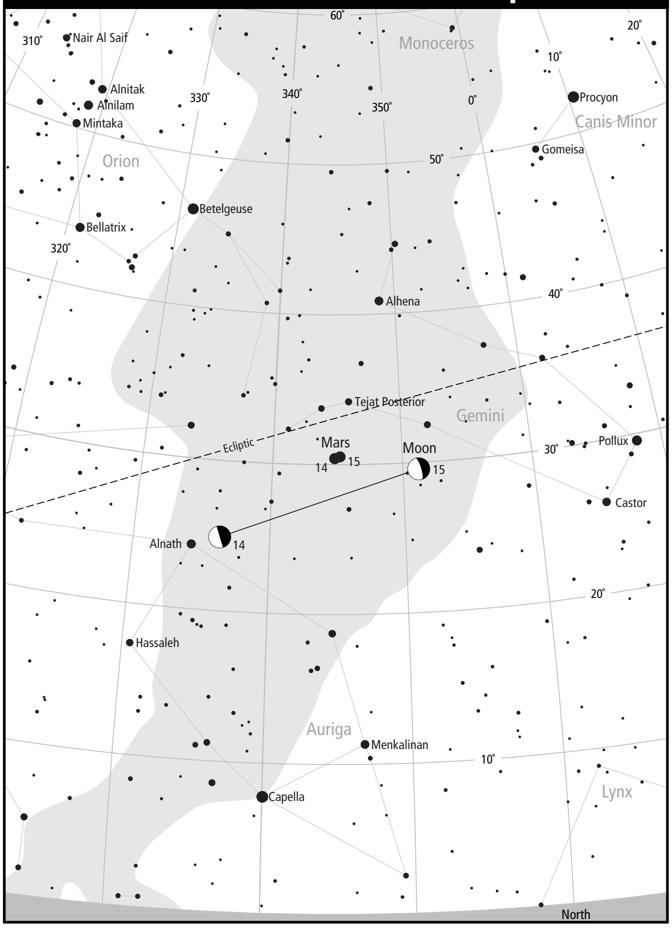
SKYVIEW 2008 MARCH 6 6am



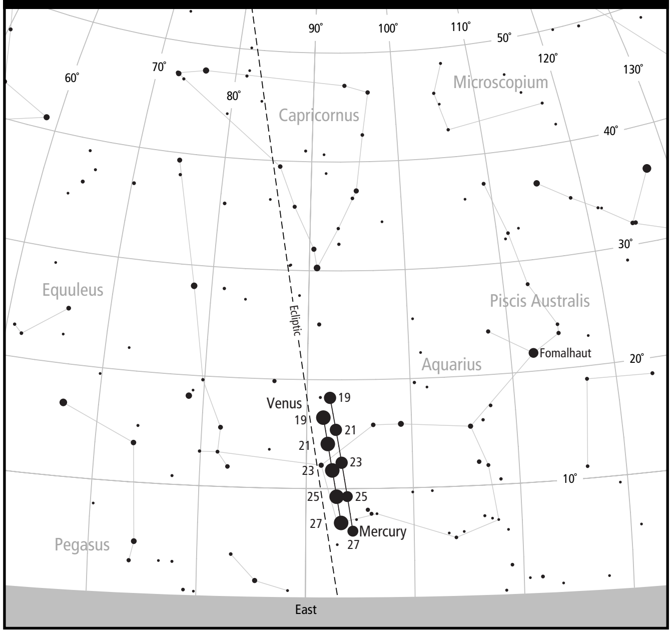
SKYVIEW 2008 MARCH 18-20 9pm



SKYVIEW 2008 MARCH 14-15 9pm



SKYVIEW 2008 MARCH 19-27 7am



HIGHLIGHTS

MERCURY *visible very low in eastern morning twilight in the first week of month.*

Venus *visible in the eastern morning twilight.*

Mars *visible in the west in the evening, sets before midnight.*

Jupiter *rises around midnight.*

Saturn *visible all evening and sets in the west well after midnight.*

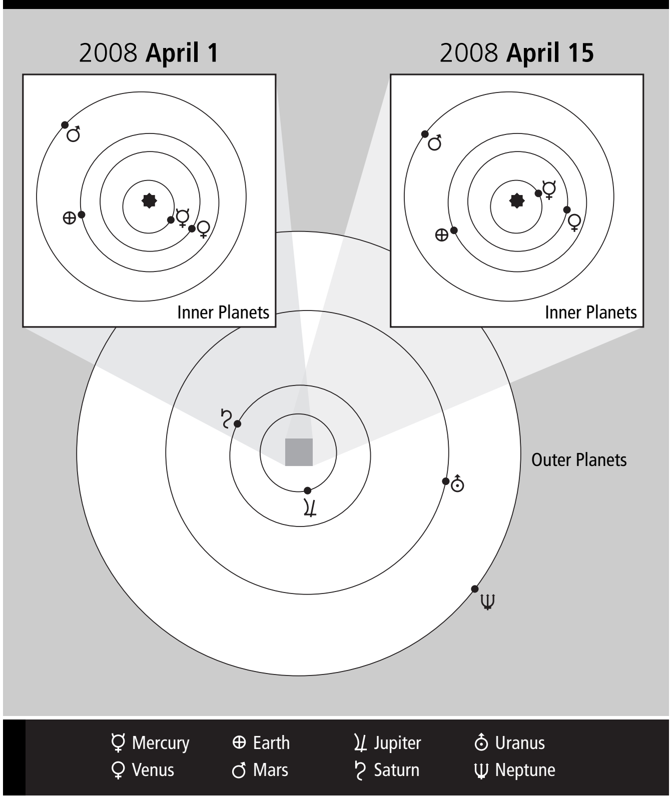
DIARY

Day	Hour	
2	17	Neptune 0°.002 S. of Moon
4	18	Uranus 3° S. of Moon
5	09	Venus 5° S. of Moon
6	12	**New Moon**
8	03	Moon at perigee
12	14	Mars 1°.2 S. of Moon
13	03	**First Quarter**
15	22	*Regulus* 0°.9 N. of Moon
16	02	Saturn 3° N. of Moon
16	15	Mercury in superior conjunction
20	18	**Full Moon**
22		Maximum activity of pi-Puppids meteors
23	18	Moon at apogee
23	23	*Antares* 0°.3 N. of Moon - occultation
27	13	Jupiter 3° N. of Moon
28	22	**Last Quarter**
29	04	Mars 5° S. of *Pollux*
30	03	Neptune 0°.3 S. of Moon

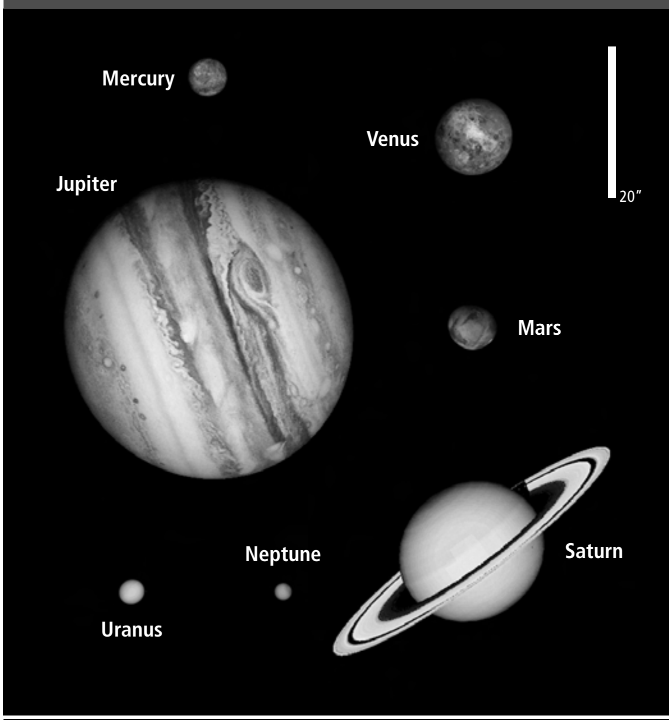
SUN+MOON RISE/SET

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 (%)
1	0628	85	0507	1220	1812	275	1933	0100	1515	33
2	0629	85	0508	1220	1811	276	1932	0202	1549	24
3	0629	84	0508	1220	1810	276	1931	0306	1620	15
4	0630	84	0509	1220	1809	276	1930	0410	1651	8
5	0631	83	0510	1219	1807	277	1928	0516	1722	3
6	0631	83	0510	1219	1806	277	1927	0625	1755	0
7	0632	82	0511	1219	1805	278	1926	0736	1832	1
8	0633	82	0512	1218	1804	278	1925	0849	1916	4
9	0633	82	0512	1218	1802	279	1924	1003	2007	9
10	0634	81	0513	1218	1801	279	1922	1114	2106	17
11	0635	81	0513	1218	1800	280	1921	1219	2211	27
12	0635	80	0514	1217	1759	280	1920	1313	2318	38
13	0636	80	0515	1217	1758	280	1919	1359	DNS	49
14	0637	79	0515	1217	1757	281	1918	1437	0026	60
15	0637	79	0516	1217	1755	281	1917	1509	0130	70
16	0638	79	0517	1216	1754	282	1916	1538	0232	79
17	0639	78	0517	1216	1753	282	1915	1605	0331	87
18	0639	78	0518	1216	1752	282	1914	1632	0428	93
19	0640	77	0518	1216	1751	283	1913	1658	0525	97
20	0641	77	0519	1216	1750	283	1912	1727	0622	99
21	0642	76	0520	1215	1749	284	1911	1759	0719	100
22	0642	76	0520	1215	1748	284	1910	1834	0817	98
23	0643	76	0521	1215	1747	285	1909	1915	0915	95
24	0644	75	0521	1215	1745	285	1908	2001	1011	91
25	0644	75	0522	1215	1744	285	1907	2053	1103	85
26	0645	75	0523	1214	1743	286	1906	2149	1151	77
27	0646	74	0523	1214	1742	286	1905	2248	1234	69
28	0646	74	0524	1214	1741	286	1904	2348	1312	59
29	0647	73	0524	1214	1740	287	1903	DNR	1346	49
30	0648	73	0525	1214	1740	287	1902	0050	1417	39

PLANET POSITIONS



PLANET APPEARANCE

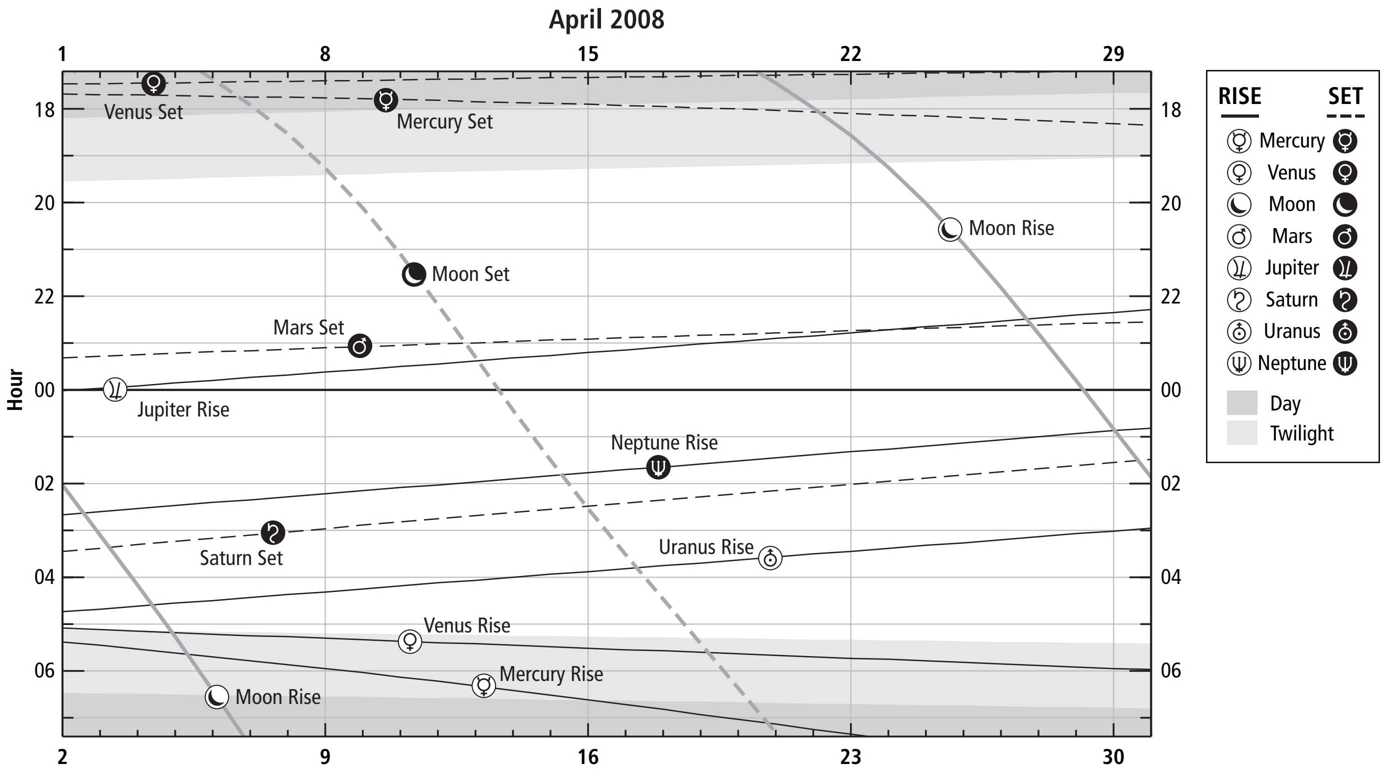


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY Rise h m	MERCURY Set h m	VENUS Rise h m	VENUS Set h m	MARS Rise h m	MARS Set h m	JUPITER Rise h m	JUPITER Set h m	SATURN Rise h m	SATURN Set h m	URANUS Rise h m	URANUS Set h m	NEPTUNE Rise h m	NEPTUNE Set h m
1	0518	1741	0504	1728	1330	2320	0005	1405	1626	0331	0448	1715	0243	1558
2	0523	1742	0505	1728	1328	2319	0001	1401	1621	0327	0444	1711	0240	1555
2							2358							
3	0527	1742	0507	1727	1326	2317	2355	1358	1617	0323	0441	1707	0236	1551
4	0532	1743	0509	1727	1324	2315	2351	1354	1613	0318	0437	1703	0232	1547
5	0537	1744	0511	1726	1322	2313	2348	1351	1609	0314	0433	1700	0228	1543
6	0542	1745	0513	1725	1319	2311	2344	1347	1605	0310	0430	1656	0224	1539
7	0547	1745	0515	1725	1317	2310	2341	1344	1601	0306	0426	1652	0221	1535
8	0552	1746	0516	1724	1315	2308	2337	1340	1557	0302	0422	1648	0217	1532
9	0557	1747	0518	1724	1313	2306	2334	1337	1553	0258	0419	1644	0213	1528
10	0602	1748	0520	1723	1311	2305	2330	1333	1549	0253	0415	1641	0209	1524
11	0608	1749	0522	1722	1309	2303	2327	1329	1545	0249	0411	1637	0205	1520
12	0613	1751	0524	1722	1307	2301	2323	1326	1541	0245	0407	1633	0202	1516
13	0619	1752	0525	1721	1305	2300	2319	1322	1537	0241	0404	1629	0158	1512
14	0625	1753	0527	1720	1303	2258	2316	1319	1533	0237	0400	1625	0154	1508
15	0631	1754	0529	1720	1301	2256	2312	1315	1529	0233	0356	1622	0150	1504
16	0637	1756	0531	1719	1259	2255	2309	1311	1525	0229	0353	1618	0146	1501
17	0643	1757	0533	1719	1257	2253	2305	1308	1521	0225	0349	1614	0142	1457
18	0649	1759	0534	1718	1255	2252	2301	1304	1517	0221	0345	1610	0139	1453
19	0656	1800	0536	1717	1252	2250	2258	1300	1513	0217	0342	1606	0135	1449
20	0702	1802	0538	1717	1250	2249	2254	1257	1509	0213	0338	1603	0131	1445
21	0708	1804	0540	1716	1248	2247	2251	1253	1505	0209	0334	1559	0127	1441
22	0715	1806	0542	1716	1246	2246	2247	1249	1501	0205	0330	1555	0123	1437
23	0721	1808	0544	1715	1244	2244	2243	1245	1457	0201	0327	1551	0119	1434
24	0727	1809	0545	1714	1242	2243	2239	1242	1453	0157	0323	1547	0116	1430
25	0734	1811	0547	1714	1240	2241	2236	1238	1449	0153	0319	1544	0112	1426
26	0740	1813	0549	1713	1238	2240	2232	1234	1445	0149	0316	1540	0108	1422
27	0746	1815	0551	1713	1236	2238	2228	1230	1441	0145	0312	1536	0104	1418
28	0752	1817	0553	1712	1234	2237	2224	1227	1437	0141	0308	1532	0100	1414
29	0758	1819	0555	1712	1232	2235	2221	1223	1433	0137	0304	1528	0056	1410
30	0803	1821	0557	1711	1230	2234	2217	1219	1429	0133	0301	1525	0052	1406

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

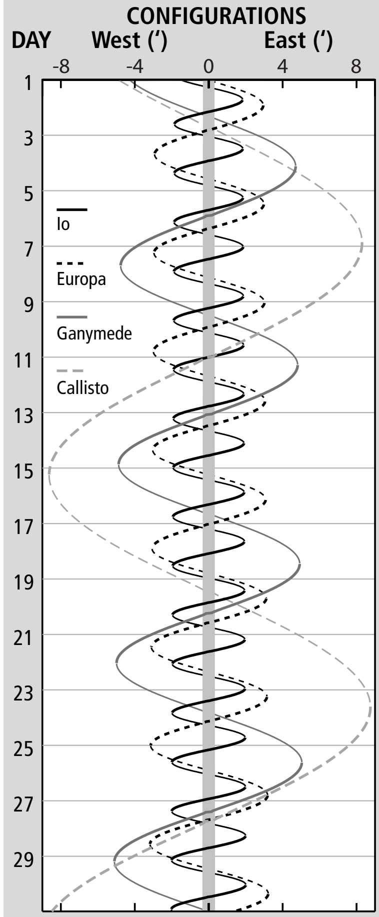
DAY	PHENOMENON h m	Sat.	Event
1	0145		GRS
1	0151	II	Oc.R.
1	0410	I	Ec.D.
2	0105	III	Ec.D.
2	0120	I	Sh.I.
2	0236	I	Tr.I.
2	0322	IV	Ec.D.
2	0334	I	Sh.E.
2	0406	III	Ec.R.
2	0451	I	Tr.E.
2	0557	IV	Ec.R.
2	0613	III	Oc.D.
3	0211	I	Oc.R.
3	0324		GRS
5	0504		GRS
6	0055		GRS
6	0454	II	Sh.I.
8	0235		GRS
8	0429	II	Oc.R.
8	0604	I	Ec.D.
9	0313	I	Sh.I.
9	0430	I	Tr.I.
9	0503	III	Ec.D.
9	0527	I	Sh.E.
10	0032	I	Ec.D.
10	0405	I	Oc.R.
10	0414		GRS
10	2356	I	Sh.E.
11	0006		GRS
11	0114	I	Tr.E.
11	0155	IV	Tr.E.
12	0553		GRS
13	0010	III	Tr.I.
13	0145		GRS
13	0319	III	Tr.E.
15	0141	II	Ec.D.
15	0324		GRS
15	2316		GRS
16	0507	I	Sh.I.
16	0624	I	Tr.I.
16	2317	II	Tr.I.
16	2324	II	Sh.E.
17	0159	II	Tr.E.
17	0225	I	Ec.D.
17	0503		GRS
17	0558	I	Oc.R.
17	2335	I	Sh.I.
18	0052	I	Tr.I.
18	0055		GRS
18	0149	I	Sh.E.
18	0307	I	Tr.E.
19	0005	IV	Ec.R.
19	0026	I	Oc.R.
20	0157	III	Sh.E.
20	0234		GRS
20	0406	III	Tr.I.
22	0413		GRS
22	0417	II	Ec.D.
23	0005		GRS
23	2318	II	Sh.I.
24	0148	II	Tr.I.
24	0158	II	Sh.E.
24	0418	I	Ec.D.
24	0430	II	Tr.E.
24	0553		GRS
25	0129	I	Sh.I.
25	0144		GRS
25	0245	I	Tr.I.
25	0343	I	Sh.E.
25	0500	I	Tr.E.
25	2247	I	Ec.D.
25	2256	II	Oc.R.
26	0218	I	Oc.R.
26	2328	I	Tr.E.
27	0254	III	Sh.I.
27	0323		GRS
27	0430	IV	Sh.I.
27	0555	III	Sh.E.
27	2315		GRS
29	0502		GRS
30	0054		GRS

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

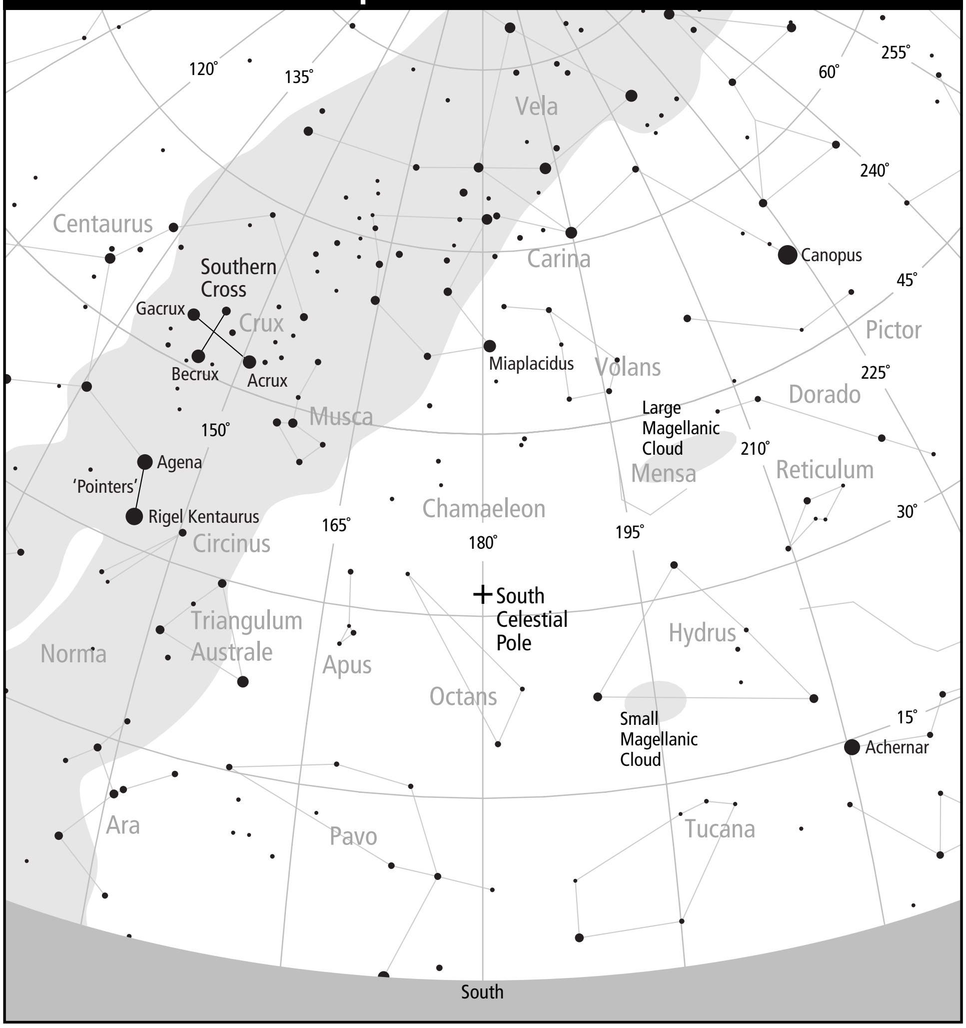
Events: D Disappear, R Reappear, E Egress, I Ingress, Ec Eclipse, Oc Occult, Sh Shadow, Tr Transit

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

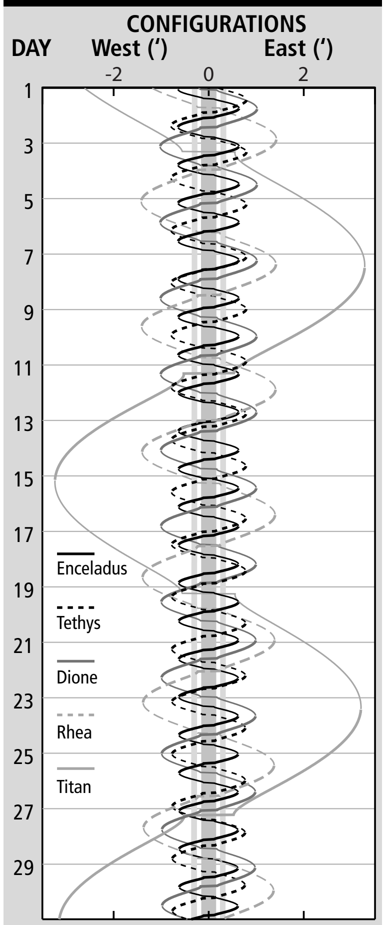
JUPITER MOONS



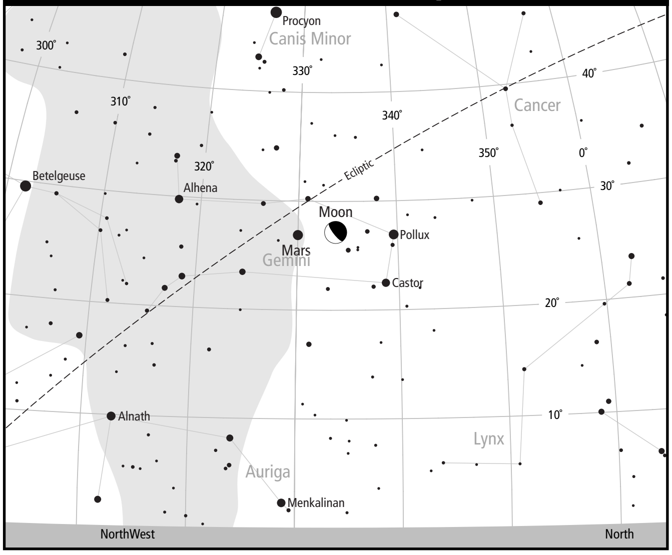
SKYVIEW APRIL 15 8pm – SOUTHERN CROSS



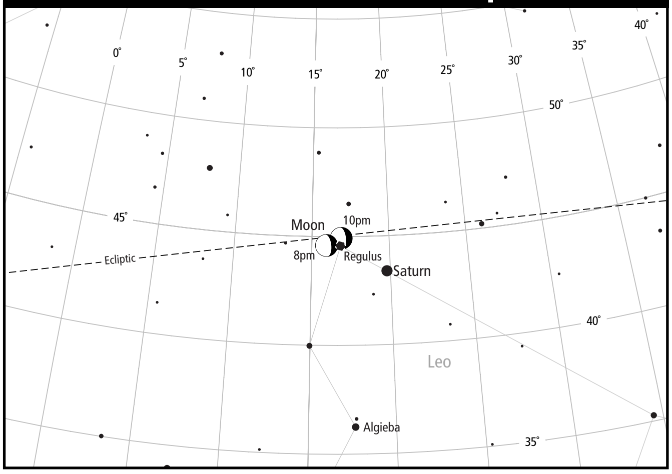
SATURN MOONS



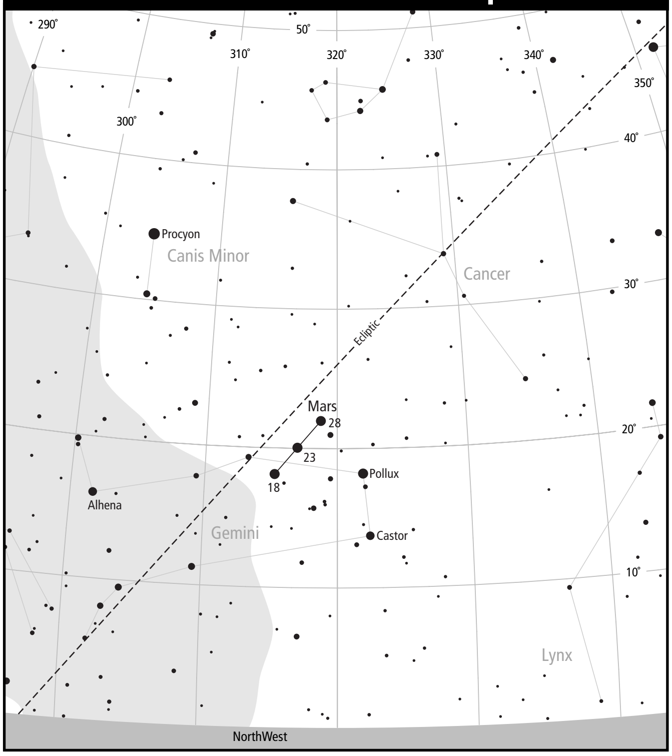
SKYVIEW 2008 APRIL 12 8pm



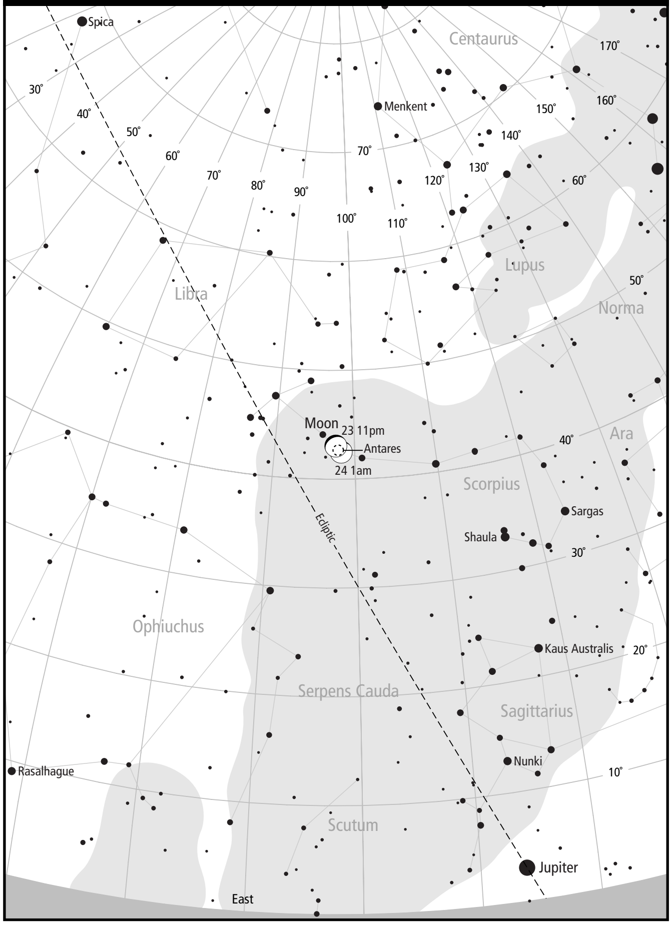
SKYVIEW 2008 APRIL 15 8-10pm



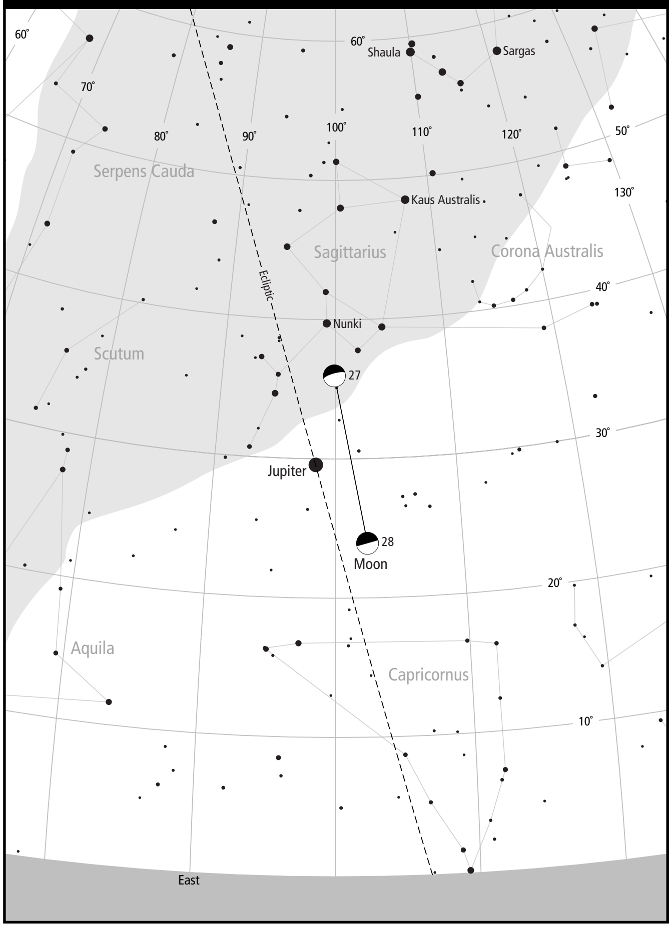
SKYVIEW 2008 APRIL 18-28 9pm



SKYVIEW 2008 APRIL 23-24



SKYVIEW 2008 APRIL 27-28 1am



MAY 2008

HIGHLIGHTS

***Mercury** visible very low in western evening twilight mid month.*

***Mars** visible in the north-west in the early evening.*

***Jupiter** rises before midnight.*

***Saturn** visible all evening, sets after midnight.*

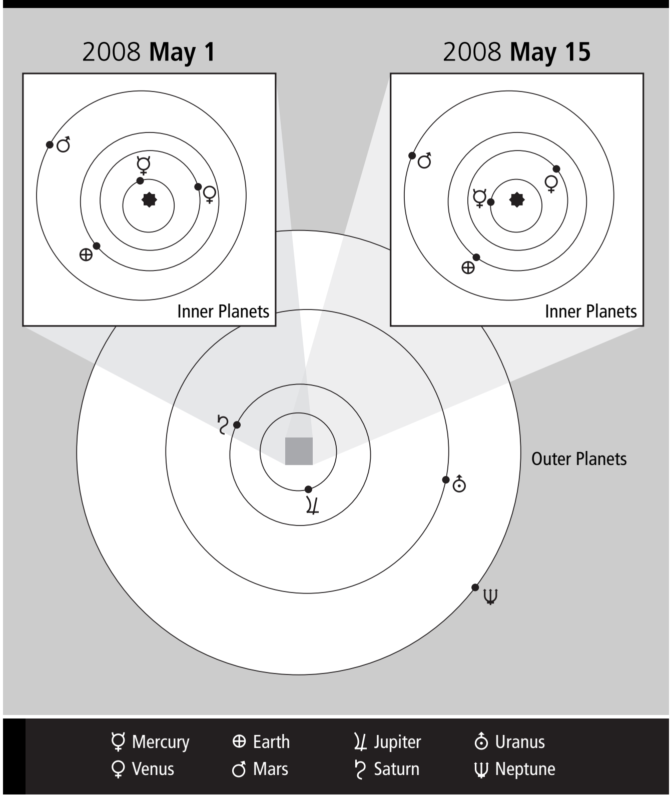
DIARY

Day	Hour	
2	07	Uranus 3° S. of Moon
3	21	Saturn stationary
5		Maximum activity of eta-Aquarid meteor shower
5	20	**New Moon**
6	11	Moon at perigee
7	06	Mercury 3° S. of Moon
9	23	Jupiter stationary
10	14	Mercury 8° N. of *Aldebaran*
10	22	Mars 0°.2 S. of Moon
12	12	**First Quarter**
13	03	*Regulus* 1°.2 N. of Moon
13	08	Saturn 3° N. of Moon
14	12	Mercury greatest elongation E. (22°)
20	10	**Full Moon**
20	22	Moon at apogee
21	07	*Antares* 0°.2 N. of Moon
24	19	Jupiter 2° N. of Moon
27	05	Mercury stationary
27	06	Neptune stationary
27	11	Neptune 0°.6 S. of Moon
28	11	**Last Quarter**
29	17	Uranus 4° S. of Moon

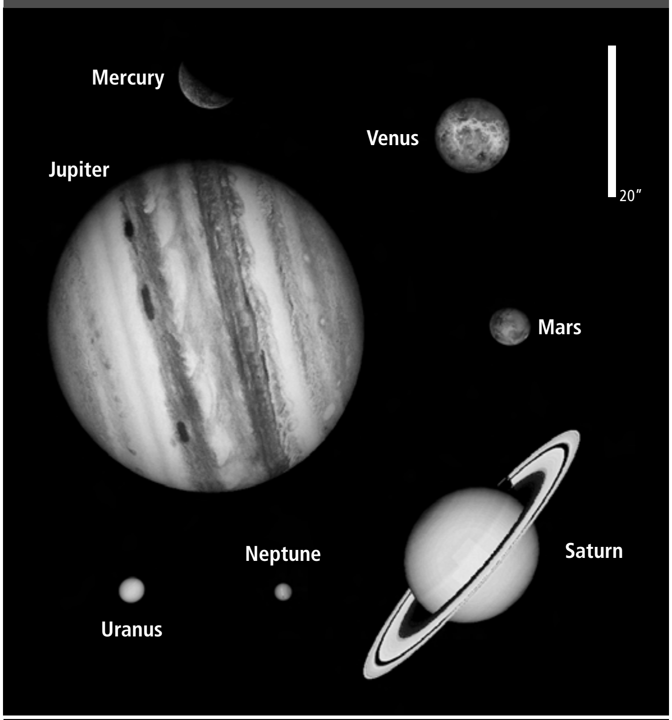
SUN+MOON RISE/SET

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 (%)
1	0648	73	0525	1214	1739	288	1902	0152	1447	29
2	0649	72	0526	1214	1738	288	1901	0255	1517	20
3	0650	72	0527	1213	1737	288	1900	0401	1549	12
4	0650	72	0527	1213	1736	289	1859	0510	1624	5
5	0651	71	0528	1213	1735	289	1858	0623	1705	1
6	0652	71	0528	1213	1734	289	1858	0738	1753	0
7	0653	71	0529	1213	1733	290	1857	0854	1850	2
8	0653	70	0529	1213	1733	290	1856	1003	1956	7
9	0654	70	0530	1213	1732	290	1856	1104	2105	15
10	0655	70	0531	1213	1731	291	1855	1155	2215	24
11	0655	69	0531	1213	1730	291	1854	1236	2322	34
12	0656	69	0532	1213	1730	291	1854	1311	DNS	45
13	0657	69	0532	1213	1729	291	1853	1341	0026	56
14	0657	68	0533	1213	1728	292	1853	1409	0126	66
15	0658	68	0533	1213	1728	292	1852	1435	0224	75
16	0659	68	0534	1213	1727	292	1852	1502	0320	83
17	0659	68	0535	1213	1726	293	1851	1530	0416	90
18	0700	67	0535	1213	1726	293	1851	1600	0513	95
19	0701	67	0536	1213	1725	293	1850	1635	0611	98
20	0701	67	0536	1213	1725	293	1850	1714	0708	100
21	0702	67	0537	1213	1724	294	1849	1758	0805	100
22	0703	66	0537	1213	1724	294	1849	1848	0859	98
23	0703	66	0538	1213	1723	294	1849	1943	0948	94
24	0704	66	0538	1213	1723	294	1848	2041	1032	89
25	0705	66	0539	1214	1722	294	1848	2140	1111	82
26	0705	65	0539	1214	1722	295	1848	2240	1146	74
27	0706	65	0540	1214	1722	295	1848	2340	1217	65
28	0706	65	0540	1214	1721	295	1847	0041	1247	55
29	0707	65	0541	1214	1721	295	1847	DNR	1315	44
30	0708	65	0541	1214	1721	295	1847	0143	1345	34
31	0708	64	0542	1214	1720	296	1847	0249	1418	24

PLANET POSITIONS



PLANET APPEARANCE

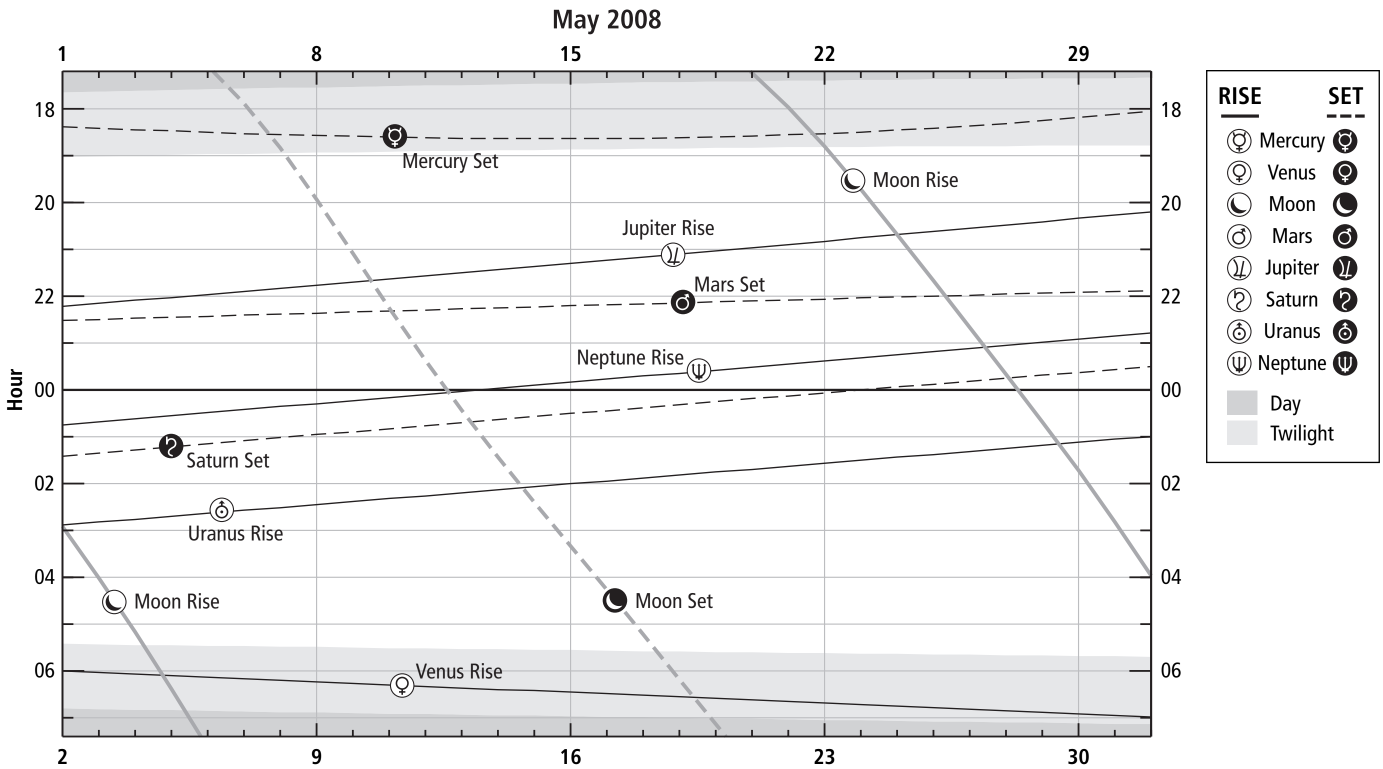


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY Rise h m	MERCURY Set h m	VENUS Rise h m	VENUS Set h m	MARS Rise h m	MARS Set h m	JUPITER Rise h m	JUPITER Set h m	SATURN Rise h m	SATURN Set h m	URANUS Rise h m	URANUS Set h m	NEPTUNE Rise h m	NEPTUNE Set h m
1	0809	1823	0558	1711	1228	2233	2213	1215	1425	0129	0257	1521	0049	1402
2	0814	1825	0600	1711	1226	2231	2209	1211	1421	0125	0253	1517	0045	1359
3	0818	1827	0602	1710	1224	2230	2205	1207	1417	0121	0249	1513	0041	1355
4	0823	1828	0604	1710	1222	2228	2202	1204	1413	0117	0246	1509	0037	1351
5	0827	1830	0606	1709	1220	2227	2158	1200	1409	0113	0242	1505	0033	1347
6	0831	1832	0608	1709	1217	2226	2154	1156	1405	0109	0238	1502	0029	1343
7	0834	1833	0610	1709	1215	2224	2150	1152	1401	0105	0234	1458	0025	1339
8	0837	1834	0612	1709	1213	2223	2146	1148	1357	0101	0231	1454	0021	1335
9	0840	1835	0614	1708	1211	2222	2142	1144	1354	0057	0227	1450	0018	1331
10	0842	1836	0616	1708	1209	2220	2138	1140	1350	0054	0223	1446	0014	1327
11	0844	1837	0618	1708	1207	2219	2134	1136	1346	0050	0219	1442	0010	1323
12	0846	1838	0620	1708	1205	2218	2130	1132	1342	0046	0216	1439	0006	1320
13	0847	1838	0622	1708	1203	2216	2126	1128	1338	0042	0212	1435	0002	1316
13													2358	
14	0848	1838	0624	1707	1201	2215	2122	1124	1334	0038	0208	1431	2354	1312
15	0848	1838	0625	1707	1159	2214	2118	1120	1330	0034	0204	1427	2350	1308
16	0848	1838	0627	1707	1157	2212	2114	1116	1326	0030	0200	1423	2346	1304
17	0847	1838	0629	1707	1155	2211	2110	1112	1322	0027	0157	1419	2342	1300
18	0846	1837	0631	1707	1152	2210	2106	1108	1319	0023	0153	1416	2339	1256
19	0845	1836	0633	1707	1150	2209	2102	1104	1315	0019	0149	1412	2335	1252
20	0843	1835	0635	1707	1148	2207	2058	1100	1311	0015	0145	1408	2331	1248
21	0841	1833	0637	1708	1146	2206	2054	1056	1307	0011	0142	1404	2327	1244
22	0839	1832	0639	1708	1144	2205	2050	1052	1303	0008	0138	1400	2323	1240
23	0836	1830	0641	1708	1142	2204	2045	1048	1259	0004	0134	1356	2319	1236
24	0832	1827	0643	1708	1140	2202	2041	1044	1255	0000	0130	1352	2315	1233
24										2356				
25	0829	1825	0645	1708	1138	2201	2037	1040	1252	2353	0126	1349	2311	1229
26	0824	1822	0647	1709	1136	2200	2033	1036	1248	2349	0123	1345	2307	1225
27	0820	1819	0649	1709	1133	2159	2029	1032	1244	2345	0119	1341	2303	1221
28	0815	1815	0651	1709	1131	2157	2025	1028	1240	2341	0115	1337	2259	1217
29	0810	1811	0653	1710	1129	2156	2020	1023	1236	2338	0111	1333	2255	1213
30	0804	1807	0655	1710	1127	2155	2016	1019	1233	2334	0107	1329	2251	1209
31	0758	1803	0657	1711	1125	2154	2012	1015	1229	2330	0103	1325	2247	1205

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Sat.	Event
1	0108	III	Oc.R.
1	0151	II	Sh.I.
1	0417	II	Tr.I.
1	0432	II	Sh.E.
1	0611	I	Ec.D.
1	0641		GRS
2	0233		GRS
2	0322	I	Sh.I.
2	0436	I	Tr.I.
2	0537	I	Sh.E.
2	2225		GRS
3	0040	I	Ec.D.
3	0127	II	Oc.R.
3	0408	I	Oc.R.
3	2304	I	Tr.I.
4	0006	I	Sh.E.
4	0119	I	Tr.E.
4	0412		GRS
4	2236	I	Oc.R.
5	0004		GRS
6	0220	IV	Oc.D.
6	0551		GRS
6	0555	IV	Oc.R.
7	0143		GRS
8	0001	III	Ec.R.

DAY	PHENOMENON h m	Sat.	Event
8	0140	III	Oc.D.
8	0425	II	Sh.I.
8	0453	III	Oc.R.
8	0644	II	Tr.I.
9	0322		GRS
9	0516	I	Sh.I.
9	0626	I	Tr.I.
9	2247	II	Ec.D.
9	2313		GRS
10	0233	I	Ec.D.
10	0356	II	Oc.R.
10	0558	I	Oc.R.
10	2345	I	Sh.I.
11	0054	I	Tr.I.
11	0159	I	Sh.E.
11	0309	I	Tr.E.
11	0501		GRS
11	2239	II	Tr.E.
12	0025	I	Oc.R.
12	0052		GRS
12	2136	I	Tr.E.
13	0640		GRS
13	2227	IV	Sh.I.
14	0128	IV	Sh.E.
14	0231		GRS

DAY	PHENOMENON h m	Sat.	Event
14	2223		GRS
15	0053	III	Ec.D.
15	0360	III	Ec.R.
15	0520	III	Oc.D.
15	0658	II	Sh.I.
16	0410		GRS
17	0002		GRS
17	0123	II	Ec.D.
17	0426	I	Ec.D.
17	0622	II	Oc.R.
18	0138	I	Sh.I.
18	0243	I	Tr.I.
18	0353	I	Sh.E.
18	0458	I	Tr.E.
18	0549		GRS
18	2218	III	Tr.E.
18	2220	II	Tr.I.
18	2255	I	Ec.D.
18	2256	II	Sh.E.
19	0102	II	Tr.E.
19	0141		GRS
19	0214	I	Oc.R.
19	2110	I	Tr.I.
19	2132		GRS
19	2222	I	Sh.E.
19	2325	I	Tr.E.
21	0320		GRS
21	2311		GRS
22	0451	III	Ec.D.
22	2211	IV	Oc.R.
23	0458		GRS
24	0050		GRS
24	0359	II	Ec.D.
24	0620	I	Ec.D.

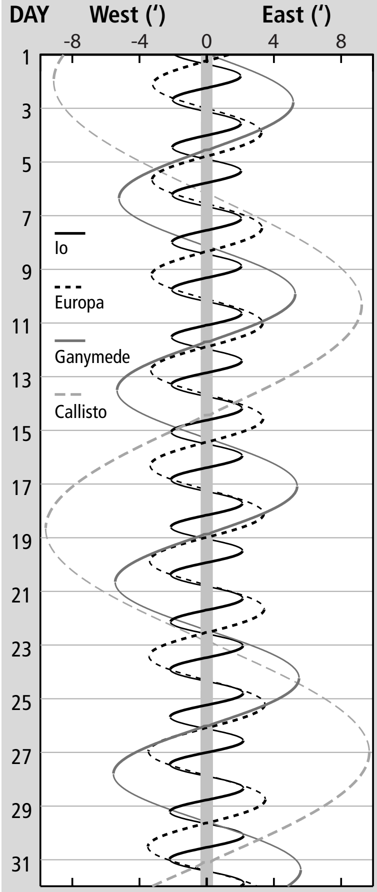
DAY	PHENOMENON h m	Sat.	Event
24	2042		GRS
25	0332	I	Sh.I.
25	0430	I	Tr.I.
25	0547	I	Sh.E.
25	0637		GRS
25	0646	I	Tr.E.
25	2154	III	Sh.E.
25	2240	III	Tr.I.
25	2248	II	Sh.I.
26	0041	II	Tr.I.
26	0048	I	Ec.D.
26	0129	II	Sh.E.
26	0153	III	Tr.E.
26	0229		GRS
26	0324	II	Tr.E.
26	0401	I	Oc.R.
26	2200	I	Sh.I.
26	2220		GRS
26	2257	I	Tr.I.
27	0016	I	Sh.E.
27	0113	I	Tr.E.
27	2159	II	Oc.R.
27	2227	I	Oc.R.
28	0408		GRS
28	2359		GRS
30	0547		GRS
31	0037	IV	Tr.I.
31	0138		GRS
31	0413	IV	Tr.E.
31	0635	II	Ec.D.
31	2130		GRS

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

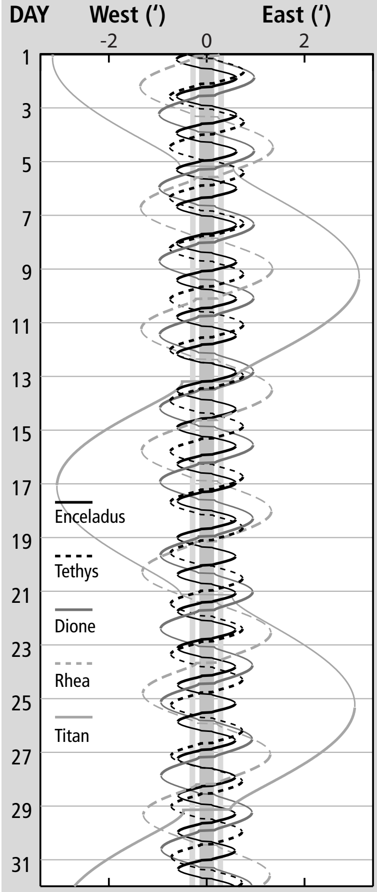
Events: D Disappear, R Reappear, E Egress, I Ingress, Ec Eclipse, Oc Occult, Sh Shadow, Tr Transit

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

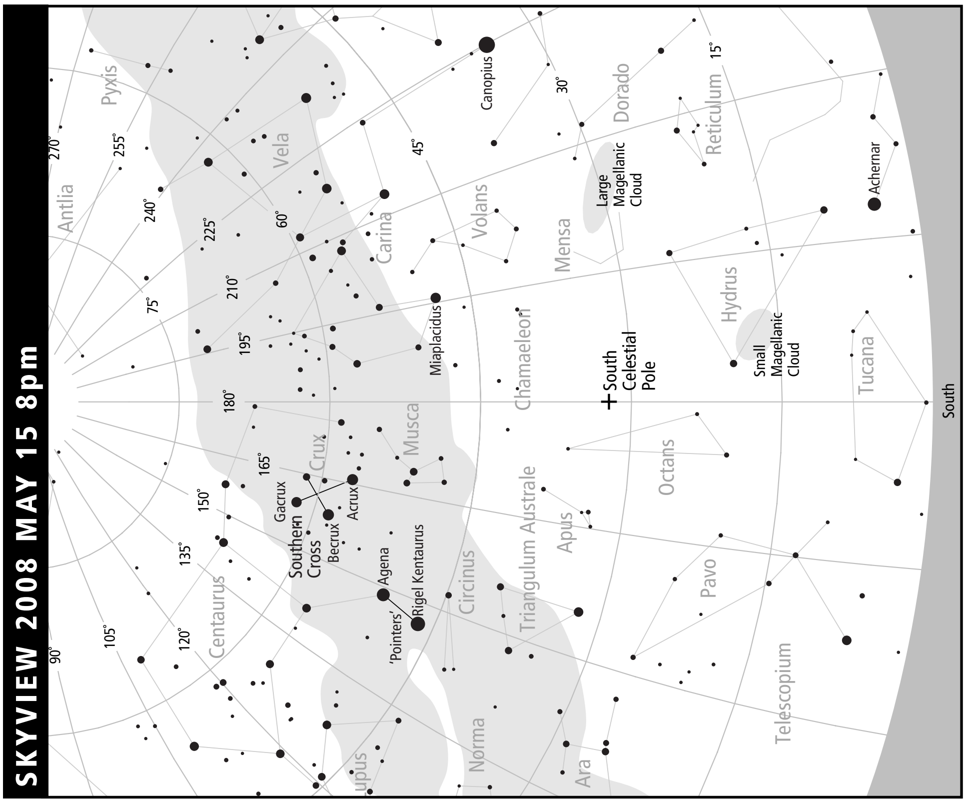
JUPITER MOONS



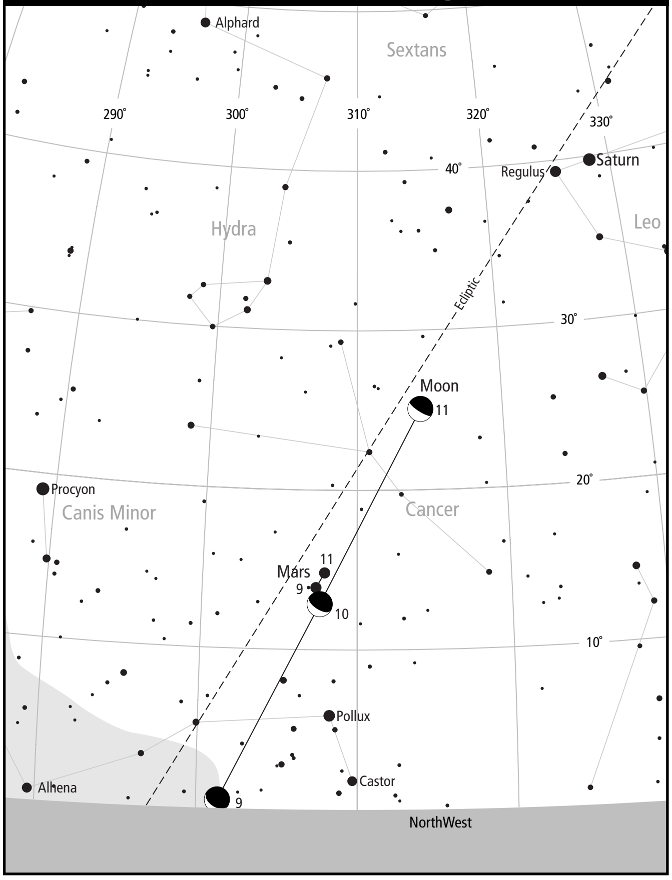
SATURN MOONS



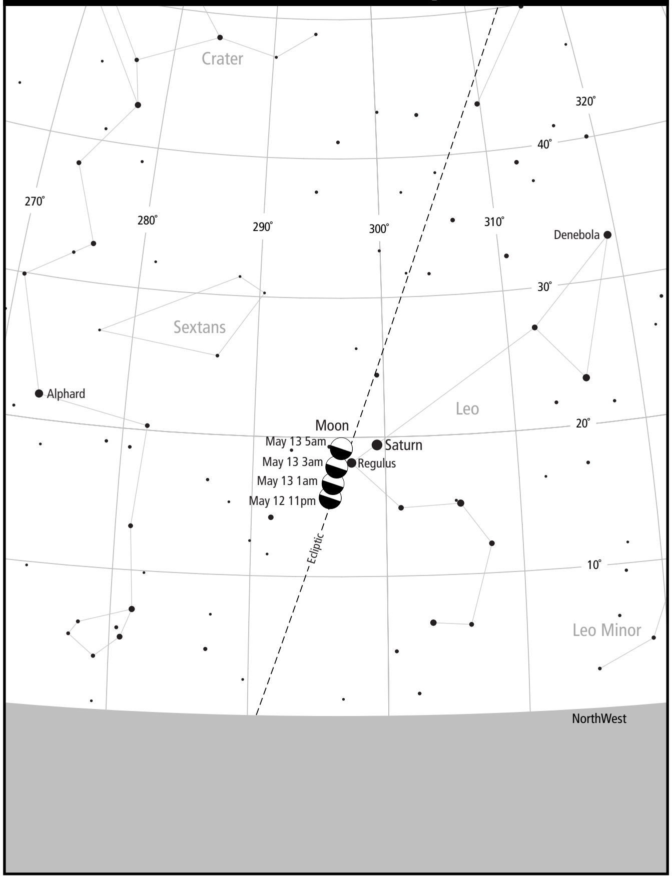
SKYVIEW 2008 MAY 15 8pm



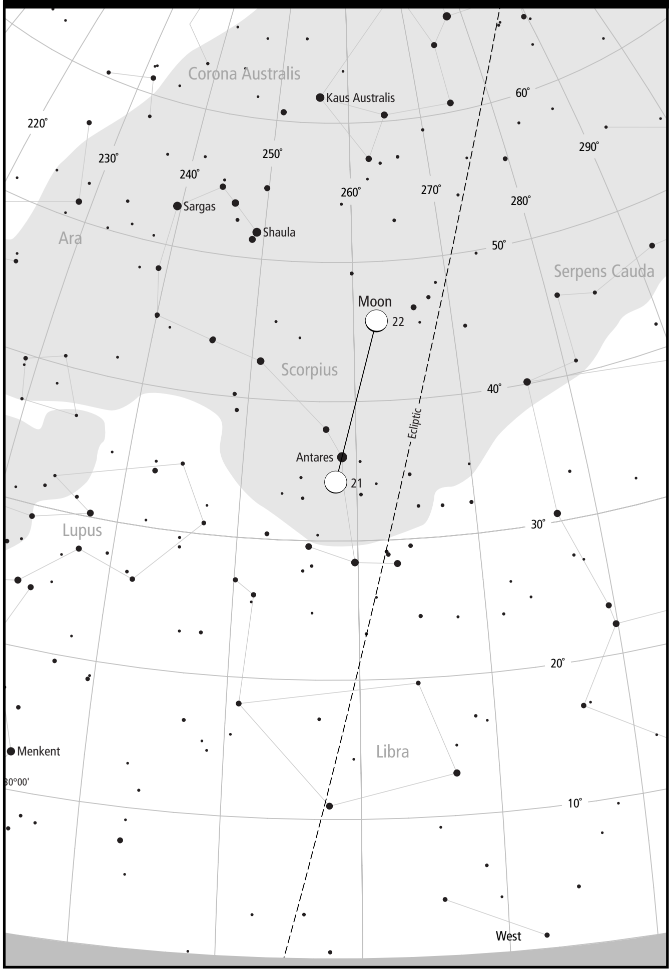
SKYVIEW 2008 MAY 9-11 9pm



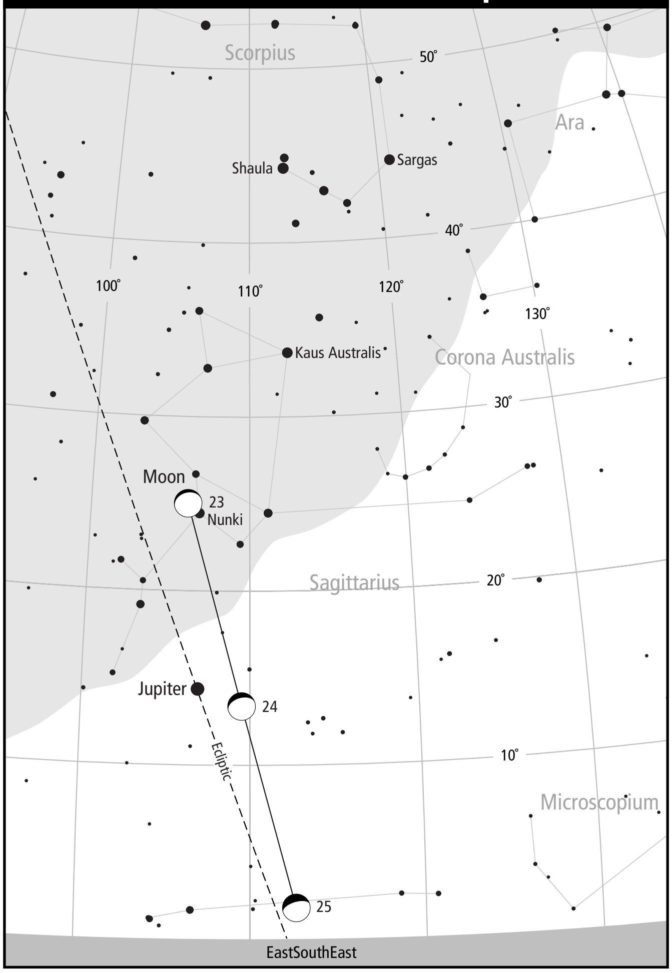
SKYVIEW 2008 MAY 12 11pm-5am



SKYVIEW 2008 MAY 21-22 5am



SKYVIEW 2008 MAY 23-25 10pm



HIGHLIGHTS

Mercury *visible low in eastern morning twilight in second half of month.*

Mars *visible in the early evening in the north-west sky.*

Jupiter *visible all night by end of month.*

Saturn *visible in the early evening in the north-west sky.*

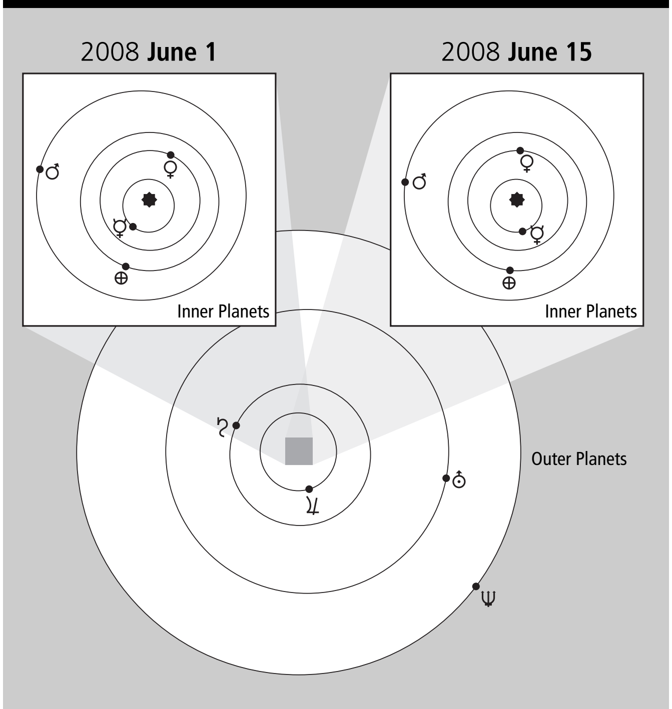
DIARY

Day	Hour	
3	21	Moon at perigee
4	03	**NEW MOON**
7	23	Mercury in inferior conjunction
8	10	Mars 1°.1 N. of Moon
9	12	Venus in superior conjunction
9	17	Saturn 3° N. of Moon
10	23	**FIRST QUARTER**
17	02	Moon at apogee
17	13	*Antares* 0°.2 N. of Moon
19	02	**FULL MOON**
19	23	Mercury stationary
20	21	Jupiter 2° N. of Moon
21	08	Solstice
23	17	Neptune 0°.8 S. of Moon
26	00	Uranus 4° S. of Moon
26	20	**LAST QUARTER**
27	16	Uranus stationary

SUN+MOON RISE/SET

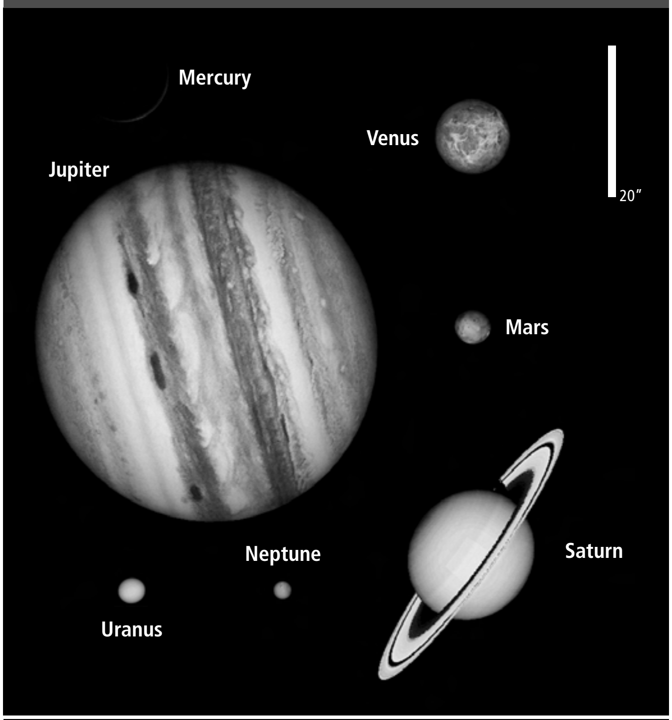
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn (%)
1	0709	64	0542	1214	1720	296	1847	0358	1455	15
2	0709	64	0543	1215	1720	296	1846	0511	1539	7
3	0710	64	0543	1215	1720	296	1846	0626	1631	2
4	0710	64	0544	1215	1719	296	1846	0740	1734	0
5	0711	64	0544	1215	1719	296	1846	0847	1843	1
6	0711	64	0544	1215	1719	296	1846	0943	1956	5
7	0712	63	0545	1215	1719	297	1846	1030	2107	12
8	0712	63	0545	1216	1719	297	1846	1109	2214	20
9	0713	63	0546	1216	1719	297	1846	1142	2317	30
10	0713	63	0546	1216	1719	297	1846	1211	DNS	40
11	0714	63	0546	1216	1719	297	1846	1238	0017	51
12	0714	63	0547	1216	1719	297	1846	1305	0114	61
13	0714	63	0547	1217	1719	297	1846	1333	0211	70
14	0715	63	0547	1217	1719	297	1846	1402	0308	78
15	0715	63	0548	1217	1719	297	1846	1435	0405	86
16	0715	63	0548	1217	1719	297	1847	1513	0502	92
17	0716	63	0548	1218	1719	297	1847	1555	0559	96
18	0716	63	0549	1218	1720	297	1847	1644	0654	99
19	0716	63	0549	1218	1720	297	1847	1738	0745	100
20	0716	63	0549	1218	1720	297	1847	1835	0831	99
21	0717	63	0549	1218	1720	297	1848	1934	0911	97
22	0717	63	0549	1219	1720	297	1848	2034	0947	92
23	0717	63	0550	1219	1721	297	1848	2134	1019	86
24	0717	63	0550	1219	1721	297	1848	2233	1049	78
25	0717	63	0550	1219	1721	297	1849	2334	1117	69
26	0717	63	0550	1219	1721	297	1849	DNR	1146	59
27	0718	63	0550	1220	1722	297	1849	0036	1216	48
28	0718	63	0550	1220	1722	297	1849	0141	1250	37
29	0718	63	0550	1220	1722	297	1850	0250	1329	27
30	0718	63	0551	1220	1723	297	1850	0402	1416	17

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ⛢ Uranus
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

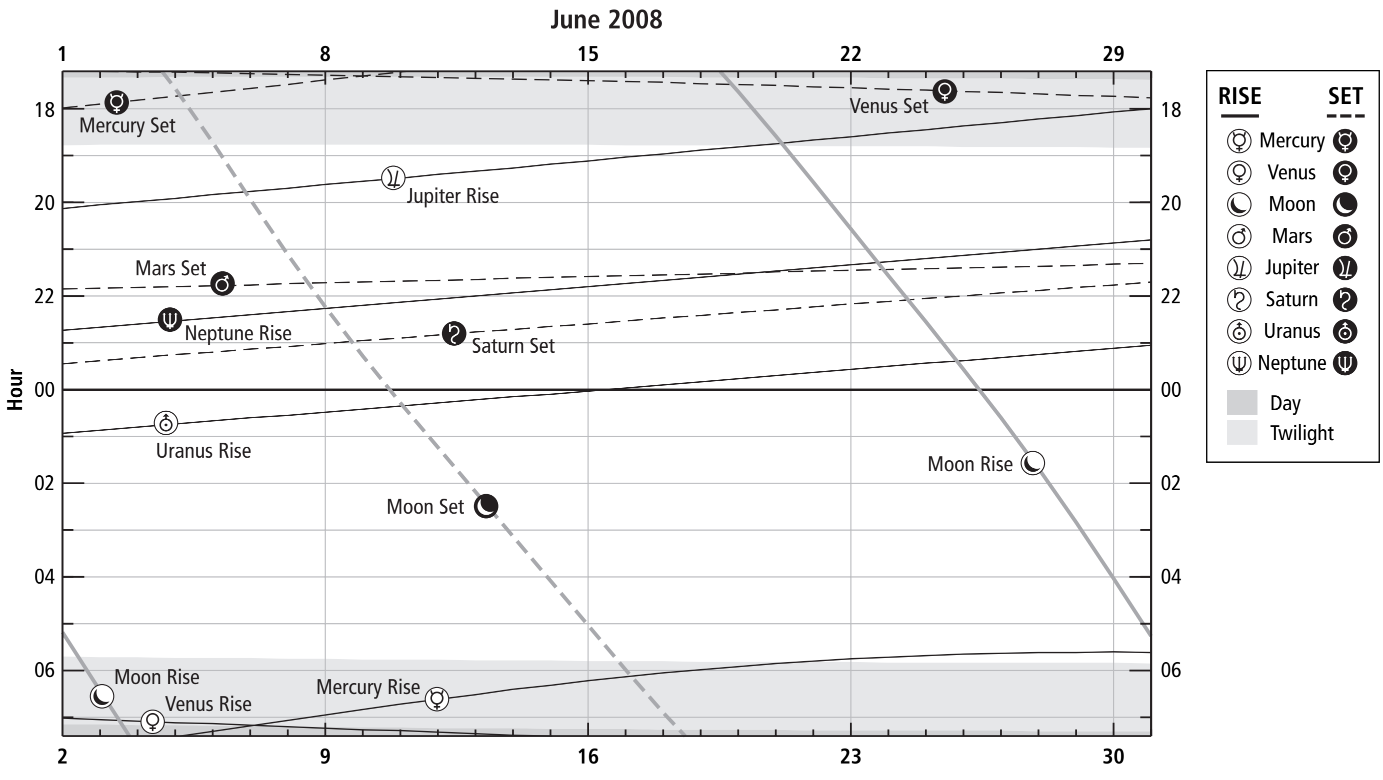


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY Rise h m	MERCURY Set h m	VENUS Rise h m	VENUS Set h m	MARS Rise h m	MARS Set h m	JUPITER Rise h m	JUPITER Set h m	SATURN Rise h m	SATURN Set h m	URANUS Rise h m	URANUS Set h m	NEPTUNE Rise h m	NEPTUNE Set h m
1	0752	1759	0659	1711	1123	2153	2008	1011	1225	2327	0100	1322	2244	1201
2	0745	1754	0701	1712	1121	2151	2003	1007	1221	2323	0056	1318	2240	1157
3	0739	1749	0703	1713	1118	2150	1959	1003	1217	2319	0052	1314	2236	1153
4	0732	1744	0705	1713	1116	2149	1955	0958	1214	2315	0048	1310	2232	1149
5	0725	1739	0707	1714	1114	2148	1950	0954	1210	2312	0044	1306	2228	1145
6	0718	1734	0708	1715	1112	2147	1946	0950	1206	2308	0040	1302	2224	1141
7	0711	1729	0710	1716	1110	2146	1942	0946	1202	2305	0036	1258	2220	1137
8	0704	1723	0712	1717	1108	2144	1937	0941	1158	2301	0033	1254	2216	1133
9	0657	1718	0714	1718	1105	2143	1933	0937	1155	2257	0029	1250	2212	1130
10	0650	1713	0716	1719	1103	2142	1929	0933	1151	2254	0025	1247	2208	1126
11	0643	1707	0717	1720	1101	2141	1924	0929	1147	2250	0021	1243	2204	1122
12	0637	1702	0719	1721	1059	2140	1920	0924	1143	2246	0017	1239	2200	1118
13	0631	1657	0721	1722	1057	2139	1916	0920	1140	2243	0013	1235	2156	1114
14	0624	1652	0723	1723	1054	2137	1911	0916	1136	2239	0009	1231	2152	1110
15	0619	1647	0724	1724	1052	2136	1907	0912	1132	2236	0006	1227	2148	1106
16	0613	1642	0726	1725	1050	2135	1902	0907	1128	2232	0002	1223	2144	1102
16											2358			
17	0608	1638	0728	1726	1048	2134	1858	0903	1125	2228	2354	1219	2140	1058
18	0603	1634	0729	1728	1046	2133	1853	0859	1121	2225	2350	1215	2136	1054
19	0559	1630	0731	1729	1043	2132	1849	0854	1117	2221	2346	1211	2132	1050
20	0555	1626	0732	1730	1041	2131	1845	0850	1113	2218	2342	1208	2128	1046
21	0551	1622	0734	1732	1039	2129	1840	0846	1110	2214	2338	1204	2124	1042
22	0548	1619	0735	1733	1037	2128	1836	0841	1106	2210	2334	1200	2120	1038
23	0545	1615	0736	1735	1035	2127	1831	0837	1102	2207	2330	1156	2116	1034
24	0543	1612	0738	1736	1032	2126	1827	0832	1059	2203	2326	1152	2112	1030
25	0541	1610	0739	1738	1030	2125	1822	0828	1055	2200	2323	1148	2108	1026
26	0539	1607	0740	1739	1028	2124	1818	0824	1051	2156	2319	1144	2104	1022
27	0538	1605	0742	1741	1026	2123	1813	0819	1048	2153	2315	1140	2100	1018
28	0537	1603	0743	1743	1023	2122	1809	0815	1044	2149	2311	1136	2056	1014
29	0537	1602	0744	1744	1021	2121	1804	0811	1040	2146	2307	1132	2052	1010
30	0536	1600	0745	1746	1019	2119	1800	0806	1036	2142	2303	1128	2048	1006

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Sat.	Event
1	0526	I	Sh.I.
1	0617	I	Tr.I.
1	2246	III	Sh.I.
2	0121	II	Sh.I.
2	0154	III	Sh.E.
2	0209	III	Tr.I.
2	0241	I	Ec.D.
2	0300	II	Tr.I.
2	0317		GRS
2	0403	II	Sh.E.
2	0523	III	Tr.E.
2	0543	II	Tr.E.
2	0547	I	Oc.R.
2	2308		GRS
2	2354	I	Sh.I.
3	0044	I	Tr.I.
3	0210	I	Sh.E.
3	0300	I	Tr.E.
3	2110	I	Ec.D.
4	0014	I	Oc.R.
4	0020	II	Oc.R.
4	0456		GRS
4	2039	I	Sh.E.
4	2127	I	Tr.E.
5	0047		GRS
5	2039		GRS
6	0634		GRS
7	0226		GRS
7	2218		GRS

DAY	PHENOMENON h m	Sat.	Event
8	0311	IV	Ec.D.
8	0630	IV	Ec.R.
9	0245	III	Sh.I.
9	0355	II	Sh.I.
9	0405		GRS
9	0435	I	Ec.D.
9	0518	II	Tr.I.
9	0535	III	Tr.I.
9	0553	III	Sh.E.
9	0637	II	Sh.E.
9	2356		GRS
10	0148	I	Sh.I.
10	0230	I	Tr.I.
10	0404	I	Sh.E.
10	0446	I	Tr.E.
10	1948		GRS
10	2231	II	Ec.D.
10	2303	I	Ec.D.
11	0159	I	Oc.R.
11	0240	II	Oc.R.
11	0544		GRS
11	2017	I	Sh.I.
11	2056	I	Tr.I.
11	2233	I	Sh.E.
11	2312	I	Tr.E.
12	0135		GRS
12	1954	II	Sh.E.
12	2025	I	Oc.R.
12	2109	II	Tr.E.

DAY	PHENOMENON h m	Sat.	Event
12	2127		GRS
12	2232	III	Oc.R.
14	0314		GRS
14	2305		GRS
16	0453		GRS
16	0628	II	Sh.I.
16	0628	I	Ec.D.
16	0643	III	Sh.I.
16	1909	IV	Tr.E.
17	0044		GRS
17	0343	I	Sh.I.
17	0415	I	Tr.I.
17	0559	I	Sh.E.
17	0631	I	Tr.E.
17	2036		GRS
18	0057	I	Ec.D.
18	0108	II	Ec.D.
18	0343	I	Oc.R.
18	0458	II	Oc.R.
18	0631		GRS
18	2211	I	Sh.I.
18	2241	I	Tr.I.
19	0027	I	Sh.E.
19	0057	I	Tr.E.
19	0223		GRS
19	1925	I	Ec.D.
19	1945	II	Sh.I.
19	2041	II	Tr.I.
19	2045	III	Ec.D.
19	2209	I	Oc.R.
19	2214		GRS
19	2228	II	Sh.E.
19	2325	II	Tr.E.
20	0153	III	Oc.R.
20	1856	I	Sh.E.
20	1924	I	Tr.E.
21	0402		GRS
21	2353		GRS

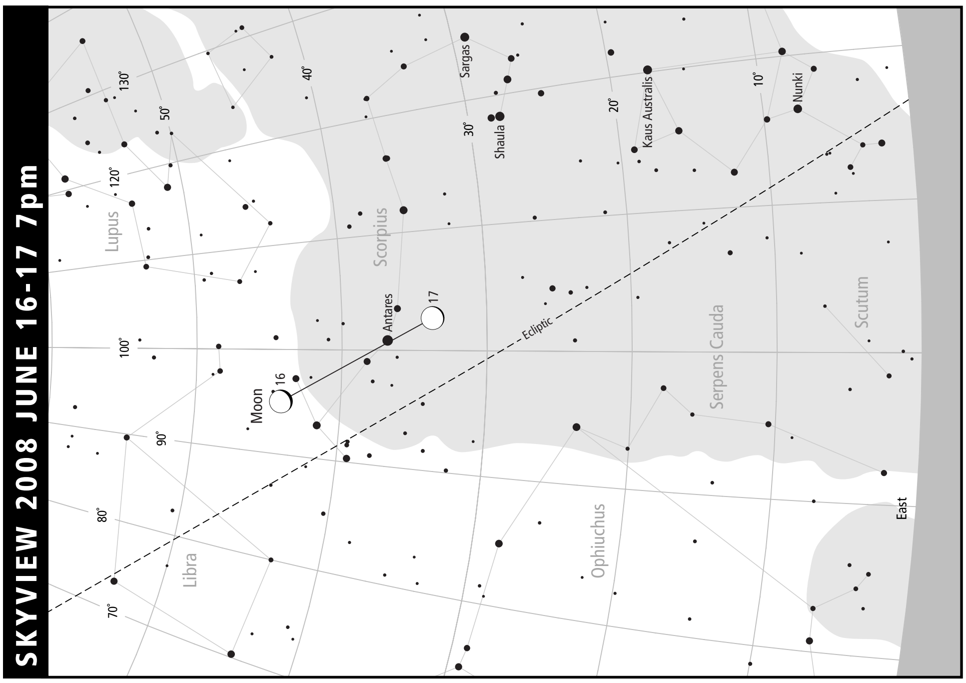
DAY	PHENOMENON h m	Sat.	Event
22	1945		GRS
23	0540		GRS
24	0132		GRS
24	0537	I	Sh.I.
24	0559	I	Tr.I.
24	2110	IV	Ec.D.
24	2123		GRS
25	0250	I	Ec.D.
25	0344	II	Ec.D.
25	0406	IV	Oc.R.
25	0527	I	Oc.R.
25	0714	II	Oc.R.
26	0005	I	Sh.I.
26	0026	I	Tr.I.
26	0222	I	Sh.E.
26	0242	I	Tr.E.
26	0311		GRS
26	2119	I	Ec.D.
26	2219	II	Sh.I.
26	2255	II	Tr.I.
26	2302		GRS
26	2353	I	Oc.R.
27	0044	III	Ec.D.
27	0102	II	Sh.E.
27	0139	II	Tr.E.
27	0512	III	Oc.R.
27	1834	I	Sh.I.
27	1852	I	Tr.I.
27	1854		GRS
27	2050	I	Sh.E.
27	2108	I	Tr.E.
28	0449		GRS
28	1819	I	Oc.R.
28	2022	II	Oc.R.
29	0041		GRS
29	2032		GRS
30	0628		GRS
30	1848	III	Tr.E.

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

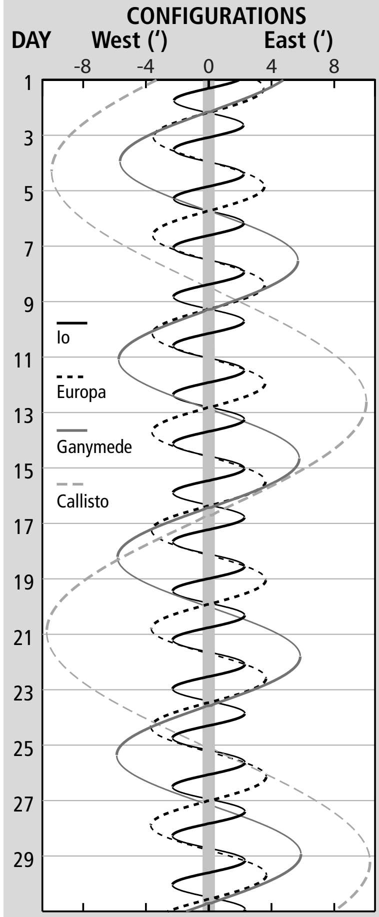
Events: D Disappear; R Reappear; E Egress; I Ingress; Ec Eclipse; Oc Occult; Sh Shadow; Tr Transit

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

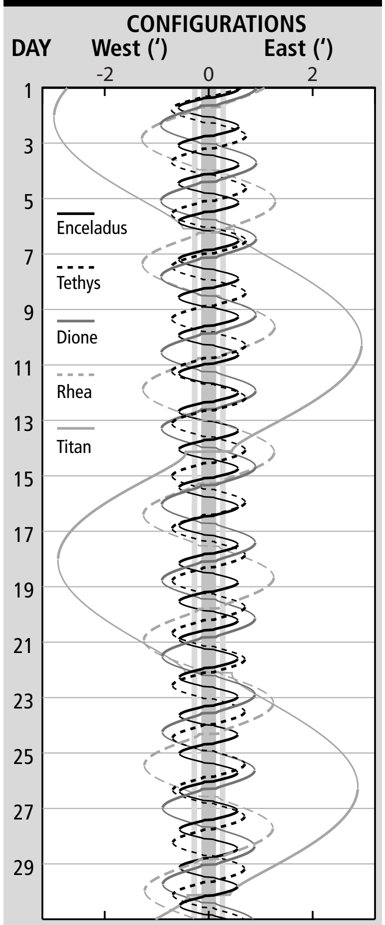
SKYVIEW 2008 JUNE 16-17 7pm



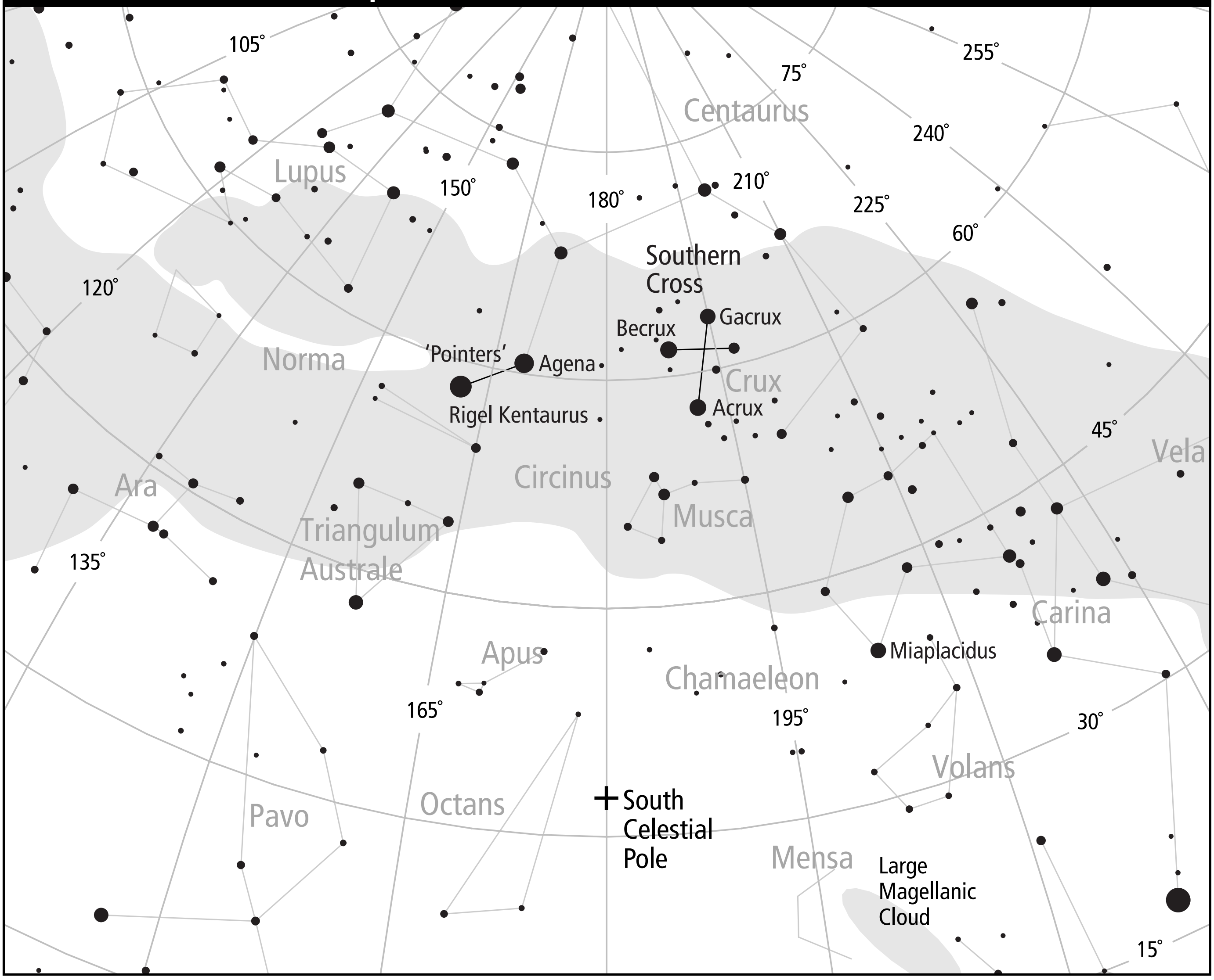
JUPITER MOONS



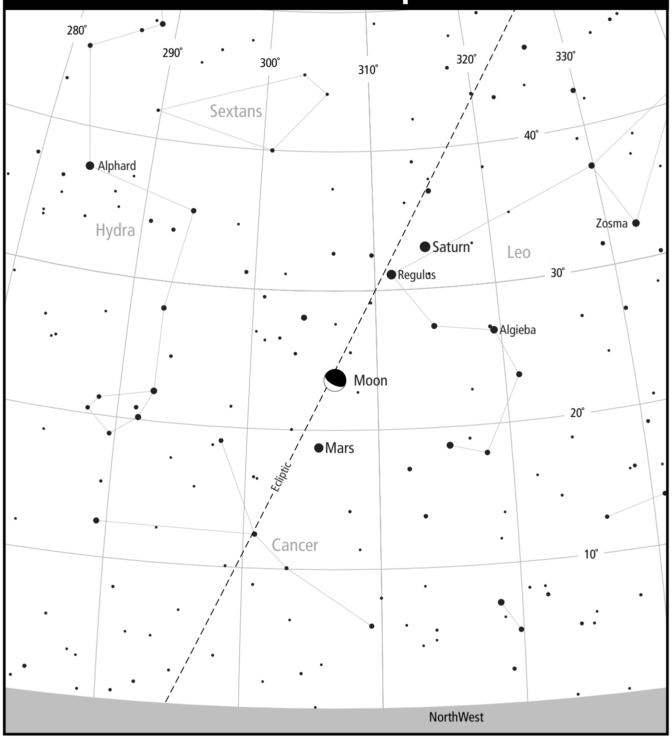
SATURN MOONS



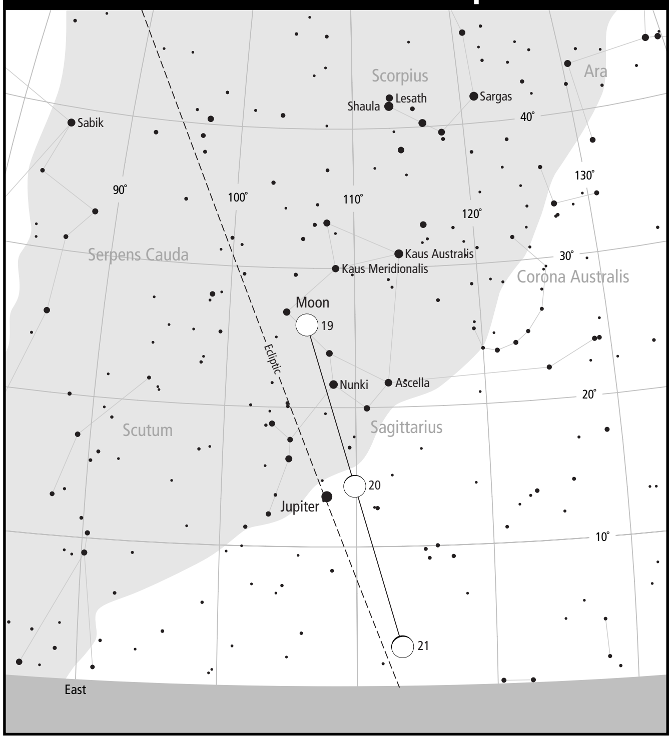
SKYVIEW 2008 JUNE 15 8pm



SKYVIEW 2008 JUNE 8 8pm



SKYVIEW 2008 JUNE 19-21 8pm



JULY 2008

HIGHLIGHTS

Moon *occultation of Antares on 14th.*

Mercury *visible low in eastern morning twilight early in month.*

Mars *visible in the early evening in the WNW sky, conjunction with Saturn on 11th.*

Jupiter *visible all night.*

Saturn *visible in the early evening in the WNW sky.*

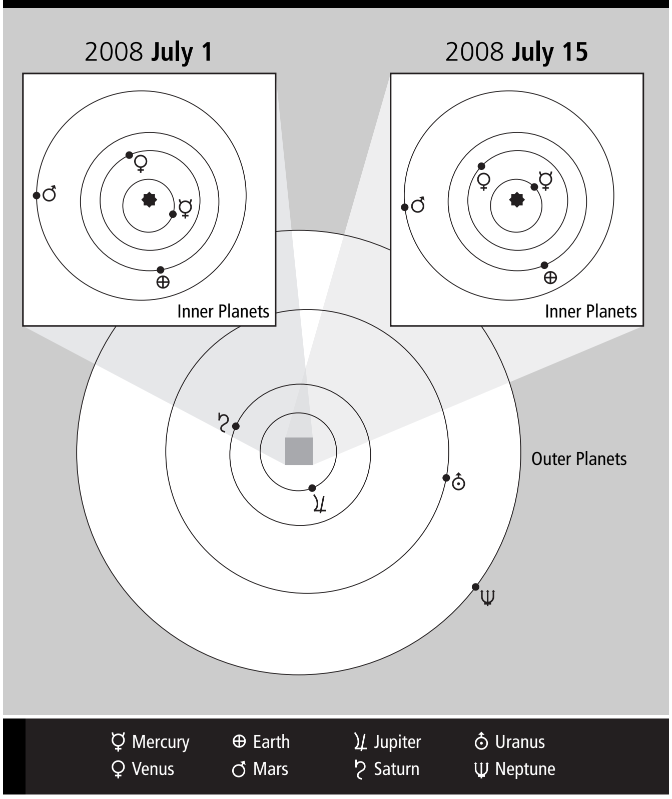
DIARY

Day	Hour	
1	12	Mars 0°.7 N. of *Regulus*
1	23	Mercury 8° S. of Moon
2	02	Mercury greatest elongation W. (22°)
2	05	Moon at perigee
3	10	**New Moon**
4	16	Earth at aphelion
7	02	Mars 3° N. of Moon
7	06	Saturn 3° N. of Moon
9	16	Jupiter at opposition
10	13	**First Quarter**
11	14	Mars 0°.7 S. of Saturn
14	12	Moon at apogee
14	20	*Antares* 0°.3 N. of Moon – occultation
17	20	Jupiter 3° N. of Moon
18	16	**Full Moon**
20	21	Neptune 0°.9 S. of Moon
23	06	Uranus 4° S. of Moon
26	03	**Last Quarter**
27		Max act. of Piscis Austrinid meteor shower
27		Max act. of delta-Aquarid S. meteor shwr
29		Max act. of alpha-Capricornid meteor shwr
30	04	Mercury in superior conjunction
30	07	Moon at perigee

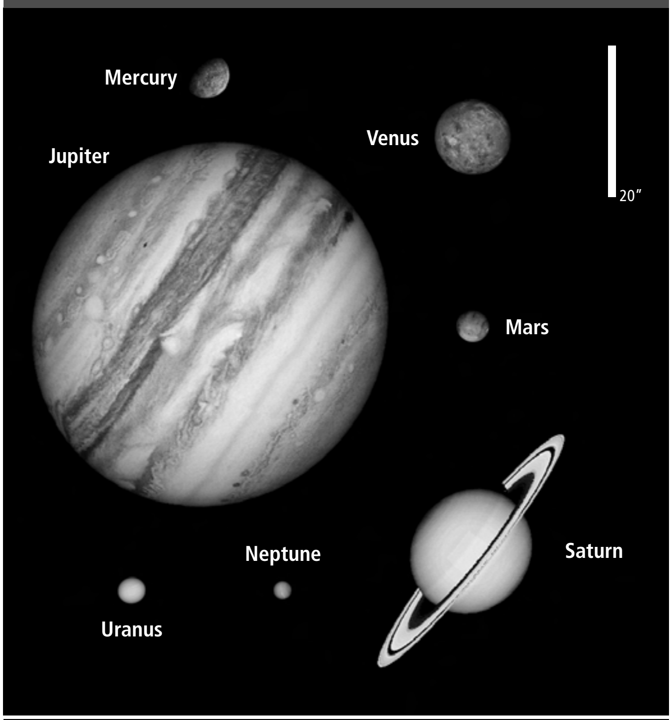
SUN+MOON RISE/SET

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 (%)
1	0718	63	0551	1220	1723	297	1850	0516	1513	9
2	0718	63	0551	1221	1724	297	1851	0625	1619	3
3	0718	63	0551	1221	1724	297	1851	0727	1731	0
4	0718	63	0551	1221	1725	297	1852	0819	1844	1
5	0718	63	0551	1221	1725	297	1852	0902	1955	4
6	0717	64	0551	1221	1725	296	1852	0939	2101	9
7	0717	64	0550	1222	1726	296	1853	1010	2204	17
8	0717	64	0550	1222	1726	296	1853	1039	2304	25
9	0717	64	0550	1222	1727	296	1854	1106	DNS	35
10	0717	64	0550	1222	1727	296	1854	1134	0002	45
11	0716	64	0550	1222	1728	296	1854	1203	0100	55
12	0716	64	0550	1222	1729	295	1855	1235	0157	64
13	0716	65	0550	1222	1729	295	1855	1311	0255	73
14	0715	65	0549	1222	1730	295	1856	1352	0353	81
15	0715	65	0549	1223	1730	295	1856	1439	0448	88
16	0715	65	0549	1223	1731	295	1857	1531	0541	93
17	0714	65	0548	1223	1731	295	1857	1628	0628	97
18	0714	66	0548	1223	1732	294	1858	1727	0711	100
19	0713	66	0548	1223	1733	294	1858	1828	0748	100
20	0713	66	0547	1223	1733	294	1859	1928	0822	98
21	0713	66	0547	1223	1734	294	1859	2028	0852	95
22	0712	66	0547	1223	1734	293	1900	2128	0921	89
23	0711	67	0546	1223	1735	293	1900	2229	0949	82
24	0711	67	0546	1223	1736	293	1901	2332	1018	73
25	0710	67	0545	1223	1736	293	1901	DNR	1050	63
26	0710	68	0545	1223	1737	292	1902	0038	1126	51
27	0709	68	0544	1223	1737	292	1902	0148	1209	40
28	0708	68	0544	1223	1738	292	1903	0258	1300	29
29	0708	68	0543	1223	1739	292	1903	0408	1400	19
30	0707	69	0543	1223	1739	291	1904	0512	1508	11
31	0706	69	0542	1223	1740	291	1904	0607	1620	4

PLANET POSITIONS



PLANET APPEARANCE

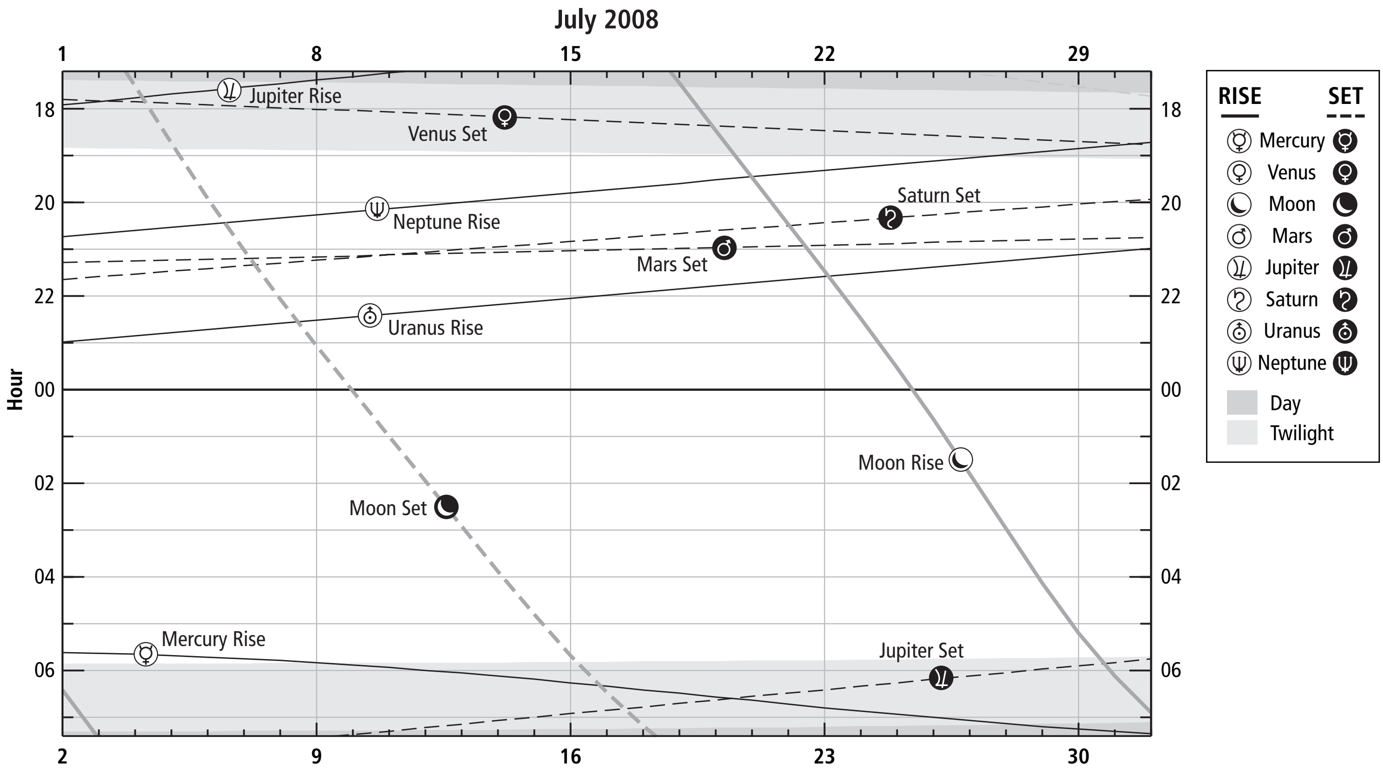


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY Rise h m	MERCURY Set h m	VENUS Rise h m	VENUS Set h m	MARS Rise h m	MARS Set h m	JUPITER Rise h m	JUPITER Set h m	SATURN Rise h m	SATURN Set h m	URANUS Rise h m	URANUS Set h m	NEPTUNE Rise h m	NEPTUNE Set h m
1	0537	1559	0746	1748	1017	2118	1755	0802	1033	2139	2259	1124	2044	1002
2	0537	1559	0747	1750	1014	2117	1751	0757	1029	2135	2255	1120	2040	0958
3	0538	1558	0748	1751	1012	2116	1746	0753	1025	2132	2251	1116	2036	0954
4	0539	1558	0749	1753	1010	2115	1741	0748	1022	2128	2247	1113	2032	0950
5	0541	1558	0750	1755	1008	2114	1737	0744	1018	2125	2243	1109	2028	0946
6	0543	1558	0751	1757	1005	2113	1732	0740	1014	2121	2239	1105	2024	0942
7	0545	1559	0752	1759	1003	2112	1728	0735	1011	2118	2235	1101	2020	0938
8	0547	1600	0753	1801	1001	2111	1723	0731	1007	2114	2231	1057	2016	0934
9	0550	1602	0753	1802	0959	2110	1719	0726	1003	2111	2227	1053	2012	0930
10	0553	1603	0754	1804	0956	2109	1714	0722	1000	2107	2223	1049	2008	0926
11	0556	1605	0755	1806	0954	2107	1710	0718	0956	2104	2219	1045	2004	0922
12	0600	1608	0755	1808	0952	2106	1705	0713	0952	2100	2215	1041	2000	0918
13	0603	1611	0756	1810	0949	2105	1701	0709	0949	2057	2211	1037	1956	0914
14	0607	1614	0756	1812	0947	2104	1656	0704	0945	2054	2207	1033	1952	0910
15	0611	1617	0757	1814	0945	2103	1652	0700	0941	2050	2203	1029	1948	0906
16	0616	1621	0757	1816	0943	2102	1647	0655	0938	2047	2159	1025	1944	0902
17	0620	1625	0758	1818	0940	2101	1643	0651	0934	2043	2155	1021	1940	0858
18	0625	1630	0758	1820	0938	2100	1638	0647	0931	2040	2151	1017	1936	0854
19	0629	1634	0758	1822	0936	2059	1633	0642	0927	2036	2147	1013	1931	0850
20	0634	1639	0758	1824	0933	2058	1629	0638	0923	2033	2143	1009	1927	0846
21	0638	1645	0759	1826	0931	2057	1624	0633	0920	2030	2139	1005	1923	0842
22	0643	1650	0759	1828	0929	2056	1620	0629	0916	2026	2135	1001	1919	0838
23	0648	1656	0759	1830	0927	2055	1615	0625	0912	2023	2131	0957	1915	0834
24	0652	1702	0759	1832	0924	2054	1611	0620	0909	2019	2127	0953	1911	0830
25	0656	1708	0759	1834	0922	2053	1606	0616	0905	2016	2123	0949	1907	0826
26	0700	1714	0759	1836	0920	2051	1602	0611	0902	2012	2119	0945	1903	0822
27	0704	1720	0759	1838	0917	2050	1558	0607	0858	2009	2115	0941	1859	0818
28	0708	1726	0759	1840	0915	2049	1553	0603	0854	2006	2111	0937	1855	0814
29	0712	1732	0759	1842	0913	2048	1549	0558	0851	2002	2107	0933	1851	0810
30	0715	1738	0759	1844	0911	2047	1544	0554	0847	1959	2103	0929	1847	0806
31	0718	1744	0758	1846	0908	2046	1540	0550	0843	1956	2059	0925	1843	0802

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Sat.	Event
1	0220		GRS
1	2211		GRS
2	0444	I	Ec.D.
2	0621	II	Ec.D.
2	0711	I	Oc.R.
2	1803		GRS
3	0200	I	Sh.I.
3	0210	I	Tr.I.
3	0358		GRS
3	0416	I	Sh.E.
3	0425	IV	Sh.I.
3	0426	I	Tr.E.
3	0552	IV	Tr.I.
3	2313	I	Ec.D.
3	2350		GRS
4	0053	II	Sh.I.
4	0109	II	Tr.I.
4	0137	I	Oc.R.
4	0336	II	Sh.E.
4	0353	II	Tr.E.
4	0443	III	Ec.D.
4	1941		GRS
4	2029	I	Sh.I.
4	2036	I	Tr.I.
4	2245	I	Sh.E.
4	2252	I	Tr.E.
5	0537		GRS
5	1741	I	Ec.D.
5	1939	II	Ec.D.
5	2003	I	Oc.R.
5	2237	II	Oc.R.
6	0129		GRS
6	2120		GRS

DAY	PHENOMENON h m	Sat.	Event
7	0716		GRS
7	1840	III	Sh.I.
7	1851	III	Tr.I.
7	2153	III	Sh.E.
7	2204	III	Tr.E.
8	0307		GRS
8	2259		GRS
9	0638	I	Ec.D.
9	1850		GRS
10	0354	I	Tr.I.
10	0355	I	Sh.I.
10	0446		GRS
10	0610	I	Tr.E.
10	0611	I	Sh.E.
11	0038		GRS
11	0105	I	Oc.D.
11	0322	II	Tr.I.
11	0322	I	Ec.R.
11	0327	II	Sh.I.
11	0606	II	Tr.E.
11	0611	II	Sh.E.
11	1847	IV	Ec.R.
11	2029		GRS
11	2220	I	Tr.I.
11	2223	I	Sh.I.
12	0036	I	Tr.E.
12	0040	I	Sh.E.
12	0625		GRS
12	1931	I	Oc.D.
12	2151	I	Ec.R.
12	2206	II	Oc.D.
13	0103	II	Ec.R.
13	0216		GRS

DAY	PHENOMENON h m	Sat.	Event
13	1902	I	Tr.E.
13	1908	I	Sh.E.
13	2208		GRS
14	1759		GRS
14	1913	II	Tr.E.
14	1928	II	Sh.E.
14	2208	III	Tr.I.
14	2241	III	Sh.I.
15	0122	III	Tr.E.
15	0155	III	Sh.E.
15	0355		GRS
15	2347		GRS
16	1938		GRS
17	0534		GRS
17	0538	I	Tr.I.
17	0549	I	Sh.I.
18	0126		GRS
18	0248	I	Oc.D.
18	0517	I	Ec.R.
18	0536	II	Tr.I.
18	0601	II	Sh.I.
18	2117		GRS
19	0004	I	Tr.I.
19	0018	I	Sh.I.
19	0220	I	Tr.E.
19	0235	I	Sh.E.
19	2003	IV	Tr.I.
19	2114	I	Oc.D.
19	2227	IV	Sh.I.
19	2338	IV	Tr.E.
19	2345	I	Ec.R.
20	0022	II	Oc.D.
20	0206	IV	Sh.E.
20	0304		GRS
20	0341	II	Ec.R.
20	1830	I	Tr.I.
20	1847	I	Sh.I.
20	2046	I	Tr.E.
20	2103	I	Sh.E.
20	2256		GRS
21	1814	I	Ec.R.
21	1843	II	Tr.I.
21	1848		GRS

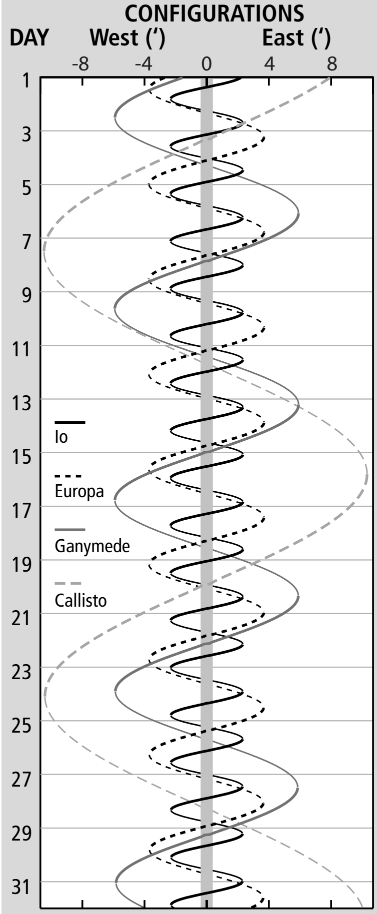
DAY	PHENOMENON h m	Sat.	Event
21	1918	II	Sh.I.
21	2126	II	Tr.E.
21	2202	II	Sh.E.
22	0125	III	Tr.I.
22	0240	III	Sh.I.
22	0439	III	Tr.E.
22	0443		GRS
22	0555	III	Sh.E.
23	0035		GRS
23	2026		GRS
25	0214		GRS
25	0432	I	Oc.D.
25	1955	III	Ec.R.
25	2205		GRS
26	0149	I	Tr.I.
26	0213	I	Sh.I.
26	0405	I	Tr.E.
26	0429	I	Sh.E.
26	1757		GRS
26	2259	I	Oc.D.
27	0140	I	Ec.R.
27	0239	II	Oc.D.
27	0353		GRS
27	2015	I	Tr.I.
27	2042	I	Sh.I.
27	2231	I	Tr.E.
27	2258	I	Sh.E.
27	2344		GRS
28	0458	IV	Oc.D.
28	1936		GRS
28	2008	I	Ec.R.
28	2057	II	Tr.I.
28	2153	II	Sh.I.
28	2341	II	Tr.E.
29	0037	II	Sh.E.
29	0444	III	Tr.I.
29	0532		GRS
30	0123		GRS
30	1937	II	Ec.R.
30	2115		GRS

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

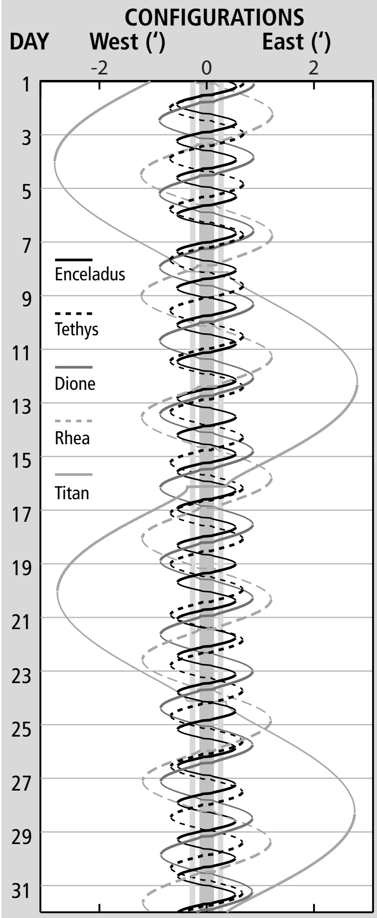
Events: D Disappear; R Reappear; E Egress; I Ingress; Ec Eclipse; Oc Occult; Sh Shadow; Tr Transit

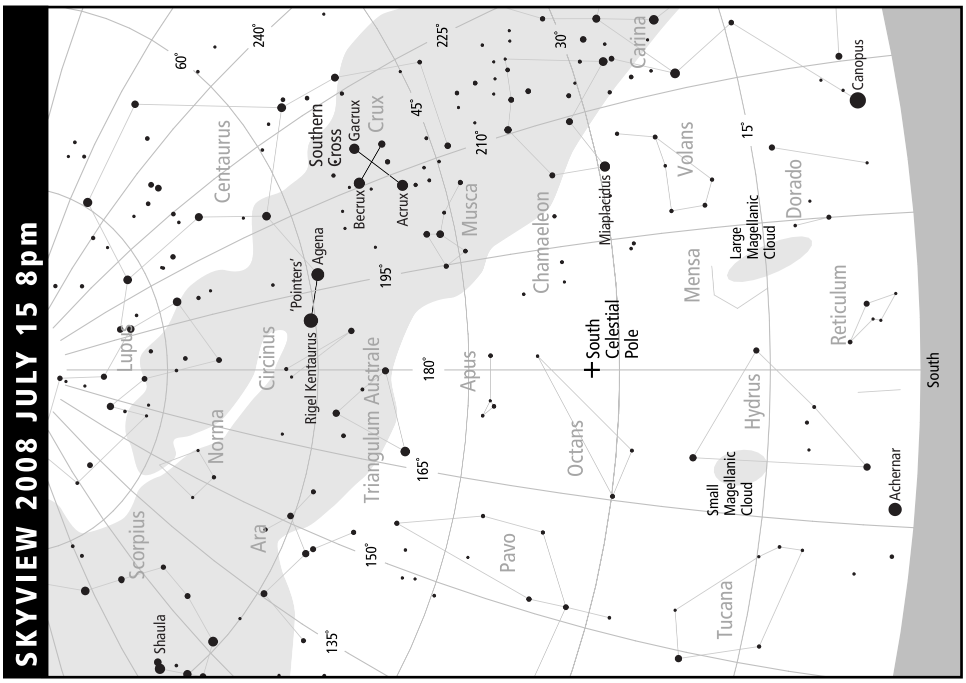
GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

JUPITER MOONS

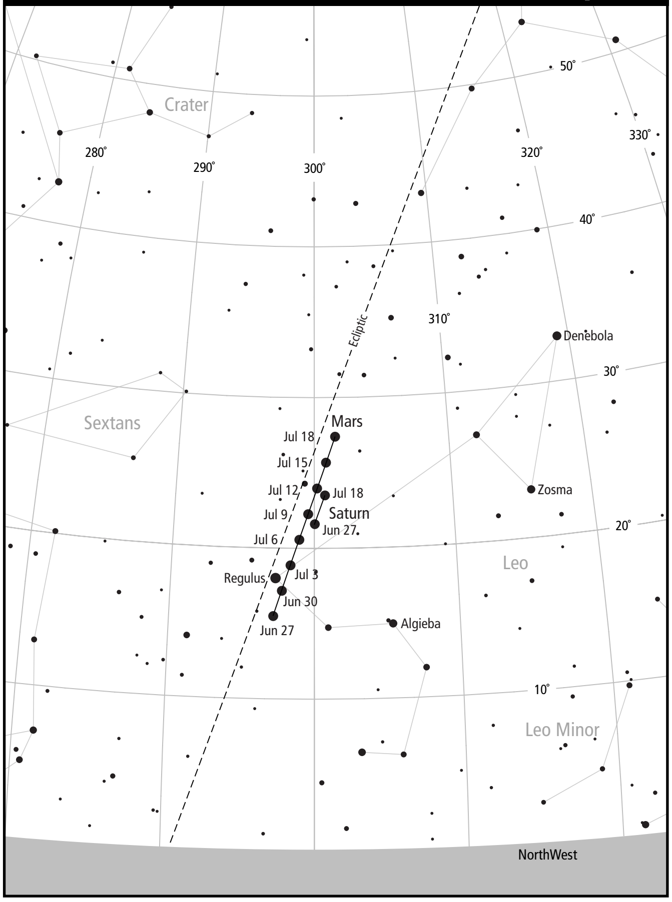


SATURN MOONS

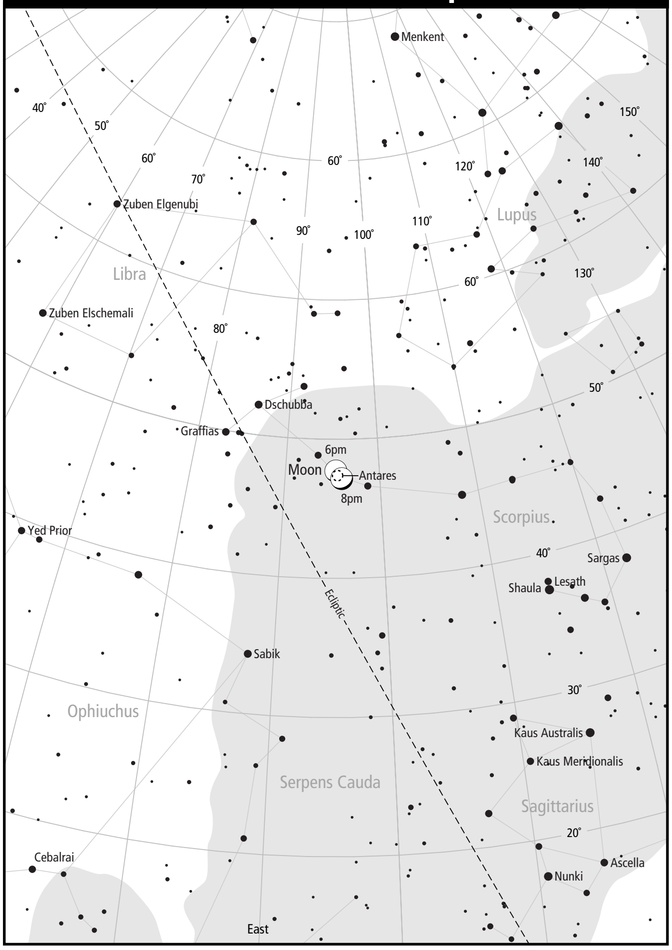




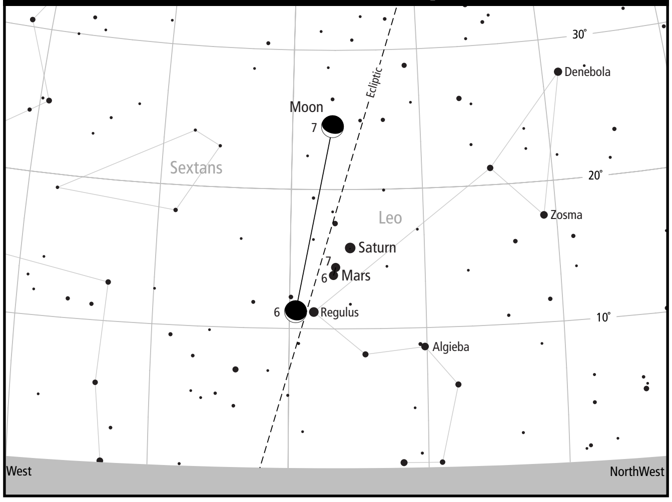
SKYVIEW 2008 JUNE 27 - JULY 18 8pm



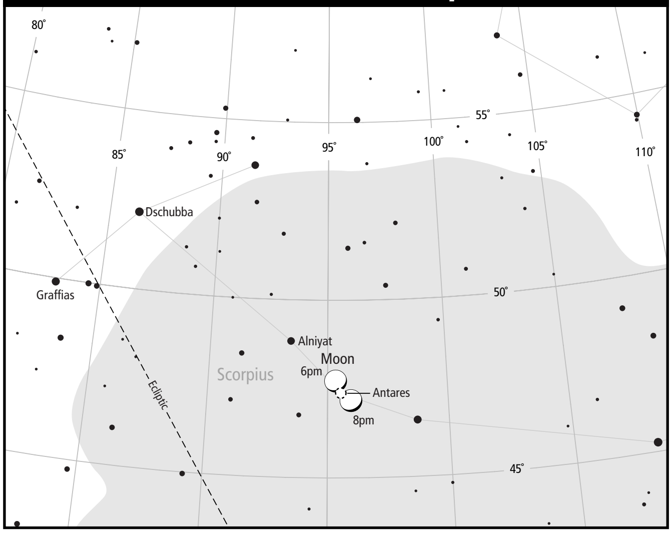
SKYVIEW 2008 JULY 14 6-8pm



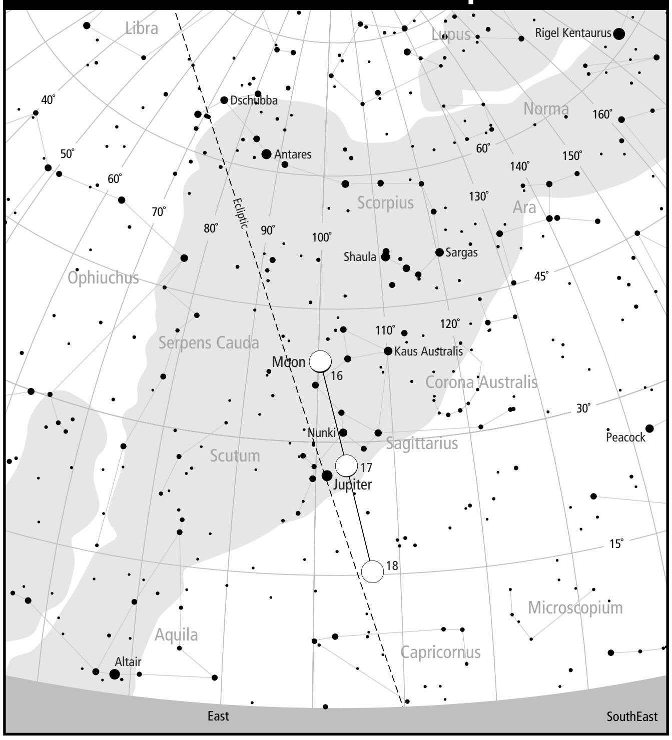
SKYVIEW 2008 JULY 6-7 8pm



SKYVIEW 2008 JULY 14 6-8pm (zoomed in)



SKYVIEW 2008 JULY 16-18 8pm



AUGUST 2008

HIGHLIGHTS

Moon *partial lunar eclipse before sunrise on 17th.*

Mercury *visible low in eastern evening twilight late in month.*

Venus *visible low in eastern evening twilight late in month. In conjunction with Saturn 13th.*

Mars *visible low in eastern evening sky all month.*

Jupiter *visible nearly all night, sets before morning twilight.*

Saturn *visible in the early evening twilight in the NW sky in the first half of the month.*

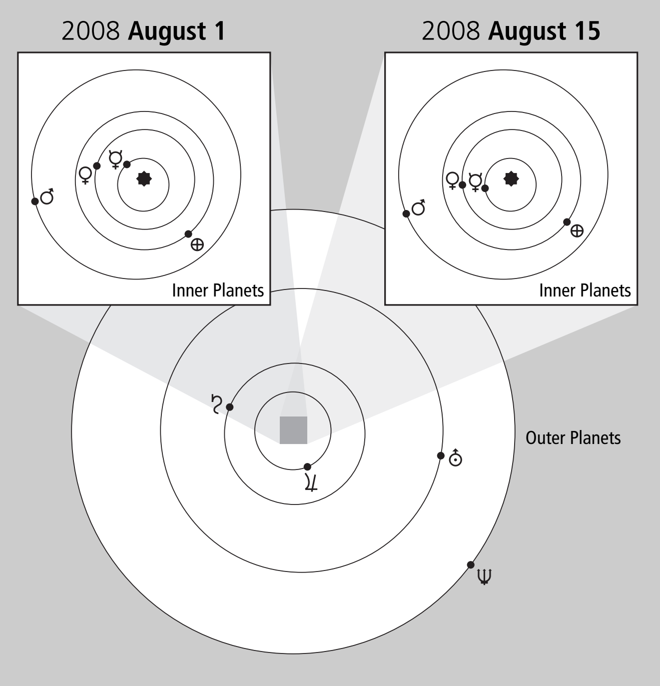
DIARY

Day	Hour	
1	18	**New Moon**
3	22	Saturn 4° N. of Moon
4	20	Mars 4° N. of Moon
6	04	Venus 1°.1 N. of *Regulus*
9	04	**First Quarter**
10	13	Mercury 1°.1 N. of *Regulus*
11	03	*Antares* 0°.4 N. of Moon
11	04	Moon apogee
13	22	Jupiter 3° N. of Moon
14	03	Venus 0°.2 S. of Saturn
15	16	Neptune at opposition
16	08	Mercury 0°.7 S. of Saturn
17	03	Neptune 0°.8 S. of Moon
17	02	**Full Moon – Eclipse**
19	10	Uranus 4° S. of Moon
23	13	Mercury 1°.2 S. of Venus
24	08	**Last Quarter**
26	12	Moon at perigee
31	04	**New Moon**

SUN+MOON RISE/SET

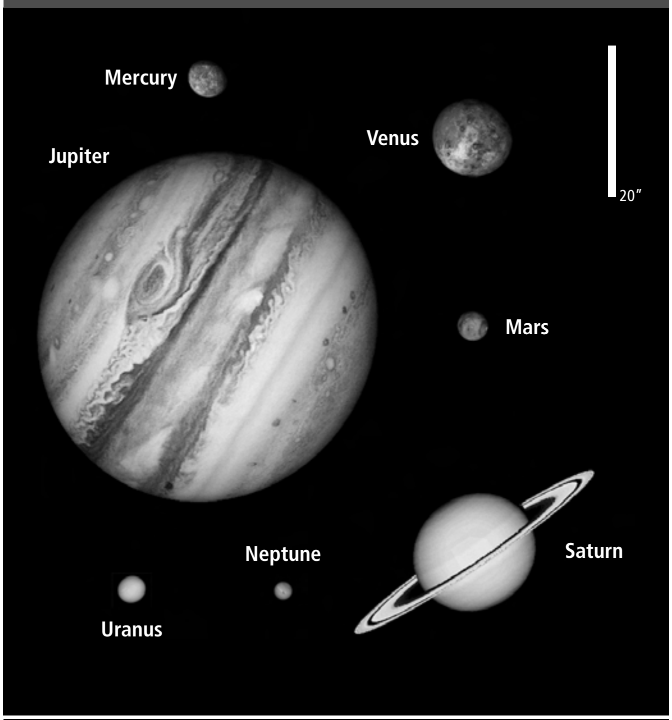
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn (%)
1	0705	69	0541	1223	1741	291	1905	0654	1732	1
2	0705	70	0541	1223	1741	290	1905	0733	1841	0
3	0704	70	0540	1223	1742	290	1906	0807	1947	2
4	0703	70	0539	1223	1743	290	1906	0837	2049	6
5	0702	70	0539	1223	1743	289	1907	0906	2149	13
6	0701	71	0538	1222	1744	289	1907	0934	2248	21
7	0701	71	0537	1222	1745	289	1908	1003	2347	29
8	0700	71	0536	1222	1745	288	1908	1034	DNS	39
9	0659	72	0536	1222	1746	288	1909	1109	0045	48
10	0658	72	0535	1222	1746	288	1909	1148	0143	58
11	0657	73	0534	1222	1747	287	1910	1233	0240	67
12	0656	73	0533	1222	1748	287	1911	1323	0334	76
13	0655	73	0532	1221	1748	287	1911	1418	0423	83
14	0654	74	0531	1221	1749	286	1912	1517	0508	90
15	0653	74	0530	1221	1750	286	1912	1617	0547	95
16	0652	74	0529	1221	1750	286	1913	1718	0622	98
17	0651	75	0528	1221	1751	285	1913	1819	0654	100
18	0650	75	0528	1220	1752	285	1914	1920	0724	99
19	0649	75	0527	1220	1752	284	1914	2022	0752	97
20	0648	76	0526	1220	1753	284	1915	2125	0822	91
21	0646	76	0525	1220	1753	284	1915	2231	0853	84
22	0645	77	0523	1219	1754	283	1916	2339	0927	75
23	0644	77	0522	1219	1755	283	1916	DNR	1007	65
24	0643	77	0521	1219	1755	282	1917	0048	1055	54
25	0642	78	0520	1219	1756	282	1918	0157	1150	42
26	0641	78	0519	1218	1756	282	1918	0301	1254	31
27	0639	79	0518	1218	1757	281	1919	0359	1403	21
28	0638	79	0517	1218	1758	281	1919	0447	1513	12
29	0637	80	0516	1217	1758	280	1920	0529	1622	6
30	0636	80	0515	1217	1759	280	1920	0604	1729	2
31	0635	80	0513	1217	1800	279	1921	0636	1832	0

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ⛢ Uranus
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

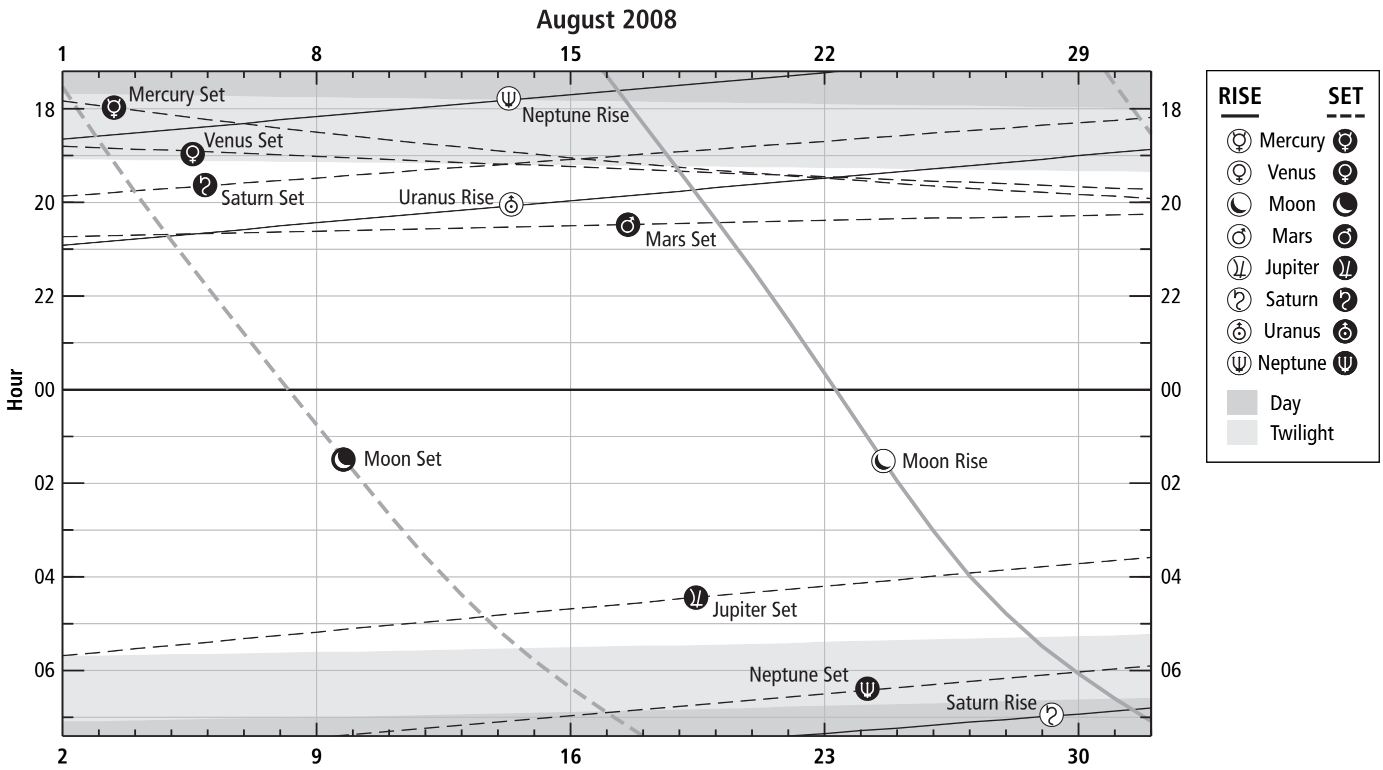


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		SATURN		URANUS		NEPTUNE	
	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	0721	1750	0758	1848	0906	2045	1535	0545	0840	1952	2055	0921	1839	0758
2	0724	1756	0758	1850	0904	2044	1531	0541	0836	1949	2051	0917	1835	0754
3	0727	1802	0758	1852	0901	2043	1526	0537	0833	1945	2047	0913	1831	0750
4	0729	1808	0757	1853	0859	2042	1522	0532	0829	1942	2043	0909	1827	0746
5	0731	1814	0757	1855	0857	2041	1518	0528	0825	1939	2039	0905	1823	0742
6	0733	1819	0757	1857	0854	2040	1513	0524	0822	1935	2035	0901	1819	0738
7	0735	1825	0756	1859	0852	2039	1509	0519	0818	1932	2030	0857	1814	0734
8	0737	1830	0756	1901	0850	2038	1505	0515	0815	1929	2026	0853	1810	0730
9	0738	1835	0756	1903	0848	2037	1500	0511	0811	1925	2022	0849	1806	0726
10	0739	1840	0755	1905	0845	2036	1456	0506	0807	1922	2018	0845	1802	0722
11	0741	1845	0755	1907	0843	2035	1452	0502	0804	1918	2014	0841	1758	0718
12	0741	1849	0754	1909	0841	2034	1447	0458	0800	1915	2010	0837	1754	0714
13	0742	1854	0754	1911	0838	2033	1443	0454	0757	1912	2006	0833	1750	0710
14	0743	1858	0753	1912	0836	2032	1439	0449	0753	1908	2002	0829	1746	0706
15	0744	1903	0752	1914	0834	2031	1434	0445	0749	1905	1958	0825	1742	0702
16	0744	1907	0752	1916	0832	2030	1430	0441	0746	1902	1954	0821	1738	0658
17	0744	1911	0751	1918	0829	2029	1426	0437	0742	1858	1950	0817	1734	0654
18	0745	1915	0751	1920	0827	2028	1422	0433	0739	1855	1946	0813	1730	0650
19	0745	1919	0750	1922	0825	2027	1417	0428	0735	1852	1941	0809	1726	0646
20	0745	1922	0749	1924	0822	2026	1413	0424	0731	1848	1937	0805	1722	0642
21	0745	1926	0749	1925	0820	2025	1409	0420	0728	1845	1933	0801	1718	0638
22	0744	1929	0748	1927	0818	2024	1405	0416	0724	1842	1929	0757	1714	0634
23	0744	1932	0747	1929	0816	2023	1401	0412	0721	1838	1925	0753	1709	0630
24	0744	1936	0747	1931	0813	2022	1356	0408	0717	1835	1921	0749	1705	0626
25	0743	1939	0746	1933	0811	2021	1352	0404	0714	1831	1917	0745	1701	0622
26	0743	1942	0745	1934	0809	2020	1348	0359	0710	1828	1913	0741	1657	0618
27	0742	1945	0744	1936	0807	2020	1344	0355	0706	1825	1909	0737	1653	0614
28	0741	1947	0744	1938	0804	2019	1340	0351	0703	1821	1905	0733	1649	0610
29	0741	1950	0743	1940	0802	2018	1336	0347	0659	1818	1900	0729	1645	0606
30	0740	1952	0742	1942	0800	2017	1332	0343	0656	1815	1856	0725	1641	0602
31	0739	1955	0741	1943	0758	2016	1328	0339	0652	1811	1852	0721	1637	0558

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

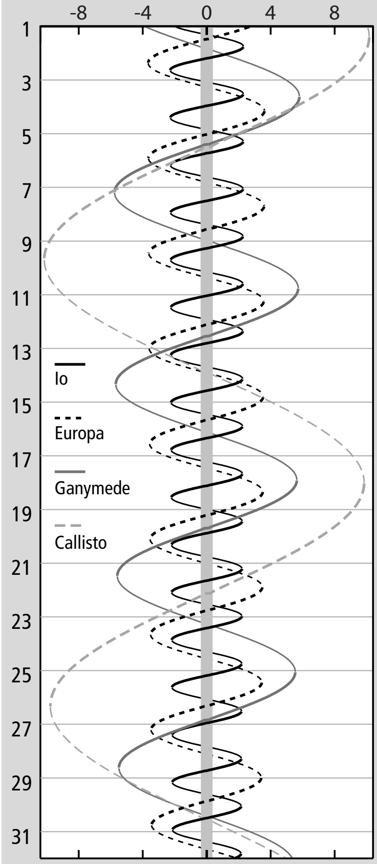
DAY	PHENOMENON h m	Sat.	Event
1	0302		GRS
1	1824	III	Oc.D.
1	2254		GRS
1	2355	III	Ec.R.
2	0334	I	Tr.I.
2	0408	I	Sh.I.
2	1845		GRS
3	0043	I	Oc.D.
3	0334	I	Ec.R.
3	0441		GRS
3	0456	II	Oc.D.
3	2200	I	Tr.I.
3	2237	I	Sh.I.
4	0017	I	Tr.E.
4	0033		GRS
4	0053	I	Sh.E.
4	1910	I	Oc.D.
4	2024		GRS
4	2203	I	Ec.R.
4	2314	II	Tr.I.
5	0028	II	Sh.I.
5	0157	II	Tr.E.
5	0312	II	Sh.E.
5	1843	I	Tr.E.
5	1922	I	Sh.E.
5	2017	IV	Sh.E.
6	0212		GRS
6	1806	II	Oc.D.
6	2203		GRS
6	2215	II	Ec.R.
7	1755		GRS
8	0351		GRS
8	2148	III	Oc.D.
8	2342		GRS
9	0356	III	Ec.R.
9	1934		GRS
10	0229	I	Oc.D.
10	2347	I	Tr.I.
11	0032	I	Sh.I.
11	0121		GRS
11	0203	I	Tr.E.
11	0248	I	Sh.E.
11	2056	I	Oc.D.
11	2113		GRS
11	2358	I	Ec.R.
12	0131	II	Tr.I.
12	0303	II	Sh.I.
12	0415	II	Tr.E.
12	1756	III	Sh.E.
12	1814	I	Tr.I.
12	1901	I	Sh.I.
12	2029	I	Tr.E.
12	2117	I	Sh.E.
13	0301		GRS
13	1826	I	Ec.R.
13	1944	IV	Oc.D.
13	2026	II	Oc.D.
13	2252		GRS
13	2322	IV	Oc.R.
14	0052	II	Ec.R.
14	0316	IV	Ec.D.
14	1844		GRS
15	0440		GRS
15	1905	II	Sh.E.
16	0031		GRS
16	0115	III	Oc.D.
16	0428	III	Oc.R.
16	0439	III	Ec.D.
16	2023		GRS
17	0416	I	Oc.D.
18	0134	I	Tr.I.
18	0211		GRS
18	0227	I	Sh.I.
18	0350	I	Tr.E.
18	2202		GRS
18	2243	I	Oc.D.
19	0153	I	Ec.R.
19	0351	II	Tr.I.
19	1754		GRS
19	1812	III	Tr.E.
19	1839	III	Sh.I.
19	2001	I	Tr.I.
19	2056	I	Sh.I.
19	2157	III	Sh.E.
19	2217	I	Tr.E.
19	2312	I	Sh.E.
20	0350		GRS
20	2021	I	Ec.R.
20	2248	II	Oc.D.
20	2341		GRS
21	0329	II	Ec.R.
21	1933		GRS
22	0139	IV	Tr.I.
22	1856	II	Sh.I.
22	1946	II	Tr.E.
22	2141	II	Sh.E.
23	0121		GRS
23	2112		GRS
25	0260		GRS
25	0323	I	Tr.I.
25	2252		GRS
26	0031	I	Oc.D.
26	0348	I	Ec.R.
26	1832	III	Tr.I.
26	1843		GRS
26	2145	III	Tr.E.
26	2150	I	Tr.I.
26	2240	III	Sh.I.
26	2251	I	Sh.I.
27	0005	I	Tr.E.
27	0107	I	Sh.E.
27	0158	III	Sh.E.
27	1858	I	Oc.D.
27	2216	I	Ec.R.
28	0031		GRS
28	0112	II	Oc.D.
28	1833	I	Tr.E.
28	1936	I	Sh.E.
28	2023		GRS
29	1925	II	Tr.I.
29	2132	II	Sh.I.
29	2209	II	Tr.E.
30	0017	II	Sh.E.
30	0210		GRS
30	2120	IV	Ec.D.
30	2202		GRS
31	0119	IV	Ec.R.
31	1925	II	Ec.R.

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

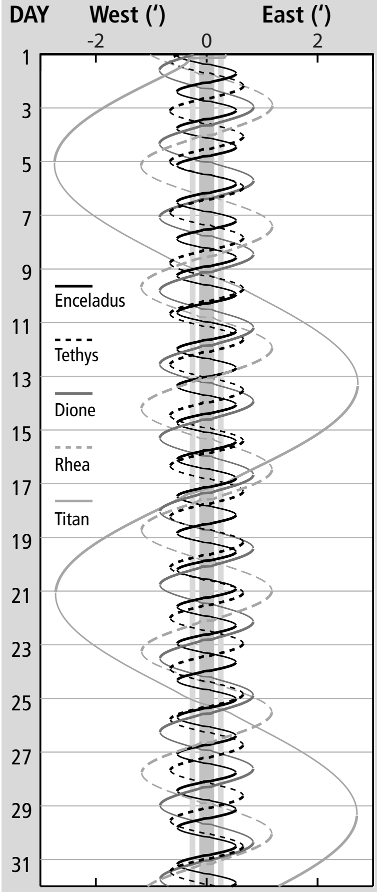
Events: D Disappear; R Reappear; E Egress; I Ingress; Ec Eclipse; Oc Occult; Sh Shadow; Tr Transit

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

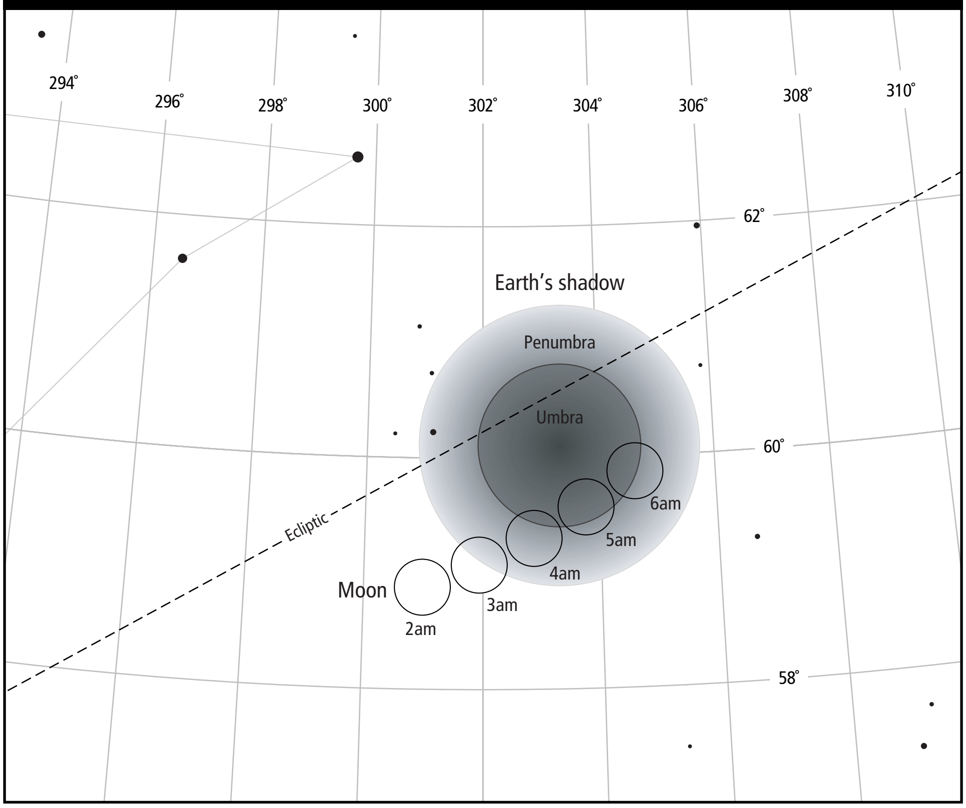
JUPITER MOONS



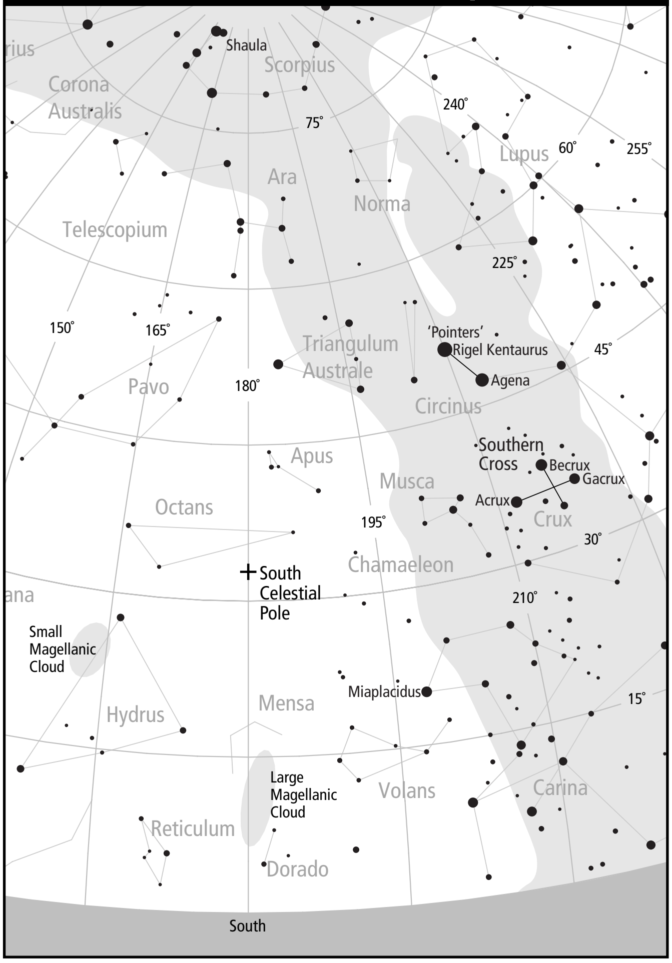
SATURN MOONS



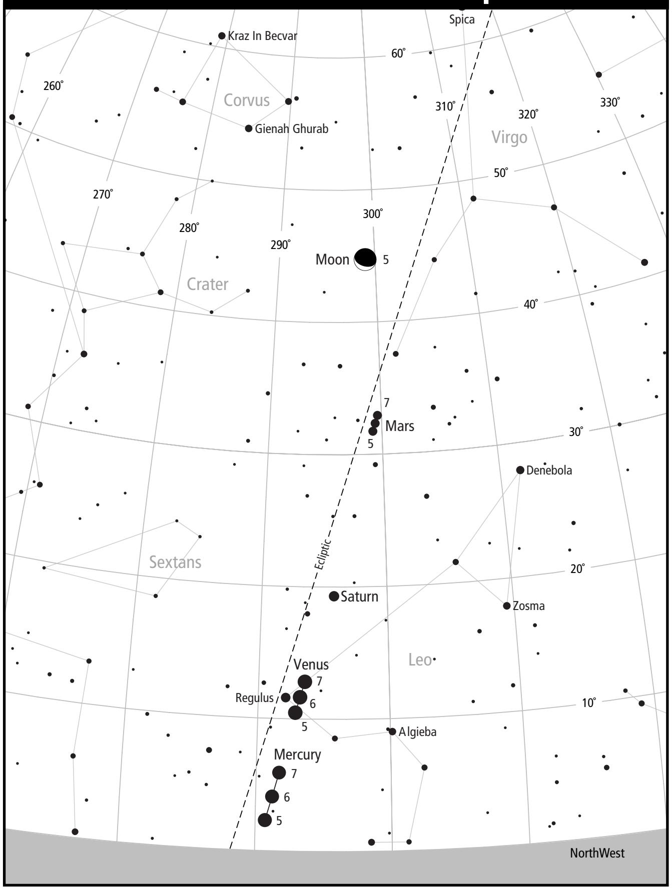
SKYVIEW 2008 AUGUST 17 2am-6am



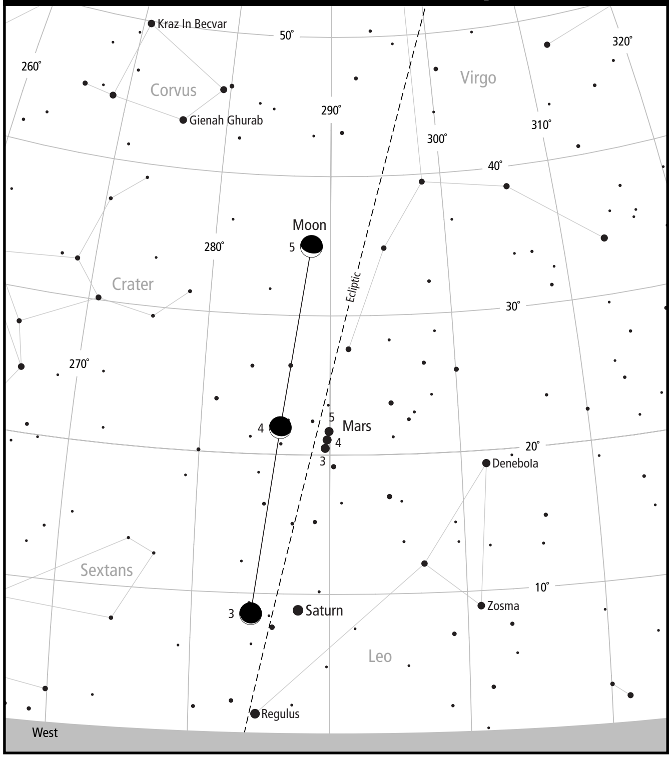
SKYVIEW 2008 AUGUST 15 8pm



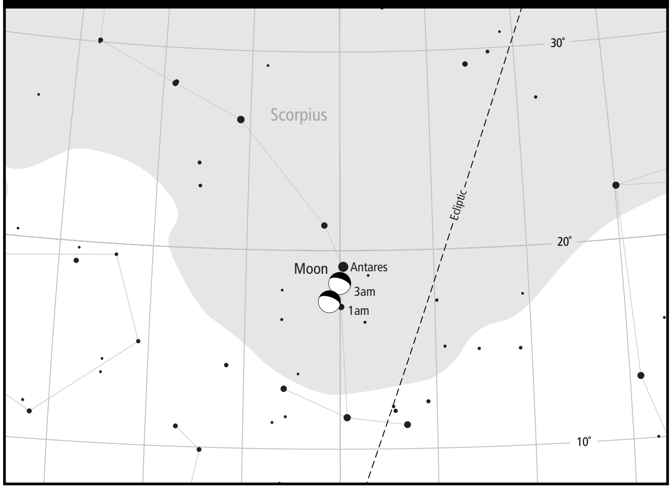
SKYVIEW 2008 AUGUST 5-7 6pm



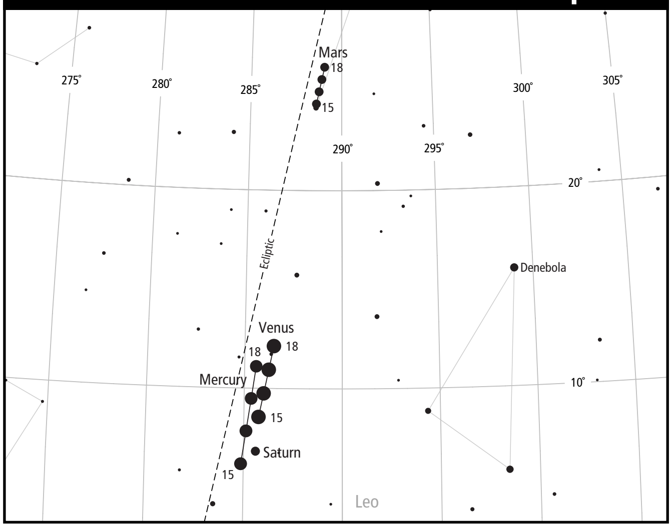
SKYVIEW 2008 AUGUST 3-5 7pm



SKYVIEW 2008 AUGUST 11 1am-3am



SKYVIEW 2008 AUGUST 15-18 6.30pm



SEPTEMBER 2008

HIGHLIGHTS

Mercury, ***Venus*** *and* ***Mars*** *close and visible low in western evening twilight.*

Jupiter *visible all evening and sets before morning twilight .*

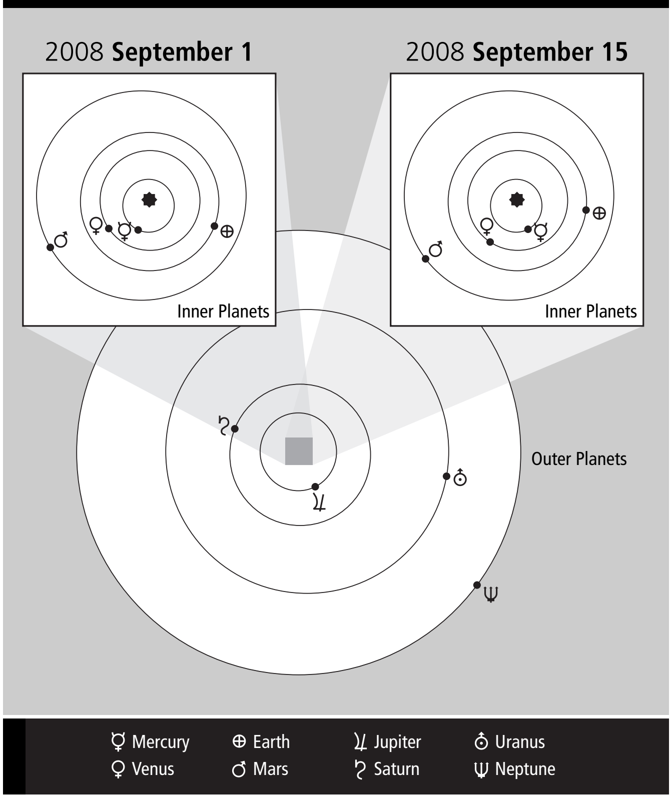
DIARY

Day	Hour	
2	05	Venus 5° N. of Moon
2	07	Mercury 3° N. of Moon
2	16	Mars 5° N. of Moon
4	10	Saturn inferior conjunction with Sun
7	11	*Antares* 0°.3 N. of Moon
7	22	**First Quarter**
7	23	Moon at apogee
8	11	Jupiter stationary
10	04	Jupiter 3° N. of Moon
11	12	Mercury greatest elongation E. (27°)
11	13	Mercury 4° S. of Venus
12	05	Venus 0°.3 N. of Mars
13	05	Mercury 3° S. of Mars
13	10	Neptune 0°.8 S. of Moon
13	10	Uranus at opposition
15	16	Uranus 4° S. of Moon
15	17	**Full Moon**
18	17	Venus 3° N. of *Spica*
19	13	Mercury 4° S. of Mars
20	11	Moon at perigee
22	13	**Last Quarter**
23	00	Equinox
24	03	Mars 2° N. of *Spica*
24	13	Mercury stationary
28	04	Saturn 5° N. of Moon
29	16	**New Moon**

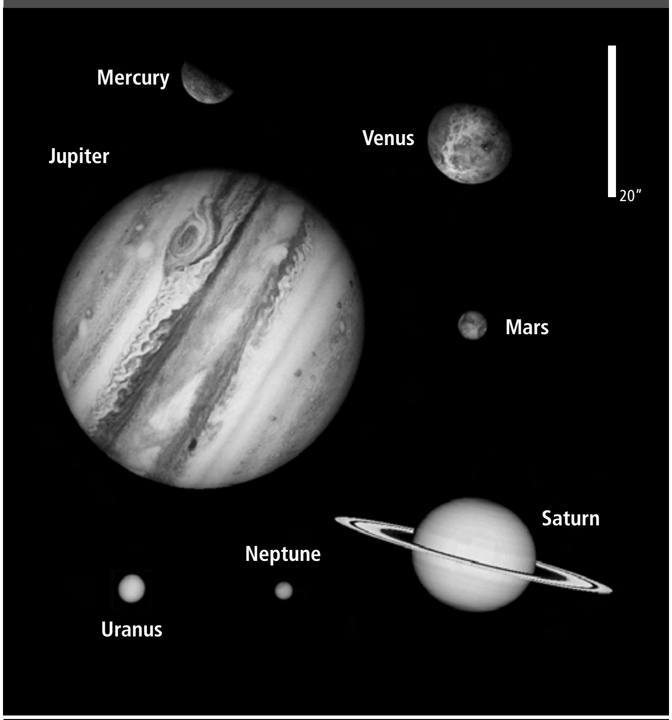
SUN+MOON RISE/SET

DAY	SUN Rise h m	SUN Azimuth (°)	SUN Twlght h m	SUN Transit Time h m	SUN Set h m	SUN Azimuth (°)	SUN Twlght h m	MOON Rise h m	MOON Set h m	MOON Illumintn (%)
1	0633	81	0512	1217	1800	279	1921	0705	1934	1
2	0632	81	0511	1216	1801	279	1922	0733	2034	4
3	0631	82	0510	1216	1801	278	1923	0802	2133	9
4	0630	82	0509	1216	1802	278	1923	0833	2233	16
5	0628	83	0507	1215	1803	277	1924	0906	2331	24
6	0627	83	0506	1215	1803	277	1924	0944	DNS	32
7	0626	83	0505	1215	1804	276	1925	1026	0029	41
8	0625	84	0504	1214	1804	276	1925	1114	0124	51
9	0623	84	0502	1214	1805	275	1926	1207	0215	60
10	0622	85	0501	1214	1806	275	1927	1304	0302	69
11	0621	85	0500	1213	1806	275	1927	1404	0343	78
12	0619	86	0458	1213	1807	274	1928	1505	0420	86
13	0618	86	0457	1212	1807	274	1929	1606	0453	92
14	0617	87	0456	1212	1808	273	1929	1707	0524	97
15	0615	87	0454	1212	1809	273	1930	1810	0553	99
16	0614	87	0453	1211	1809	272	1930	1914	0623	100
17	0613	88	0452	1211	1810	272	1931	2020	0654	98
18	0611	88	0450	1211	1810	271	1932	2129	0728	93
19	0610	89	0449	1210	1811	271	1932	2239	0807	87
20	0609	89	0448	1210	1812	271	1933	2349	0852	78
21	0607	90	0446	1210	1812	270	1934	DNR	0946	68
22	0606	90	0445	1209	1813	270	1934	0055	1047	56
23	0605	91	0443	1209	1813	269	1935	0154	1154	45
24	0604	91	0442	1209	1814	269	1936	0244	1302	34
25	0602	92	0441	1208	1815	268	1937	0327	1410	24
26	0601	92	0439	1208	1815	268	1937	0404	1516	15
27	0600	92	0438	1208	1816	267	1938	0436	1619	8
28	0558	93	0436	1207	1817	267	1939	0505	1720	3
29	0557	93	0435	1207	1817	266	1939	0534	1821	1
30	0556	94	0434	1207	1818	266	1940	0602	1920	0

PLANET POSITIONS



PLANET APPEARANCE

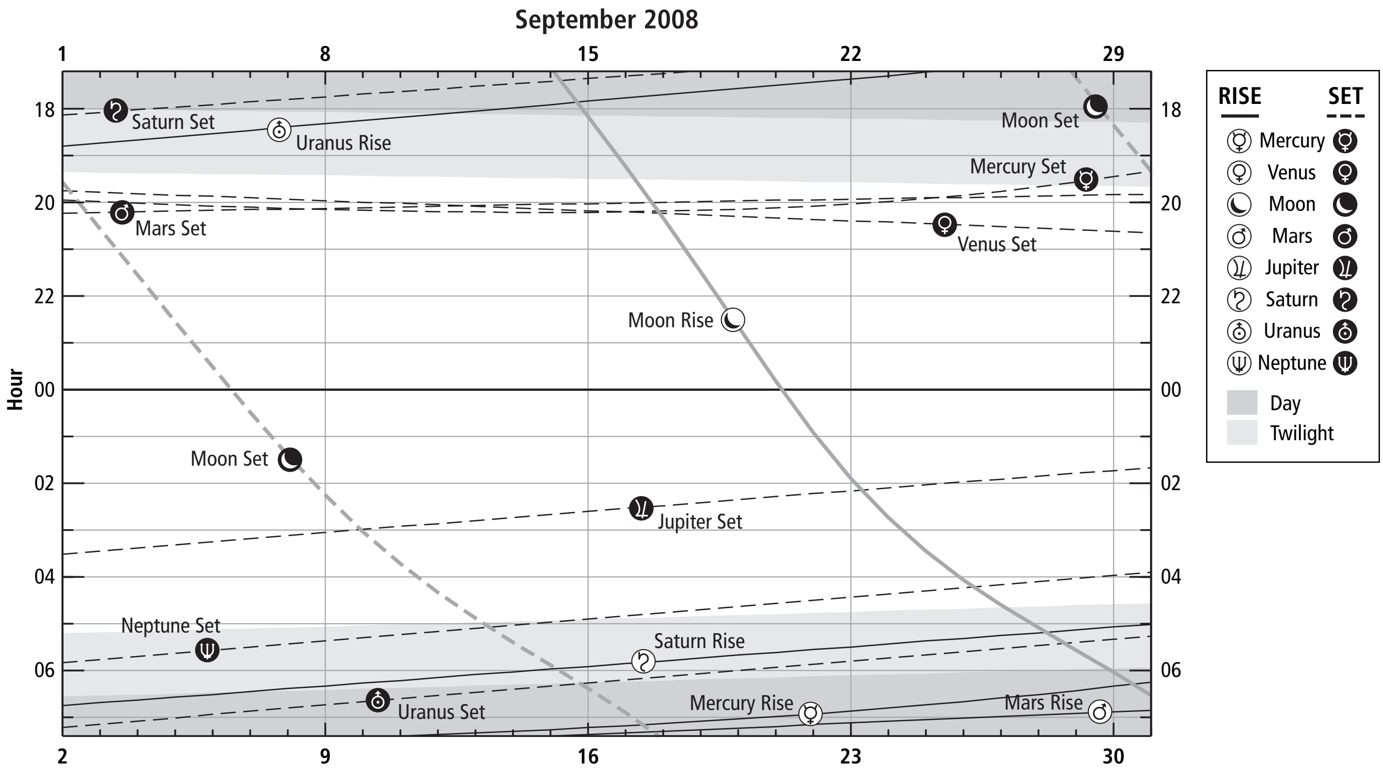


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		SATURN		URANUS		NEPTUNE	
	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	0738	1957	0741	1945	0755	2015	1324	0335	0648	1808	1848	0717	1633	0554
2	0737	1959	0740	1947	0753	2014	1320	0331	0645	1805	1844	0713	1629	0550
3	0736	2001	0739	1949	0751	2013	1316	0327	0641	1801	1840	0709	1625	0546
4	0735	2003	0738	1951	0749	2012	1312	0323	0638	1758	1836	0705	1621	0542
5	0733	2005	0737	1952	0746	2011	1308	0319	0634	1755	1832	0701	1617	0538
6	0732	2006	0737	1954	0744	2010	1304	0315	0631	1751	1828	0656	1613	0534
7	0731	2008	0736	1956	0742	2009	1300	0311	0627	1748	1823	0652	1609	0530
8	0729	2009	0735	1958	0740	2009	1256	0307	0623	1745	1819	0648	1605	0526
9	0727	2010	0734	2000	0738	2008	1252	0303	0620	1741	1815	0644	1601	0522
10	0726	2011	0734	2001	0735	2007	1248	0259	0616	1738	1811	0640	1557	0518
11	0724	2012	0733	2003	0733	2006	1244	0255	0613	1735	1807	0636	1552	0514
12	0722	2012	0732	2005	0731	2005	1240	0252	0609	1731	1803	0632	1548	0510
13	0720	2013	0731	2007	0729	2004	1236	0248	0605	1728	1759	0628	1544	0506
14	0718	2013	0731	2009	0727	2003	1232	0244	0602	1725	1755	0624	1540	0502
15	0716	2013	0730	2011	0724	2002	1229	0240	0558	1721	1750	0620	1536	0458
16	0713	2012	0729	2012	0722	2002	1225	0236	0555	1718	1746	0616	1532	0454
17	0711	2011	0728	2014	0720	2001	1221	0232	0551	1715	1742	0612	1528	0450
18	0708	2010	0728	2016	0718	2000	1217	0229	0548	1711	1738	0608	1524	0446
19	0705	2009	0727	2018	0716	1959	1213	0225	0544	1708	1734	0604	1520	0442
20	0702	2007	0726	2020	0714	1958	1210	0221	0540	1705	1730	0600	1516	0438
21	0659	2005	0726	2022	0712	1957	1206	0217	0537	1701	1726	0556	1512	0434
22	0656	2002	0725	2024	0709	1957	1202	0213	0533	1658	1722	0552	1508	0430
23	0652	1959	0724	2025	0707	1956	1158	0210	0530	1654	1718	0548	1504	0426
24	0648	1955	0724	2027	0705	1955	1155	0206	0526	1651	1713	0544	1500	0422
25	0644	1951	0723	2029	0703	1954	1151	0202	0522	1648	1709	0540	1456	0418
26	0640	1946	0723	2031	0701	1954	1147	0158	0519	1644	1705	0536	1452	0414
27	0635	1940	0722	2033	0659	1953	1144	0155	0515	1641	1701	0532	1448	0410
28	0631	1934	0722	2035	0657	1952	1140	0151	0512	1638	1657	0528	1444	0406
29	0626	1927	0721	2037	0655	1951	1136	0147	0508	1634	1653	0524	1440	0402
30	0620	1920	0721	2039	0653	1950	1133	0144	0504	1631	1649	0520	1436	0358

SOLAR SYSTEM RISE/SET



JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Sat.	Event
1	2341		GRS
2	0220	I	Oc.D.
2	1933		GRS
2	2210	III	Tr.I.
2	2340	I	Tr.I.
3	0046	I	Sh.I.
3	0123	III	Tr.E.
3	0155	I	Tr.E.
3	0241	III	Sh.I.
3	0302	I	Sh.E.
3	2047	I	Oc.D.
4	0011	I	Ec.R.
4	0121		GRS
4	1807	I	Tr.I.
4	1915	I	Sh.I.
4	2023	I	Tr.E.
4	2112		GRS
4	2131	I	Sh.E.
5	1840	I	Ec.R.

DAY	PHENOMENON h m	Sat.	Event
5	2151	II	Tr.I.
6	0008	II	Sh.I.
6	0034	II	Tr.E.
6	0253	II	Sh.E.
6	0300		GRS
6	1958	III	Ec.R.
6	2252		GRS
7	1844		GRS
7	2116	IV	Tr.E.
7	2202	II	Ec.R.
9	0031		GRS
9	2023		GRS
10	0131	I	Tr.I.
10	0152	III	Tr.I.
10	0242	I	Sh.I.
10	2238	I	Oc.D.
11	0207	I	Ec.R.
11	0211		GRS
11	1959	I	Tr.I.

DAY	PHENOMENON h m	Sat.	Event
11	2111	I	Sh.I.
11	2203		GRS
11	2214	I	Tr.E.
11	2326	I	Sh.E.
12	2035	I	Ec.R.
13	0019	II	Tr.I.
13	0244	II	Sh.I.
13	1858	III	Oc.R.
13	2038	III	Ec.D.
13	2342		GRS
13	2360	III	Ec.R.
14	1922	II	Oc.D.
14	1934		GRS
15	0040	II	Ec.R.
16	0122		GRS
16	1847	II	Sh.E.
16	1930	IV	Ec.R.
16	2114		GRS
18	0030	I	Oc.D.
18	2151	I	Tr.I.
18	2253		GRS
18	2306	I	Sh.I.
19	0006	I	Tr.E.
19	0122	I	Sh.E.
19	1845		GRS
19	1858	I	Oc.D.
19	2231	I	Ec.R.
20	1834	I	Tr.E.
20	1932	III	Oc.D.

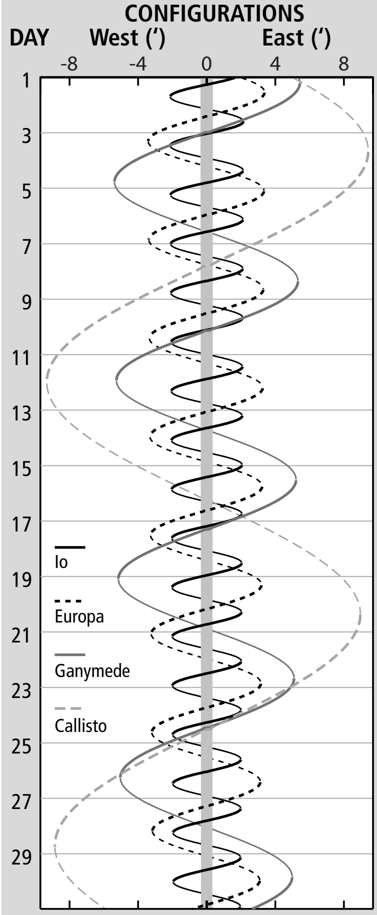
DAY	PHENOMENON h m	Sat.	Event
20	1950	I	Sh.E.
20	2247	III	Oc.R.
21	0033		GRS
21	0039	III	Ec.D.
21	2025		GRS
21	2154	II	Oc.D.
23	1838	II	Sh.I.
23	1849	II	Tr.E.
23	2124	II	Sh.E.
23	2204		GRS
24	2247	IV	Sh.I.
25	2344		GRS
25	2345	I	Tr.I.
26	0101	I	Sh.I.
26	1936		GRS
26	2051	I	Oc.D.
27	0026	I	Ec.R.
27	1930	I	Sh.I.
27	2028	I	Tr.E.
27	2146	I	Sh.E.
27	2326	III	Oc.D.
28	0124		GRS
28	1855	I	Ec.R.
28	2115		GRS
29	0028	II	Oc.D.
30	1839	II	Tr.I.
30	2115	II	Sh.I.
30	2123	II	Tr.E.
30	2255		GRS

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

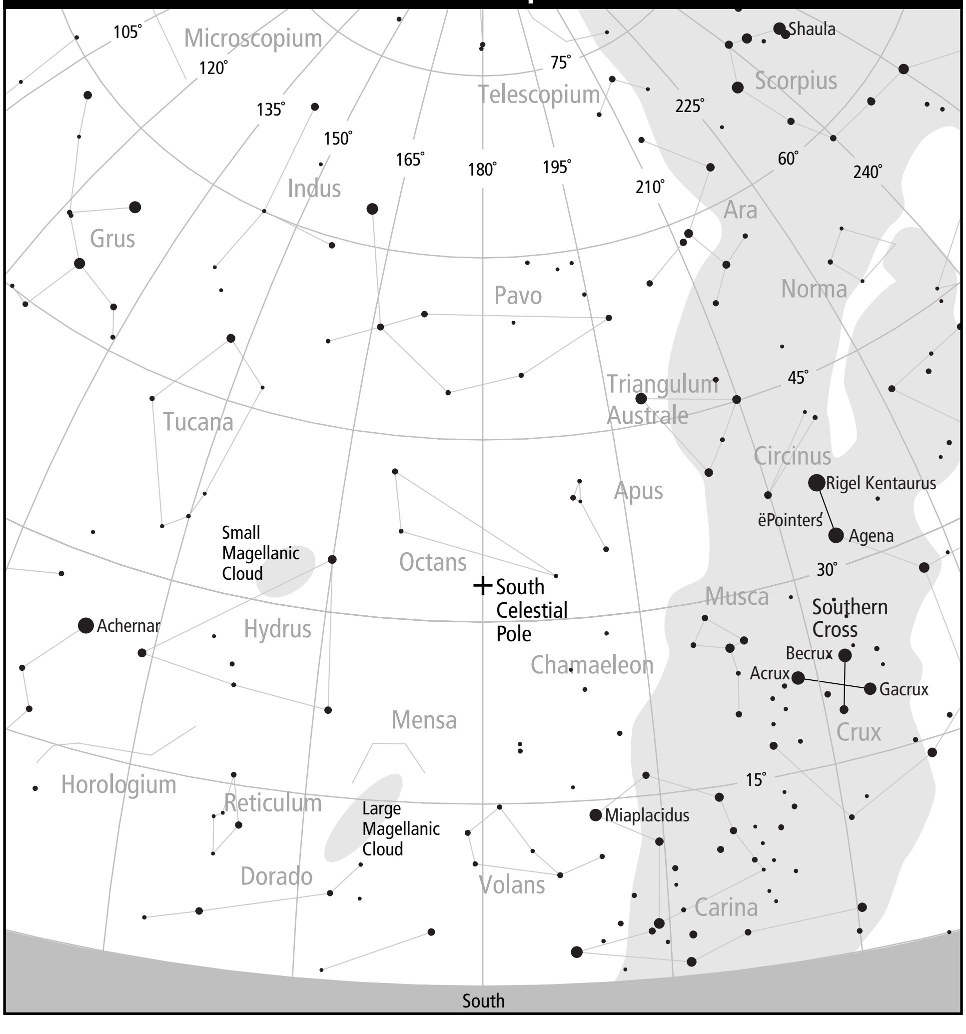
Events: D Disappear; E Egress; Ec Eclipse; Sh Shadow; R Reappear; I Ingress; Oc Occult; Tr Transit

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

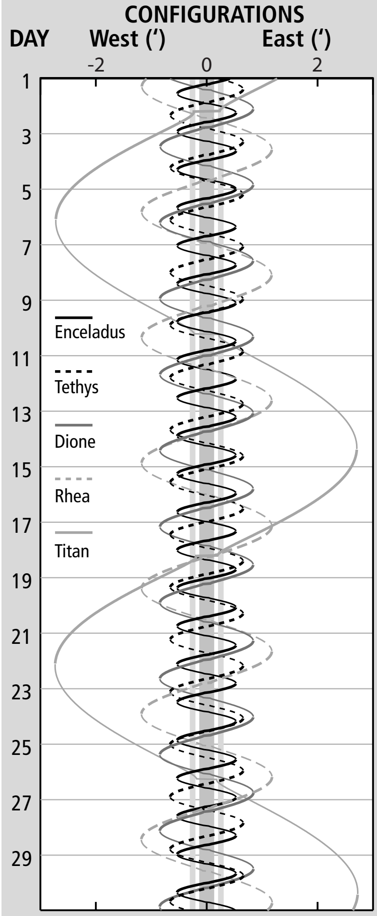
JUPITER MOONS



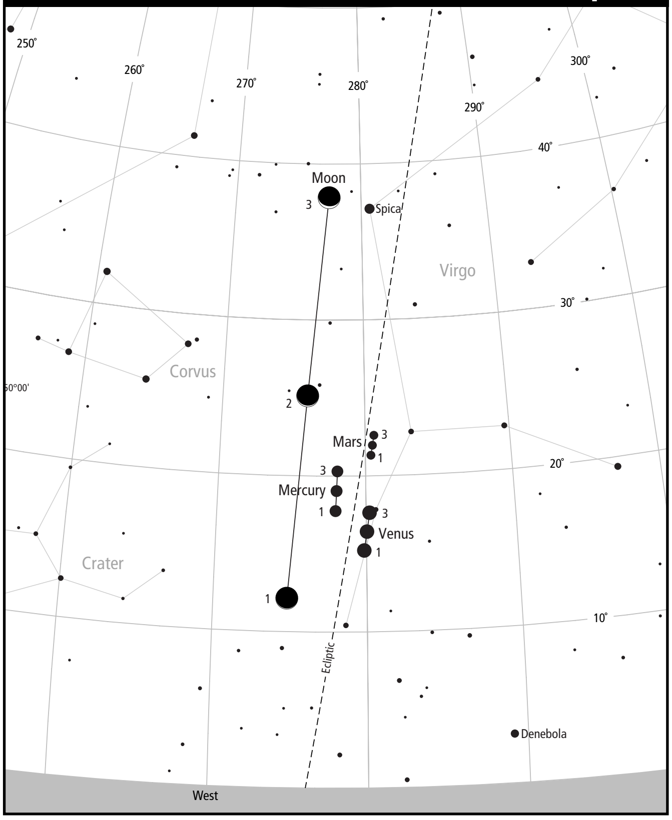
SKYVIEW 2008 SEPTEMBER 15 8pm



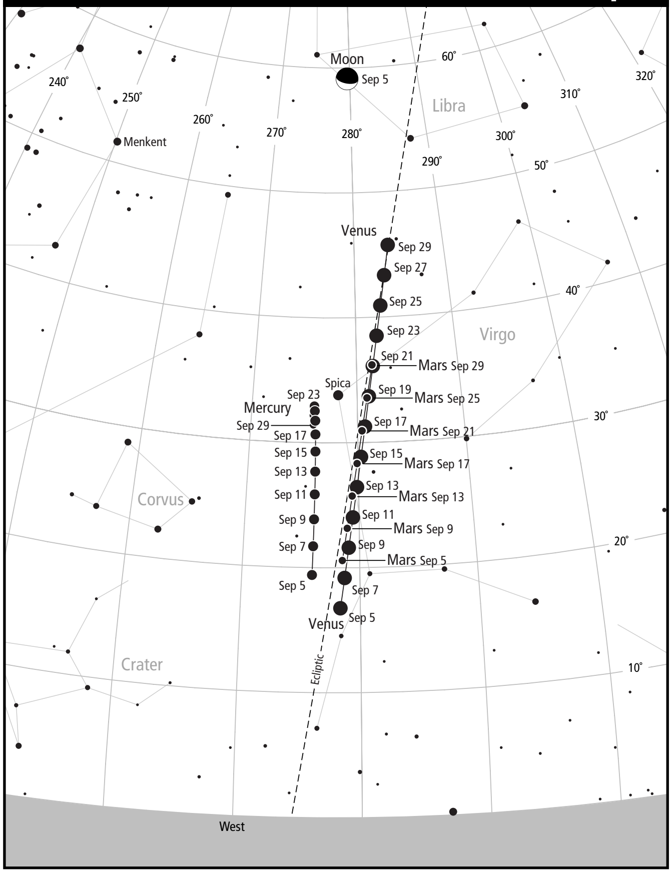
SATURN MOONS



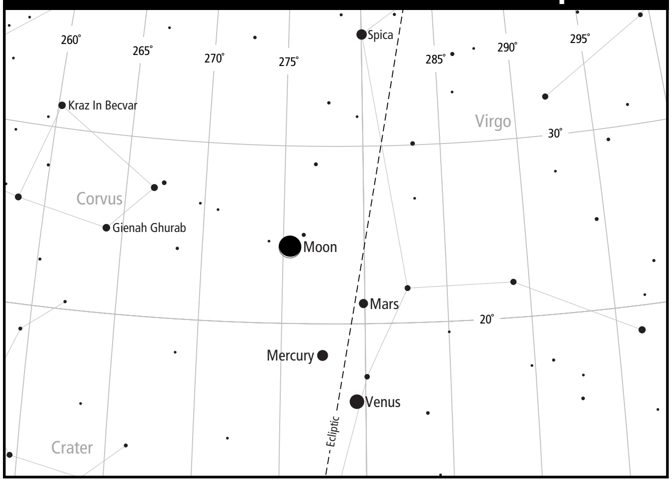
SKYVIEW 2008 SEPTEMBER 1-3 6.30pm



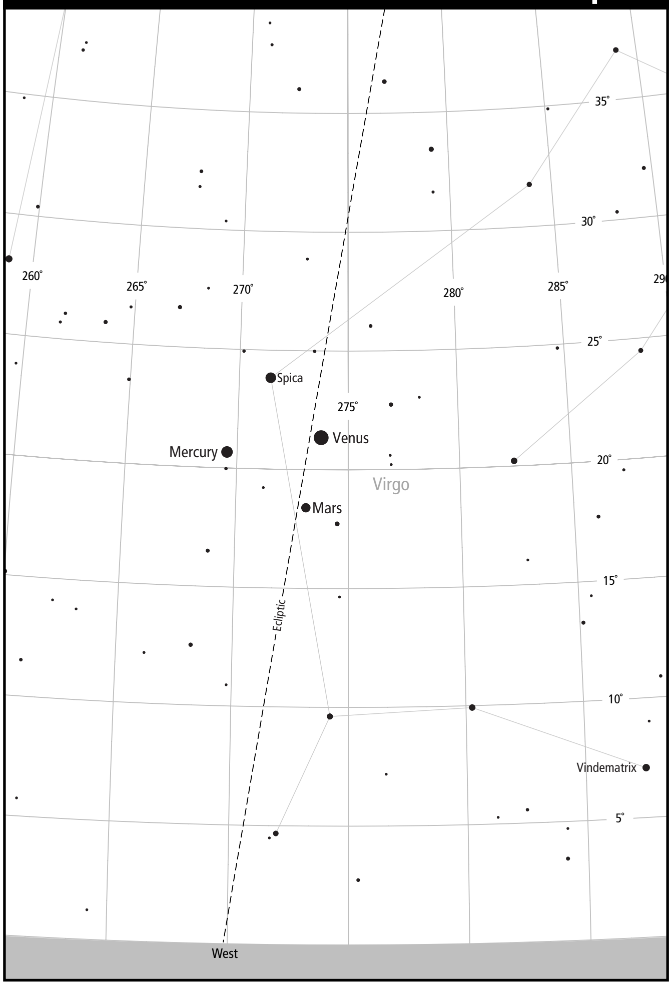
SKYVIEW 2008 SEPTEMBER 5-26 6.30pm



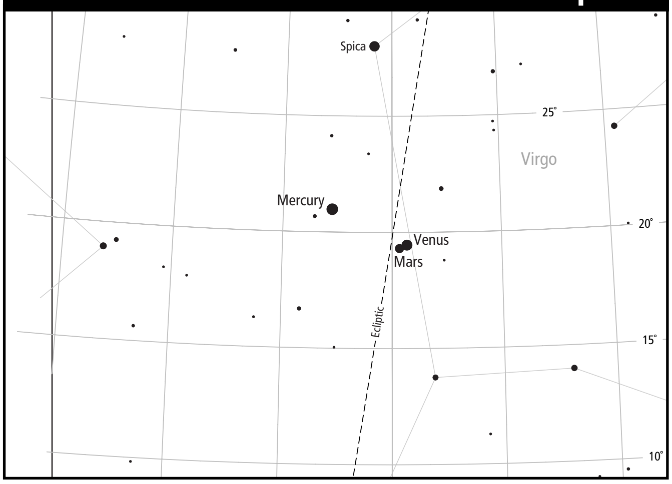
SKYVIEW 2008 SEPTEMBER 2 6.30pm



SKYVIEW 2008 SEPTEMBER 1-2 6.30pm



SKYVIEW 2008 SEPTEMBER 12 6.30pm



OCTOBER 2008

Daylight Saving in effect

HIGHLIGHTS

***Moon** occults Antares on 4th.*
***Venus** clearly visible in the west in early evening.*
***Mars** visible very low in western evening twilight in first week of month.*
***Jupiter** visible all evening.*
***Saturn** visible before dawn in the eastern sky.*

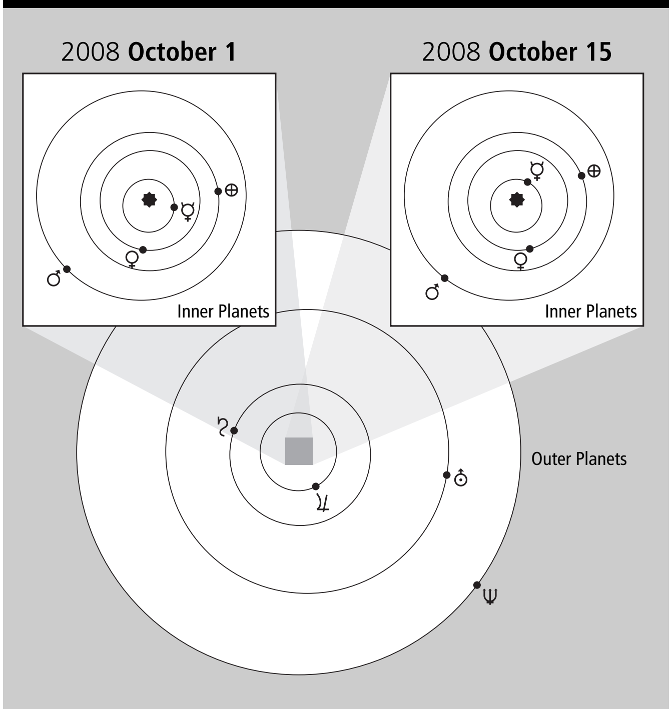
DIARY

Day	Hour	
1	12	Mars 5° N. of Moon
2	10	Venus 5° N. of Moon
4	20	*Antares* 0°.1 N. of Moon - occultation
5	19	Moon at apogee
7	05	Mercury in inferior conjunction
7	15	Jupiter 2° N. of Moon
7	17	**First Quarter**
10	18	Neptune 0°.9 S. of Moon
13	00	Uranus 4° S. of Moon
15	04	**Full Moon**
15	13	Mercury stationary
17	14	Moon at perigee
18		Maximum activity of epsilon-Geminid meteor shower
21		Maximum activity of epsilon-Orionid meteor shower
21	20	**Last Quarter**
22	18	Mercury greatest elongation W. (18°)
25	16	Saturn 5° N. of Moon
26	22	Venus 3° N. of *Antares*
28	03	Mercury 7° N. of Moon
29	08	**New Moon**
31	05	Mercury 4° N. of *Spica*

SUN+MOON RISE/SET

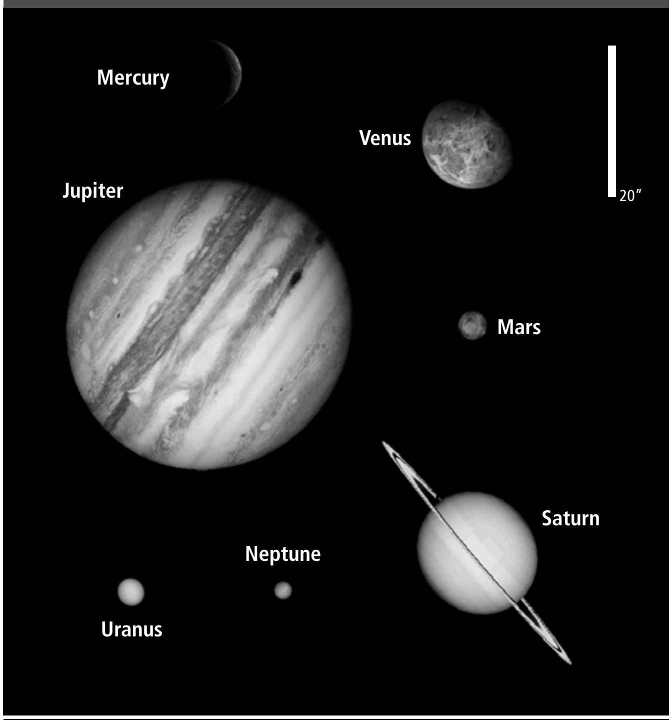
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn (%)
1	0554	94	0432	1206	1819	265	1941	0632	2020	2
2	0553	95	0431	1206	1819	265	1942	0704	2119	6
3	0552	95	0429	1206	1820	265	1943	0740	2218	11
4	0550	96	0428	1205	1821	264	1943	0821	2314	18
5	0549	96	0426	1205	1821	264	1944	0907	DNS	26
6	0548	97	0425	1205	1822	263	1945	0958	0007	34
7	0547	97	0424	1204	1823	263	1946	1053	0055	43
8	0545	97	0422	1204	1823	262	1947	1150	0138	53
9	0544	98	0421	1204	1824	262	1948	1250	0216	62
10	0543	98	0419	1204	1825	261	1948	1350	0250	72
11	0542	99	0418	1203	1825	261	1949	1451	0321	80
12	0541	99	0417	1203	1826	260	1950	1552	0351	88
13	0539	100	0415	1203	1827	260	1951	1656	0420	94
14	0538	100	0414	1203	1828	260	1952	1802	0451	98
15	0537	101	0412	1202	1828	259	1953	1911	0524	100
16	0536	101	0411	1202	1829	259	1954	2023	0602	99
17	0535	101	0410	1202	1830	258	1955	2136	0647	95
18	0533	102	0408	1202	1830	258	1956	2245	0739	89
19	0532	102	0407	1202	1831	257	1957	2348	0839	81
20	0531	103	0406	1201	1832	257	1958	DNR	0946	70
21	0530	103	0404	1201	1833	257	1959	0042	1055	60
22	0529	104	0403	1201	1834	256	2000	0127	1203	48
23	0528	104	0402	1201	1834	256	2001	0205	1309	37
24	0527	104	0400	1201	1835	255	2002	0238	1412	27
25	0526	105	0359	1201	1836	255	2003	0308	1512	18
26	0625	105	0458	1301	1937	255	2104	0436	1712	11
27	0624	106	0457	1300	1938	254	2105	0504	1810	5
28	0623	106	0455	1300	1938	254	2106	0533	1909	2
29	0622	106	0454	1300	1939	253	2107	0604	2008	0
30	0621	107	0453	1300	1940	253	2108	0639	2107	1
31	0620	107	0452	1300	1941	253	2110	0718	2204	3

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ⛢ Uranus
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

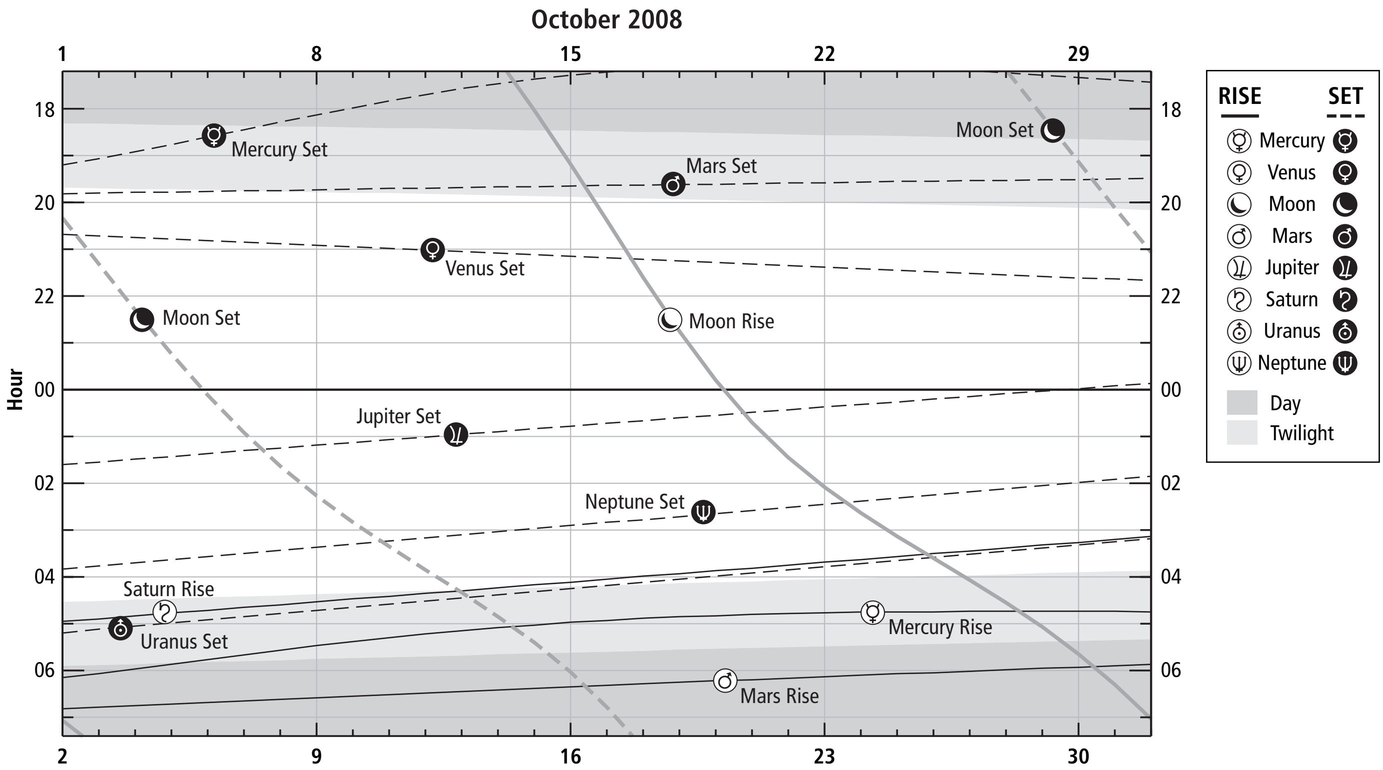


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY Rise h m	MERCURY Set h m	VENUS Rise h m	VENUS Set h m	MARS Rise h m	MARS Set h m	JUPITER Rise h m	JUPITER Set h m	SATURN Rise h m	SATURN Set h m	URANUS Rise h m	URANUS Set h m	NEPTUNE Rise h m	NEPTUNE Set h m
1	0615	1912	0720	2041	0651	1950	1129	0140	0501	1628	1645	0516	1432	0354
2	0609	1904	0720	2043	0649	1949	1126	0136	0457	1624	1641	0512	1428	0350
3	0604	1855	0719	2045	0647	1948	1122	0133	0454	1621	1636	0507	1424	0346
4	0558	1846	0719	2047	0645	1947	1118	0129	0450	1617	1632	0503	1420	0342
5	0552	1836	0719	2049	0643	1947	1115	0126	0446	1614	1628	0459	1416	0338
6	0546	1827	0718	2051	0641	1946	1111	0122	0443	1611	1624	0455	1412	0334
7	0540	1817	0718	2053	0639	1945	1108	0118	0439	1607	1620	0451	1408	0330
8	0534	1808	0718	2055	0637	1945	1104	0115	0436	1604	1616	0447	1404	0326
9	0528	1759	0718	2057	0635	1944	1101	0111	0432	1600	1612	0443	1400	0322
10	0523	1750	0717	2059	0633	1943	1057	0108	0428	1557	1608	0439	1356	0318
11	0518	1742	0717	2101	0631	1942	1054	0104	0425	1554	1604	0435	1352	0314
12	0513	1734	0717	2103	0629	1942	1050	0101	0421	1550	1600	0431	1348	0310
13	0509	1728	0717	2105	0627	1941	1047	0057	0418	1547	1556	0427	1344	0306
14	0505	1722	0717	2107	0625	1940	1043	0054	0414	1543	1551	0423	1340	0302
15	0502	1717	0717	2109	0623	1940	1040	0050	0410	1540	1547	0419	1336	0258
16	0458	1713	0717	2111	0621	1939	1037	0047	0407	1537	1543	0415	1332	0254
17	0456	1710	0717	2113	0619	1938	1033	0043	0403	1533	1539	0411	1328	0250
18	0453	1707	0717	2115	0617	1938	1030	0040	0359	1530	1535	0407	1324	0247
19	0451	1706	0718	2117	0615	1937	1026	0036	0356	1526	1531	0403	1320	0243
20	0450	1705	0718	2119	0613	1937	1023	0033	0352	1523	1527	0359	1316	0239
21	0448	1705	0718	2121	0612	1936	1020	0029	0349	1519	1523	0355	1312	0235
22	0447	1705	0718	2123	0610	1935	1016	0026	0345	1516	1519	0351	1308	0231
23	0446	1706	0719	2125	0608	1935	1013	0022	0341	1513	1515	0347	1304	0227
24	0445	1707	0719	2127	0606	1934	1010	0019	0338	1509	1511	0343	1300	0223
25	0445	1709	0719	2129	0604	1933	1006	0016	0334	1506	1507	0339	1256	0219
26	0545	1811	0820	2231	0703	2032	1103	0012	0430	1602	1603	0435	1352	0315
27	0544	1814	0820	2233	0701	2032	1100	0109	0427	1559	1559	0431	1348	0311
28	0544	1817	0821	2235	0659	2031	1056	0105	0423	1555	1555	0427	1344	0307
29	0544	1820	0822	2237	0657	2031	1053	0102	0419	1552	1551	0423	1341	0303
30	0544	1823	0822	2238	0656	2030	1050	0059	0416	1548	1546	0419	1337	0259
31	0544	1826	0823	2240	0654	2029	1047	0055	0412	1545	1542	0415	1333	0255

SOLAR SYSTEM RISE/SET



Daylight Saving in effect

JUPITER MOONS + GREAT RED SPOT

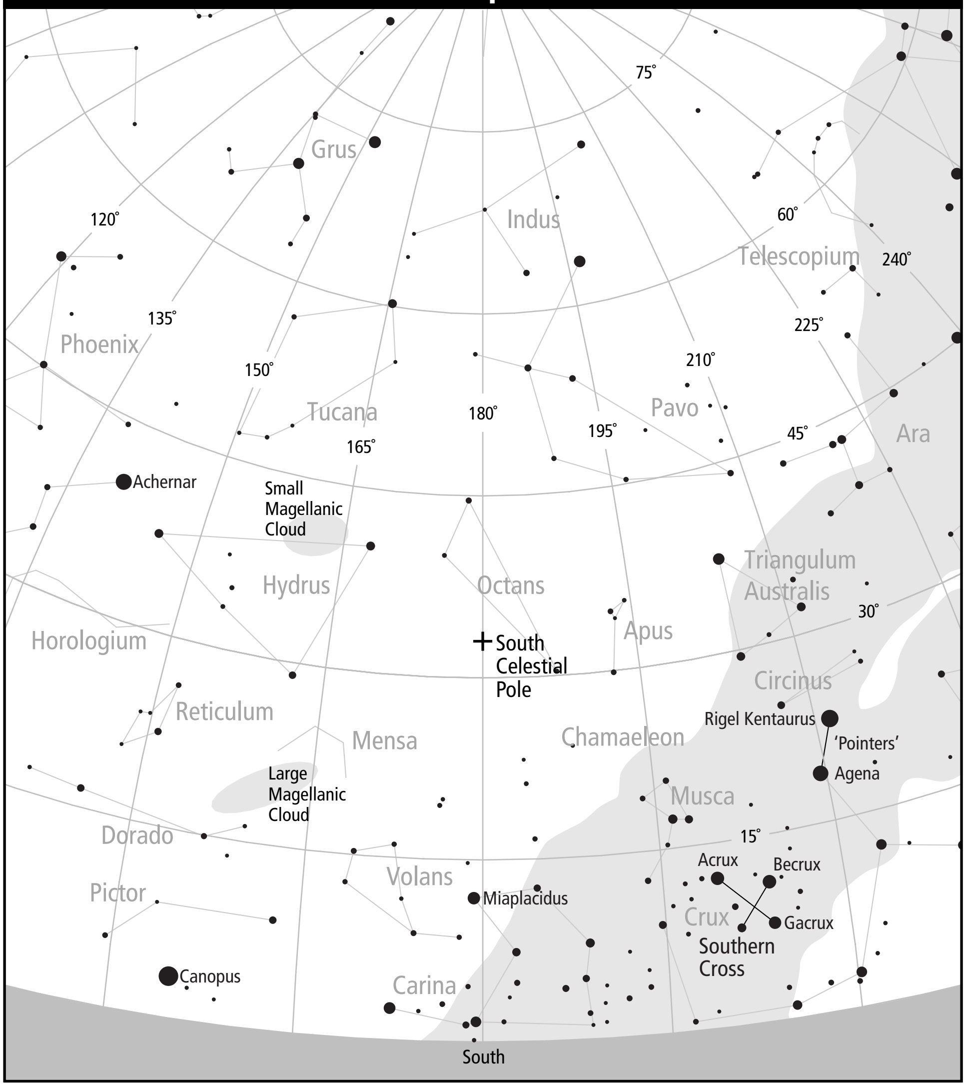
DAY	PHENOMENON h m	Sat.	Event
1	0001	II	Sh.E.
1	1842	III	Sh.I.
1	1847		GRS
1	2203	III	Sh.E.
2	1912	II	Ec.R.
2	2117	IV	Oc.D.
3	0035		GRS
3	0102	IV	Oc.R.
3	2027		GRS
3	2246	I	Oc.D.
4	2008	I	Tr.I.
4	2126	I	Sh.I.
4	2223	I	Tr.E.
4	2341	I	Sh.E.
5	2050	I	Ec.R.
5	2207		GRS
7	2115	II	Tr.I.
7	2346		GRS
7	2352	II	Sh.I.
7	2359	II	Tr.E.
8	1938		GRS
8	2040	III	Tr.E.
8	2243	III	Sh.I.
9	2149	II	Ec.R.
10	2118		GRS
11	0041	I	Oc.D.
11	2104	IV	Sh.E.
11	2204	I	Tr.I.
11	2321	I	Sh.I.
12	0019	I	Tr.E.
12	1910	I	Oc.D.
12	2246	I	Ec.R.
12	2258		GRS
13	1848	I	Tr.E.
13	1850		GRS
13	2005	I	Sh.E.
14	2353	II	Tr.I.
15	0038		GRS
15	2030		GRS
15	2130	III	Tr.I.
16	0045	III	Tr.E.
16	1902	II	Oc.D.
17	0026	II	Ec.R.
17	2210		GRS
18	1834	II	Sh.E.
19	0000	I	Tr.I.
19	1930	IV	Oc.R.
19	2006	III	Ec.R.
19	2107	I	Oc.D.
19	2350		GRS
20	1942		GRS
20	1945	I	Sh.I.
20	2045	I	Tr.E.
20	2201	I	Sh.E.
21	1910	I	Ec.R.
22	2121		GRS
23	2143	II	Oc.D.
24	2301		GRS
25	1839	II	Tr.E.
25	1853		GRS
25	2111	II	Sh.E.
26	1959	III	Oc.R.
26	2141	III	Ec.D.
27	0004	I	Oc.D.
27	0106	III	Ec.R.
27	2127	I	Tr.I.
27	2133		GRS
27	2240	I	Sh.I.
27	2342	I	Tr.E.
28	0022	IV	Tr.I.
28	0056	I	Sh.E.
28	2206	I	Ec.R.
29	2313		GRS

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

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

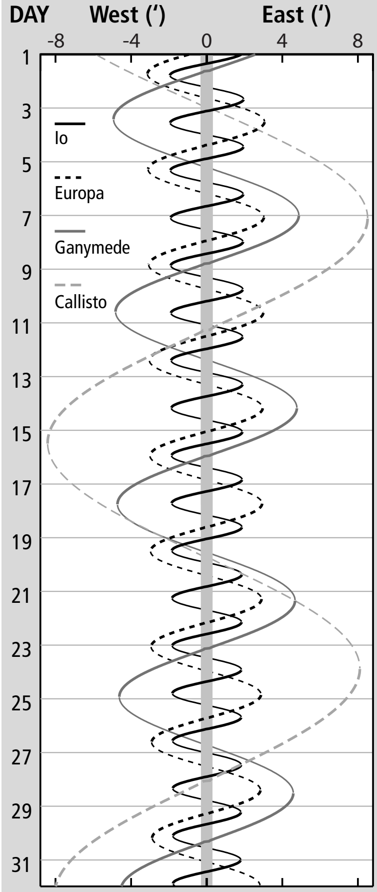
GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

SKYVIEW 2008 OCTOBER 15 8pm



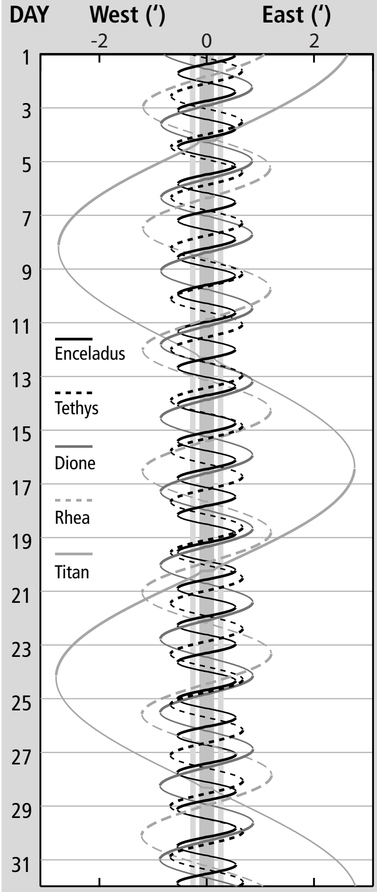
JUPITER MOONS

CONFIGURATIONS

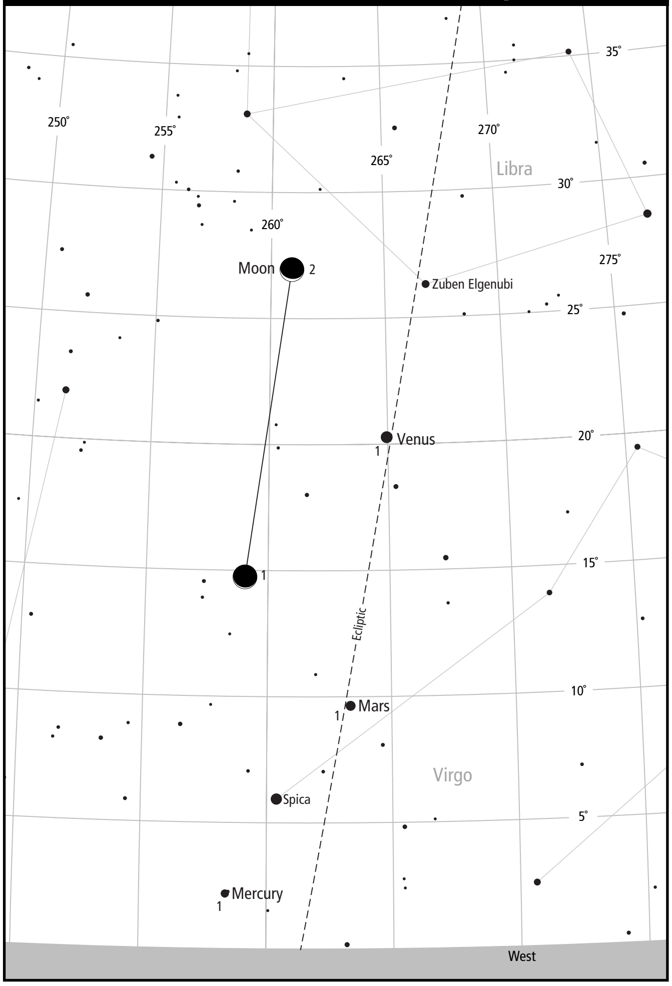


SATURN MOONS

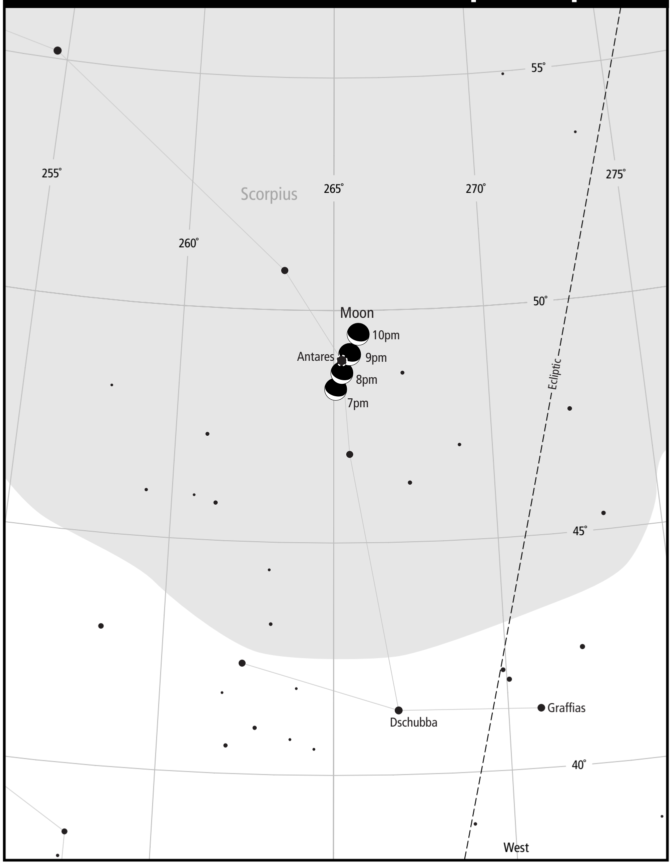
CONFIGURATIONS



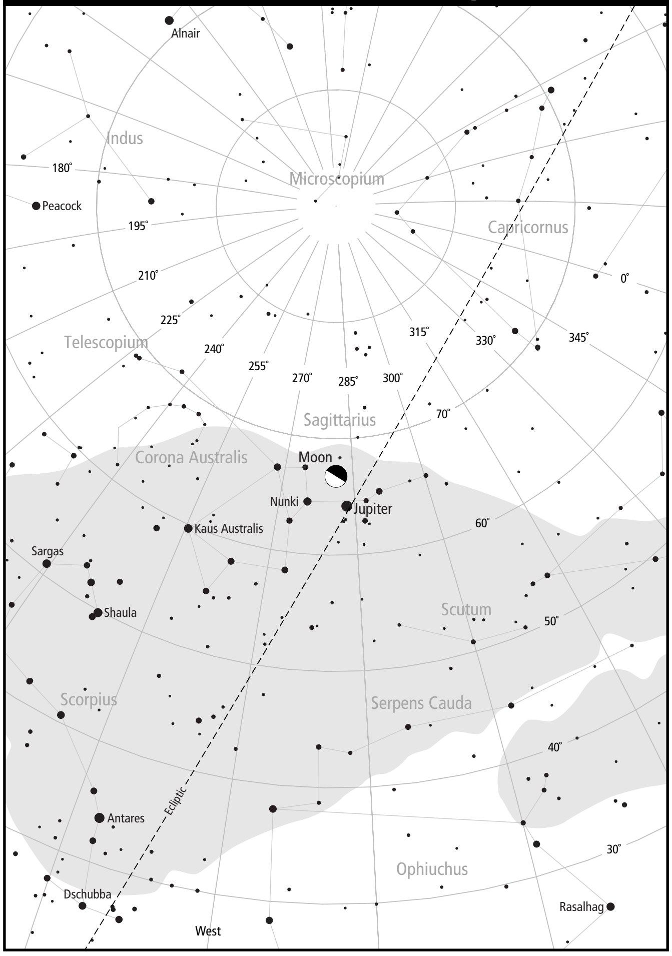
SKYVIEW 2008 OCTOBER 1-2 7pm



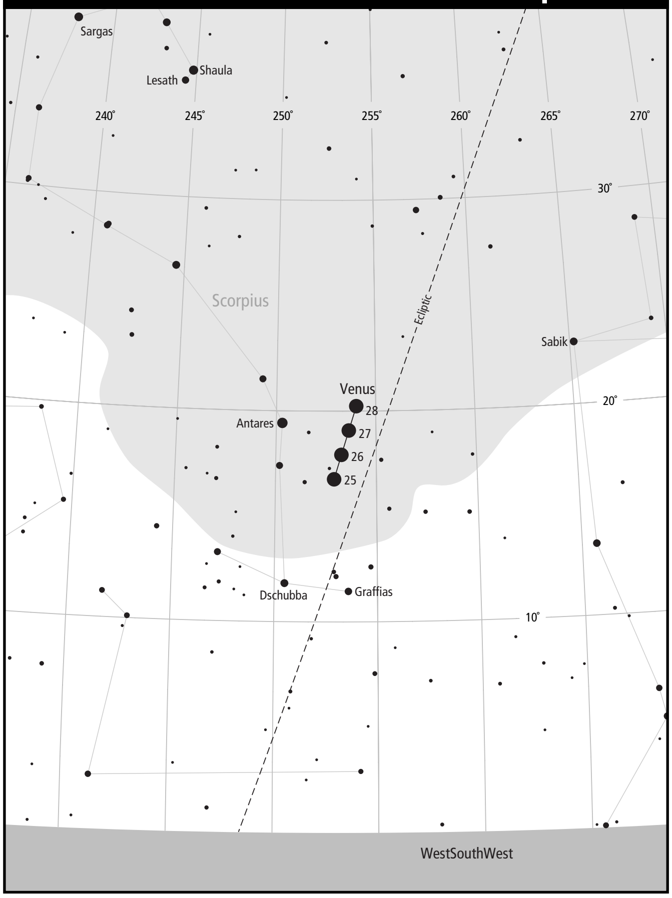
SKYVIEW 2008 OCTOBER 4 7pm-10pm



SKYVIEW 2008 OCTOBER 7 8pm



SKYVIEW 2008 OCTOBER 25-28 8pm



NOVEMBER 2008

Daylight Saving in effect

HIGHLIGHTS

Venus *clearly visible in the WSW sky in the early evening.*

Jupiter *visible nearly all evening and close to Venus by end of month.*

Saturn *visible before morning twilight in the ENE sky.*

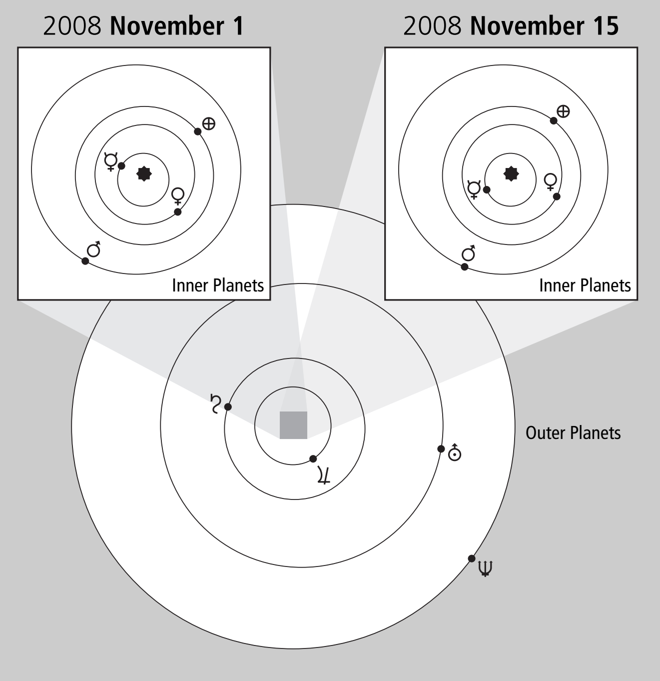
DIARY

Day	Hour	
1	03	*Antares* 0°.06 S. of Moon
1	17	Venus 3° N. of Moon
2	14	Moon at apogee
2	16	Neptune stationary
4	07	Jupiter 1°.9 N. of Moon
5		Maximum activity of Southern Taurid meteor shower
6	13	**First Quarter**
7	04	Neptune 1°.1 S. of Moon
9	10	Uranus 4° S. of Moon
12		Maximum activity of Northern Taurid meteor shower
13	15	**Full Moon**
14	19	Moon at perigee
17		Maximum activity of Leonid meteor shower
20	07	**Last Quarter**
21		Maximum activity of alpha-Monocerotid meteor shower
22	03	Saturn 6° N. of Moon
26	02	Mercury in superior conjunction
28	02	**New Moon**
28	09	Uranus stationary
30	02	Moon at apogee

SUN+MOON RISE/SET

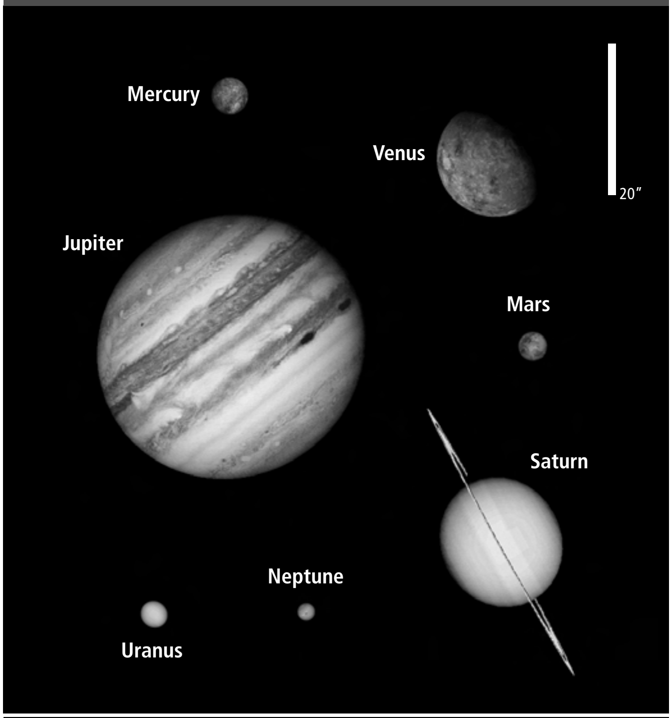
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn (%)
1	0619	108	0450	1300	1942	252	2111	0802	2259	7
2	0618	108	0449	1300	1943	252	2112	0851	2348	12
3	0617	108	0448	1300	1943	251	2113	0944	DNS	19
4	0617	109	0447	1300	1944	251	2114	1040	0033	27
5	0616	109	0446	1300	1945	251	2115	1138	0112	36
6	0615	109	0445	1300	1946	250	2117	1236	0147	45
7	0614	110	0444	1300	1947	250	2118	1335	0219	55
8	0613	110	0443	1300	1948	250	2119	1435	0248	65
9	0613	111	0442	1300	1949	249	2120	1536	0317	74
10	0612	111	0441	1301	1950	249	2121	1640	0347	83
11	0611	111	0440	1301	1950	249	2122	1747	0418	91
12	0611	112	0439	1301	1951	248	2124	1858	0454	96
13	0610	112	0438	1301	1952	248	2125	2012	0535	99
14	0609	112	0437	1301	1953	248	2126	2126	0625	100
15	0609	113	0436	1301	1954	247	2127	2234	0724	97
16	0608	113	0435	1301	1955	247	2128	2333	0831	92
17	0608	113	0434	1302	1956	247	2130	DNR	0942	84
18	0607	113	0433	1302	1957	246	2131	0023	1053	74
19	0607	114	0433	1302	1958	246	2132	0105	1201	64
20	0606	114	0432	1302	1959	246	2133	0140	1306	53
21	0606	114	0431	1302	1959	246	2134	0211	1407	42
22	0605	115	0430	1303	2000	245	2136	0239	1506	32
23	0605	115	0430	1303	2001	245	2137	0307	1605	23
24	0605	115	0429	1303	2002	245	2138	0335	1703	15
25	0604	115	0429	1304	2003	245	2139	0406	1801	9
26	0604	115	0428	1304	2004	244	2140	0439	1900	4
27	0604	116	0428	1304	2005	244	2142	0516	1957	1
28	0604	116	0427	1305	2006	244	2143	0559	2052	0
29	0604	116	0427	1305	2007	244	2144	0646	2144	1
30	0603	116	0426	1305	2007	244	2145	0738	2230	4

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ⛢ Uranus
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

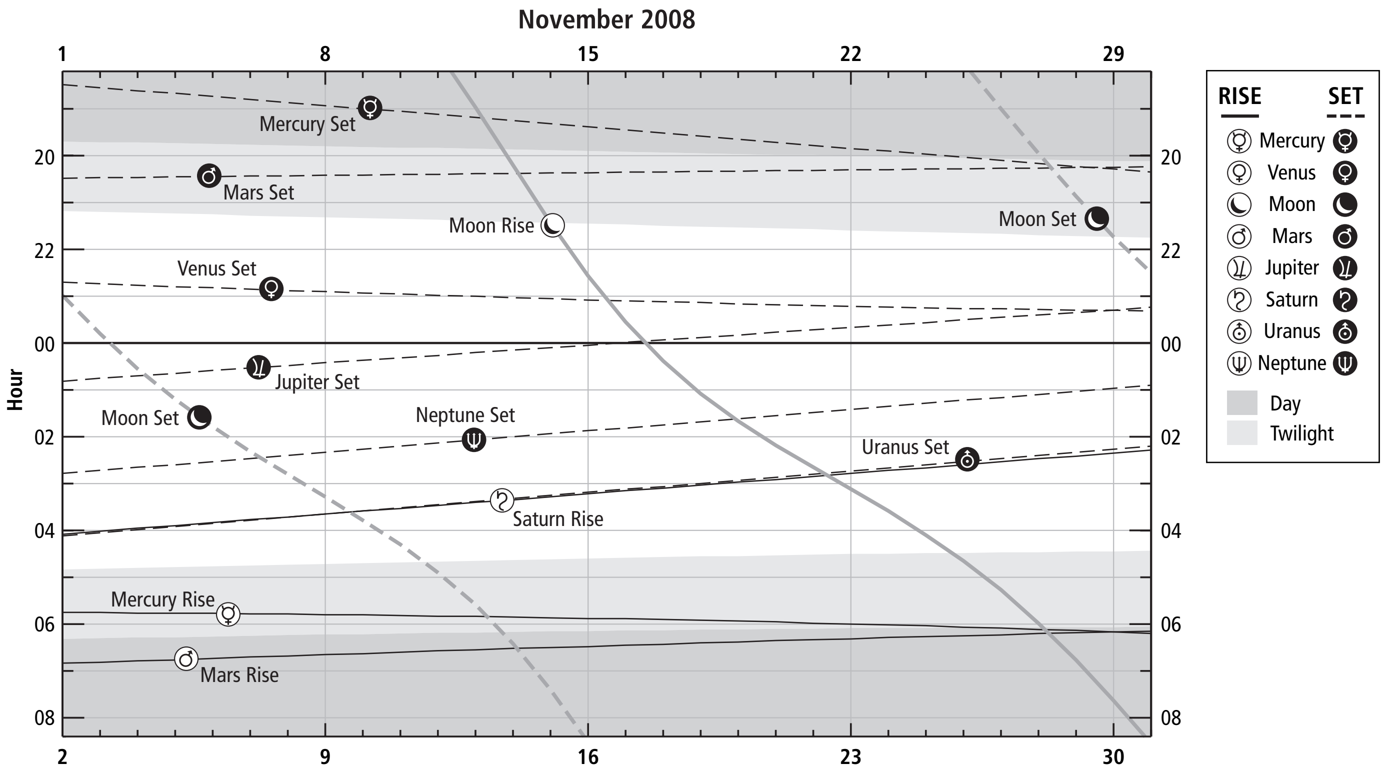


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY Rise h m	MERCURY Set h m	VENUS Rise h m	VENUS Set h m	MARS Rise h m	MARS Set h m	JUPITER Rise h m	JUPITER Set h m	SATURN Rise h m	SATURN Set h m	URANUS Rise h m	URANUS Set h m	NEPTUNE Rise h m	NEPTUNE Set h m
1	0545	1829	0824	2242	0652	2029	1043	0052	0408	1541	1538	0411	1329	0251
2	0545	1833	0824	2244	0650	2028	1040	0049	0405	1538	1534	0407	1325	0247
3	0545	1837	0825	2246	0649	2028	1037	0045	0401	1534	1530	0403	1321	0243
4	0546	1840	0826	2248	0647	2027	1034	0042	0357	1531	1526	0359	1317	0239
5	0546	1844	0827	2249	0646	2027	1031	0039	0354	1527	1522	0355	1313	0236
6	0546	1848	0828	2251	0644	2026	1027	0035	0350	1524	1518	0351	1309	0232
7	0547	1852	0829	2253	0642	2026	1024	0032	0346	1520	1514	0347	1305	0228
8	0547	1856	0830	2254	0641	2025	1021	0029	0343	1517	1510	0343	1301	0224
9	0548	1900	0831	2256	0639	2025	1018	0025	0339	1513	1506	0339	1257	0220
10	0548	1903	0832	2257	0638	2024	1015	0022	0335	1510	1502	0335	1253	0216
11	0549	1907	0834	2259	0636	2024	1012	0019	0332	1506	1458	0331	1249	0212
12	0550	1911	0835	2300	0634	2023	1008	0016	0328	1503	1454	0327	1246	0208
13	0550	1915	0836	2302	0633	2023	1005	0012	0324	1459	1450	0323	1242	0204
14	0551	1919	0837	2303	0631	2022	1002	0009	0321	1455	1446	0319	1238	0200
15	0552	1923	0839	2305	0630	2022	0959	0006	0317	1452	1442	0315	1234	0156
16	0553	1927	0840	2306	0629	2021	0956	0003	0313	1448	1438	0311	1230	0152
16								2359						
17	0553	1931	0842	2307	0627	2021	0953	2356	0309	1445	1434	0307	1226	0149
18	0554	1935	0843	2308	0626	2020	0950	2353	0306	1441	1430	0304	1222	0145
19	0555	1939	0844	2310	0624	2020	0947	2350	0302	1438	1426	0300	1218	0141
20	0556	1943	0846	2311	0623	2019	0944	2346	0258	1434	1422	0256	1214	0137
21	0557	1947	0847	2312	0621	2019	0941	2343	0255	1430	1419	0252	1211	0133
22	0559	1951	0849	2313	0620	2018	0938	2340	0251	1427	1415	0248	1207	0129
23	0600	1954	0851	2314	0619	2018	0934	2337	0247	1423	1411	0244	1203	0125
24	0601	1958	0852	2315	0617	2017	0931	2334	0243	1419	1407	0240	1159	0121
25	0602	2002	0854	2316	0616	2017	0928	2330	0240	1416	1403	0236	1155	0117
26	0604	2006	0856	2316	0615	2016	0925	2327	0236	1412	1359	0232	1151	0113
27	0605	2010	0857	2317	0614	2016	0922	2324	0232	1409	1355	0228	1147	0110
28	0607	2014	0859	2318	0612	2015	0919	2321	0228	1405	1351	0224	1143	0106
29	0608	2017	0901	2318	0611	2015	0916	2318	0225	1401	1347	0220	1140	0102
30	0610	2021	0902	2319	0610	2014	0913	2314	0221	1358	1343	0216	1136	0058

SOLAR SYSTEM RISE/SET



Daylight Saving in effect

JUPITER MOONS + GREAT RED SPOT

DAY	PHENOMENON h m	Satellite	Event	DAY	PHENOMENON h m	Satellite	Event	DAY	PHENOMENON h m	Satellite	Event
1	2045		GRS	4	36	I	Sh.I.	15	2229		GRS
1	2201	II	Sh.I.	4	2032	I	Oc.D.	17	2015	II	Oc.D.
1	2222	II	Tr.E.	5	1	I	Ec.R.	18	2002		GRS
2	49	II	Sh.E.	5	2010	I	Tr.E.	19	2154	I	Tr.I.
2	2053	III	Oc.D.	5	2120	I	Sh.E.	19	2254	I	Sh.I.
3	12	III	Oc.R.	5	2242	IV	Ec.D.	20	2142		GRS
3	1957	II	Ec.R.	6	5		GRS	20	2221	I	Ec.R.
3	2225		GRS	6	1957		GRS	20	2300	III	Tr.E.
3	2325	I	Tr.I.	8	2137		GRS	20	2345	III	Sh.I.
				8	2221	II	Tr.I.	22	2114	IV	Ec.R.
				10	2233	II	Ec.R.	22	2322		GRS
				10	2317		GRS	24	2301	II	Oc.D.
				11	2232	I	Oc.D.	25	2054		GRS
				12	1954	I	Tr.I.	26	2006	II	Tr.E.
				12	2059	I	Sh.I.	26	2202	II	Sh.E.
				12	2209	I	Tr.E.	27	2103	I	Oc.D.
				12	2315	I	Sh.E.	27	2234		GRS
				13	2026	I	Ec.R.	28	2040	I	Tr.E.
				13	2049		GRS	28	2134	I	Sh.E.
				13	2311	III	Sh.E.				
				13	2351	IV	Tr.E.				

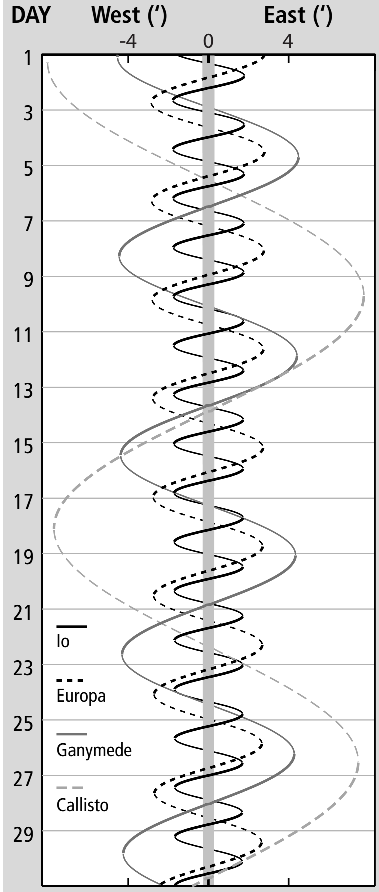
Moons:
I Io — III Ganymede
II Europa — IV Callisto

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

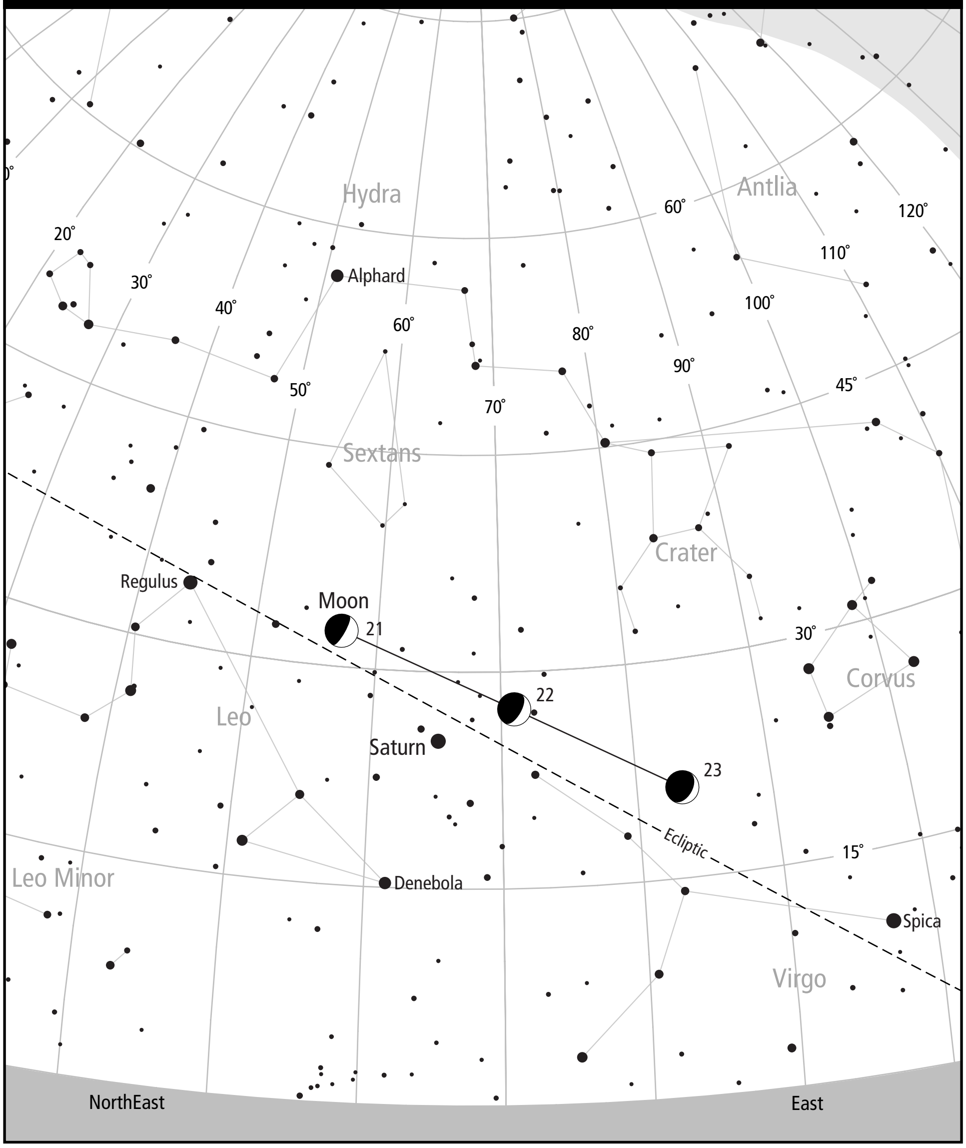
GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

JUPITER MOONS

CONFIGURATIONS

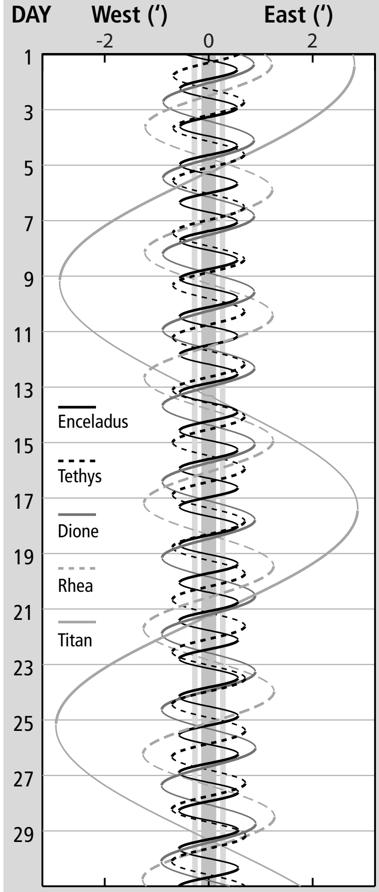


SKYVIEW 2008 NOVEMBER 21-23 5am

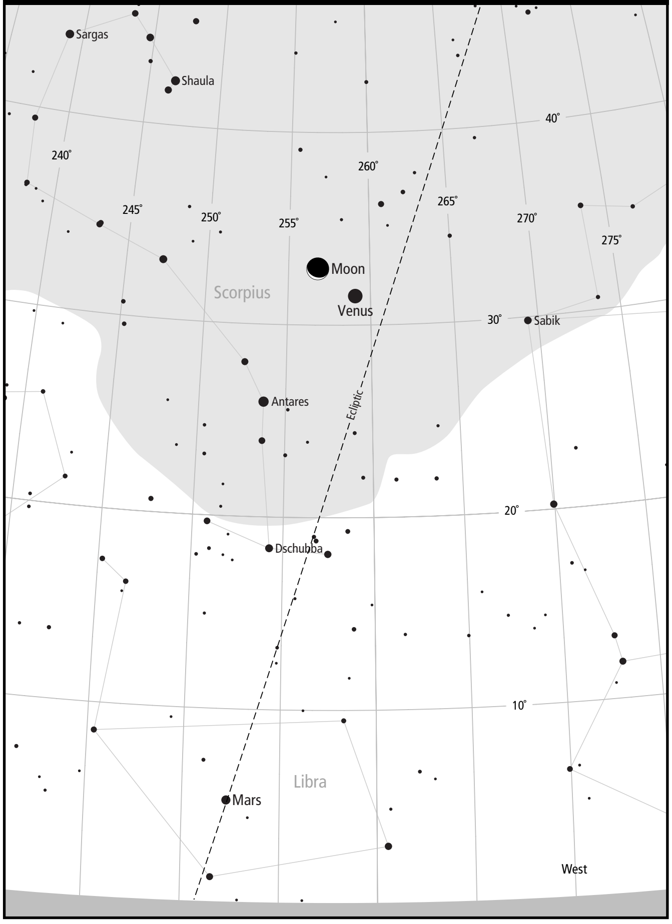


SATURN MOONS

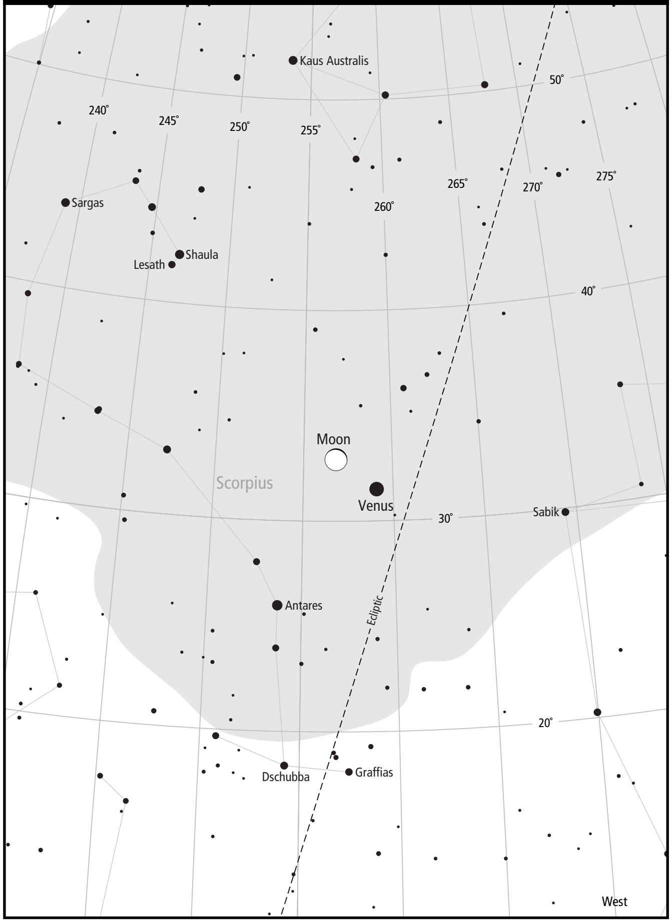
CONFIGURATIONS



SKYVIEW 2008 NOVEMBER 1 7pm



SKYVIEW 2008 NOVEMBER 15 7pm



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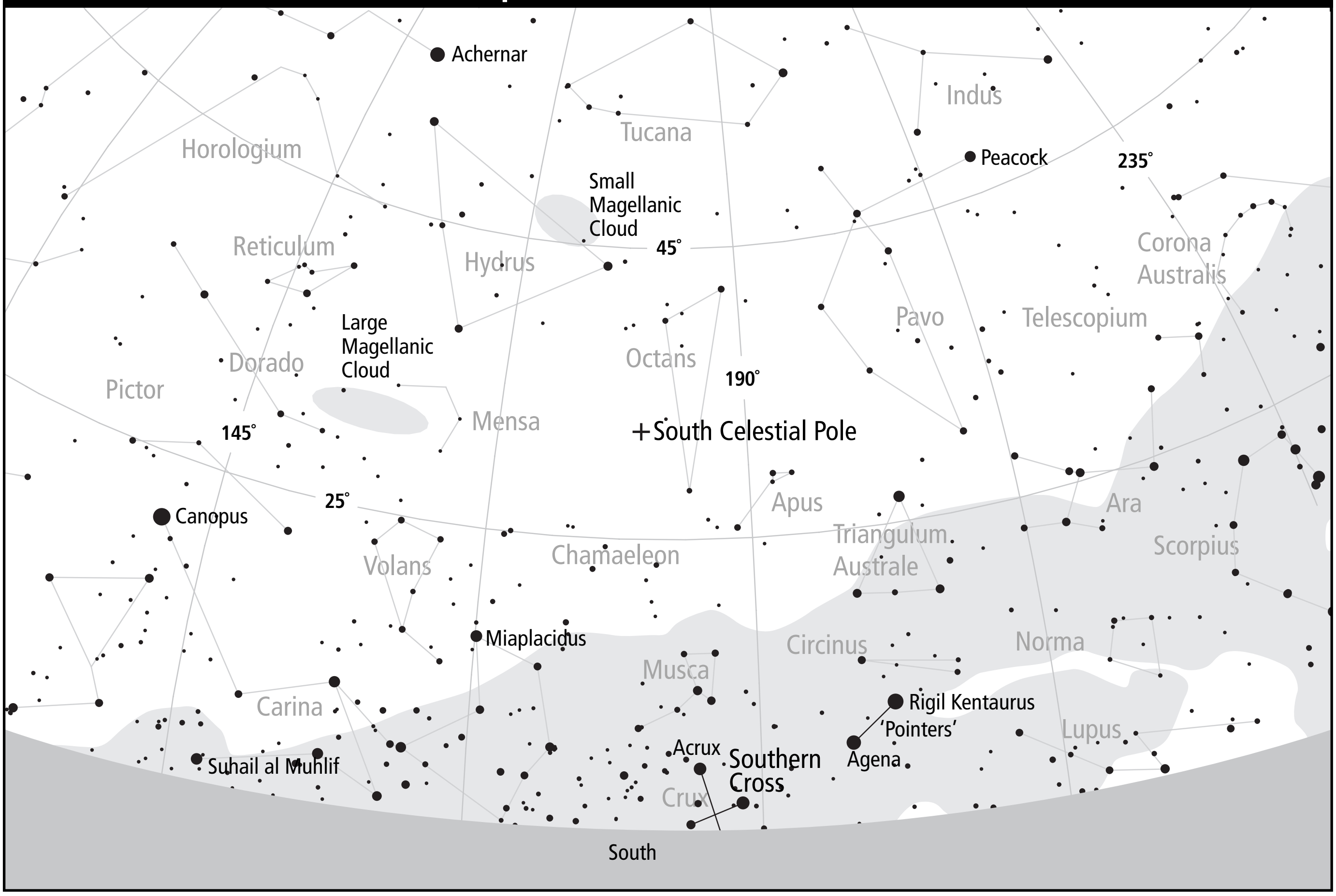


DECEMBER 2008

Daylight Saving in effect

HIGHLIGHTS

Moon *occults Jupiter on 29th.*
Mercury *visible low in WSW twilight in the last week of month.*
Venus *clearly visible in the western sky in the early evening. Conjunction with Jupiter on 1st.*
Jupiter *visible in western evening and sets at the end of evening twlilight by the end of the month. Conjunction with Venus on 1st and Mercury on the 31st.*
Saturn *rises after midnight.*

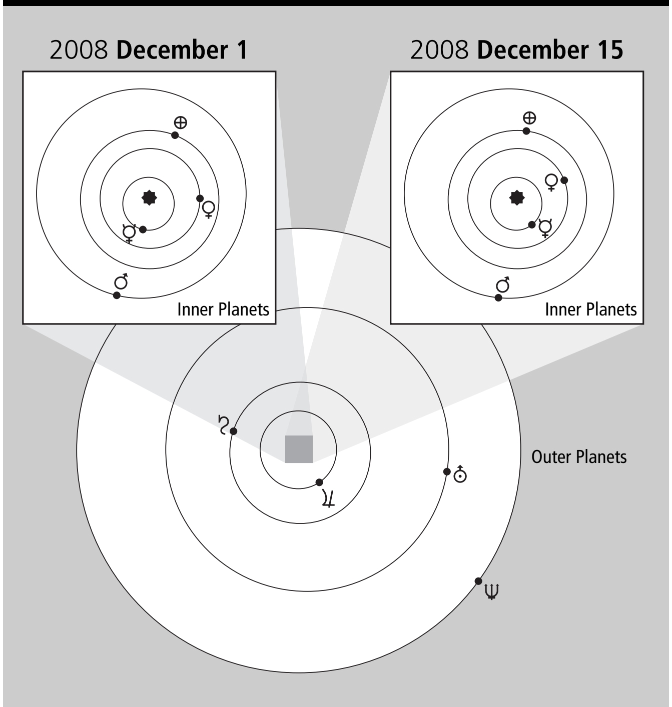
DIARY

Day	Hour	
1	10	Venus 2° S. of Jupiter
2	00	Jupiter 1°.3 N. of Moon
2	01	Venus 0°.8 S. of Moon
4	12	Neptune 1°.4 S. of Moon
6		Max activity of Phoenicid meteor shower
6		Max act. of Puppid-Velids meteor shower
6	06	**First Quarter**
6	07	Mars in conjunction with Sun
6	18	Uranus 4° S. of Moon
8		Max act. of Monocerotid (Dec.) mtr shwr
11		Max act. of sigma-Hydrid meteor shower
13		Max activity of Geminid meteor shower
13	02	**Full Moon**
13	07	Moon at perigee
19	12	Saturn 6° N. of Moon
19	19	**Last Quarter**
20		Max act. of Coma Berenicid meteor shwr
21	21	Solstice
25	16	*Antares* 0°.09 S. of Moon
27	03	Moon at apogee
27	11	Venus 1°.5 S. of Neptune
27	21	**New Moon**
29	13	Mercury 0°.7 S. of Moon
29	19	Jupiter 0°.6 N. of Moon - occultation
31	15	Mercury 1°.3 S. of Jupiter
31	20	Neptune 1°.7 S. of Moon

SUN+MOON RISE/SET

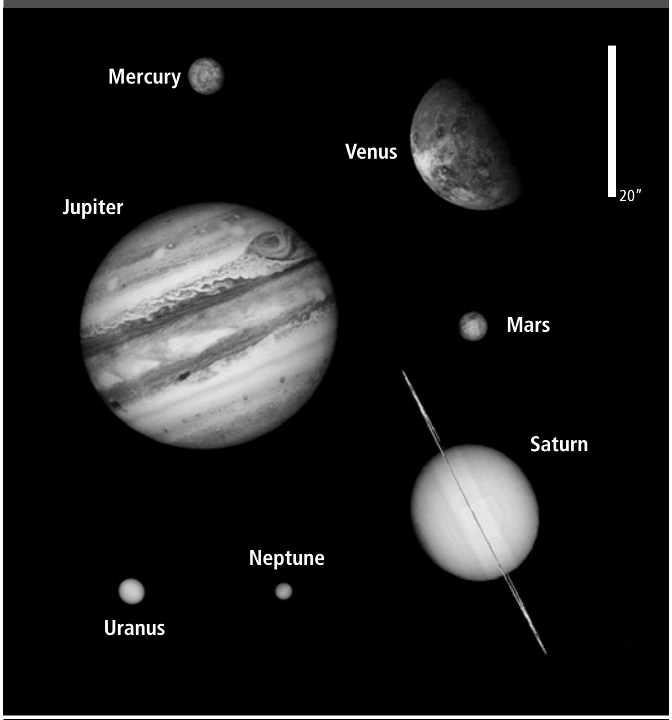
DAY	SUN							MOON		
	Rise h m	Azimuth (°)	Twlght h m	Transit Time h m	Set h m	Azimuth (°)	Twlght h m	Rise h m	Set h m	Illumintn (%)
1	0603	117	0426	1306	2008	243	2146	0833	2311	8
2	0603	117	0426	1306	2009	243	2147	0930	2346	13
3	0603	117	0425	1306	2010	243	2148	1028	DNS	21
4	0603	117	0425	1307	2011	243	2149	1126	0019	29
5	0603	117	0425	1307	2011	243	2150	1223	0048	38
6	0603	117	0425	1308	2012	243	2151	1321	0116	48
7	0603	118	0425	1308	2013	242	2152	1422	0144	58
8	0603	118	0424	1309	2014	242	2153	1525	0214	68
9	0604	118	0424	1309	2015	242	2154	1632	0246	78
10	0604	118	0424	1309	2015	242	2155	1744	0324	87
11	0604	118	0424	1310	2016	242	2156	1857	0408	94
12	0604	118	0425	1310	2017	242	2156	2010	0503	98
13	0604	118	0425	1311	2017	242	2157	2115	0606	100
14	0605	118	0425	1311	2018	242	2158	2211	0718	99
15	0605	118	0425	1312	2019	242	2159	2258	0832	94
16	0605	118	0425	1312	2019	242	2159	2337	0945	87
17	0606	118	0426	1313	2020	242	2200	DNR	1053	79
18	0606	118	0426	1313	2020	241	2201	0011	1158	69
19	0606	119	0426	1314	2021	241	2201	0041	1259	58
20	0607	119	0427	1314	2022	241	2202	0110	1359	48
21	0607	119	0427	1315	2022	241	2202	0138	1457	38
22	0608	119	0428	1315	2023	241	2203	0208	1556	28
23	0608	119	0428	1316	2023	241	2203	0240	1654	20
24	0609	119	0429	1316	2023	241	2204	0316	1751	13
25	0609	118	0429	1317	2024	242	2204	0357	1847	7
26	0610	118	0430	1317	2024	242	2204	0442	1940	3
27	0611	118	0431	1318	2025	242	2205	0533	2028	1
28	0611	118	0431	1318	2025	242	2205	0628	2110	0
29	0612	118	0432	1319	2025	242	2205	0725	2147	1
30	0613	118	0433	1319	2026	242	2205	0822	2221	4
31	0613	118	0434	1320	2026	242	2205	0920	2251	9

PLANET POSITIONS



☿ Mercury ⊕ Earth ♃ Jupiter ⛢ Uranus
♀ Venus ♂ Mars ♄ Saturn ♆ Neptune

PLANET APPEARANCE

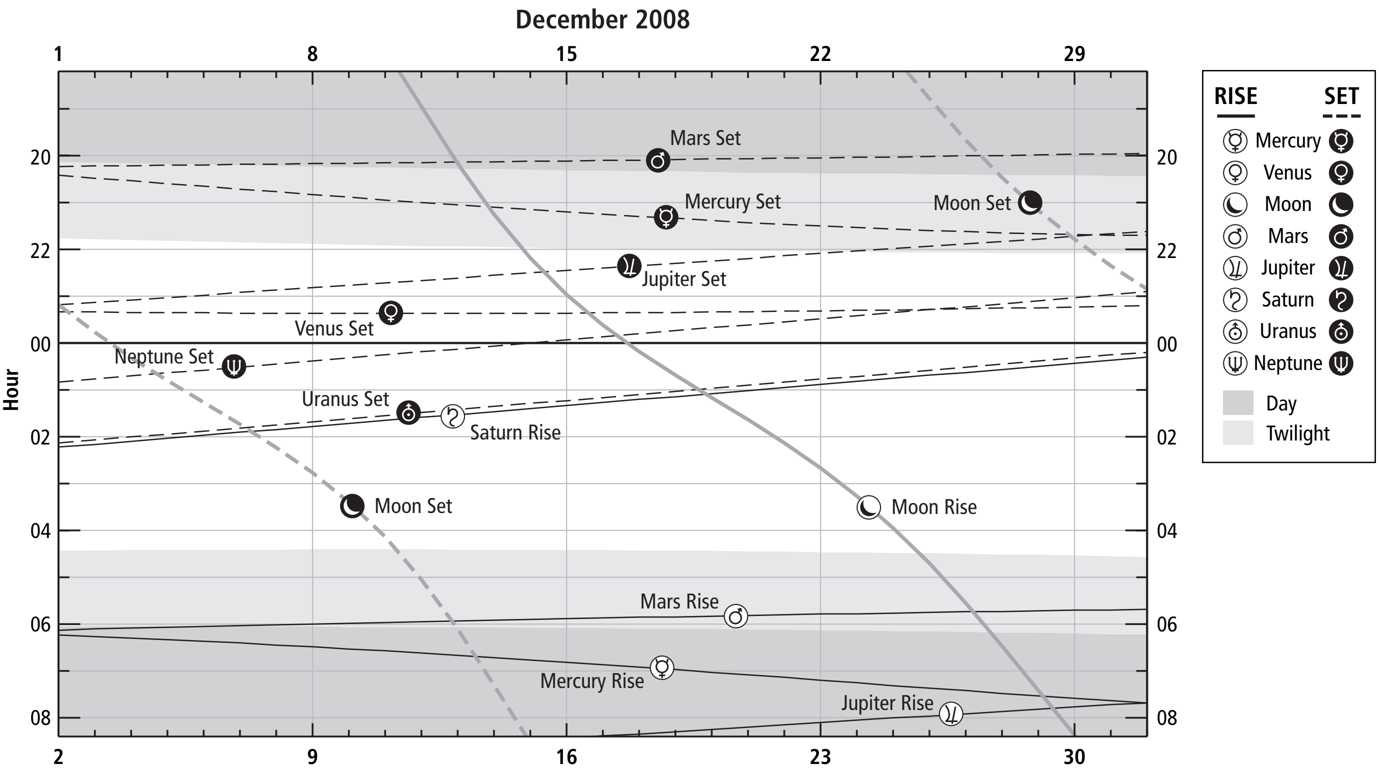


1 degree (1°) = 60 arc minutes (60′) = 3600 arc seconds (3600″)
Therefore 20″ = 1/3′ = 1/180°

PLANETS RISE/SET

DAY	MERCURY		VENUS		MARS		JUPITER		SATURN		URANUS		NEPTUNE	
	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	2025	0904	2320	0609	2014	0910	2311	0217	1354	1339	0212	1132	0054
2	0614	2029	0906	2320	0608	2013	0907	2308	0213	1350	1335	0208	1128	0050
3	0616	2032	0908	2321	0606	2013	0904	2305	0210	1346	1331	0204	1124	0046
4	0618	2036	0909	2321	0605	2012	0901	2302	0206	1343	1327	0200	1120	0042
5	0620	2039	0911	2321	0604	2012	0859	2259	0202	1339	1324	0157	1116	0038
6	0622	2043	0913	2322	0603	2011	0856	2255	0158	1335	1320	0153	1113	0035
7	0624	2046	0915	2322	0602	2011	0853	2252	0154	1332	1316	0149	1109	0031
8	0627	2050	0916	2322	0601	2010	0850	2249	0151	1328	1312	0145	1105	0027
9	0629	2053	0918	2322	0600	2010	0847	2246	0147	1324	1308	0141	1101	0023
10	0632	2057	0920	2322	0559	2009	0844	2243	0143	1320	1304	0137	1057	0019
11	0634	2100	0922	2322	0558	2009	0841	2240	0139	1317	1300	0133	1053	0015
12	0637	2103	0923	2322	0557	2008	0838	2237	0135	1313	1256	0129	1050	0011
13	0640	2106	0925	2322	0556	2008	0835	2233	0132	1309	1252	0125	1046	0008
14	0643	2109	0927	2322	0555	2007	0832	2230	0128	1305	1249	0121	1042	0004
15	0646	2112	0929	2322	0554	2007	0829	2227	0124	1302	1245	0117	1038	0000
15														2356
16	0649	2115	0930	2321	0553	2006	0826	2224	0120	1258	1241	0114	1034	2352
17	0652	2118	0932	2321	0552	2006	0823	2221	0116	1254	1237	0110	1030	2348
18	0655	2120	0934	2321	0551	2005	0821	2218	0112	1250	1233	0106	1027	2344
19	0658	2123	0935	2320	0551	2004	0818	2215	0109	1246	1229	0102	1023	2340
20	0702	2126	0937	2320	0550	2004	0815	2212	0105	1242	1225	0058	1019	2337
21	0705	2128	0939	2319	0549	2003	0812	2208	0101	1239	1222	0054	1015	2333
22	0708	2130	0940	2319	0548	2003	0809	2205	0057	1235	1218	0050	1011	2329
23	0712	2132	0942	2318	0547	2002	0806	2202	0053	1231	1214	0046	1008	2325
24	0715	2134	0944	2318	0547	2002	0803	2159	0049	1227	1210	0043	1004	2321
25	0719	2136	0945	2317	0546	2001	0800	2156	0045	1223	1206	0039	1000	2317
26	0722	2137	0947	2316	0545	2000	0758	2153	0041	1219	1202	0035	0956	2314
27	0725	2139	0948	2315	0544	2000	0755	2150	0038	1215	1159	0031	0952	2310
28	0729	2140	0950	2315	0544	1959	0752	2147	0034	1211	1155	0027	0949	2306
29	0732	2141	0951	2314	0543	1958	0749	2143	0030	1208	1151	0023	0945	2302
30	0735	2142	0953	2313	0542	1958	0746	2140	0026	1204	1147	0019	0941	2258
31	0738	2142	0954	2312	0542	1957	0743	2137	0022	1200	1143	0015	0937	2254

SOLAR SYSTEM RISE/SET



Daylight Saving in effect

JUPITER MOONS + GREAT RED SPOT

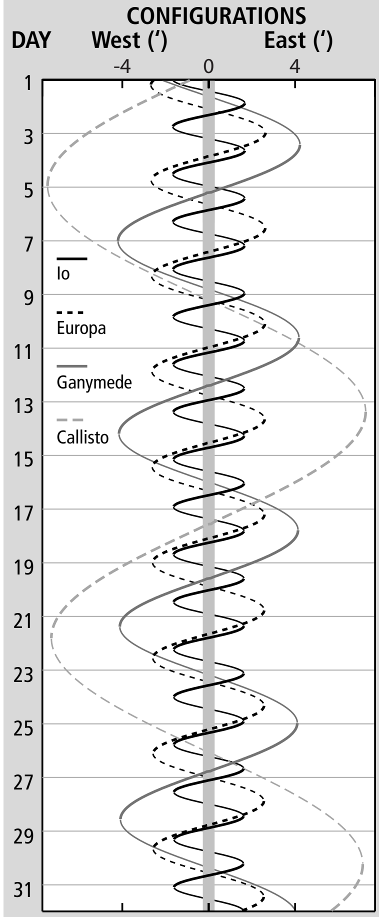
Moons:
I Io — III Ganymede
II Europa — IV Callisto

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

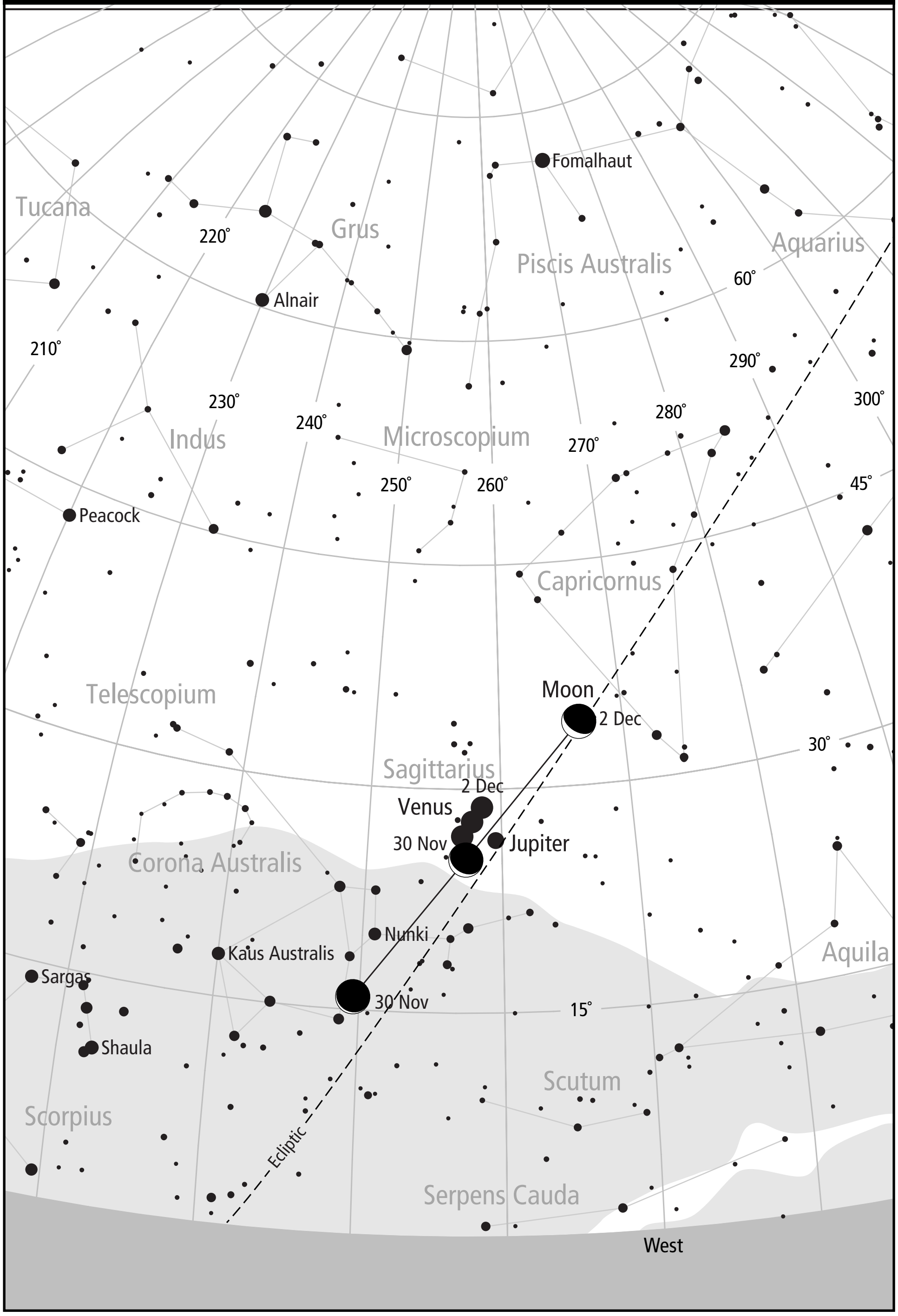
GRS Jupiter's Great Red Spot will be visible for approximately 1 hour around time shown

DAY	PHENOMENON h m	Satellite	Event	DAY	PHENOMENON h m	Satellite	Event
1	2113	III	Ec.R.	14	2151		GRS
2	2146		GRS	19	2048	II	Oc.D.
3	2151	II	Sh.I.	19	2103		GRS
3	2256	II	Tr.E.	20	2138	I	Oc.D.
5	2024	I	Tr.I.	21	2113	I	Tr.E.
5	2113	I	Sh.I.	21	2148	I	Sh.E.
5	2240	I	Tr.E.	26	2114	III	Tr.E.
6	2041	I	Ec.R.	28	2056	II	Tr.E.
7	2058		GRS	28	2058	I	Tr.I.
9	2238		GRS	28	2126	I	Sh.I.
12	2213	II	Ec.R.	29	2056	I	Ec.R.
12	2225	I	Tr.I.	31	2108		GRS

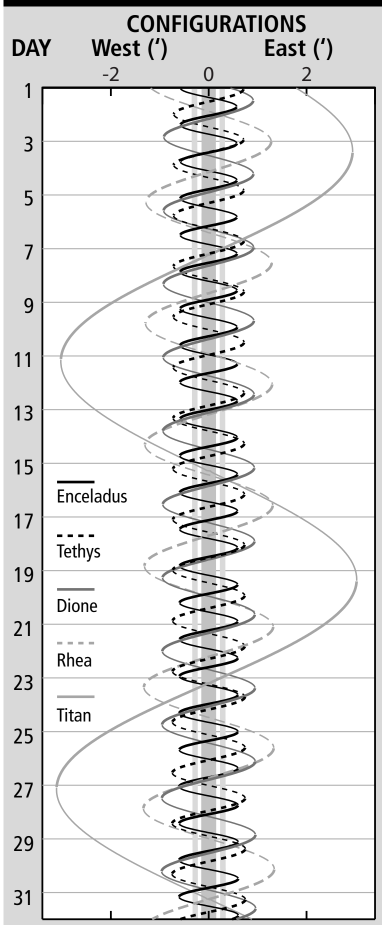
JUPITER MOONS



SKYVIEW 2008 NOVEMBER 30 - DECEMBER 2 9pm



SATURN MOONS



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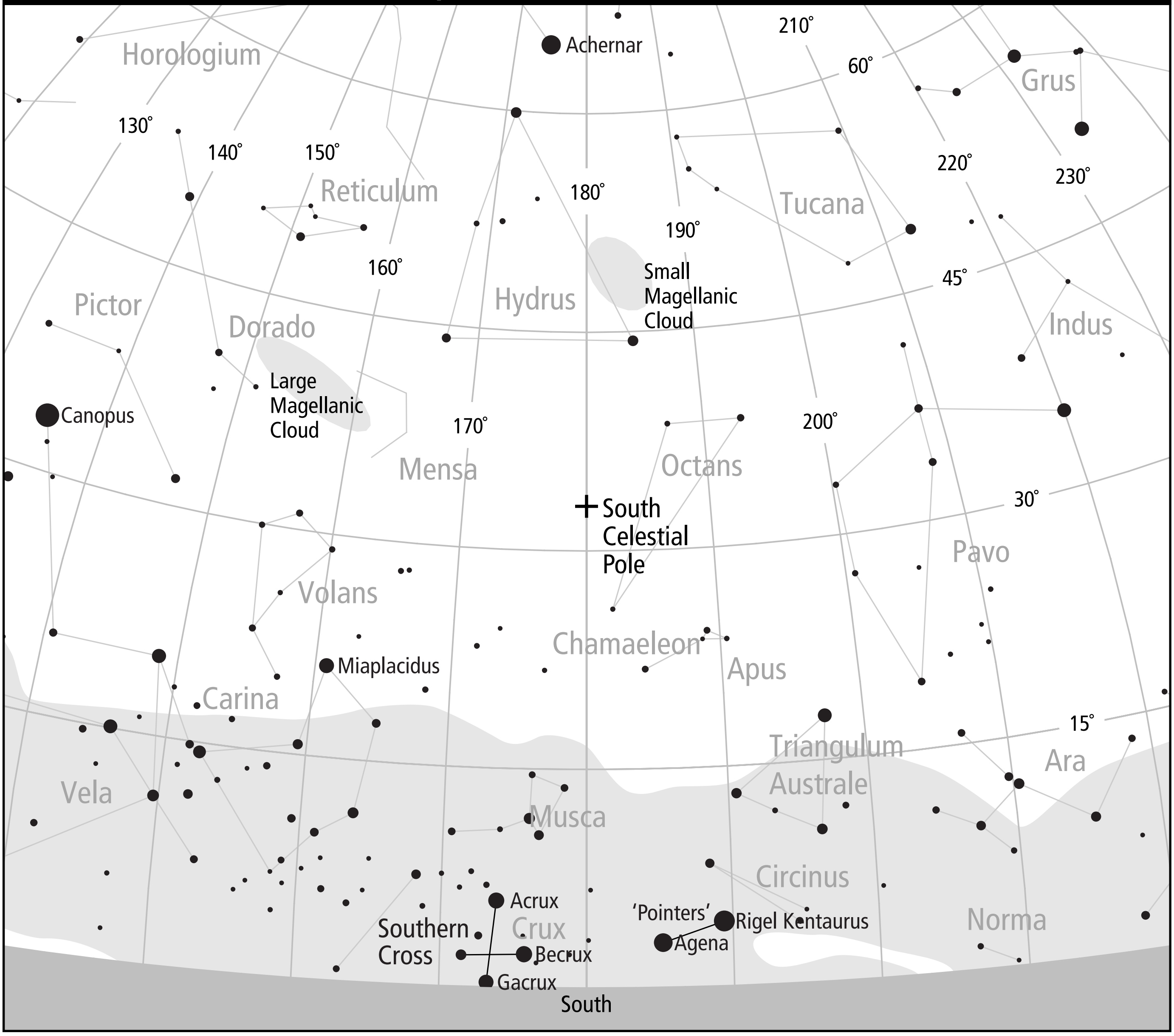

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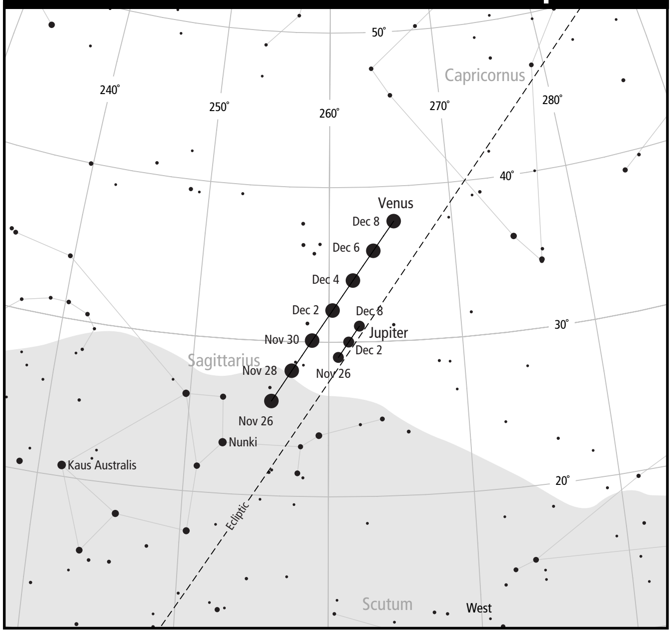
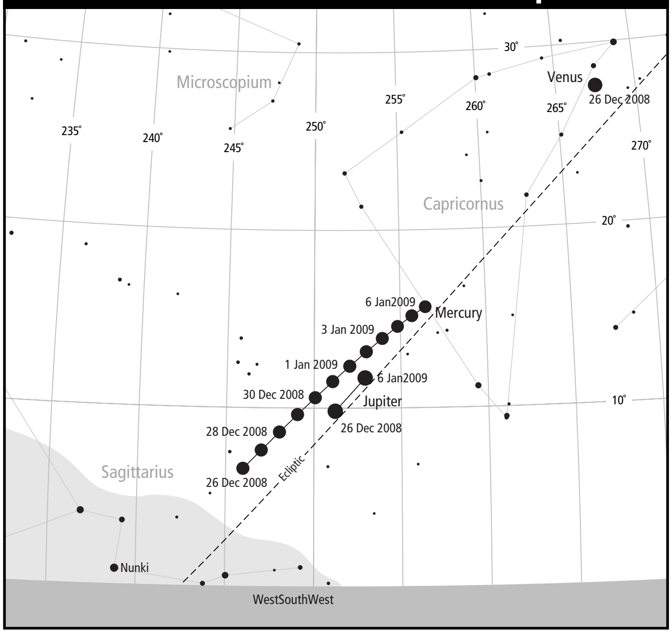


SKYVIEW 2008 DEC 26 - JAN 5 9pm

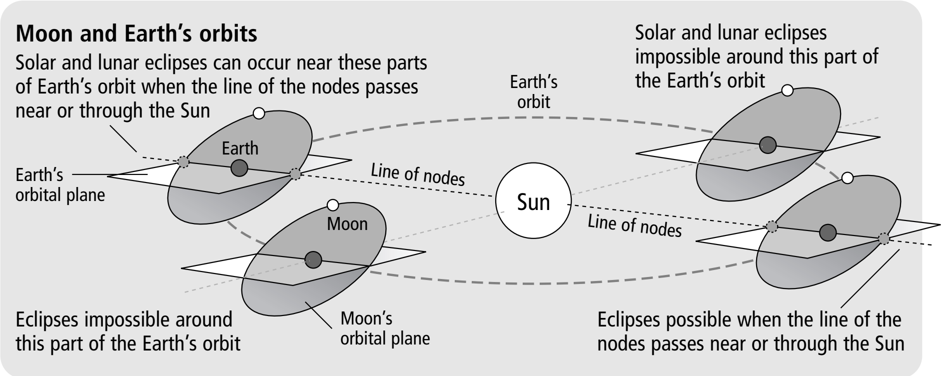


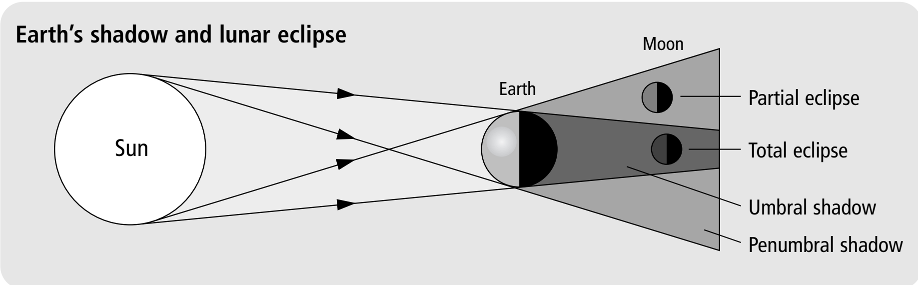
SPECIAL EVENTS – ECLIPSES & OCCULTATIONS

***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 the 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 full 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, or a total lunar eclipse.





Lunar eclipses can only occur at Full Moon phase, where the Moon and Sun are on opposite sides of the Earth. So the Moon starts out very bright and can dim significantly especially for a total eclipse. The amount of dimming depends on which part of the Earth's shadow the Moon traverses. Also, 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 that is then reflected back to Earth. The colour and brightness can vary between total lunar eclipses as it depends on the type and amount of dust in the atmosphere that the sunlight traverses.

Lunar eclipses are necessarily night-time 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.

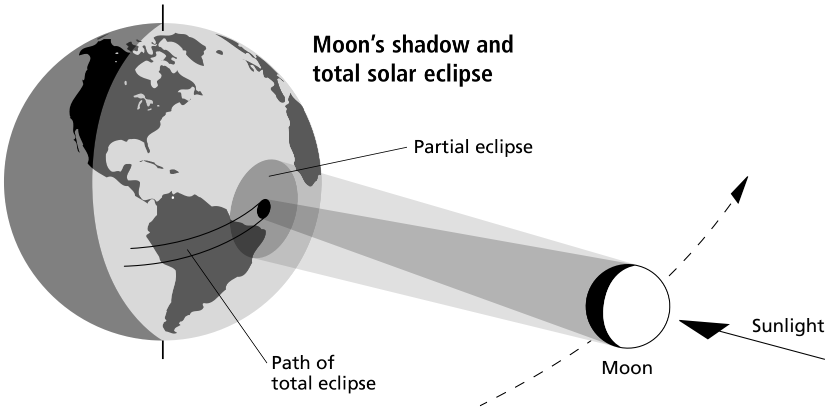
Before the night of a lunar eclipse in 1504, Christopher Columbus tricked disgruntled natives, in what is now Jamaica, to continue supplying him with food when he told them that God would make the Moon "appear inflamed with wrath, denoting the evils God would inflict upon them". The natives were so frightened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

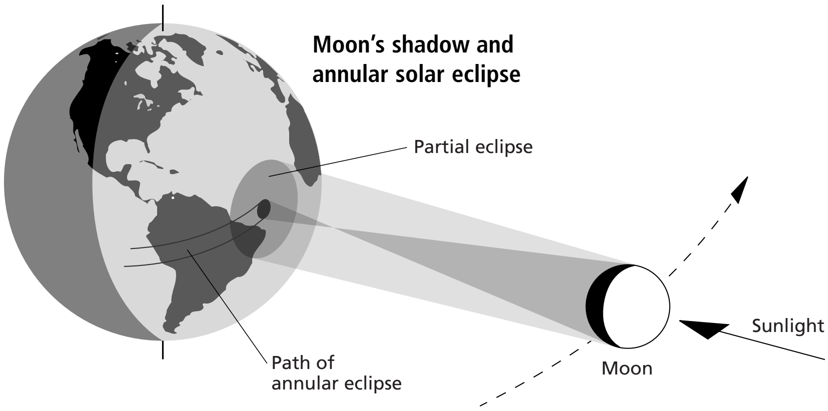
Lunar eclipses have aided our understanding of the world. Greek scientist/philosopher Aristotle (384-322 BCE) inferred that the shape of the Earth was round from the observation that the Earth's shadow seen in lunar eclipses was always circular. In the 3rd C BCE, Aristarchus of Samos calculated the diameter of the Moon 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.

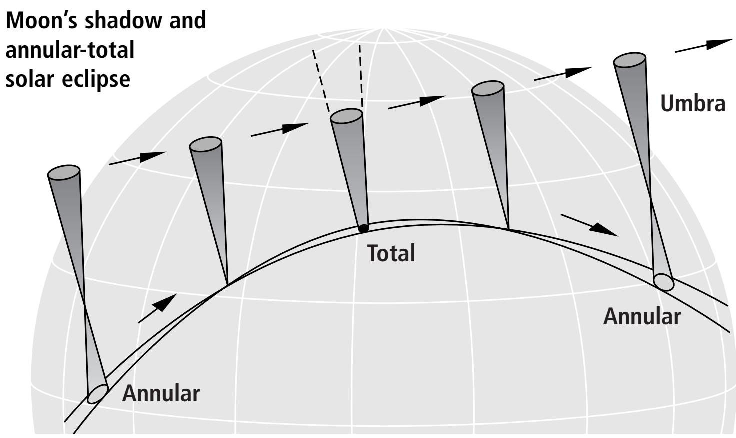
Solar and lunar eclipses often occur in pairs, and this is evident in the two pairs of eclipses that occur this year. This pairing occurs because the orbital plane of the Moon about the Earth is aligned with the Earth - Sun direction around these times. This is the basic requirement in order for an eclipse 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.

Solar eclipses







Solar eclipses are daytime eclipses and can only occur at New Moon phase when the Sun and Earth are on opposite sides of the Moon. The Moon's full shadow (umbra) is significantly smaller than that cast by the Earth and total solar eclipses only occur in a region approximately 20km wide. This shadow moves across the Earth in response to the motion of the Moon in its orbit about Earth, and Earth's orbital motion around the Sun. The penumbra of the Moon is quite large and a wide swath around the region of total eclipse experiences a partial solar eclipse. The amount of partial eclipse uniformly decreases to zero at the outer edge of the penumbra. Sometimes the Sun, Moon and Earth alignment is not perfect and the eclipse is only partial.

Not only do solar eclipses require a geometrical lineup of the Sun, Moon and Earth, they also require the angular size of the Moon on the sky to be large enough to obscure the Sun. At most times the Moon covers approximately the same area on the sky as the Sun. However, at the times when the Moon is furthest from Earth, in its non-circular orbit, it covers a smaller area than that of the Sun. A similar situation occurs when the Sun is larger than average around the time the Earth is closest to the Sun (perihelion). (See the Angular Sizes of the Planets graph in the Section *Solar System Information* to see how the apparent size of both the Sun and Moon changes throughout the year.) Solar eclipses at these times cannot be total. The Sun remains visible as a ring around the edge of the Moon, over a track about 20 kilometres wide across the Earth. Such events are called annular solar eclipses. So fine is this size balance that sometimes a solar eclipse can change from annular, to total, and sometimes back to annular. This occurs because of the curvature of the Earth's surface and so the region closest to the Moon can be up to one Earth radius, 6,371 kilometres, closer than surrounding regions. The solar eclipse of 2005 April 8 was one of the rare annular total type, but unfortunately could not be witnessed from anywhere in Australia.

At the present epoch 26% of eclipses are total, 32% are annular, 35% are partial and 5% are annular-total. The remainder are relatively rare eclipses that occur at polar regions where only a part of the Moon's umbra, or its extension, intersects the Earth. On average there are 2.2 solar eclipses (of any type) per year. However, a given place on the Earth experiences a total eclipse only every 375 years and an annular eclipse every 224 years. Total eclipses are more common the further north the latitude because solar eclipses are more common in summer and Earth's perihelion occurs in the northern summer. Annular eclipses are less frequent around equatorial regions because these regions are generally closer to the Moon. Southern regions also experience more annular eclipses than corresponding northern latitudes because the Earth is at aphelion (furthest from the Sun) in the southern summer.

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 the Moon about the Earth is aligned with the Earth - 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).

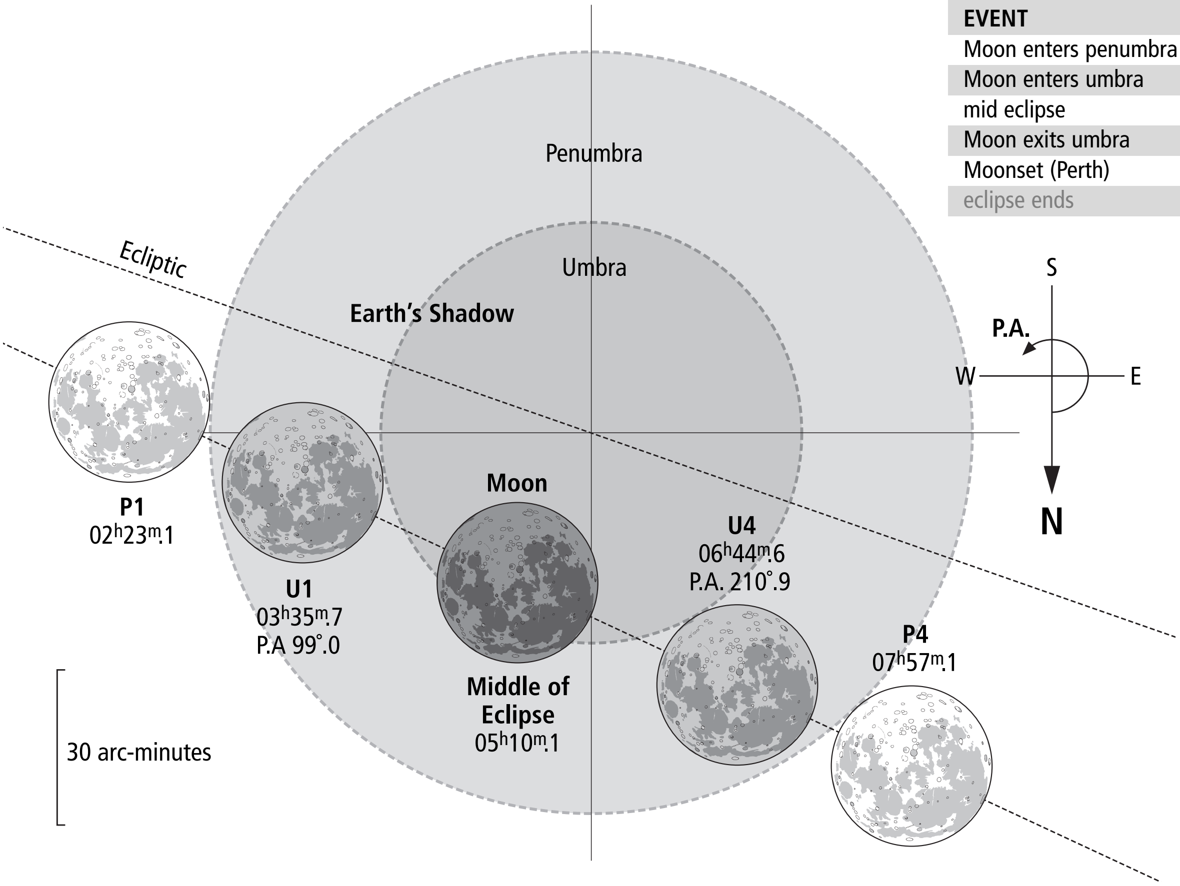
REMEMBER: Never look at the Sun with the unaided eye or with an optical instrument. You may suffer permanent eye damage.

August 17 (and August 16 elsewhere): Partial Eclipse of the Moon

This eclipse ends after the Moon has set in WA. Observers in the east of the state will see less of this eclipse. The best time to view the eclipsed Moon will be around mid eclipse.

This event is visible in its entirety from Central Asia, Eastern Europe and all but the western part of Africa.

EVENT	TIME (WAST) Hour	Minute
Moon enters penumbra	02	23
Moon enters umbra	03	36
mid eclipse	05	10
Moon exits umbra	06	45
Moonset (Perth)	06	54
eclipse ends	07	57



February 7: Annular Eclipse of the Sun

This event is not visible from anywhere in Western Australia.

This event is visible from Antarctica. A partial eclipse can be observed from south eastern Australia, New Zealand and the South Pacific. The eclipse begins at 0138 UTC (1038 WDT) at longitude 43° East and latitude 58° South and ends at 0612 UTC (1512 WDT) at longitude 175° West and latitude 14° South.

February 21: Total Eclipse of the Moon

This event is not visible from anywhere in Australia.

All of this eclipse is visible from North and South America, Western Europe and Western Africa. The eclipse begins at 0035 UTC (0935 WDT) and ends at 0617 UTC (1517 WDT).

August 1 (and August 2): Total Eclipse of the Sun

This event is not visible from anywhere in Australia.

This event is visible from northern and eastern parts of North America, Greenland, northern Europe and Asia. The eclipse begins at 0804 UTC (1604 WAST) at longitude 52° West and latitude 50° North and ends at 1238 UTC (2038 WAST) at longitude 86° East and latitude 11° North.

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

Occultations of planets and bright stars by the Moon

An occultation is 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.

The Moon passes in front of the following planets and bright stars during this year.

Moon Occultations 2008

DATE (WAST) d h	Body	Areas of Visibility	Visible in Australia?
Jan 5 19*	*Antares*	Southern South America, part of Antarctica	No
Jan 11 10*	Neptune	**Southern tips of Australia**, part of Antarctica, New Zealand	**Yes**
Jan 20 09*	Mars	North Russia, Arctic regions, northwest tip of North America	No
Jan 24 22*	*Regulus*	South Indonesia, **Australasia**, part of Antarctica	**Yes**
Feb 2 01*	*Antares*	**Australia**, New Zealand, part of Antarctica, southern part of South America	**Yes**
Feb 21 09*	*Regulus*	Most of South America, part of Antarctica	No
Feb 29 12*	*Antares*	Part of Antarctica, **southern tips of Australia**	**Yes**
Mar 5 23*	Mercury	Southern half of South America, northwest Africa	No
Mar 6 04*	Venus	Eastern Melanesia, Polynesia, North America except northwest and northeast parts	No
Mar 6 07*	Neptune	**Australia except northern part**, New Zealand, Polynesia, western Mexico	**Yes**
Mar 19 17*	*Regulus*	New Zealand, eastern Melanesia, Polynesia, part of Antarctica	No
Mar 27 19*	*Antares*	North Island New Zealand, Polynesia, southern part of South America, part of Antarctica	No
Apr 2 17	Neptune	Central South America, central Africa, Middle East	No
Apr 12 14	Mars	Northeastern Canada, Greenland, Iceland, Northern Scandinavia	No
Apr 15 22	*Regulus*	Madagascar, part of Antarctica	No
Apr 23 23	*Antares*	**Southern half of Australia**, New Zealand, Polynesia	**Yes**
Apr 30 03	Neptune	Indonesia, except Sumatra, northern Australasia, Hawaiian Islands	No
May 10 22	Mars	Northern Africa, Europe except northern part, southern Asia	No
May 13 03	*Regulus*	Southern South America, part of Antarctica	No
May 21 07	*Antares*	Eastern part of South America, southern parts of Africa	No
May 27 11	Neptune	North half of Africa, Southeast Europe, western Asia	No
June 8 10	Mars	New Zealand	No
June 17 13	*Antares*	Polynesia, southern South America	No
June 23 17	Neptune	North America except Alaska, southern Greenland	No
July 14 20	*Antares*	**Southern half of Australia**, New Zealand, Polynesia	**Yes**
July 20 21	Neptune	Eastern Asia, Japan, Alaska, Northwest part of Canada	No
Aug 11 03	*Antares*	Central South America, southern tips of Africa and Madagascar	No
Aug 17 03	Neptune	Northeast Africa. eastern Europe, W. and central Asia	No
Sept 7 11	*Antares*	**Eastern Australasia**, Polynesia, Southwest South America	No
Sept 13 10	Neptune	North America except northwest part, northern tip of South America, Iceland, United Kingdom	No
Oct 4 20	*Antares*	Southern half of Africa, Madagascar, **western Australasia**	**Yes**
Oct 10 18	Neptune	Eastern Asia, Philippines, Japan, western Alaska	No
Nov 1 03*	*Antares*	Central South America, western tip of Africa	No
Nov 7 04*	Neptune	Northeastern tip of Canada, United Kingdom except southeast part, western Scandinavia	No
Dec 2 01*	Venus	Northeastern tip of Canada, Europe, southern Scandinavia	No
Dec 25 16*	*Antares*	Southern half of Africa, Madagascar, southeast Asia	No
Dec 29 13*	Mercury	Eastern Asia, Japan, northern Indonesia	No
Dec 29 19*	Jupiter	**Australia except east part**, most of Antarctica	**Yes**

An **occultation** is an event that occurs when one object is hidden by another object that passes between it and the observer.

Astronomical occultation events include transits and eclipses. The word transit refers to cases where the nearer object appears smaller in apparent size than the more distant object, such as transit of Mercury or Venus across the Sun's disk. The word eclipse generally refers to those instances in which one object moves into the shadow of another. Each of these three events is the visible effect of a syzygy (the alignment along a straight line of three celestial objects).

Every time an occultation occurs, an eclipse also occurs. Consider a so-called 'eclipse' of the Sun by the Moon, as seen from Earth. In this event, the Moon physically moves between Earth and the Sun, thus blocking out a portion or the entire bright disk of the Sun. Although this phenomenon is usually referred to as an 'eclipse', this term is a misnomer, because the Moon is not *eclipsing* the Sun; instead the Moon is *occulting* the Sun. When the Moon *occults* the Sun, it casts a small shadow on the surface of the Earth, and therefore the Moon's shadow is partially eclipsing Earth. So a so-called 'solar eclipse' actually consists of (i) an *occultation* of the Sun by the Moon, as seen from Earth, and (ii) a partial *eclipse* of Earth by the Moon's shadow.

By contrast, an 'eclipse' of the Moon is in fact a true eclipse: the Moon moves into the shadow cast back into space by Earth, and is said to be *eclipsed* by Earth's shadow. As seen from the surface of the Moon, Earth passes directly between the Moon and the Sun, thus blocking or *occulting* the Sun as seen by a hypothetical lunar observer. Again, every *eclipse* also entails an *occultation*.

(adapted from Wikipedia)

Definition of the Planets in the Solar System

The following is reproduced in part from the resolutions of 26th General Assembly of the International Astronomical Union (IAU, the world's organisation of professional astronomers) held in Prague (Czech Republic) from 2006 August 14th to 25th.

Apparently the discussions were vigorous with supporters divided roughly into two groups. One group supported a "physical" definition – that a planet is a near spherical body in hydrostatic equilibrium (gravitational compression is balanced by an outward force such as "gas pressure"). Using this definition the planets total 12. The other group supported a "dynamical" definition where a planet is an object that gravitationally dominates its neighbourhood – in this case there are 8 planets.

The resolution adopted by the IAU General Assembly (see below) is a compromise which also defines two categories of bodies different from the planets, and modifies the former rules. The naming "minor planets" disappears and is replaced by either "dwarf planets" which designates Solar System bodies big enough to be nearly spherical, or "small Solar System bodies" which designates the other objects including the comets. The planetary satellites are not concerned by these new definitions.

An IAU process will be established to assign borderline objects into either dwarf planet and other categories.

Background

Since 1992, numerous celestial bodies orbiting around the Sun beyond Neptune's orbit have been discovered. Due to its physical and dynamical characteristics, Pluto appears associated to these trans-Neptunian bodies. In 2003, the discovery of 2003 UB_{313} (now named (136199) Eris), a trans-Neptunian object (TNO) bigger than Pluto, raised serious questions about the definition of a planet: if Pluto is a planet, Eris is another one...

IAU Resolution: Definition of a Planet in the Solar System

Contemporary observations are changing our understanding of planetary systems, and it is important that our nomenclature for objects reflect our current understanding. This applies, in particular, to the designation "planets". The word planet originally described "wanderers" that were known only as moving lights in the sky. Recent discoveries lead us to create a new definition, which we can make using currently available scientific information.

The IAU therefore resolves that planets and other bodies in our Solar System be defined into three distinct categories in the following way.

SUN & PLANET DATA

NAME	MEAN RADIUS (kilometres)	VOLUME (Earth =1)	FLATTENING (Earth =1)	MASS (x 10^{23} kg)	DENSITY (g/cm^3)	EQUATORIAL GRAVITY (m/s^2)	GEOMETRIC ALBEDO
Sun	696000	1305000	0.00005	19890850	1.408	274.0	-
Mercury	2440 ± 1	0.056	0.0000	3.302	5.427	3.701	0.106
Venus	6051.84 ± 0.01	0.857	0.000	48.685	5.204	8.870	0.65
Earth	6371.01 ± 0.02	1	0.00335	59.736	5.515	9.780327	0.367
Mars	3389.92 ± 0.04	0.151	0.00648	6.4185	3.9335 ± 0.0004	3.690	0.150
Jupiter	69911 ± 6	1321	0.06487	18986	1.326	23.12 ± 0.01	0.52
Saturn	58232 ± 6	764	0.09796	5684.6	0.6873	8.96 ± 0.01	0.47
Uranus	25362 ± 12	63	0.02293	868.32	1.318	8.69 ± 0.01	0.51
Neptune	24624 ± 21	58	0.01708	1024.3	1.638	11.00 ±0.05	0.41
Ceres*	948	0.003	-	0.0095	2.08	0.27	0.1132
Pluto*	1151	0.006	-	0.1314 ± 0.0018	2	0.655	0.3
Eris*	1200 ± 50	0.007	-	-	-	-	0.860 ± 0.07

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	-26.74	609.12	-	-	-	-	7.25
Mercury	-0.42	1407.509	0.2408467	0.38709893	0.20563069	7.00487	0.01
Venus	-4.40	-5832.444	0.61519726	0.72333199	0.00677323	3.39471	177.36
Earth	-3.86	23.93419	1.0000174	1.00000011	0.01671022	0.00005	23.45
Mars	-1.52	24.622962	1.88081578	1.52366231	0.09341233	1.85061	25.19
Jupiter	-9.4	9.92425	11.862615	5.20336301	0.04839266	1.30530	3.12
Saturn	-8.88	10.65622	29.447498	9.53707032	0.05415060	2.48446	26.73
Uranus	-7.19	17.24 ± 0.01	84.016846	19.19126393	0.04716771	0.76986	97.86
Neptune	-6.87	16.11 ± 0.01	164.79132	30.06896348	0.00858587	1.76917	29.56
Ceres*	3.3	9.075	4.59930	2.76555996	0.07990478	10.58674	-
Pluto*	-1.0	153.28	247.92065	39.48168677	0.24880766	17.14175	122.53
Eris*	-1.1	>8	557.0	67.696	0.4409	44.17853	-

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 (magnitude)
a Semi-major Axis
e Eccentricity
i Inclination
Obliquity Angle between rotation axis and orbital axis
± The uncertainty in the quantity
***** Dwarf planet

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

1. Planets

A planet is a celestial body that:

(a) is in orbit around the Sun,
(b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and
(c) has cleared the neighbourhood around its orbit.

The eight planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

2. Dwarf Planets

A dwarf planet is a celestial body that:

(a) is in orbit around the Sun,
(b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and
(c) has NOT cleared the neighbourhood around its orbit, and
(d) is not a satellite

Objects with sufficiently known characteristics to be classified as dwarf planets are (1) Ceres, (134340) Pluto, and (136199) Eris. The number in brackets is the minor planet catalogue number – a standard astronomical cataloguing/naming convention.

The following is the IAU's Minor Planet Center (MPC) explanation from 2006 September 8 for the numbering.

Since at least one of the "dwarf planets" is already included in the catalogue of numbered "minor planets", and since the MPC Terms of Reference emphasize the need for the MPC to maintain a database of the astrometric observations of such bodies observed beyond the confines of the earth's atmosphere, Pluto and (other bodies) are now being added to this list of objects with reliable orbit determinations under the numbers (134340) and (136199), respectively. It should be noted that, just as some of the numbered objects that have exhibited cometary activity also have designations in the catalogue of numbered periodic comets, the numbering of "dwarf planets" does not preclude their having dual designations in possible separate catalogues of such bodies.

Note: *This numbering does NOT mean that Pluto is an asteroid or a minor planet (a now defunct definition, see above).*

3. Small Solar System Bodies

All other objects, except satellites, orbiting the Sun shall be referred to collectively as "small Solar System bodies". This includes: the classical asteroids (except the largest one, 1 Ceres) that are not dwarf planets; the Centaurs and Neptune Trojans; the smaller TNOs (except dwarf planets such as Pluto and Eris); and all comets.

MOON & SATELLITE DATA

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 (1000km)	e eccentricity	i inclination (°)	P Sidereal Period (days)
EARTH									
Moon	0.0123	1737.5 ± 0.1	3.344 ± 0.005	-12.74	0.12	384.4	0.0554	5.16	27.322
MARS									
Deimos	3.740E-09	6.2 ± 0.18	2.247 ± 0.251	12.45 ± 0.05	0.068 ± 0.007	23.46	0.0002	1.793	1.262
Phobos	1.651E-08	11.1 ± 0.15	1.867 ± 0.076	11.4 ± 0.2	0.071 ± 0.012	9.38	0.0151	1.075	0.319
JUPITER									
Adrastea	3.95E-12	8.2 ± 2.0	3.0	18.7	0.100 ± 0.045	129	0.0018	0.054	0.298
Aitne	2.37E-14	1.5	2.6	22.7	0.04	23550	0.291	165.7	741.0r
Amalthea	1.09E-09	83.5 ± 2.4	0.849 ± 0. 199	14.1 ± 0.2	0.090 ± 0.005	181.4	0.0031	0.388	0.498
Ananke	1.58E-11	14	2.6	18.75 ± 0.02	0.04	21276	0.2435	148.889	629.77r
Aoede	4.74E-14	4	2.6	22.5	0.04	23801	0.405	159.4	748.8r
Arche	2.37E-14	1.5	2.6	22.8	0.04	22930	0.259	165.0	723.9r
Autonoe	4.74E-14	2.0	2.6	22.0	0.04	24120	0.415	151.9	765.1r
Callirrhoe	4.58E-13	4.3	2.6	20.73 ± 0.04	0.04	24103	0.2828	147.158	758.77r
Callisto	5.67E-05	2410.3 ± 1.5	1.834 ± 0.004	5.65 ± 0.10	0.17 ± 0.02	1882.7	0.0074	0.187	16.69
Carme	6.95E-11	15	2.6	17.55 ± 0.02	0.06	23400	0.2533	164.907	734.17r
Chaldene	3.95E-14	1.9	2.6	22.5	0.04	23180	0.238	165.4	723.8r
Cyllene	7.89E-15	2	2.6	23.2	0.04	24000	0.412	141.0	737.8r
Elara	4.58E-10	43	2.6	16.32 ± 0.02	0.04	11741	0.2174	26.627	259.64
Erinome	2.37E-14	1.6	2.6	22.8	0.04	23280	0.270	164.9	728.3r
Euanthe	2.37E-14	1.5	2.6	22.8	0.04	21030	0.176	145.9	620.0r
Eukelade	4.74E-14	2	2.6	22.6	0.04	24560	0.345	163.4	781.6r
Euporie	7.89E-15	1.0	2.6	23.1	0.04	19390	0.156	147.0	553.1r
Europa	2.53E-05	1560.8 ± 0.5	3.013 ± 0.005	5.29 ± 0.02	0.67 ± 0.03	671.1	0.0094	0.469	3.551
Eurydome	2.37E-14	1.5	2.6	22.7	0.04	23220	0.345	150.1	720.8r
Ganymede	7.81E-05	2631.2 ± 1.7	1.942 ± 0.005	4.61 ± 0.03	0.43 ± 0.02	1070.4	0.0011	0.170	7.155
Harpalyke	6.31E-14	2.2	2.6	22.2	0.04	21110	0.227	148.7	623.3r
Hegemone	2.37E-14	3	2.6	22.9	0.04	24510	0.264	152.6	781.6r
Helike	4.74E-14	4	2.6	22.6	0.04	20980	0.157	156.1	617.3r
Hermippe	4.74E-14	2.0	2.6	22.1	0.04	21250	0.251	150.3	631.9r
Himalia	3.55E-09	85	2.6	14.62 ± 0.02	0.04	11461	0.1623	27.496	250.56
Io	4.70E-05	1821.6 ± 0.5	3.528 ± 0.006	5.02 ± 0.03	0.63 ± 0.02	421.8	0.0041	0.036	1.769
Iocaste	1.03E-13	2.6	2.6	21.8	0.04	21270	0.218	159.7	631.5r
Isonoe	3.95E-14	1.9	2.6	22.5	0.04	23220	0.261	165.0	725.5r
Kale	7.89E-15	1.0	2.6	23.0	0.04	23120	0.475	165.3	720.9r
Kallichore	7.89E-15	2	2.6	23.7	0.04	22400	163.9	163.9	683.0r
Kalyke	1.03E-13	2.6	2.6	21.8	0.04	23580	0.243	165.2	743.0r
Karpo	2.37E-14	3	2.6	23.0	0.04	16989	0.430	51.4	456.1
Kore	7.89E-15	2	2.6	23.6	0.04	24543	0.325	145.0	779.2r
Leda	5.76E-12	10	2.6	19.50 ± 0.03	0.04	11165	0.1636	27.457	240.92
Lysithea	3.32E-11	18	2.6	18.25 ± 0.04	0.04	11717	0.1124	28.302	259.20
Magaclite	3.63E-13	2.7	2.6	21.7	0.04	23810	0.425	152.7	752.8r
Metis	3.95E-12	21.5 ± 2.0	3.0	17.5	0.061 ± 0.003	128	0.0012	0.019	0.295

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 (1000km)	e eccentricity	i inclination (°)	P Sidereal Period (days)
Mneme	7.89E-15	2	2.6	23.3	0.04	20600	0.208	148.0	599.0r
Orthosie	7.89E-15	1.0	2.6	23.1	0.04	21170	0.272	141.9	623.0r
Pasiphae	1.58E-10	30	2.6	17.00 ± 0.20	0.04	23624	0.4090	151.431	743.63r
Pasithee	7.89E-15	1.0	2.6	23.2	0.04	23030	0.288	165.4	716.3r
Praxidike	2.29E-13	3.4	2.6	21.2	0.04	21150	0.220	148.7	625.3r
Sinope	3.95E-11	19	2.6	18.05 ± 0.02	0.04	23939	0.2495	158.109	758.90r
Sponde	7.89E-15	1.0	2.6	23.0	0.04	23810	0.415	155.0	749.1r
Taygete	8.68E-14	2.5	2.6	21.9	0.04	23360	0.251	165.2	732.2r
Thebe	5.76E-12	49.3 ± 2.0	3.0	16.0	0.047 ± 0.003	221.9	0.0177	1.070	0.675
Thelxinoe	-	2	-	-	-	20700	0.233	151.1	601.0r
Themisto	3.63E-13	4.0	2.6	21.0	0.04	7284	0.2426	43.259	130.02
Thyone	4.74E-14	2.0	2.6	22.3	0.04	21310	0.295	149.0	632.4r
S/2003 J 2	7.89E-15	2	2.6	23.2	0.04	28570	0.380	151.8	982.5r
S/2003 J 3	7.89E-15	2	2.6	23.4	0.04	18340	0.241	143.7	504.0r
S/2003 J 4	7.89E-15	2	2.6	23	0.04	23260	0.204	144.9	723.2r
S/2003 J 5	4.74E-14	4	2.6	22.4	0.04	24080	0.210	165.0	759.7r
S/2003 J 9	7.89E-16	1	2.6	23.7	0.04	22440	0.269	164.5	683.0r
S/2003 J 10	7.89E-15	2	2.6	23.6	0.04	24250	0.214	164.1	767.0r
S/2003 J 12	7.89E-16	1	2.6	23.9	0.04	19002	0.376	145.8	533.3r
S/2003 J 15	7.89E-15	2	2.6	23.5	0.04	22000	0.110	140.8	668.4r
S/2003 J 16	7.89E-15	2	2.6	23.3	0.04	21000	0.270	148.6	595.4r
S/2003 J 17	7.89E-15	2	2.6	23.4	0.04	22000	0.190	163.7	690.3r
S/2003 J 18	7.89E-15	2	2.6	23.4	0.04	20700	0.119	146.5	606.3r
S/2003 J 19	7.89E-15	2	2.6	23.7	0.04	22800	0.334	162.9	701.3r
S/2003 J 23	-	2	-	23.6	-	24060	0.309	149.2	759.7r
SATURN									
Aegir	-	6	-	24.4	-	20735	0.252	167	1116r
Albiorix	3.69E-11	13	2.3	20.5	0.06	16390	0.48	34.0	738
Anthe	-	1	-	26	-	197.7	0.001	0.100	1.04
Atlas	1.90E-11	16 ± 4	0.63	19.0	0.4	137.7	0.000	0.000	0.602
Bebhionn	-	6	-	24.1	-	17119	0.469	35.01	834.8
Bergelmir	-	6	-	24.2	-	19338	0.142	158.5	1006r
Bestla	-	7	-	23.8	-	20129	0.521	145.2	1084r
Calypso	6.33E-12	9.5 ± 1.5	1.0	18.7	0.7	294.7	0.0005	1.473	1.888
Daphnis	-	7	-	24	-	136.5	0	0	0.594
Dione	1.93E-06	559. ± 5.	1.490 ± 0.040	10.4	0.6	377.4	0.0002	0.002	2.737
Enceladus	1.83E-07	249.4 ± 0.2	1.603 ± 0.345	11.8	1.0	238.1	0.0001	0.010	1.370
Epimetheus	9.41E-10	59.5 ± 3.0	0.606 ± 0.096	15.6	0.5	151.4	0.0205	0.335	0.694
Erriapo	1.34E-12	4	2.3	23.0	0.06	17610	0.47	33.5	871
Farbauti	-	5	-	24.7	-	20390	0.206	156.4	1086r
Fenrir	-	4	-	25	-	22453	0.136	164.9	1260r
Fornjot	-	6	-	24.6	-	25108	0.206	170.4	1491r
Greip	-	6	-	24.4	-	18206	0.326	179.8	921r
Hati	-	6	-	24.4	-	19856	0.372	165.8	1039r
Helene	4.48E-11	16 ± 4	1.5	18.4	0.6	377.4	0.0001	0.212	2.737
Hyperion	1.90E-08	133 ± 8	1.1 ± 0.6	14.4	0.3	1464.1	0.0175	0.568	21.28
Hyrrokkin	-	8	-	23.5	-	18437	0.333	151.4	932r
Iapetus	3.42E-06	718 ± 8	1.253 ± 0.168	11	0.6	3560.8	0.0284	7.570	79.33
Ijiraq	2.11E-12	5	2.3	22.6	0.06	11440	0.32	49.1	451
Janus	3.39E-09	88.8 ± 4.0	0.656 ± 0.094	14.4	0.6	151.5	0.0073	0.165	0.695
Jarnsaxa	-	6	-	24.7	-	18811	0.216	163.3	965r
Kari	-	7	-	23.9	-	22118	0.478	156.3	1234r
Kiviuq	5.80E-12	7	2.3	22.0	0.06	11370	0.33	48.7	449
Loge	-	6	-	24.6	-	23065	0.187	167.9	1312r
Methone	-	3	-	25	-	194	0	0	1.01
Mimas	6.72E-08	198.6 ± 0.6	1.169 ± 0.023	12.8	0.6	185.6	0.0206	1.566	0.942
Mundilfari	3.69E-13	2.8	2.3	23.8	0.06	18710	0.21	169.4	951r
Narvi	6.06E-13	3	2.3	24.0	0.06	18720	0.35	134.6	956r
Paaliaq	1.45E-11	9.5	2.3	21.3	0.06	15200	0.36	47.2	687
Pallene	-	4	-	25	-	211	0	0	1.14
Pan	4.75E-12	10 ± 3	0.63	19.4	0.5	133.6	0.0000	0.000	0.575
Pandora	3.43E-10	41.9 ± 2	0.63 ±0.1	16.4	0.5	141.7	0.0044	0.000	0.629
Phoebe	1.27E-08	110 ± 10	1.3 ±0.7	16.4	0.081 ± 0.002	12944.3	0.1644	174.751	548.21r
Polydeuces	-	4	-	25	-	377.4	0	0	2.74
Prometheus	5.80E-10	50.1 ± 3	0.63 ±0.1	15.8	0.6	139.4	0.0023	0.000	0.613
Rhea	4.08E-06	764 ± 4	1.240 ± 0.044	9.6	0.6	527.1	0.0009	0.327	4.518
Siarnaq	6.85E-11	16	2.3	20.1	0.06	18160	0.29	45.6	893
Skathi	5.54E-13	3.2	2.3	23.6	0.06	15650	0.27	148.5	729r
Skoll	-	6	-	24.5	-	17665	0.464	161.2	878r
Surtur	-	6	-	24.8	-	22707	0.451	177.5	1298r
Suttungr	3.69E-13	2.8	2.3	23.9	0.06	19470	0.11	175.8	1017r
Tarqeq		7		23.7		18009	0.160	46.09	888
Tarvos	4.75E-12	6.5	2.3	22.1	0.06	18240	0.54	34.9	926
Telesto	1.27E-11	12 ± 3	1.0	18.5	1.0	294.70	0.0010	1.158	1.888
Tethys	1.09E-06	529.8 ± 1.5	0.991 ± 0.009	10.2	0.8	294.70	0.0001	0.168	1.888

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 (1000km)	e eccentricity	i inclination (°)	P Sidereal Period (days)
Thrymr	3.69E-13	2.8	2.3	23.9	0.06	20470	0.47	175.0	1089r
Titan	2.37E-04	2575 ± 2	1.881 ± 0.005	8.4	0.2	1221.9	0.0288	1.634	15.95
Ymir	8.70E-12	8	2.3	21.7	0.06	23100	0.33	173.1	1312r
S/2004 S7	-	6	-	24.5	-	19800	0.580	165.1	1103r
S/2004 S 12	-	5	-	24.8	-	19650	0.401	164.0	1048r
S/2004 S 13	-	6	-	24.5	-	18450	0.273	167.4	906r
S/2004 S 17	-	4	-	25.2	-	18600	0.259	166.6	986r
S/2006 S 1	-	6	-	24.6	-	18981	0.130	154.2	970r
S/2006 S 3	-	6	-	24.6	-	21132	0.471	150.8	1142r
S/2007 S 2		6		24.4		16560	0.218	176.7	800r
S/2007 S 3		5		24.9		20518	0.130	177.2	1100r
URANUS									
Ariel	1.56E-05	578.9 ± 0.6	1.665 ± 0.147	13.70 ± 0.04	0.39 ± 0.04	190.9	0.0012	0.041	2.520
Belinda	4.11E-09	40.3 ± 8	1.3	21.47 ± 0.09	0.07	75.3	0.0001	0.031	0.624
Bianca	1.07E-09	25.7 ± 2	1.3	22.52 ± 0.24	0.07	59.2	0.0009	0.193	0.435
Caliban	8.46E-09	49	1.5	22.42 ± 0.03	0.07	7231	0.1587	140.881	579.73r
Cordelia	5.18E-10	20.1 ± 3	1.3	23.62 ± 0.35	0.07	49.8	0.0003	0.085	0.335
Cressida	3.95E-09	39.8 ± 2	1.3	21.58 ± 0.11	0.07	61.8	0.0004	0.006	0.464
Cupid	-	12	-	26	-	74.8	0	0	-
Desdemona	2.05E-09	32.0 ± 4	1.3	21.99 ± 0.16	0.07	62.7	0.0001	0.113	0.474
Ferdinand	1.55E-11	6	1.5	25.1	0.04	20901	0.368	169.8	2823.4r
Francisco	1.55E-11	6	1.5	25.0	0.04	4276	0.146	145.2	266.6r
Juliet	6.42E-09	46.8 ± 4	1.3	21.12 ± 0.05	0.07	64.4	0.0007	0.065	0.493
Mab	-	16	-	26	-	97.7	0	0	-
Margaret	1.21E-11	6	1.5	25.2	0.04	14345	0.661	56.6	1694.8
Miranda	7.59E-07	235.8 ± 0.7	1.201 ± 0.137	15.79 ± 0.04	0.32 ± 0.03	129.9	0.0013	4.338	1.413
Oberon	3.47E-05	761.4 ± 2.6	1.630 ± 0.043	13.70 ± 0.04	0.23 ± 0.03	583.5	0.0014	0.068	13.46
Ophelia	6.21E-10	21.4 ± 4	1.3	23.26 ± 0.25	0.07	53.8	0.0099	0.104	0.376
Perdita	-	40	-	24.0	-	76.4	0	0	0.638
Portia	1.94E-08	67.6 ± 4	1.3	20.42 ± 0.05	0.07	66.1	0.0001	0.059	0.513
Prospero	2.42E-10	15	1.5	23.2	0.07	16418	0.443	151.91	1992.8r
Puck	3.33E-08	81 ± 2	1.3	19.75 ± 0.05	0.07	86	0.0001	0.319	0.762
Rosalind	2.93E-09	36 ± 6	1.3	21.79 ± 0.13	0.07	69.9	0.0001	0.279	0.558
Setebos	2.42E-10	15	1.5	23.3	0.07	17459	0.588	158.17	2202.3r
Stephano	6.90E-11	10	1.5	24.1	0.07	8002	0.230	144.06	676.5r
Sycorax	6.20E-08	95	1.5	20.82 ± 0.04	0.07	12179	0.5224	159.404	1288.30r
Titania	4.06E-05	788.9 ± 1.8	1.715 ± 0.044	13.49 ± 0.04	0.27 ± 0.03	436.3	0.0011	0.079	8.706
Trinculo	8.63E-12	5	1.5	25.4	0.04	8571	0.208	166.33	758.1r
Umbriel	1.35E-05	584.7 ± 2.8	1.400 ± 0.163	14.47 ± 0.04	0.21 ± 0.02	266	0.0039	0.128	4.144
NEPTUNE									
Despina	2.42E-08	75 ± 3	1.3	22.0	0.090	52.526	0.0002	0.064	0.335
Galatea	4.31E-08	88 ± 4	1.3	21.8	0.079	61.953	0.0000	0.062	0.429
Halimede	1.04E-09	24	1.5	24.5	0.16	15728	0.571	134.1	1879.7r
Laomedeia	1.04E-09	24	1.5	25.4	0.16	23571	0.424	34.7	3167.9
Larissa	5.70E-08	97 ± 3	1.3	21.5	0.091	73.548	0.0014	0.205	0.555
Naiad	2.24E-09	33 ± 3	1.3	23.9	0.072	48.227	0.0004	4.746	0.294
Nereid	3.56E-07	170 ± 25	1.5	19.7	0.155	5513.4	0.7512	7.232	360.14
Neso	1.90E-09	30	1.5	24.6	0.04	48387	0.450	137.4	9374.0r
Proteus	5.80E-07	210 ± 7	1.3	19.8	0.096	117.647	0.0005	0.026	1.122
Psamathe	1.73E-10	14	1.5	25.6	0.16	46695	0.495	132.6	9115.9r
Sao	1.04E-09	24	1.5	25.4	0.16	22422	0.293	48.5	2914.1
Thalassa	4.31E-09	41 ± 3	1.3	23.3	0.091	50.075	0.0002	0.209	0.327
Triton	2.46E-04	1353.4 ± 0.9	2.061 ± 0.007	13.472 ± 0.041	0.756 ± 0.041	354.8	0.0000	156.834	5.877r
PLUTO*									
Charon	0.123	593 ± 13	1.853 ± 0.158	17.26 ± 0.01	0.372 ± 0.012	19.41	0.0002	99.089	6.387
Nix	-	-	-	23	-	64.7	-	-	38.2
Hydra	-	-	-	23	-	49.4	-	-	25.5
ERIS*									
Dysnomia	-	150 ± 50	-	-	-	33000	-	-	14

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
P Sidereal period (mean value)
***** Dwarf planet

Note 1: Moons are listed in alphabetical order, except for those recently discovered.
Note 2: Some data is unavailable owing to the relatively short time since the body was discovered
Note 3: Scientific notation is used in order to save space. Eg. 1.66667E-08 is the 'computer notation' equivalent to $1.66667 \times 10^{-08} = 0.0000000166667$
Note 4: Moon names of the form S/2004 X 1 are only provisional. The S indicates a satellite of a planet (a moon), the next four digits indicate the year in which it was discovered, the X can have values J, S, U or N indicating the moon orbits either Jupiter, Saturn, Uranus or Neptune, respectively, and the last number indicates the order in which this moon was discovered if more than one was discovered for the planet in the given year.
Note 5: r indicates retrograde motion.

Data from NASA/JPL (http://ssd.jpl.nasa.gov/), NASA/GSFC (http://nssdc.gsfc.nasa.gov/planetary) and The Giant Planet Satellite and Moon Page (http://www.dtm.ciw.edu/sheppard/satellites)

Planet, dwarf planet and satellite names

The naked eye planets were named in antiquity. But what about newly discovered moons and the geographical features revealed by 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 modern 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 and/or 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 'a piece of land'.
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. The Moon is known as Luna in Italian, Latin, and Spanish, as Lune in French, as Mond in German, and as Selene in Greek.
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 attendant or son of Mars. Greek word means flight.
Deimos	Outer Martian satellite and named for one of Mars' horses/sons/ companions. Deimos means fear in Greek.
Ceres*	The first discovered and largest known asteroid. Discovered by Piazzi in 1801. Named for the old-Italian goddess of agriculture, grain, and the love a mother bears for her child. In later mythology, Ceres is identified with the Greek Demeter. She is the daughter of Saturn and the mother of Proserpina.
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. Satellites in the Jovian system are named for Zeus/Jupiter's lovers and descendants.
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 to 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.
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.
Amalthea	A naiad (a goat in some accounts, a princess of Crete in others) who suckled Zeus (Jupiter) as a young child.
Himalia	A Rhodian nymph who bore three sons of Zeus.
Elara	Daughter of King Orchomenus, a paramour of Zeus, and the mother of the giant Tityus.

NAME	MEANING
Pasiphaë	Wife of Minos, mother of the Minotaur.
Sinope	Daughter of the river god Asopus and Merope, she was abducted by Apollo.
Lysithea	Daughter of Kadmos, also named Semele, mother of Dionysos by Zeus. According to others, she was the daughter of Evenus and mother of Helenus by Jupiter.
Carme	A nymph and attendant of Artemis; mother, by Zeus, of Britomartis.
Ananke	Goddess of fate and necessity, mother of Adrastea by Zeus.
Leda	Seduced by Zeus in the form of a swan, she was the mother of Pollux and Helen.
Thebe	A nymph abducted by Zeus, she is the namesake of the Greek city of Thebes.
Adrastea	A nymph of Crete to whose care Rhea entrusted the infant Zeus.
Metis	First wife of Zeus. He swallowed her when she became pregnant; Athena was subsequently born from the forehead of Zeus.
Callirrhoe	A daughter of the river god Achelous, wife of Alcmaeon who lost the war for Thebes.
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.
Megaclite	Daughter of Macareus, who with Zeus gave birth to Thebe and Locrus.
Taygete	One of the Greek Pleiades. Daughter of Atlas, mother of Lacedaemon by Zeus.
Chaldene	Bore the son Solymos with Zeus.
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 the night bird called Chalkis, and Clymenus hanged himself.
Kalyke	Nymph who bore the handsome son Endymion with Zeus.
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.
Erinome	Daughter of Celes, compelled by Venus to fall in love with Zeus.
Isonoe	A Danaid who bore with Zeus the son Orchomenos or Chrysen.
Praxidike	Greek goddess of punishment of evil actions, justice, and of retribution.
Autonoe	Mother of the Graces by Zeus, according to some authorities.
Thyone	Semele, mother of Dionysos by Zeus. She received the name of Thyone in Hades by Dionysos before he ascended up with her from there to heaven.
Hermippe	Consort of Zeus and mother of Orchomenos by him.
Aitne	A Sicilian nymph and lover of Zeus.
Eurydome	Mother of the Graces by Zeus, according to some authorities.
Euanthe	Mother of the Graces by Zeus, according to some authorities.
Euporie	One of the Horae (seasons), a daughter of Jupiter and Themis.
Orthosie	One of the Horae (seasons), a daughter of Jupiter and Themis.
Sponde	One of the Horae (seasons), daughter of Jupiter.
Kale	One of the Graces, a daughter of Zeus, husband of Hephaistos.
Pasithee	One of the Graces, a daughter of Zeus.
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.

MEANINGS OF PLANET AND SATELLITE NAMES

NAME	MEANING
Saturn	Most of Saturn's satellites were named for Titans who, according to Greek mythology, were brothers and sisters of Saturn. In Greek mythology, the Titans were a race of godlike giants who were considered to be the personifications of the forces of nature. They were the twelve children (six sons and six daughters) of Gaia and Uranus. Satellites in the Saturnian system are named for Greco-Roman Titans, descendants of the Titans, the Roman god of the beginning, and giants from Greco-Roman and other mythologies. Gallic, Inuit and Norse names identify three different orbit inclination groups.
Mimas	Named for a Titan felled by Hephaestus (or Ares) in the war between the Titans and Olympian gods.
Enceladus	The Giant 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.
Dione	Dione was the sister of Cronos and mother (by Zeus) of Aphrodite.
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.
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 with Janus but they never actually collide.
Helene	The daughter of Tityrus, and one of the Amazons. A granddaughter of Kronos, for her beauty she triggered off the Trojan War
Telesto	One of 3,000 Oceanides, water nymphs born to Oceanus and Tethys.
Calypso	Daughter of the Titans Oceanus and Tethys and paramour of Odysseus.
Atlas	Held the heavens on his shoulders.
Prometheus	Son of the Titan Iapetus, 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.
Pan	Son of the Titan Kronos and Rhea. He was half human, half goat – god of pastoralism.
Ymir	Ymir is the primordial Norse giant and the progenitor of the race of frost giants.
Paaliaq	An Inuit giant.
Tarvos	A Gallic giant.
Ijiraq	An Inuit giant.
Suttungr	Named for a Norse giant who kindled flames that destroyed the world.
Kiviuq	An Inuit giant.
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).
Albiorix	'King of the world'. An alternative name of the Gallic god Teutates. He is the god of war, fertility, and wealth.
Skathi	A giantess, called the 'snow-shoe goddess', and the embodiment of winter. She is the wife of the god Njord.
Erriapo	A Gallic giant.
Siarnaq	An Inuit giant.
Thrymr	Named for a Norse giant.
Daphnis	The son of Hermes and a nymph. He was known as a shepherd and flute player. He is regarded as the inventor of bucolic poetry.
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.
Ariel	A sylph in Pope's 'Rape of the Lock'.
Umbriel	A malevolent spirit in Pope's 'Rape of the Lock'.

NAME	MEANING
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'.
Miranda	Heroine of Shakespeare's 'The Tempest'.
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'.
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'.
Perdita	The daughter of Leontes and Hermione in 'The Winter's Tale'.
Ferdinand	The son of the King of Naples in 'The Tempest'.
Francisco	A lord in 'The Tempest'.
Mab	Queen Mab, a fairy queen from English folklore who is mentioned in 'Romeo and Juliet'.
Cupid	A character in 'Timon of Athens'.
Margaret	The servant of Hero in 'Much Ado About Nothing'.
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. Instead, this planet is named for the Roman god of the sea. Satellites in the Neptunian system are named for characters from Greek or Roman mythology associated with Neptune /Poseidon orthe oceans.
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.
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.
Psamathe	A Nereid, and with Aeacus the mother of Phocus.
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.
Nix	The goddess of night and the mother of Charon. (Sometimes spelt Nyx.)
Hydra	The nine-headed monster that guarded Lake Lerna, one of the entrances to the underworld.
Eris*	Brown, Trujillo, and Rabinowitz discovered Eris on January 5, 2005 in their TNO search programme. Named for the Greek goddess of discord and strife. She is Ares' constant companion and follows him everywhere. Eris is sinister and mean, and her greatest joy is to make trouble.
Dysnomia	The female Spirit of lawlessness.

Note: Moons are listed in order of their discovery.
* Dwarf planet

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)	CONST.
January	**1**	**18**	**41**	**15.3**	**-23**	**05**	**59**	**0.983**	**Sgr**
Jan	2	18	45	40.5	-23	01	24	0.983	Sgr
Jan	3	18	50	05.3	-22	56	21	0.983	Sgr
Jan	4	18	54	29.9	-22	50	51	0.983	Sgr
Jan	5	18	58	54.0	-22	44	53	0.983	Sgr
Jan	6	19	03	17.8	-22	38	29	0.983	Sgr
Jan	7	19	07	41.2	-22	31	37	0.983	Sgr
Jan	8	19	12	04.1	-22	24	19	0.983	Sgr
Jan	9	19	16	26.5	-22	16	34	0.983	Sgr
Jan	10	19	20	48.4	-22	08	23	0.983	Sgr
Jan	11	19	25	09.8	-21	59	45	0.983	Sgr
Jan	12	19	29	30.6	-21	50	42	0.983	Sgr
Jan	13	19	33	50.8	-21	41	14	0.983	Sgr
Jan	14	19	38	10.4	-21	31	20	0.984	Sgr
Jan	15	19	42	29.4	-21	21	02	0.984	Sgr
Jan	16	19	46	47.7	-21	10	18	0.984	Sgr
Jan	17	19	51	05.2	-20	59	11	0.984	Sgr
Jan	18	19	55	22.1	-20	47	39	0.984	Sgr
Jan	19	19	59	38.3	-20	35	44	0.984	Sgr
Jan	20	20	03	53.7	-20	23	26	0.984	Sgr
Jan	21	20	08	08.4	-20	10	45	0.984	Cap
Jan	22	20	12	22.4	-19	57	41	0.984	Cap
Jan	23	20	16	35.5	-19	44	14	0.984	Cap
Jan	24	20	20	47.9	-19	30	26	0.984	Cap
Jan	25	20	24	59.6	-19	16	16	0.984	Cap
Jan	26	20	29	10.4	-19	01	45	0.984	Cap
Jan	27	20	33	20.5	-18	46	52	0.985	Cap
Jan	28	20	37	29.8	-18	31	40	0.985	Cap
Jan	29	20	41	38.3	-18	16	07	0.985	Cap
Jan	30	20	45	46.0	-18	00	14	0.985	Cap
Jan	31	20	49	52.9	-17	44	01	0.985	Cap
February	**1**	**20**	**53**	**59.1**	**-17**	**27**	**30**	**0.985**	**Cap**
Feb	2	20	58	04.4	-17	10	40	0.985	Cap
Feb	3	21	02	08.9	-16	53	31	0.985	Cap
Feb	4	21	06	12.6	-16	36	05	0.986	Cap
Feb	5	21	10	15.5	-16	18	21	0.986	Cap
Feb	6	21	14	17.6	-16	00	21	0.986	Cap
Feb	7	21	18	18.9	-15	42	04	0.986	Cap
Feb	8	21	22	19.4	-15	23	30	0.986	Cap
Feb	9	21	26	19.1	-15	04	41	0.986	Cap
Feb	10	21	30	18.0	-14	45	37	0.987	Cap
Feb	11	21	34	16.1	-14	26	17	0.987	Cap
Feb	12	21	38	13.4	-14	06	44	0.987	Cap
Feb	13	21	42	09.9	-13	46	56	0.987	Cap
Feb	14	21	46	05.6	-13	26	55	0.987	Cap
Feb	15	21	50	00.6	-13	06	41	0.987	Cap
Feb	16	21	53	54.8	-12	46	15	0.988	Cap
Feb	17	21	57	48.3	-12	25	36	0.988	Cap
Feb	18	22	01	41.0	-12	04	45	0.988	Aqr
Feb	19	22	05	33.0	-11	43	43	0.988	Aqr
Feb	20	22	09	24.4	-11	22	30	0.988	Aqr
Feb	21	22	13	15.0	-11	01	06	0.989	Aqr
Feb	22	22	17	05.0	-10	39	32	0.989	Aqr
Feb	23	22	20	54.3	-10	17	48	0.989	Aqr
Feb	24	22	24	43.0	-09	55	54	0.989	Aqr
Feb	25	22	28	31.1	-09	33	51	0.990	Aqr
Feb	26	22	32	18.6	-09	11	40	0.990	Aqr
Feb	27	22	36	05.6	-08	49	20	0.990	Aqr
Feb	28	22	39	52.0	-08	26	52	0.990	Aqr
Feb	29	22	43	37.8	-08	04	17	0.991	Aqr
March	**1**	**22**	**47**	**23.2**	**-07**	**41**	**34**	**0.991**	**Aqr**
Mar	2	22	51	08.0	-07	18	45	0.991	Aqr
Mar	3	22	54	52.4	-06	55	49	0.991	Aqr
Mar	4	22	58	36.3	-06	32	47	0.992	Aqr
Mar	5	23	02	19.8	-06	09	40	0.992	Aqr
Mar	6	23	06	02.8	-05	46	28	0.992	Aqr
Mar	7	23	09	45.4	-05	23	10	0.992	Aqr
Mar	8	23	13	27.6	-04	59	49	0.993	Aqr
Mar	9	23	17	09.5	-04	36	23	0.993	Aqr
Mar	10	23	20	51.0	-04	12	54	0.993	Aqr
Mar	11	23	24	32.1	-03	49	22	0.993	Aqr
Mar	12	23	28	12.9	-03	25	47	0.994	Aqr
Mar	13	23	31	53.4	-03	02	10	0.994	Psc
Mar	14	23	35	33.6	-02	38	31	0.994	Psc
Mar	15	23	39	13.5	-02	14	51	0.994	Psc
Mar	16	23	42	53.1	-01	51	09	0.995	Psc
Mar	17	23	46	32.6	-01	27	27	0.995	Psc
Mar	18	23	50	11.8	-01	03	44	0.995	Psc
Mar	19	23	53	50.8	-00	40	01	0.996	Psc
Mar	20	23	57	29.6	-00	16	19	0.996	Psc
Mar	21	00	01	08.3	+00	07	23	0.996	Psc
Mar	22	00	04	46.9	+00	31	05	0.996	Psc
Mar	23	00	08	25.3	+00	54	44	0.997	Psc
Mar	24	00	12	03.7	+01	18	23	0.997	Psc
Mar	25	00	15	42.1	+01	41	59	0.997	Psc
Mar	26	00	19	20.4	+02	05	33	0.997	Psc
Mar	27	00	22	58.7	+02	29	04	0.998	Psc
Mar	28	00	26	37.1	+02	52	33	0.998	Psc
Mar	29	00	30	15.5	+03	15	58	0.998	Psc
Mar	30	00	33	53.9	+03	39	19	0.999	Psc
Mar	31	00	37	32.4	+04	02	37	0.999	Psc
April	**1**	**00**	**41**	**11.0**	**+04**	**25**	**50**	**0.999**	**Psc**
Apr	2	00	44	49.7	+04	48	58	1.000	Psc
Apr	3	00	48	28.6	+05	12	02	1.000	Psc
Apr	4	00	52	07.6	+05	34	60	1.000	Psc
Apr	5	00	55	46.8	+05	57	52	1.000	Psc
Apr	6	00	59	26.2	+06	20	38	1.001	Psc
Apr	7	01	03	05.8	+06	43	17	1.001	Psc
Apr	8	01	06	45.6	+07	05	50	1.001	Psc
Apr	9	01	10	25.6	+07	28	15	1.002	Psc
Apr	10	01	14	05.8	+07	50	33	1.002	Psc
Apr	11	01	17	46.3	+08	12	42	1.002	Psc
Apr	12	01	21	27.1	+08	34	43	1.002	Psc
Apr	13	01	25	08.2	+08	56	35	1.003	Psc
Apr	14	01	28	49.5	+09	18	19	1.003	Psc
Apr	15	01	32	31.2	+09	39	53	1.003	Psc
Apr	16	01	36	13.2	+10	01	17	1.003	Psc
Apr	17	01	39	55.5	+10	22	31	1.004	Psc
Apr	18	01	43	38.2	+10	43	35	1.004	Psc
Apr	19	01	47	21.3	+11	04	28	1.004	Ari
Apr	20	01	51	04.8	+11	25	10	1.005	Ari
Apr	21	01	54	48.7	+11	45	41	1.005	Ari
Apr	22	01	58	33.1	+12	06	00	1.005	Ari
Apr	23	02	02	17.9	+12	26	08	1.005	Ari
Apr	24	02	06	03.1	+12	46	03	1.006	Ari
Apr	25	02	09	48.9	+13	05	46	1.006	Ari
Apr	26	02	13	35.1	+13	25	16	1.006	Ari
Apr	27	02	17	21.8	+13	44	33	1.006	Ari
Apr	28	02	21	09.0	+14	03	36	1.007	Ari
Apr	29	02	24	56.8	+14	22	25	1.007	Ari
Apr	30	02	28	45.1	+14	41	01	1.007	Ari
May	**1**	**02**	**32**	**34.0**	**+14**	**59**	**22**	**1.008**	**Ari**

GEOCENTRIC POSITION OF SUN (continued)

Note: positions refer to 0000 WAST

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (AU)	CONST.
May	2	02	36	23.4	+15	17	28	1.008	Ari
May	3	02	40	13.3	+15	35	19	1.008	Ari
May	4	02	44	03.8	+15	52	54	1.008	Ari
May	5	02	47	54.9	+16	10	14	1.009	Ari
May	6	02	51	46.6	+16	27	18	1.009	Ari
May	7	02	55	38.8	+16	44	05	1.009	Ari
May	8	02	59	31.6	+17	00	36	1.009	Ari
May	9	03	03	24.9	+17	16	49	1.010	Ari
May	10	03	07	18.8	+17	32	45	1.010	Ari
May	11	03	11	13.2	+17	48	23	1.010	Ari
May	12	03	15	08.2	+18	03	43	1.010	Ari
May	13	03	19	03.8	+18	18	45	1.010	Ari
May	14	03	22	59.9	+18	33	28	1.011	Ari
May	15	03	26	56.5	+18	47	53	1.011	Tau
May	16	03	30	53.7	+19	01	58	1.011	Tau
May	17	03	34	51.5	+19	15	44	1.011	Tau
May	18	03	38	49.8	+19	29	11	1.011	Tau
May	19	03	42	48.6	+19	42	17	1.012	Tau
May	20	03	46	48.0	+19	55	04	1.012	Tau
May	21	03	50	47.9	+20	07	30	1.012	Tau
May	22	03	54	48.4	+20	19	35	1.012	Tau
May	23	03	58	49.4	+20	31	20	1.012	Tau
May	24	04	02	50.9	+20	42	44	1.013	Tau
May	25	04	06	53.0	+20	53	46	1.013	Tau
May	26	04	10	55.5	+21	04	27	1.013	Tau
May	27	04	14	58.6	+21	14	46	1.013	Tau
May	28	04	19	02.1	+21	24	43	1.013	Tau
May	29	04	23	06.2	+21	34	18	1.014	Tau
May	30	04	27	10.7	+21	43	31	1.014	Tau
May	31	04	31	15.6	+21	52	21	1.014	Tau
June	**1**	**04**	**35**	**21.0**	**+22**	**00**	**48**	**1.014**	**Tau**
Jun	2	04	39	26.8	+22	08	52	1.014	Tau
Jun	3	04	43	33.0	+22	16	33	1.014	Tau
Jun	4	04	47	39.6	+22	23	50	1.015	Tau
Jun	5	04	51	46.6	+22	30	44	1.015	Tau
Jun	6	04	55	53.8	+22	37	15	1.015	Tau
Jun	7	05	00	01.4	+22	43	21	1.015	Tau
Jun	8	05	04	09.2	+22	49	04	1.015	Tau
Jun	9	05	08	17.3	+22	54	22	1.015	Tau
Jun	10	05	12	25.7	+22	59	16	1.015	Tau
Jun	11	05	16	34.2	+23	03	46	1.015	Tau
Jun	12	05	20	43.0	+23	07	52	1.015	Tau
Jun	13	05	24	51.9	+23	11	33	1.016	Tau
Jun	14	05	29	00.9	+23	14	49	1.016	Tau
Jun	15	05	33	10.1	+23	17	41	1.016	Tau
Jun	16	05	37	19.4	+23	20	09	1.016	Tau
Jun	17	05	41	28.7	+23	22	11	1.016	Tau
Jun	18	05	45	38.2	+23	23	49	1.016	Tau
Jun	19	05	49	47.7	+23	25	03	1.016	Tau
Jun	20	05	53	57.2	+23	25	51	1.016	Tau
Jun	21	05	58	06.7	+23	26	15	1.016	Tau
Jun	22	06	02	16.2	+23	26	14	1.016	Gem
Jun	23	06	06	25.7	+23	25	48	1.016	Gem
Jun	24	06	10	35.1	+23	24	57	1.016	Gem
Jun	25	06	14	44.4	+23	23	42	1.016	Gem
Jun	26	06	18	53.6	+23	22	02	1.017	Gem
Jun	27	06	23	02.8	+23	19	58	1.017	Gem
Jun	28	06	27	11.8	+23	17	28	1.017	Gem
Jun	29	06	31	20.6	+23	14	34	1.017	Gem
Jun	30	06	35	29.2	+23	11	16	1.017	Gem
July	**1**	**06**	**39**	**37.6**	**+23**	**07**	**33**	**1.017**	**Gem**
Jul	2	06	43	45.8	+23	03	26	1.017	Gem
Jul	3	06	47	53.8	+22	58	55	1.017	Gem
Jul	4	06	52	01.4	+22	53	59	1.017	Gem
Jul	5	06	56	08.7	+22	48	40	1.017	Gem
Jul	6	07	00	15.7	+22	42	57	1.017	Gem
Jul	7	07	04	22.3	+22	36	50	1.017	Gem
Jul	8	07	08	28.5	+22	30	19	1.017	Gem
Jul	9	07	12	34.3	+22	23	26	1.017	Gem
Jul	10	07	16	39.7	+22	16	09	1.017	Gem
Jul	11	07	20	44.6	+22	08	29	1.017	Gem
Jul	12	07	24	49.1	+22	00	27	1.017	Gem
Jul	13	07	28	53.1	+21	52	02	1.017	Gem
Jul	14	07	32	56.6	+21	43	14	1.017	Gem
Jul	15	07	36	59.7	+21	34	04	1.016	Gem
Jul	16	07	41	02.2	+21	24	33	1.016	Gem
Jul	17	07	45	04.1	+21	14	39	1.016	Gem
Jul	18	07	49	05.6	+21	04	24	1.016	Gem
Jul	19	07	53	06.5	+20	53	48	1.016	Gem
Jul	20	07	57	06.9	+20	42	51	1.016	Gem
Jul	21	08	01	06.7	+20	31	32	1.016	Cnc
Jul	22	08	05	06.0	+20	19	53	1.016	Cnc
Jul	23	08	09	04.7	+20	07	54	1.016	Cnc
Jul	24	08	13	02.9	+19	55	34	1.016	Cnc
Jul	25	08	17	00.4	+19	42	54	1.016	Cnc
Jul	26	08	20	57.5	+19	29	55	1.016	Cnc
Jul	27	08	24	53.9	+19	16	36	1.016	Cnc
Jul	28	08	28	49.7	+19	02	58	1.015	Cnc
Jul	29	08	32	45.0	+18	49	01	1.015	Cnc
Jul	30	08	36	39.7	+18	34	45	1.015	Cnc
Jul	31	08	40	33.8	+18	20	11	1.015	Cnc
August	**1**	**08**	**44**	**27.3**	**+18**	**05**	**19**	**1.015**	**Cnc**
Aug	2	08	48	20.2	+17	50	09	1.015	Cnc
Aug	3	08	52	12.5	+17	34	41	1.015	Cnc
Aug	4	08	56	04.1	+17	18	57	1.015	Cnc
Aug	5	08	59	55.2	+17	02	55	1.015	Cnc
Aug	6	09	03	45.6	+16	46	38	1.014	Cnc
Aug	7	09	07	35.4	+16	30	04	1.014	Cnc
Aug	8	09	11	24.7	+16	13	14	1.014	Cnc
Aug	9	09	15	13.3	+15	56	08	1.014	Cnc
Aug	10	09	19	01.3	+15	38	48	1.014	Cnc
Aug	11	09	22	48.7	+15	21	12	1.014	Leo
Aug	12	09	26	35.6	+15	03	22	1.013	Leo
Aug	13	09	30	21.8	+14	45	18	1.013	Leo
Aug	14	09	34	07.5	+14	26	59	1.013	Leo
Aug	15	09	37	52.7	+14	08	27	1.013	Leo
Aug	16	09	41	37.3	+13	49	42	1.013	Leo
Aug	17	09	45	21.4	+13	30	43	1.012	Leo
Aug	18	09	49	04.9	+13	11	31	1.012	Leo
Aug	19	09	52	48.0	+12	52	07	1.012	Leo
Aug	20	09	56	30.6	+12	32	31	1.012	Leo
Aug	21	10	00	12.7	+12	12	43	1.012	Leo
Aug	22	10	03	54.3	+11	52	43	1.011	Leo
Aug	23	10	07	35.5	+11	32	31	1.011	Leo
Aug	24	10	11	16.3	+11	12	09	1.011	Leo
Aug	25	10	14	56.7	+10	51	36	1.011	Leo
Aug	26	10	18	36.7	+10	30	52	1.011	Leo
Aug	27	10	22	16.3	+10	09	58	1.010	Leo
Aug	28	10	25	55.6	+09	48	55	1.010	Leo
Aug	29	10	29	34.4	+09	27	41	1.010	Leo
Aug	30	10	33	13.0	+09	06	19	1.010	Leo
Aug	31	10	36	51.2	+08	44	48	1.010	Leo

GEOCENTRIC POSITION OF SUN (continued)

MONTH	DAY	RA h	m	s	DECLINATION °	′	″	DISTANCE (AU)	CONST.
September	**1**	**10**	**40**	**29.1**	**+08**	**23**	**09**	**1.009**	**Leo**
Sep	2	10	44	06.7	+08	01	22	1.009	Leo
Sep	3	10	47	44.0	+07	39	27	1.009	Leo
Sep	4	10	51	21.0	+07	17	24	1.009	Leo
Sep	5	10	54	57.7	+06	55	15	1.008	Leo
Sep	6	10	58	34.3	+06	32	59	1.008	Leo
Sep	7	11	02	10.5	+06	10	37	1.008	Leo
Sep	8	11	05	46.6	+05	48	08	1.008	Leo
Sep	9	11	09	22.5	+05	25	34	1.007	Leo
Sep	10	11	12	58.2	+05	02	55	1.007	Leo
Sep	11	11	16	33.7	+04	40	10	1.007	Leo
Sep	12	11	20	09.1	+04	17	21	1.006	Leo
Sep	13	11	23	44.4	+03	54	28	1.006	Leo
Sep	14	11	27	19.6	+03	31	30	1.006	Leo
Sep	15	11	30	54.7	+03	08	29	1.006	Leo
Sep	16	11	34	29.8	+02	45	24	1.005	Leo
Sep	17	11	38	04.8	+02	22	16	1.005	Vir
Sep	18	11	41	39.9	+01	59	05	1.005	Vir
Sep	19	11	45	15.0	+01	35	51	1.005	Vir
Sep	20	11	48	50.1	+01	12	35	1.004	Vir
Sep	21	11	52	25.3	+00	49	17	1.004	Vir
Sep	22	11	56	00.6	+00	25	58	1.004	Vir
Sep	23	11	59	36.0	+00	02	37	1.004	Vir
Sep	24	12	03	11.6	-00	20	45	1.003	Vir
Sep	25	12	06	47.3	-00	44	08	1.003	Vir
Sep	26	12	10	23.2	-01	07	30	1.003	Vir
Sep	27	12	13	59.3	-01	30	53	1.002	Vir
Sep	28	12	17	35.6	-01	54	15	1.002	Vir
Sep	29	12	21	12.1	-02	17	36	1.002	Vir
Sep	30	12	24	48.8	-02	40	56	1.002	Vir
October	**1**	**12**	**28**	**25.8**	**-03**	**04**	**14**	**1.001**	**Vir**
Oct	2	12	32	03.1	-03	27	30	1.001	Vir
Oct	3	12	35	40.7	-03	50	44	1.001	Vir
Oct	4	12	39	18.6	-04	13	55	1.000	Vir
Oct	5	12	42	56.9	-04	37	03	1.000	Vir
Oct	6	12	46	35.5	-05	00	08	1.000	Vir
Oct	7	12	50	14.4	-05	23	09	1.000	Vir
Oct	8	12	53	53.8	-05	46	05	0.999	Vir
Oct	9	12	57	33.5	-06	08	57	0.999	Vir
Oct	10	13	01	13.7	-06	31	44	0.999	Vir
Oct	11	13	04	54.3	-06	54	26	0.998	Vir
Oct	12	13	08	35.4	-07	17	02	0.998	Vir
Oct	13	13	12	16.9	-07	39	32	0.998	Vir
Oct	14	13	15	59.0	-08	01	55	0.997	Vir
Oct	15	13	19	41.6	-08	24	12	0.997	Vir
Oct	16	13	23	24.8	-08	46	22	0.997	Vir
Oct	17	13	27	08.5	-09	08	24	0.997	Vir
Oct	18	13	30	52.8	-09	30	19	0.996	Vir
Oct	19	13	34	37.8	-09	52	06	0.996	Vir
Oct	20	13	38	23.3	-10	13	44	0.996	Vir
Oct	21	13	42	09.6	-10	35	13	0.996	Vir
Oct	22	13	45	56.5	-10	56	33	0.995	Vir
Oct	23	13	49	44.1	-11	17	43	0.995	Vir
Oct	24	13	53	32.4	-11	38	43	0.995	Vir
Oct	25	13	57	21.4	-11	59	33	0.994	Vir
Oct	26	14	01	11.2	-12	20	12	0.994	Vir
Oct	27	14	05	01.6	-12	40	39	0.994	Vir
Oct	28	14	08	52.9	-13	00	55	0.994	Vir
Oct	29	14	12	44.9	-13	20	59	0.993	Vir
Oct	30	14	16	37.6	-13	40	49	0.993	Vir
Oct	31	14	20	31.2	-14	00	27	0.993	Vir

MONTH	DAY	RA h	m	s	DECLINATION °	′	″	DISTANCE (AU)	CONST.
November	**1**	**14**	**24**	**25.5**	**-14**	**19**	**52**	**0.993**	**Lib**
Nov	2	14	28	20.6	-14	39	02	0.992	Lib
Nov	3	14	32	16.5	-14	57	58	0.992	Lib
Nov	4	14	36	13.2	-15	16	40	0.992	Lib
Nov	5	14	40	10.7	-15	35	06	0.992	Lib
Nov	6	14	44	09.0	-15	53	17	0.991	Lib
Nov	7	14	48	08.1	-16	11	12	0.991	Lib
Nov	8	14	52	08.1	-16	28	51	0.991	Lib
Nov	9	14	56	08.8	-16	46	13	0.991	Lib
Nov	10	15	00	10.4	-17	03	18	0.990	Lib
Nov	11	15	04	12.9	-17	20	06	0.990	Lib
Nov	12	15	08	16.1	-17	36	35	0.990	Lib
Nov	13	15	12	20.2	-17	52	47	0.990	Lib
Nov	14	15	16	25.2	-18	08	39	0.989	Lib
Nov	15	15	20	31.0	-18	24	13	0.989	Lib
Nov	16	15	24	37.6	-18	39	28	0.989	Lib
Nov	17	15	28	45.1	-18	54	22	0.989	Lib
Nov	18	15	32	53.5	-19	08	57	0.989	Lib
Nov	19	15	37	02.7	-19	23	11	0.988	Lib
Nov	20	15	41	12.8	-19	37	05	0.988	Lib
Nov	21	15	45	23.6	-19	50	37	0.988	Lib
Nov	22	15	49	35.4	-20	03	47	0.988	Lib
Nov	23	15	53	47.9	-20	16	36	0.988	Lib
Nov	24	15	58	01.2	-20	29	02	0.987	Sco
Nov	25	16	02	15.4	-20	41	05	0.987	Sco
Nov	26	16	06	30.2	-20	52	46	0.987	Sco
Nov	27	16	10	45.9	-21	04	03	0.987	Sco
Nov	28	16	15	02.3	-21	14	56	0.987	Sco
Nov	29	16	19	19.4	-21	25	25	0.986	Sco
Nov	30	16	23	37.1	-21	35	30	0.986	Oph
December	**1**	**16**	**27**	**55.6**	**-21**	**45**	**10**	**0.986**	**Oph**
Dec	2	16	32	14.7	-21	54	25	0.986	Oph
Dec	3	16	36	34.4	-22	03	14	0.986	Oph
Dec	4	16	40	54.7	-22	11	39	0.986	Oph
Dec	5	16	45	15.6	-22	19	37	0.985	Oph
Dec	6	16	49	37.0	-22	27	09	0.985	Oph
Dec	7	16	53	58.9	-22	34	15	0.985	Oph
Dec	8	16	58	21.3	-22	40	55	0.985	Oph
Dec	9	17	02	44.2	-22	47	08	0.985	Oph
Dec	10	17	07	07.5	-22	52	54	0.985	Oph
Dec	11	17	11	31.2	-22	58	13	0.985	Oph
Dec	12	17	15	55.3	-23	03	05	0.985	Oph
Dec	13	17	20	19.8	-23	07	30	0.984	Oph
Dec	14	17	24	44.6	-23	11	27	0.984	Oph
Dec	15	17	29	09.7	-23	14	56	0.984	Oph
Dec	16	17	33	35.1	-23	17	58	0.984	Oph
Dec	17	17	38	00.7	-23	20	31	0.984	Oph
Dec	18	17	42	26.5	-23	22	37	0.984	Oph
Dec	19	17	46	52.6	-23	24	15	0.984	Sgr
Dec	20	17	51	18.8	-23	25	24	0.984	Sgr
Dec	21	17	55	45.1	-23	26	05	0.984	Sgr
Dec	22	18	00	11.5	-23	26	18	0.984	Sgr
Dec	23	18	04	38.0	-23	26	03	0.984	Sgr
Dec	24	18	09	04.5	-23	25	19	0.984	Sgr
Dec	25	18	13	30.9	-23	24	07	0.984	Sgr
Dec	26	18	17	57.3	-23	22	27	0.983	Sgr
Dec	27	18	22	23.6	-23	20	19	0.983	Sgr
Dec	28	18	26	49.8	-23	17	42	0.983	Sgr
Dec	29	18	31	15.8	-23	14	38	0.983	Sgr
Dec	30	18	35	41.6	-23	11	05	0.983	Sgr
Dec	31	18	40	07.1	-23	07	05	0.983	Sgr

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 (1,000km)	CONST.
January	**1**	**12**	**46**	**07.8**	**-08**	**02**	**16**	**401.0**	**Vir**
Jan	2	13	29	55.3	-13	11	58	404.2	Vir
Jan	3	14	15	05.5	-17	48	01	406.2	Vir
Jan	4	15	02	20.7	-21	40	37	407.0	Lib
Jan	5	15	52	04.3	-24	38	56	406.6	Sco
Jan	6	16	44	12.1	-26	31	55	405.2	Sco
Jan	7	17	38	07.8	-27	09	56	403.1	Oph
Jan	8	18	32	48.3	-26	27	08	400.4	Sgr
Jan	9	19	27	01.5	-24	23	16	397.3	Sgr
Jan	10	20	19	49.3	-21	03	57	394.0	Cap
Jan	11	21	10	44.1	-16	39	38	390.5	Cap
Jan	12	21	59	51.7	-11	23	35	387.0	Aqr
Jan	13	22	47	46.4	-05	30	20	383.5	Aqr
Jan	14	23	35	22.1	+00	45	00	379.9	Psc
Jan	15	00	23	45.7	+07	06	32	376.4	Psc
Jan	16	01	14	11.4	+13	16	45	373.0	Psc
Jan	17	02	07	51.7	+18	55	23	369.8	Ari
Jan	18	03	05	41.5	+23	38	50	367.1	Ari
Jan	19	04	07	50.9	+27	01	25	365.2	Tau
Jan	20	05	13	16.2	+28	40	06	364.2	Aur
Jan	21	06	19	37.7	+28	21	49	364.5	Aur
Jan	22	07	24	07.6	+26	09	22	366.1	Gem
Jan	23	08	24	40.4	+22	20	37	369.1	Cnc
Jan	24	09	20	28.9	+17	21	46	373.2	Cnc
Jan	25	10	11	53.1	+11	39	49	378.1	Leo
Jan	26	10	59	50.1	+05	38	05	383.5	Leo
Jan	27	11	45	29.6	-00	25	04	388.9	Vir
Jan	28	12	30	01.1	-06	15	33	394.0	Vir
Jan	29	13	14	29.2	-11	42	09	398.3	Vir
Jan	30	13	59	51.0	-16	35	10	401.6	Vir
Jan	31	14	46	52.8	-20	45	05	403.6	Lib
February	**1**	**15**	**36**	**05.4**	**-24**	**02**	**03**	**404.4**	**Lib**
Feb	2	16	27	36.6	-26	15	53	404.0	Sco
Feb	3	17	21	05.3	-27	17	03	402.4	Oph
Feb	4	18	15	42.1	-26	58	38	399.9	Sgr
Feb	5	19	10	21.9	-25	18	03	396.7	Sgr
Feb	6	20	04	03.7	-22	18	21	393.1	Sgr
Feb	7	20	56	09.1	-18	07	53	389.4	Cap
Feb	8	21	46	31.3	-12	59	07	385.8	Cap
Feb	9	22	35	32.3	-07	07	11	382.5	Aqr
Feb	10	23	23	56.1	-00	48	47	379.5	Psc
Feb	11	00	12	41.1	+05	38	19	377.1	Psc
Feb	12	01	02	52.8	+11	55	12	375.0	Psc
Feb	13	01	55	36.4	+17	41	36	373.4	Ari
Feb	14	02	51	43.6	+22	35	40	372.1	Ari
Feb	15	03	51	32.1	+26	14	54	371.1	Tau
Feb	16	04	54	23.3	+28	19	04	370.6	Tau
Feb	17	05	58	35.6	+28	35	04	370.5	Aur
Feb	18	07	01	51.8	+27	01	33	371.1	Gem
Feb	19	08	02	12.7	+23	49	50	372.5	Cnc
Feb	20	08	58	36.2	+19	20	09	374.6	Cnc
Feb	21	09	51	00.7	+13	56	12	377.5	Leo
Feb	22	10	40	05.4	+08	00	51	381.0	Leo
Feb	23	11	26	48.2	+01	54	05	385.1	Leo
Feb	24	12	12	12.0	-04	07	30	389.3	Vir
Feb	25	12	57	17.3	-09	50	03	393.4	Vir
Feb	26	13	42	58.5	-15	01	45	397.0	Vir
Feb	27	14	30	00.7	-19	31	56	399.9	Lib
Feb	28	15	18	55.6	-23	10	24	401.8	Lib
Feb	29	16	09	55.4	-25	47	21	402.5	Sco
March	**1**	**17**	**02**	**47.3**	**-27**	**13**	**51**	**402.0**	**Oph**

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (1,000km)	CONST.
Mar	2	17	56	53.4	-27	23	01	400.3	Sgr
Mar	3	18	51	18.7	-26	11	24	397.6	Sgr
Mar	4	19	45	07.9	-23	40	02	394.0	Sgr
Mar	5	20	37	42.0	-19	54	34	389.8	Cap
Mar	6	21	28	48.3	-15	04	43	385.5	Cap
Mar	7	22	18	41.8	-09	23	32	381.3	Aqr
Mar	8	23	07	59.6	-03	06	49	377.6	Psc
Mar	9	23	57	34.1	+03	27	10	374.6	Psc
Mar	10	00	48	26.4	+09	57	50	372.4	Psc
Mar	11	01	41	37.1	+16	02	35	371.2	Psc
Mar	12	02	37	54.1	+21	17	27	370.8	Ari
Mar	13	03	37	33.1	+25	18	45	371.1	Tau
Mar	14	04	39	57.4	+27	46	11	371.9	Tau
Mar	15	05	43	32.7	+28	27	15	373.1	Tau
Mar	16	06	46	12.5	+27	20	41	374.7	Gem
Mar	17	07	46	06.0	+24	36	42	376.4	Gem
Mar	18	08	42	13.4	+20	33	20	378.4	Cnc
Mar	19	09	34	31.3	+15	31	40	380.6	Leo
Mar	20	10	23	35.2	+09	52	20	383.1	Leo
Mar	21	11	10	19.7	+03	53	58	385.8	Leo
Mar	22	11	55	45.0	-02	07	05	388.8	Vir
Mar	23	12	40	49.6	-07	56	18	391.8	Vir
Mar	24	13	26	26.6	-13	20	36	394.7	Vir
Mar	25	14	13	20.0	-18	07	45	397.4	Vir
Mar	26	15	02	00.6	-22	06	16	399.6	Lib
Mar	27	15	52	40.8	-25	05	27	401.0	Sco
Mar	28	16	45	08.9	-26	56	01	401.4	Sco
Mar	29	17	38	49.4	-27	31	03	400.8	Oph
Mar	30	18	32	50.5	-26	47	07	399.1	Sgr
Mar	31	19	26	19.5	-24	44	49	396.3	Sgr
April	**1**	**20**	**18**	**38.3**	**-21**	**28**	**40**	**392.6**	**Cap**
Apr	2	21	09	34.2	-17	06	24	388.2	Cap
Apr	3	21	59	20.4	-11	48	22	383.4	Aqr
Apr	4	22	48	32.6	-05	47	22	378.6	Aqr
Apr	5	23	38	02.9	+00	41	01	374.2	Psc
Apr	6	00	28	53.1	+07	17	44	370.6	Psc
Apr	7	01	22	07.5	+13	39	58	368.1	Psc
Apr	8	02	18	39.6	+19	21	32	366.9	Ari
Apr	9	03	18	52.3	+23	54	51	367.0	Ari
Apr	10	04	22	12.5	+26	55	12	368.2	Tau
Apr	11	05	27	01.6	+28	06	21	370.3	Tau
Apr	12	06	30	59.4	+27	25	17	373.0	Gem
Apr	13	07	31	59.6	+25	02	29	376.1	Gem
Apr	14	08	28	53.0	+21	17	15	379.2	Cnc
Apr	15	09	21	34.2	+16	31	35	382.3	Cnc
Apr	16	10	10	41.6	+11	06	09	385.2	Leo
Apr	17	10	57	14.5	+05	18	45	388.0	Leo
Apr	18	11	42	17.3	-00	35	24	390.5	Vir
Apr	19	12	26	52.6	-06	22	53	392.9	Vir
Apr	20	13	11	56.6	-11	51	05	395.1	Vir
Apr	21	13	58	17.0	-16	47	45	397.0	Vir
Apr	22	14	46	28.0	-21	00	40	398.7	Lib
Apr	23	15	36	44.8	-24	17	60	399.9	Lib
Apr	24	16	28	57.5	-26	29	11	400.6	Sco
Apr	25	17	22	30.0	-27	26	17	400.6	Oph
Apr	26	18	16	26.8	-27	05	15	399.8	Sgr
Apr	27	19	09	49.6	-25	26	35	398.1	Sgr
Apr	28	20	01	55.0	-22	34	54	395.4	Sgr
Apr	29	20	52	25.7	-18	37	50	391.9	Cap
Apr	30	21	41	32.8	-13	44	54	387.6	Cap
May	**1**	**22**	**29**	**51.2**	**-08**	**06**	**55**	**382.7**	**Aqr**

GEOCENTRIC POSITION OF MOON (continued)

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (1,000km)	CONST.
May	2	23	18	13.6	-01	56	25	377.7	Psc
May	3	00	07	44.6	+04	31	22	373.0	Psc
May	4	00	59	35.1	+10	57	09	368.9	Psc
May	5	01	54	52.2	+16	56	47	365.9	Ari
May	6	02	54	20.1	+22	01	43	364.3	Ari
May	7	03	57	51.2	+25	42	26	364.1	Tau
May	8	05	04	00.6	+27	35	10	365.5	Tau
May	9	06	10	16.5	+27	29	36	368.1	Gem
May	10	07	13	57.8	+25	32	27	371.6	Gem
May	11	08	13	18.9	+22	03	31	375.7	Cnc
May	12	09	07	53.2	+17	27	47	380.0	Cnc
May	13	09	58	13.9	+12	08	54	384.2	Leo
May	14	10	45	23.4	+06	26	29	388.0	Leo
May	15	11	30	32.9	+00	36	10	391.3	Leo
May	16	12	14	51.6	-05	09	13	394.1	Vir
May	17	12	59	22.7	-10	38	10	396.2	Vir
May	18	13	45	00.4	-15	39	27	397.9	Vir
May	19	14	32	26.9	-20	01	30	399.1	Lib
May	20	15	22	05.6	-23	32	22	399.8	Lib
May	21	16	13	54.7	-26	00	36	400.1	Sco
May	22	17	07	22.4	-27	16	43	400.0	Oph
May	23	18	01	31.7	-27	15	05	399.3	Sgr
May	24	18	55	16.3	-25	55	07	398.1	Sgr
May	25	19	47	41.1	-23	21	15	396.3	Sgr
May	26	20	38	17.6	-19	41	37	393.8	Cap
May	27	21	27	08.8	-15	06	25	390.6	Cap
May	28	22	14	44.3	-09	46	40	386.8	Aqr
May	29	23	01	54.0	-03	53	59	382.5	Aqr
May	30	23	49	41.5	+02	18	47	377.9	Psc
May	31	00	39	19.6	+08	36	15	373.4	Psc
June	**1**	**01**	**32**	**03.6**	**+14**	**38**	**51**	**369.4**	**Psc**
Jun	2	02	28	58.2	+20	01	52	366.1	Ari
Jun	3	03	30	32.0	+24	16	23	364.1	Tau
Jun	4	04	36	03.8	+26	53	52	363.6	Tau
Jun	5	05	43	25.9	+27	34	38	364.6	Tau
Jun	6	06	49	39.5	+26	15	39	367.1	Gem
Jun	7	07	52	11.5	+23	11	41	370.7	Gem
Jun	8	08	49	49.0	+18	48	18	375.2	Cnc
Jun	9	09	42	38.4	+13	32	52	380.0	Leo
Jun	10	10	31	33.9	+07	49	05	384.9	Leo
Jun	11	11	17	48.2	+01	55	27	389.3	Leo
Jun	12	12	02	35.4	-03	53	51	393.1	Vir
Jun	13	12	47	04.6	-09	27	15	396.2	Vir
Jun	14	13	32	17.0	-14	34	24	398.4	Vir
Jun	15	14	19	02.6	-19	04	48	399.7	Vir
Jun	16	15	07	55.5	-22	47	29	400.3	Lib
Jun	17	15	59	06.1	-25	31	08	400.2	Sco
Jun	18	16	52	14.7	-27	05	25	399.6	Sco
Jun	19	17	46	31.3	-27	22	57	398.6	Sgr
Jun	20	18	40	47.9	-26	21	06	397.1	Sgr
Jun	21	19	33	58.9	-24	02	49	395.3	Sgr
Jun	22	20	25	21.7	-20	35	55	393.2	Cap
Jun	23	21	14	45.5	-16	11	13	390.8	Cap
Jun	24	22	02	29.6	-11	00	57	388.0	Aqr
Jun	25	22	49	16.4	-05	17	37	384.8	Aqr
Jun	26	23	36	04.2	+00	45	51	381.4	Psc
Jun	27	00	24	01.7	+06	55	28	377.8	Psc
Jun	28	01	14	23.4	+12	54	48	374.2	Psc
Jun	29	02	08	20.7	+18	23	34	370.9	Ari
Jun	30	03	06	44.8	+22	57	13	368.2	Ari
July	**1**	**04**	**09**	**37.2**	**+26**	**08**	**39**	**366.3**	**Tau**

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (1,000km)	CONST.
Jul	2	05	15	40.7	+27	34	04	365.7	Tau
Jul	3	06	22	23.6	+27	01	08	366.4	Gem
Jul	4	07	26	55.1	+24	34	50	368.4	Gem
Jul	5	08	27	16.4	+20	35	17	371.7	Cnc
Jul	6	09	22	51.3	+15	29	57	375.9	Leo
Jul	7	10	14	08.5	+09	45	52	380.7	Leo
Jul	8	11	02	10.3	+03	45	40	385.6	Leo
Jul	9	11	48	09.0	-02	13	10	390.2	Vir
Jul	10	12	33	15.5	-07	57	10	394.3	Vir
Jul	11	13	18	34.0	-13	15	20	397.4	Vir
Jul	12	14	04	59.7	-17	57	38	399.6	Vir
Jul	13	14	53	14.2	-21	54	02	400.8	Lib
Jul	14	15	43	39.3	-24	54	09	400.9	Lib
Jul	15	16	36	10.0	-26	47	52	400.1	Sco
Jul	16	17	30	10.7	-27	26	53	398.6	Oph
Jul	17	18	24	41.4	-26	46	34	396.6	Sgr
Jul	18	19	18	35.4	-24	47	28	394.1	Sgr
Jul	19	20	10	59.7	-21	35	30	391.5	Cap
Jul	20	21	01	29.4	-17	20	48	388.8	Cap
Jul	21	21	50	10.7	-12	16	01	386.1	Cap
Jul	22	22	37	35.3	-06	34	59	383.5	Aqr
Jul	23	23	24	33.2	-00	31	60	381.0	Psc
Jul	24	00	12	06.0	+05	38	02	378.5	Psc
Jul	25	01	01	22.3	+11	38	58	376.2	Psc
Jul	26	01	53	30.4	+17	12	25	374.0	Ari
Jul	27	02	49	25.9	+21	57	07	372.0	Ari
Jul	28	03	49	30.5	+25	29	33	370.5	Tau
Jul	29	04	53	05.0	+27	27	12	369.6	Tau
Jul	30	05	58	20.0	+27	34	37	369.4	Tau
Jul	31	07	02	45.1	+25	49	27	370.3	Gem
August	**1**	**08**	**04**	**08.9**	**+22**	**24**	**03**	**372.1**	**Cnc**
Aug	2	09	01	23.9	+17	41	06	375.0	Cnc
Aug	3	09	54	29.7	+12	06	53	378.7	Leo
Aug	4	10	44	09.8	+06	06	00	382.9	Sex
Aug	5	11	31	26.7	-00	00	54	387.4	Leo
Aug	6	12	17	26.7	-05	57	23	391.8	Vir
Aug	7	13	03	12.8	-11	30	17	395.6	Vir
Aug	8	13	49	40.0	-16	28	31	398.7	Vir
Aug	9	14	37	32.6	-20	42	00	400.8	Lib
Aug	10	15	27	18.3	-24	00	58	401.7	Lib
Aug	11	16	19	02.3	-26	16	03	401.4	Sco
Aug	12	17	12	23.2	-27	19	02	400.1	Oph
Aug	13	18	06	34.8	-27	04	22	397.8	Sgr
Aug	14	19	00	38.2	-25	30	34	394.8	Sgr
Aug	15	19	53	39.8	-22	40	58	391.3	Sgr
Aug	16	20	45	07.2	-18	43	21	387.6	Cap
Aug	17	21	34	55.6	-13	48	59	383.9	Cap
Aug	18	22	23	26.3	-08	11	27	380.6	Aqr
Aug	19	23	11	20.4	-02	05	55	377.7	Psc
Aug	20	23	59	32.4	+04	11	10	375.4	Psc
Aug	21	00	49	04.2	+10	22	03	373.7	Psc
Aug	22	01	40	58.2	+16	07	21	372.5	Psc
Aug	23	02	36	06.4	+21	05	58	371.8	Ari
Aug	24	03	34	52.9	+24	55	49	371.6	Tau
Aug	25	04	36	51.9	+27	16	14	371.7	Tau
Aug	26	05	40	37.5	+27	52	28	372.3	Tau
Aug	27	06	44	02.5	+26	40	15	373.3	Gem
Aug	28	07	45	05.8	+23	47	47	374.9	Gem
Aug	29	08	42	34.3	+19	33	03	377.1	Cnc
Aug	30	09	36	14.2	+14	18	52	379.8	Leo
Aug	31	10	26	35.8	+08	28	27	383.1	Leo

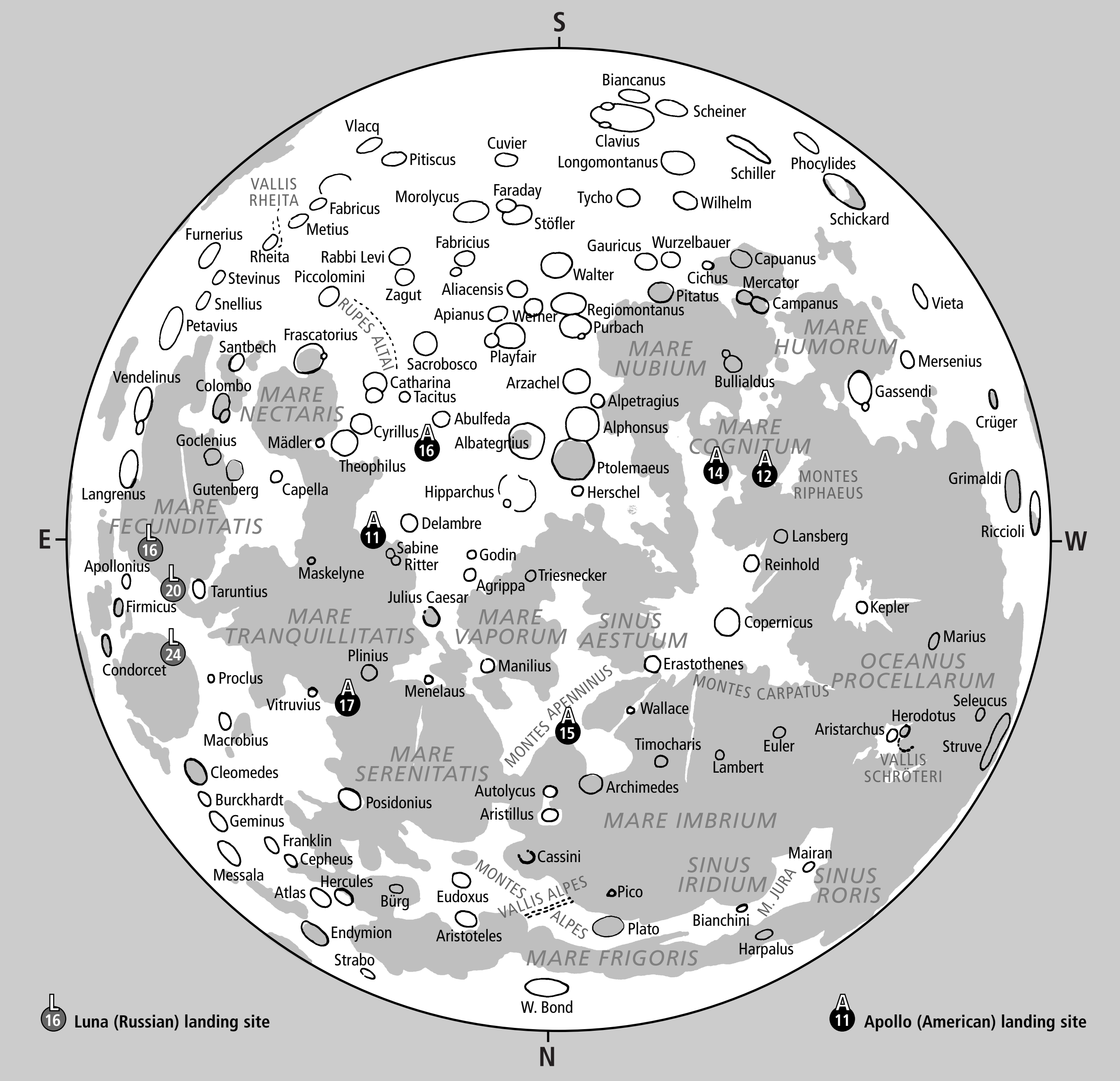
GEOCENTRIC POSITION OF MOON (continued)

Note: positions refer to 0000 WAST

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (1,000km)	CONST.
September	**1**	**11**	**14**	**32.1**	**+02**	**22**	**49**	**386.8**	**Leo**
Sep	2	12	01	03.4	-03	39	60	390.7	Vir
Sep	3	12	47	08.4	-09	24	46	394.5	Vir
Sep	4	13	33	39.6	-14	38	35	397.9	Vir
Sep	5	14	21	19.7	-19	10	04	400.6	Vir
Sep	6	15	10	36.7	-22	48	59	402.5	Lib
Sep	7	16	01	39.4	-25	26	03	403.2	Sco
Sep	8	16	54	13.5	-26	53	25	402.6	Oph
Sep	9	17	47	42.7	-27	05	36	400.9	Sgr
Sep	10	18	41	17.4	-26	00	23	398.0	Sgr
Sep	11	19	34	10.0	-23	39	24	394.2	Sgr
Sep	12	20	25	48.3	-20	08	04	389.7	Cap
Sep	13	21	16	03.8	-15	34	58	384.8	Cap
Sep	14	22	05	12.5	-10	11	23	380.0	Aqr
Sep	15	22	53	49.9	-04	10	58	375.6	Aqr
Sep	16	23	42	46.1	+02	10	12	371.9	Psc
Sep	17	00	32	59.9	+08	33	25	369.1	Psc
Sep	18	01	25	31.3	+14	37	19	367.5	Psc
Sep	19	02	21	10.7	+19	58	21	367.0	Ari
Sep	20	03	20	20.9	+24	12	14	367.4	Ari
Sep	21	04	22	35.4	+26	56	57	368.7	Tau
Sep	22	05	26	29.3	+27	57	22	370.7	Tau
Sep	23	06	29	57.2	+27	09	20	373.0	Gem
Sep	24	07	31	00.3	+24	40	54	375.7	Gem
Sep	25	08	28	27.0	+20	49	10	378.6	Cnc
Sep	26	09	22	03.9	+15	55	20	381.7	Leo
Sep	27	10	12	21.0	+10	20	46	384.9	Leo
Sep	28	11	00	10.6	+04	25	03	388.2	Leo
Sep	29	11	46	32.4	-01	34	31	391.6	Vir
Sep	30	12	32	24.5	-07	22	39	395.0	Vir
October	**1**	**13**	**18**	**38.6**	**-12**	**45**	**35**	**398.2**	**Vir**
Oct	2	14	05	56.5	-17	30	50	401.0	Vir
Oct	3	14	54	45.9	-21	26	57	403.3	Lib
Oct	4	15	45	15.4	-24	23	50	404.8	Lib
Oct	5	16	37	11.7	-26	13	15	405.3	Sco
Oct	6	17	30	00.4	-26	49	36	404.7	Oph
Oct	7	18	22	54.9	-26	10	41	402.8	Sgr
Oct	8	19	15	09.9	-24	17	52	399.7	Sgr
Oct	9	20	06	14.7	-21	15	41	395.4	Sgr
Oct	10	20	56	01.1	-17	11	02	390.2	Cap
Oct	11	21	44	44.1	-12	12	44	384.5	Cap
Oct	12	22	32	58.8	-06	31	22	378.5	Aqr
Oct	13	23	21	35.3	-00	19	54	372.8	Psc
Oct	14	00	11	34.3	+06	05	21	367.8	Psc
Oct	15	01	04	00.9	+12	23	53	363.9	Psc
Oct	16	01	59	54.0	+18	10	46	361.5	Ari
Oct	17	02	59	46.7	+22	57	57	360.7	Ari
Oct	18	04	03	20.0	+26	18	06	361.5	Tau
Oct	19	05	09	04.2	+27	50	45	363.7	Tau
Oct	20	06	14	35.5	+27	28	38	367.0	Gem
Oct	21	07	17	30.3	+25	19	34	371.0	Gem
Oct	22	08	16	20.1	+21	42	34	375.4	Cnc
Oct	23	09	10	46.7	+17	00	56	379.9	Cnc
Oct	24	10	01	23.7	+11	37	07	384.3	Leo
Oct	25	10	49	10.3	+05	50	30	388.5	Sex
Oct	26	11	35	12.5	-00	02	33	392.4	Leo
Oct	27	12	20	33.9	-05	47	53	395.9	Vir
Oct	28	13	06	10.6	-11	12	37	399.2	Vir
Oct	29	13	52	48.5	-16	04	30	402.0	Vir
Oct	30	14	40	58.8	-20	11	47	404.4	Lib
Oct	31	15	30	52.9	-23	23	31	406.3	Lib

MONTH	DAY	RA h	RA m	RA s	DECLINATION °	DECLINATION ′	DECLINATION ″	DISTANCE (1,000km)	CONST.
November	**1**	**16**	**22**	**19.1**	**-25**	**30**	**28**	**407.4**	**Sco**
Nov	2	17	14	42.2	-26	26	12	407.7	Oph
Nov	3	18	07	12.5	-26	08	04	407.0	Sgr
Nov	4	18	58	59.9	-24	37	25	405.2	Sgr
Nov	5	19	49	28.9	-21	59	01	402.2	Sgr
Nov	6	20	38	27.6	-18	19	52	398.0	Cap
Nov	7	21	26	08.4	-13	48	08	392.8	Aqr
Nov	8	22	13	05.3	-08	32	42	386.7	Aqr
Nov	9	23	00	08.7	-02	43	31	380.1	Psc
Nov	10	23	48	21.4	+03	27	16	373.4	Psc
Nov	11	00	38	55.1	+09	43	46	367.1	Psc
Nov	12	01	33	02.8	+15	44	40	361.8	Psc
Nov	13	02	31	43.6	+21	02	43	358.0	Ari
Nov	14	03	35	12.6	+25	06	34	356.0	Tau
Nov	15	04	42	26.1	+27	27	01	356.0	Tau
Nov	16	05	50	54.0	+27	46	32	358.0	Tau
Nov	17	06	57	30.4	+26	06	16	361.6	Gem
Nov	18	07	59	54.4	+22	44	41	366.5	Gem
Nov	19	08	57	13.6	+18	08	56	372.1	Cnc
Nov	20	09	49	51.1	+12	46	10	378.0	Leo
Nov	21	10	38	49.6	+06	59	09	383.9	Leo
Nov	22	11	25	23.9	+01	05	45	389.3	Leo
Nov	23	12	10	46.5	-04	39	58	394.2	Vir
Nov	24	12	56	02.2	-10	06	03	398.4	Vir
Nov	25	13	42	04.5	-15	01	27	402.0	Vir
Nov	26	14	29	32.5	-19	15	21	404.8	Lib
Nov	27	15	18	46.1	-22	37	08	407.0	Lib
Nov	28	16	09	40.3	-24	57	07	408.5	Sco
Nov	29	17	01	44.5	-26	07	54	409.3	Oph
Nov	30	17	54	07.9	-26	05	41	409.4	Sgr
December	**1**	**18**	**45**	**54.2**	**-24**	**51**	**07**	**408.7**	**Sgr**
Dec	2	19	36	18.5	-22	28	57	407.0	Sgr
Dec	3	20	24	58.9	-19	06	44	404.4	Cap
Dec	4	21	11	60.0	-14	53	23	400.6	Cap
Dec	5	21	57	49.6	-09	58	11	395.9	Cap
Dec	6	22	43	13.5	-04	30	25	390.2	Aqr
Dec	7	23	29	11.1	+01	19	57	383.7	Psc
Dec	8	00	16	52.7	+07	21	04	376.8	Psc
Dec	9	01	07	36.6	+13	17	21	370.0	Psc
Dec	10	02	02	39.7	+18	47	36	363.7	Ari
Dec	11	03	02	57.7	+23	24	10	358.5	Ari
Dec	12	04	08	27.8	+26	35	20	354.9	Tau
Dec	13	05	17	32.2	+27	52	58	353.4	Tau
Dec	14	06	27	04.9	+27	03	42	354.1	Gem
Dec	15	07	33	47.9	+24	15	30	356.8	Gem
Dec	16	08	35	37.5	+19	53	44	361.4	Cnc
Dec	17	09	32	09.5	+14	30	13	367.3	Leo
Dec	18	10	24	09.0	+08	34	17	373.9	Leo
Dec	19	11	12	50.5	+02	29	06	380.7	Leo
Dec	20	11	59	33.2	-03	28	06	387.2	Vir
Dec	21	12	45	29.7	-09	04	14	393.1	Vir
Dec	22	13	31	41.8	-14	08	37	398.3	Vir
Dec	23	14	18	57.1	-18	31	27	402.4	Vir
Dec	24	15	07	45.2	-22	03	16	405.6	Lib
Dec	25	15	58	12.3	-24	35	05	407.9	Sco
Dec	26	16	49	58.0	-25	59	21	409.3	Sco
Dec	27	17	42	18.2	-26	11	28	409.9	Oph
Dec	28	18	34	17.0	-25	10	52	409.7	Sgr
Dec	29	19	25	03.2	-23	01	22	408.8	Sgr
Dec	30	20	14	04.8	-19	50	20	407.2	Cap
Dec	31	21	01	15.5	-15	47	18	404.8	Cap

MAP OF THE MOON



MOON PHASES Note: all times in WAST

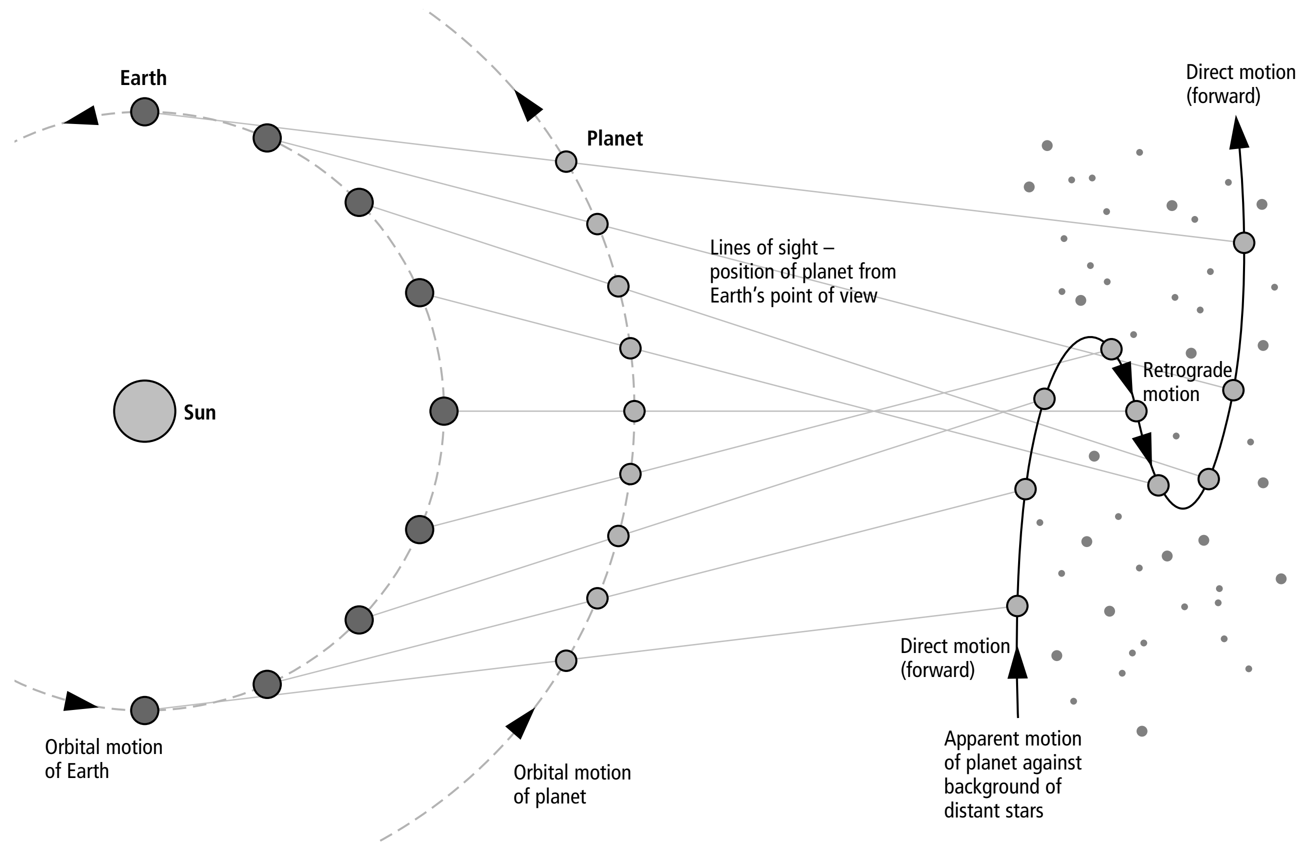
Lunation	NEW MOON Month	d	h m	FIRST QUARTER Month	d	h m	FULL MOON Month	d	h m	LAST QUARTER Month	d	h m
1052	Jan	8	19 37	Jan	16	03 46	Jan	22	21 34	Jan	30	13 03
1053	Feb	7	11 44	Feb	14	11 33	Feb	21	11 30	Feb	29	10 18
1054	Mar	8	01 14	Mar	14	18 45	Mar	22	02 40	Mar	30	05 47
1055	Apr	6	11 55	Apr	13	02 32	Apr	20	18 25	Apr	28	22 12
1056	May	5	20 18	May	12	11 47	May	20	10 11	May	28	10 56
1057	Jun	4	03 22	Jun	10	23 03	Jun	19	01 30	Jun	26	20 10
1058	Jul	3	10 18	Jul	10	12 35	Jul	18	15 59	Jul	26	02 41
1059	Aug	1	18 12	Aug	9	04 20	Aug	17	05 16	Aug	24	07 49
1060	Aug	31	03 58	Sep	7	22 04	Sep	15	17 13	Sep	22	13 04
1061	Sep	29	16 12	Oct	7	17 04	Oct	15	04 02	Oct	21	19 55
1062	Oct	29	07 14	Nov	6	12 03	Nov	13	14 17	Nov	20	05 31
1063	Nov	28	00 54	Dec	6	05 25	Dec	13	00 37	Dec	19	18 29
1064	Dec	27	20 22									

Moon Facts

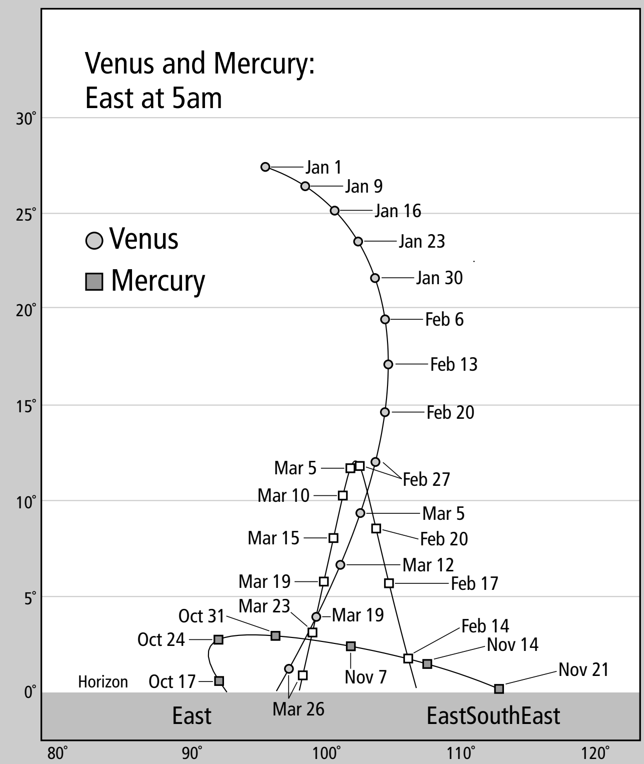
1. The Moon was probably created when an object the size of Mars crashed into Earth, shortly after the Solar System began forming about 4.5 billion years ago.
2. The Moon always shows us the same face. Long ago, the Earth’s gravity slowed the Moon’s rotation about its axis. Once the Moon’s rotation slowed enough to match its orbital period (the time it takes the Moon to go around Earth) the effect steadied. Many of the innermost moons around other planets behave similarly.
3. The Moon’s heavily cratered surface is the result of intense bombardment by space rocks between 4.3 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. 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.
5. 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 so that the day lengthens by about 1.5 milliseconds every century.
6. 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 so that the day lengthens by about 1.5 milliseconds every century.
7. 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.
8. The Moon is moving away from the Earth. Each year, the Moon ‘steals’ 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 22,500 km from Earth, but it’s now more than 380,000 km away.
9. The Moon’s orbit lies approximately in the same plane as the Earth’s about the Sun. At Last Quarter phase the Moon’s orbital position is at its furthest ahead of the Earth. The location of the Moon is also within about 5° of the direction that the Earth is heading at that time.

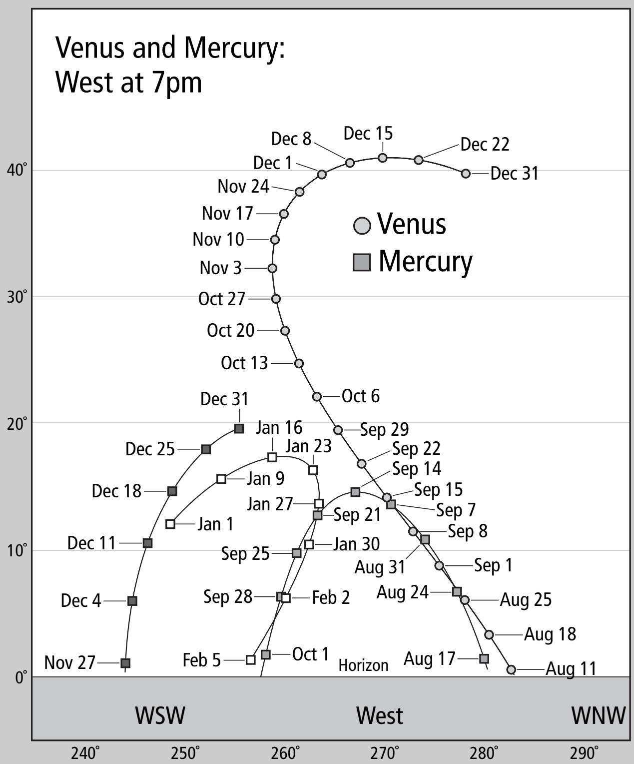
The Wandering Planets

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

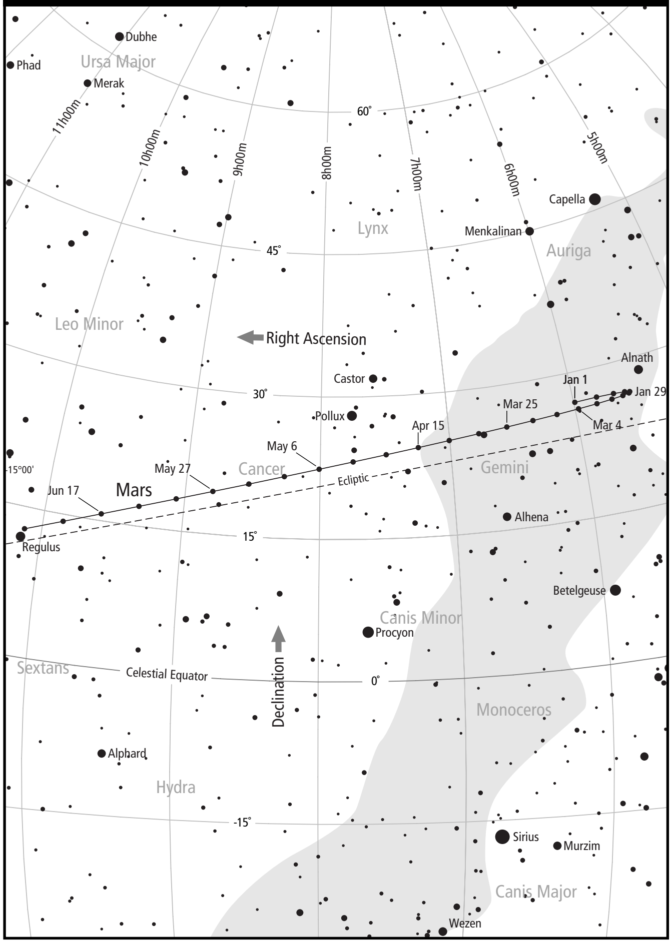


VENUS AND MERCURY 2008

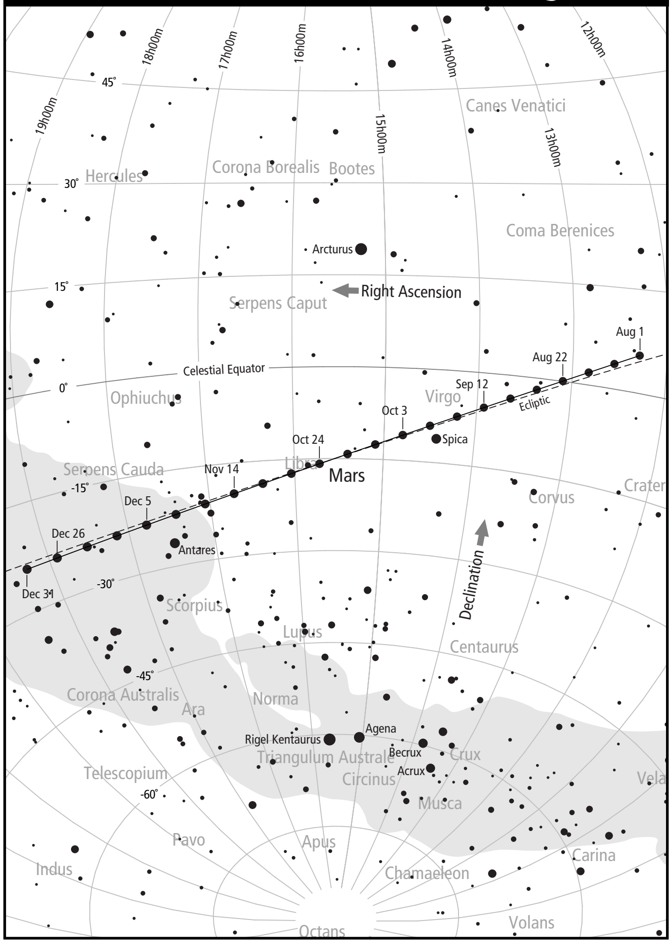




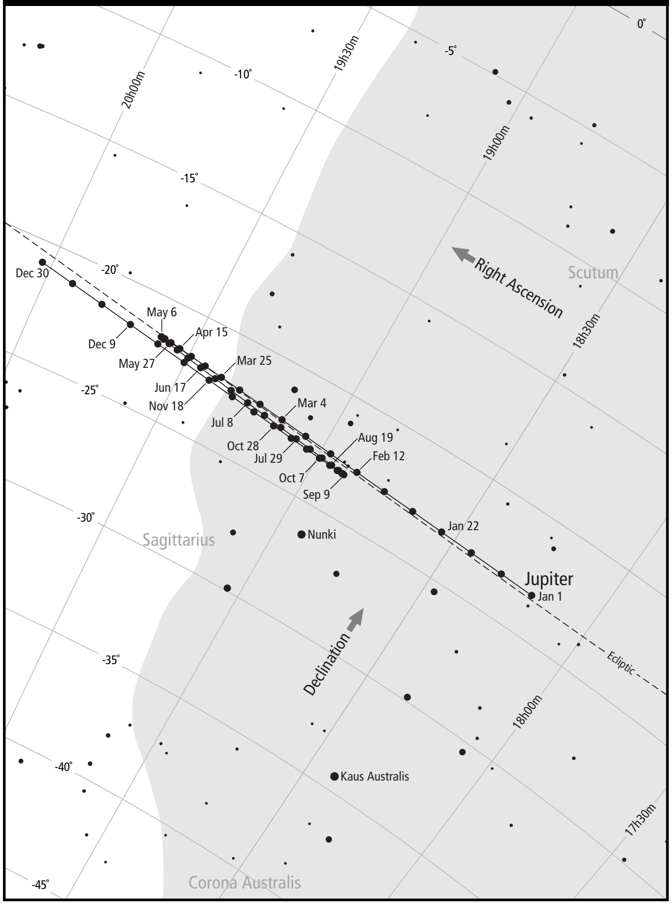
PLANET FINDER: MARS 2008 Jan-Jul



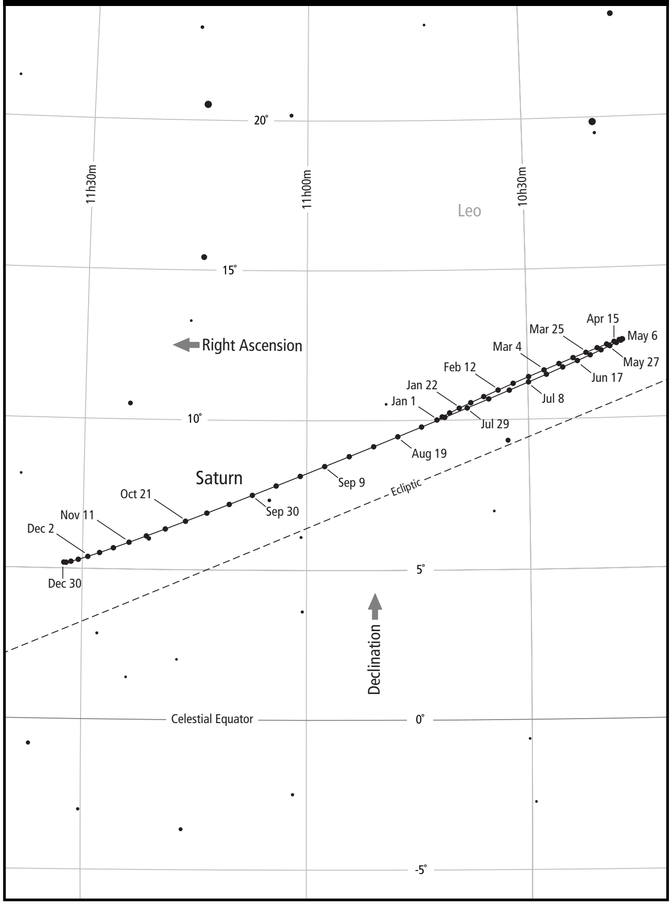
PLANET FINDER: MARS 2008 Aug-Dec



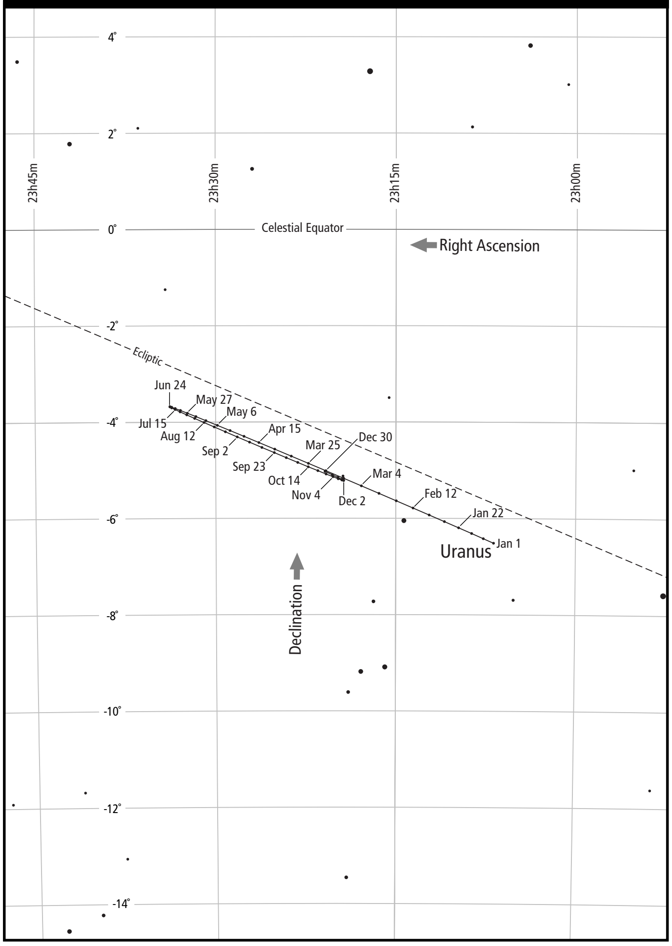
PLANET FINDER: JUPITER 2008



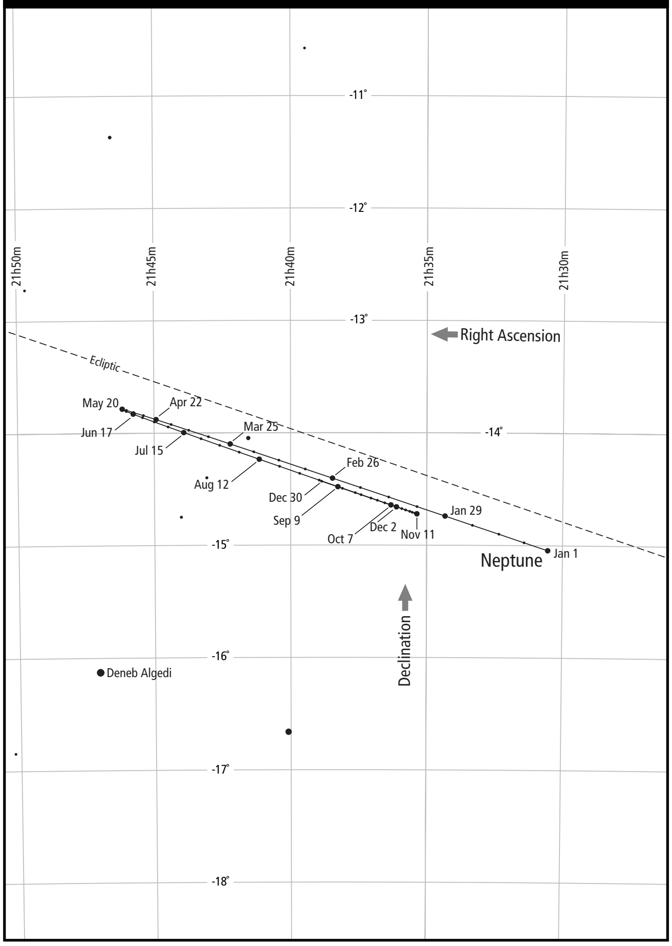
PLANET FINDER: SATURN 2008



PLANET FINDER: URANUS 2008



PLANET FINDER: NEPTUNE 2008



GEOCENTRIC PLANET POSITIONS (EPOCH J2000.0) Note: positions refer to 0000 WAST

MTH	DAY	MERCURY				VENUS				MARS				JUPITER			
		RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.
Jan	1	19 17 36.8	-24 23 19	1.38	Sgr	15 57 12.9	-18 21 13	1.15	Lib	05 59 27.7	+26 56 14	0.61	Tau	18 12 19.5	-23 14 17	6.22	Sgr
Jan	2	19 24 40.9	-24 10 44	1.37	Sgr	16 02 11.7	-18 37 23	1.15	Lib	05 57 50.6	+26 57 03	0.61	Tau	18 13 19.2	-23 14 04	6.22	Sgr
Jan	3	19 31 44.0	-23 56 35	1.35	Sgr	16 07 11.7	-18 53 05	1.16	Sco	05 56 15.4	+26 57 42	0.61	Tau	18 14 18.9	-23 13 50	6.22	Sgr
Jan	4	19 38 45.7	-23 40 53	1.34	Sgr	16 12 12.8	-19 08 18	1.17	Sco	05 54 42.4	+26 58 13	0.62	Tau	18 15 18.5	-23 13 34	6.22	Sgr
Jan	5	19 45 45.7	-23 23 37	1.33	Sgr	16 17 15.1	-19 23 02	1.17	Sco	05 53 11.7	+26 58 35	0.62	Tau	18 16 18.1	-23 13 17	6.21	Sgr
Jan	6	19 52 43.5	-23 04 49	1.32	Sgr	16 22 18.5	-19 37 16	1.18	Sco	05 51 43.6	+26 58 49	0.62	Tau	18 17 17.6	-23 12 58	6.21	Sgr
Jan	7	19 59 38.7	-22 44 29	1.30	Sgr	16 27 23.1	-19 51 00	1.19	Oph	05 50 18.1	+26 58 55	0.63	Tau	18 18 17.0	-23 12 38	6.21	Sgr
Jan	8	20 06 30.6	-22 22 37	1.29	Sgr	16 32 28.7	-20 04 13	1.19	Oph	05 48 55.4	+26 58 54	0.63	Tau	18 19 16.4	-23 12 17	6.20	Sgr
Jan	9	20 13 18.8	-21 59 17	1.27	Cap	16 37 35.4	-20 16 54	1.20	Oph	05 47 35.6	+26 58 46	0.63	Tau	18 20 15.6	-23 11 54	6.20	Sgr
Jan	10	20 20 02.6	-21 34 29	1.26	Cap	16 42 43.1	-20 29 03	1.20	Oph	05 46 19.0	+26 58 32	0.64	Tau	18 21 14.8	-23 11 30	6.19	Sgr
Jan	11	20 26 41.1	-21 08 16	1.24	Cap	16 47 51.8	-20 40 38	1.21	Oph	05 45 05.4	+26 58 11	0.64	Tau	18 22 13.8	-23 11 05	6.19	Sgr
Jan	12	20 33 13.5	-20 40 43	1.22	Cap	16 53 01.5	-20 51 40	1.22	Oph	05 43 55.2	+26 57 46	0.65	Tau	18 23 12.8	-23 10 38	6.19	Sgr
Jan	13	20 39 38.8	-20 11 52	1.20	Cap	16 58 12.1	-21 02 07	1.22	Oph	05 42 48.4	+26 57 15	0.65	Tau	18 24 11.6	-23 10 10	6.18	Sgr
Jan	14	20 45 55.9	-19 41 51	1.18	Cap	17 03 23.5	-21 12 00	1.23	Oph	05 41 45.0	+26 56 39	0.66	Tau	18 25 10.3	-23 09 40	6.18	Sgr
Jan	15	20 52 03.6	-19 10 45	1.16	Cap	17 08 35.9	-21 21 18	1.24	Oph	05 40 45.1	+26 55 60	0.66	Tau	18 26 08.8	-23 09 10	6.17	Sgr
Jan	16	20 58 00.3	-18 38 41	1.14	Cap	17 13 49.0	-21 30 00	1.24	Oph	05 39 48.8	+26 55 17	0.67	Tau	18 27 07.3	-23 08 38	6.17	Sgr
Jan	17	21 03 44.5	-18 05 50	1.11	Cap	17 19 02.9	-21 38 06	1.25	Oph	05 38 56.0	+26 54 30	0.67	Tau	18 28 05.6	-23 08 04	6.16	Sgr
Jan	18	21 09 14.4	-17 32 22	1.09	Cap	17 24 17.5	-21 45 35	1.25	Oph	05 38 07.0	+26 53 41	0.68	Tau	18 29 03.7	-23 07 30	6.15	Sgr
Jan	19	21 14 27.8	-16 58 31	1.06	Cap	17 29 32.8	-21 52 27	1.26	Oph	05 37 21.5	+26 52 49	0.69	Tau	18 30 01.7	-23 06 54	6.15	Sgr
Jan	20	21 19 22.7	-16 24 30	1.04	Cap	17 34 48.7	-21 58 42	1.27	Oph	05 36 39.8	+26 51 55	0.69	Tau	18 30 59.5	-23 06 17	6.14	Sgr
Jan	21	21 23 56.5	-15 50 37	1.01	Cap	17 40 05.2	-22 04 19	1.27	Oph	05 36 01.6	+26 50 60	0.70	Tau	18 31 57.2	-23 05 39	6.14	Sgr
Jan	22	21 28 06.6	-15 17 10	0.99	Cap	17 45 22.3	-22 09 18	1.28	Sgr	05 35 27.2	+26 50 03	0.70	Tau	18 32 54.7	-23 04 59	6.13	Sgr
Jan	23	21 31 50.2	-14 44 31	0.96	Cap	17 50 39.9	-22 13 38	1.28	Sgr	05 34 56.4	+26 49 05	0.71	Tau	18 33 52.0	-23 04 19	6.12	Sgr
Jan	24	21 35 04.4	-14 13 03	0.93	Cap	17 55 57.9	-22 17 20	1.29	Sgr	05 34 29.2	+26 48 06	0.72	Tau	18 34 49.1	-23 03 37	6.12	Sgr
Jan	25	21 37 46.1	-13 43 11	0.90	Cap	18 01 16.4	-22 20 22	1.29	Sgr	05 34 05.7	+26 47 06	0.72	Tau	18 35 46.1	-23 02 54	6.11	Sgr
Jan	26	21 39 52.6	-13 15 19	0.88	Cap	18 06 35.2	-22 22 45	1.30	Sgr	05 33 45.7	+26 46 07	0.73	Tau	18 36 42.8	-23 02 10	6.10	Sgr
Jan	27	21 41 21.1	-12 49 55	0.85	Cap	18 11 54.2	-22 24 29	1.31	Sgr	05 33 29.3	+26 45 07	0.74	Tau	18 37 39.3	-23 01 25	6.09	Sgr
Jan	28	21 42 09.2	-12 27 25	0.82	Cap	18 17 13.6	-22 25 33	1.31	Sgr	05 33 16.5	+26 44 07	0.75	Tau	18 38 35.7	-23 00 39	6.09	Sgr
Jan	29	21 42 15.1	-12 08 12	0.80	Cap	18 22 33.1	-22 25 57	1.32	Sgr	05 33 07.1	+26 43 08	0.75	Tau	18 39 31.8	-22 59 52	6.08	Sgr
Jan	30	21 41 37.7	-11 52 40	0.77	Cap	18 27 52.7	-22 25 41	1.32	Sgr	05 33 01.3	+26 42 09	0.76	Tau	18 40 27.7	-22 59 04	6.07	Sgr
Jan	31	21 40 17.0	-11 41 04	0.75	Cap	18 33 12.4	-22 24 46	1.33	Sgr	05 32 58.8	+26 41 11	0.77	Tau	18 41 23.4	-22 58 14	6.06	Sgr
Feb	1	21 38 13.8	-11 33 39	0.73	Cap	18 38 32.1	-22 23 10	1.33	Sgr	05 32 59.8	+26 40 13	0.78	Tau	18 42 18.9	-22 57 24	6.05	Sgr
Feb	2	21 35 30.5	-11 30 29	0.71	Cap	18 43 51.8	-22 20 54	1.34	Sgr	05 33 04.1	+26 39 16	0.78	Tau	18 43 14.1	-22 56 33	6.04	Sgr
Feb	3	21 32 10.8	-11 31 33	0.70	Cap	18 49 11.4	-22 17 58	1.34	Sgr	05 33 11.8	+26 38 20	0.79	Tau	18 44 09.0	-22 55 41	6.04	Sgr
Feb	4	21 28 19.5	-11 36 42	0.68	Cap	18 54 30.8	-22 14 22	1.35	Sgr	05 33 22.7	+26 37 25	0.80	Tau	18 45 03.7	-22 54 48	6.03	Sgr
Feb	5	21 24 02.8	-11 45 37	0.67	Aqr	18 59 50.0	-22 10 06	1.36	Sgr	05 33 36.9	+26 36 31	0.81	Tau	18 45 58.2	-22 53 54	6.02	Sgr
Feb	6	21 19 27.9	-11 57 54	0.66	Aqr	19 05 08.9	-22 05 11	1.36	Sgr	05 33 54.3	+26 35 38	0.82	Tau	18 46 52.4	-22 52 59	6.01	Sgr
Feb	7	21 14 42.5	-12 13 03	0.65	Aqr	19 10 27.5	-21 59 35	1.37	Sgr	05 34 14.8	+26 34 46	0.82	Tau	18 47 46.3	-22 52 03	6.00	Sgr
Feb	8	21 09 54.5	-12 30 30	0.65	Aqr	19 15 45.7	-21 53 21	1.37	Sgr	05 34 38.3	+26 33 54	0.83	Tau	18 48 39.9	-22 51 06	5.99	Sgr
Feb	9	21 05 11.6	-12 49 41	0.65	Aqr	19 21 03.4	-21 46 27	1.38	Sgr	05 35 05.0	+26 33 04	0.84	Tau	18 49 33.2	-22 50 09	5.98	Sgr
Feb	10	21 00 40.9	-13 09 60	0.65	Aqr	19 26 20.7	-21 38 54	1.38	Sgr	05 35 34.6	+26 32 14	0.85	Tau	18 50 26.3	-22 49 11	5.97	Sgr
Feb	11	20 56 28.5	-13 30 54	0.65	Aqr	19 31 37.4	-21 30 42	1.39	Sgr	05 36 07.1	+26 31 25	0.86	Tau	18 51 19.0	-22 48 12	5.96	Sgr
Feb	12	20 52 39.4	-13 51 54	0.66	Aqr	19 36 53.6	-21 21 52	1.39	Sgr	05 36 42.5	+26 30 37	0.87	Tau	18 52 11.4	-22 47 12	5.95	Sgr
Feb	13	20 49 17.4	-14 12 36	0.67	Aqr	19 42 09.1	-21 12 24	1.40	Sgr	05 37 20.7	+26 29 49	0.87	Tau	18 53 03.5	-22 46 12	5.94	Sgr
Feb	14	20 46 25.4	-14 32 38	0.67	Aqr	19 47 23.9	-21 02 18	1.40	Sgr	05 38 01.7	+26 29 02	0.88	Tau	18 53 55.3	-22 45 11	5.93	Sgr
Feb	15	20 44 04.9	-14 51 44	0.68	Cap	19 52 38.1	-20 51 35	1.41	Sgr	05 38 45.4	+26 28 15	0.89	Tau	18 54 46.8	-22 44 10	5.92	Sgr
Feb	16	20 42 16.6	-15 09 41	0.70	Cap	19 57 51.4	-20 40 14	1.41	Sgr	05 39 31.7	+26 27 29	0.90	Tau	18 55 37.9	-22 43 07	5.90	Sgr
Feb	17	20 41 00.4	-15 26 19	0.71	Cap	20 03 04.0	-20 28 17	1.42	Sgr	05 40 20.5	+26 26 43	0.91	Tau	18 56 28.6	-22 42 05	5.89	Sgr
Feb	18	20 40 15.6	-15 41 32	0.72	Cap	20 08 15.8	-20 15 45	1.42	Cap	05 41 11.9	+26 25 56	0.92	Tau	18 57 19.1	-22 41 01	5.88	Sgr
Feb	19	20 40 01.3	-15 55 14	0.74	Cap	20 13 26.7	-20 02 36	1.43	Cap	05 42 05.6	+26 25 10	0.93	Tau	18 58 09.1	-22 39 58	5.87	Sgr
Feb	20	20 40 15.9	-16 07 22	0.75	Cap	20 18 36.8	-19 48 52	1.43	Cap	05 43 01.8	+26 24 23	0.94	Tau	18 58 58.8	-22 38 54	5.86	Sgr
Feb	21	20 40 57.8	-16 17 54	0.76	Cap	20 23 45.9	-19 34 33	1.44	Cap	05 44 00.3	+26 23 37	0.95	Tau	18 59 48.2	-22 37 49	5.85	Sgr
Feb	22	20 42 05.5	-16 26 50	0.78	Cap	20 28 54.2	-19 19 40	1.44	Cap	05 45 01.1	+26 22 49	0.96	Tau	19 00 37.2	-22 36 44	5.83	Sgr
Feb	23	20 43 37.0	-16 34 09	0.80	Cap	20 34 01.5	-19 04 14	1.45	Cap	05 46 04.0	+26 22 01	0.96	Tau	19 01 25.8	-22 35 38	5.82	Sgr
Feb	24	20 45 30.8	-16 39 52	0.81	Cap	20 39 07.8	-18 48 14	1.45	Cap	05 47 09.1	+26 21 13	0.97	Tau	19 02 14.0	-22 34 33	5.81	Sgr
Feb	25	20 47 45.1	-16 43 58	0.83	Cap	20 44 13.1	-18 31 41	1.46	Cap	05 48 16.4	+26 20 23	0.98	Tau	19 03 01.8	-22 33 27	5.80	Sgr
Feb	26	20 50 18.4	-16 46 29	0.84	Cap	20 49 17.5	-18 14 37	1.46	Cap	05 49 25.7	+26 19 32	0.99	Tau	19 03 49.2	-22 32 20	5.78	Sgr
Feb	27	20 53 09.1	-16 47 25	0.86	Cap	20 54 20.8	-17 57 01	1.47	Cap	05 50 37.0	+26 18 40	1.00	Tau	19 04 36.3	-22 31 14	5.77	Sgr
Feb	28	20 56 15.8	-16 46 48	0.87	Cap	20 59 23.1	-17 38 54	1.47	Cap	05 51 50.3	+26 17 47	1.01	Tau	19 05 22.9	-22 30 07	5.76	Sgr
Feb	29	20 59 37.3	-16 44 38	0.89	Cap	21 04 24.4	-17 20 16	1.48	Cap	05 53 05.5	+26 16 52	1.02	Tau	19 06 09.1	-22 28 60	5.75	Sgr
Mar	1	21 03 12.2	-16 40 57	0.91	Cap	21 09 24.6	-17 01 09	1.48	Cap	05 54 22.6	+26 15 55	1.03	Tau	19 06 54.9	-22 27 52	5.73	Sgr
Mar	2	21 06 59.5	-16 35 45	0.92	Cap	21 14 23.8	-16 41 34	1.49	Cap	05 55 41.5	+26 14 57	1.04	Tau	19 07 40.2	-22 26 45	5.72	Sgr
Mar	3	21 10 58.2	-16 29 04	0.94	Cap	21 19 22.0	-16 21 29	1.49	Cap	05 57 02.2	+26 13 57	1.05	Tau	19 08 25.1	-22 25 38	5.71	Sgr
Mar	4	21 15 07.3	-16 20 55	0.95	Cap	21 24 19.0	-16 00 57	1.49	Cap	05 58 24.7	+26 12 54	1.06	Tau	19 09 09.6	-22 24 30	5.69	Sgr
Mar	5	21 19 26.0	-16 11 19	0.97	Cap	21 29 15.1	-15 39 59	1.50	Cap	05 59 49.0	+26 11 49	1.07	Tau	19 09 53.6	-22 23 23	5.68	Sgr
Mar	6	21 23 53.5	-16 00 16	0.98	Cap	21 34 10.0	-15 18 33	1.50	Cap	06 01 14.9	+26 10 42	1.08	Gem	19 10 37.1	-22 22 15	5.66	Sgr
Mar	7	21 28 29.1	-15 47 49	1.00	Cap	21 39 04.0	-14 56 43	1.51	Cap	06 02 42.4	+26 09 32	1.09	Gem	19 11 20.2	-22 21 08	5.65	Sgr

GEOCENTRIC PLANET POSITIONS (continued) Note: positions refer to 0000 WAST

		MERCURY				VENUS				MARS				JUPITER			
MTH	DAY	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.
Mar	8	21 33 12.1	-15 33 57	1.01	Cap	21 43 56.8	-14 34 27	1.51	Cap	06 04 11.6	+26 08 19	1.10	Gem	19 12 02.8	-22 20 01	5.64	Sgr
Mar	9	21 38 02.0	-15 18 41	1.02	Cap	21 48 48.7	-14 11 47	1.52	Cap	06 05 42.3	+26 07 03	1.11	Gem	19 12 44.9	-22 18 53	5.62	Sgr
Mar	10	21 42 58.3	-15 02 03	1.04	Cap	21 53 39.5	-13 48 44	1.52	Cap	06 07 14.6	+26 05 44	1.12	Gem	19 13 26.6	-22 17 46	5.61	Sgr
Mar	11	21 48 00.5	-14 44 04	1.05	Cap	21 58 29.2	-13 25 18	1.53	Cap	06 08 48.3	+26 04 21	1.13	Gem	19 14 07.7	-22 16 40	5.59	Sgr
Mar	12	21 53 08.1	-14 24 44	1.07	Cap	22 03 18.0	-13 01 30	1.53	Aqr	06 10 23.5	+26 02 55	1.14	Gem	19 14 48.3	-22 15 33	5.58	Sgr
Mar	13	21 58 20.9	-14 04 04	1.08	Cap	22 08 05.8	-12 37 20	1.53	Aqr	06 12 00.2	+26 01 26	1.15	Gem	19 15 28.4	-22 14 27	5.56	Sgr
Mar	14	22 03 38.5	-13 42 05	1.09	Aqr	22 12 52.6	-12 12 50	1.54	Aqr	06 13 38.1	+25 59 53	1.16	Gem	19 16 08.0	-22 13 21	5.55	Sgr
Mar	15	22 09 00.6	-13 18 47	1.11	Aqr	22 17 38.5	-11 48 01	1.54	Aqr	06 15 17.5	+25 58 16	1.17	Gem	19 16 47.1	-22 12 16	5.54	Sgr
Mar	16	22 14 27.0	-12 54 12	1.12	Aqr	22 22 23.4	-11 22 52	1.55	Aqr	06 16 58.1	+25 56 35	1.18	Gem	19 17 25.6	-22 11 11	5.52	Sgr
Mar	17	22 19 57.3	-12 28 20	1.13	Aqr	22 27 07.4	-10 57 24	1.55	Aqr	06 18 39.9	+25 54 50	1.19	Gem	19 18 03.6	-22 10 06	5.51	Sgr
Mar	18	22 25 31.6	-12 01 12	1.14	Aqr	22 31 50.5	-10 31 39	1.55	Aqr	06 20 23.0	+25 53 00	1.20	Gem	19 18 41.1	-22 09 02	5.49	Sgr
Mar	19	22 31 09.5	-11 32 49	1.15	Aqr	22 36 32.8	-10 05 36	1.56	Aqr	06 22 07.2	+25 51 06	1.21	Gem	19 19 18.0	-22 07 59	5.48	Sgr
Mar	20	22 36 51.0	-11 03 11	1.17	Aqr	22 41 14.3	-09 39 17	1.56	Aqr	06 23 52.6	+25 49 08	1.22	Gem	19 19 54.3	-22 06 56	5.46	Sgr
Mar	21	22 42 36.0	-10 32 19	1.18	Aqr	22 45 54.9	-09 12 43	1.57	Aqr	06 25 39.1	+25 47 05	1.23	Gem	19 20 30.1	-22 05 53	5.44	Sgr
Mar	22	22 48 24.4	-10 00 13	1.19	Aqr	22 50 34.8	-08 45 53	1.57	Aqr	06 27 26.7	+25 44 57	1.24	Gem	19 21 05.4	-22 04 51	5.43	Sgr
Mar	23	22 54 16.1	-09 26 55	1.20	Aqr	22 55 13.9	-08 18 50	1.57	Aqr	06 29 15.3	+25 42 45	1.25	Gem	19 21 40.0	-22 03 50	5.41	Sgr
Mar	24	23 00 11.2	-08 52 25	1.21	Aqr	22 59 52.4	-07 51 32	1.58	Aqr	06 31 05.0	+25 40 27	1.26	Gem	19 22 14.1	-22 02 50	5.40	Sgr
Mar	25	23 06 09.5	-08 16 43	1.22	Aqr	23 04 30.2	-07 24 02	1.58	Aqr	06 32 55.6	+25 38 05	1.27	Gem	19 22 47.6	-22 01 50	5.38	Sgr
Mar	26	23 12 11.2	-07 39 51	1.23	Aqr	23 09 07.3	-06 56 19	1.58	Aqr	06 34 47.2	+25 35 37	1.28	Gem	19 23 20.5	-22 00 51	5.37	Sgr
Mar	27	23 18 16.3	-07 01 50	1.24	Aqr	23 13 43.9	-06 28 25	1.59	Aqr	06 36 39.8	+25 33 04	1.29	Gem	19 23 52.9	-21 59 53	5.35	Sgr
Mar	28	23 24 24.8	-06 22 40	1.25	Aqr	23 18 19.8	-06 00 21	1.59	Aqr	06 38 33.2	+25 30 25	1.30	Gem	19 24 24.6	-21 58 55	5.34	Sgr
Mar	29	23 30 36.7	-05 42 22	1.26	Aqr	23 22 55.3	-05 32 06	1.60	Aqr	06 40 27.6	+25 27 41	1.31	Gem	19 24 55.7	-21 57 59	5.32	Sgr
Mar	30	23 36 52.3	-05 00 57	1.27	Aqr	23 27 30.2	-05 03 42	1.60	Aqr	06 42 22.8	+25 24 51	1.32	Gem	19 25 26.1	-21 57 03	5.30	Sgr
Mar	31	23 43 11.5	-04 18 26	1.28	Aqr	23 32 04.7	-04 35 09	1.60	Aqr	06 44 18.8	+25 21 56	1.33	Gem	19 25 56.0	-21 56 09	5.29	Sgr
Apr	1	23 49 34.5	-03 34 51	1.28	Aqr	23 36 38.7	-04 06 28	1.61	Aqr	06 46 15.7	+25 18 55	1.33	Gem	19 26 25.2	-21 55 15	5.27	Sgr
Apr	2	23 56 01.4	-02 50 12	1.29	Psc	23 41 12.4	-03 37 40	1.61	Aqr	06 48 13.4	+25 15 47	1.34	Gem	19 26 53.8	-21 54 22	5.26	Sgr
Apr	3	00 02 32.4	-02 04 30	1.30	Psc	23 45 45.7	-03 08 45	1.61	Psc	06 50 11.9	+25 12 34	1.35	Gem	19 27 21.7	-21 53 31	5.24	Sgr
Apr	4	00 09 07.6	-01 17 49	1.31	Psc	23 50 18.7	-02 39 45	1.62	Psc	06 52 11.2	+25 09 15	1.36	Gem	19 27 49.0	-21 52 41	5.22	Sgr
Apr	5	00 15 47.3	-00 30 09	1.31	Psc	23 54 51.5	-02 10 40	1.62	Psc	06 54 11.2	+25 05 49	1.37	Gem	19 28 15.6	-21 51 51	5.21	Sgr
Apr	6	00 22 31.5	+00 18 28	1.32	Psc	23 59 23.9	-01 41 30	1.62	Psc	06 56 11.9	+25 02 17	1.38	Gem	19 28 41.5	-21 51 03	5.19	Sgr
Apr	7	00 29 20.4	+01 07 59	1.32	Cet	00 03 56.2	-01 12 16	1.63	Psc	06 58 13.3	+24 58 39	1.39	Gem	19 29 06.8	-21 50 16	5.18	Sgr
Apr	8	00 36 14.2	+01 58 21	1.33	Cet	00 08 28.3	-00 43 00	1.63	Psc	07 00 15.4	+24 54 55	1.40	Gem	19 29 31.4	-21 49 31	5.16	Sgr
Apr	9	00 43 13.1	+02 49 32	1.33	Psc	00 13 00.3	-00 13 42	1.63	Psc	07 02 18.1	+24 51 04	1.41	Gem	19 29 55.3	-21 48 46	5.14	Sgr
Apr	10	00 50 17.3	+03 41 27	1.33	Psc	00 17 32.1	+00 15 38	1.64	Psc	07 04 21.5	+24 47 06	1.42	Gem	19 30 18.5	-21 48 03	5.13	Sgr
Apr	11	00 57 26.7	+04 34 03	1.34	Psc	00 22 04.0	+00 44 59	1.64	Psc	07 06 25.5	+24 43 01	1.43	Gem	19 30 41.0	-21 47 22	5.11	Sgr
Apr	12	01 04 41.7	+05 27 15	1.34	Psc	00 26 35.8	+01 14 20	1.64	Cet	07 08 30.1	+24 38 50	1.44	Gem	19 31 02.7	-21 46 41	5.10	Sgr
Apr	13	01 12 02.1	+06 20 57	1.34	Psc	00 31 07.6	+01 43 40	1.65	Cet	07 10 35.3	+24 34 33	1.45	Gem	19 31 23.8	-21 46 02	5.08	Sgr
Apr	14	01 19 28.1	+07 15 04	1.34	Psc	00 35 39.5	+02 12 59	1.65	Cet	07 12 41.0	+24 30 08	1.46	Gem	19 31 44.2	-21 45 25	5.06	Sgr
Apr	15	01 26 59.6	+08 09 27	1.34	Psc	00 40 11.5	+02 42 16	1.65	Psc	07 14 47.2	+24 25 37	1.47	Gem	19 32 03.9	-21 44 49	5.05	Sgr
Apr	16	01 34 36.4	+09 04 01	1.33	Psc	00 44 43.6	+03 11 30	1.65	Psc	07 16 53.9	+24 20 59	1.48	Gem	19 32 22.8	-21 44 14	5.03	Sgr
Apr	17	01 42 18.4	+09 58 35	1.33	Psc	00 49 15.9	+03 40 40	1.66	Psc	07 19 01.1	+24 16 13	1.49	Gem	19 32 41.0	-21 43 41	5.02	Sgr
Apr	18	01 50 05.4	+10 52 60	1.32	Ari	00 53 48.5	+04 09 47	1.66	Psc	07 21 08.7	+24 11 21	1.50	Gem	19 32 58.5	-21 43 10	5.00	Sgr
Apr	19	01 57 56.7	+11 47 05	1.32	Ari	00 58 21.3	+04 38 49	1.66	Psc	07 23 16.8	+24 06 22	1.51	Gem	19 33 15.2	-21 42 40	4.98	Sgr
Apr	20	02 05 52.1	+12 40 40	1.31	Ari	01 02 54.5	+05 07 45	1.66	Psc	07 25 25.3	+24 01 16	1.52	Gem	19 33 31.2	-21 42 12	4.97	Sgr
Apr	21	02 13 50.7	+13 33 33	1.30	Ari	01 07 28.0	+05 36 36	1.67	Psc	07 27 34.2	+23 56 03	1.53	Gem	19 33 46.5	-21 41 45	4.95	Sgr
Apr	22	02 21 51.8	+14 25 30	1.29	Ari	01 12 01.8	+06 05 19	1.67	Psc	07 29 43.5	+23 50 43	1.54	Gem	19 34 01.0	-21 41 20	4.94	Sgr
Apr	23	02 29 54.6	+15 16 20	1.28	Ari	01 16 36.2	+06 33 55	1.67	Psc	07 31 53.2	+23 45 16	1.55	Gem	19 34 14.7	-21 40 56	4.92	Sgr
Apr	24	02 37 58.0	+16 05 50	1.27	Ari	01 21 10.9	+07 02 23	1.68	Psc	07 34 03.3	+23 39 42	1.56	Gem	19 34 27.7	-21 40 34	4.90	Sgr
Apr	25	02 46 00.9	+16 53 48	1.25	Ari	01 25 46.2	+07 30 41	1.68	Psc	07 36 13.7	+23 34 00	1.57	Gem	19 34 39.9	-21 40 14	4.89	Sgr
Apr	26	02 54 02.2	+17 40 02	1.23	Ari	01 30 22.1	+07 58 50	1.68	Psc	07 38 24.4	+23 28 12	1.58	Gem	19 34 51.4	-21 39 56	4.87	Sgr
Apr	27	03 02 00.7	+18 24 21	1.22	Ari	01 34 58.5	+08 26 49	1.68	Psc	07 40 35.5	+23 22 16	1.59	Gem	19 35 02.1	-21 39 39	4.86	Sgr
Apr	28	03 09 55.1	+19 06 36	1.20	Ari	01 39 35.6	+08 54 37	1.68	Psc	07 42 46.9	+23 16 13	1.59	Gem	19 35 12.0	-21 39 25	4.84	Sgr
Apr	29	03 17 44.1	+19 46 39	1.18	Ari	01 44 13.3	+09 22 12	1.69	Psc	07 44 58.6	+23 10 03	1.60	Gem	19 35 21.1	-21 39 11	4.83	Sgr
Apr	30	03 25 26.6	+20 24 24	1.16	Ari	01 48 51.7	+09 49 36	1.69	Psc	07 47 10.6	+23 03 45	1.61	Gem	19 35 29.5	-21 39 00	4.81	Sgr
May	1	03 33 01.4	+20 59 45	1.14	Tau	01 53 30.8	+10 16 45	1.69	Psc	07 49 22.9	+22 57 20	1.62	Gem	19 35 37.0	-21 38 51	4.80	Sgr
May	2	03 40 27.4	+21 32 38	1.12	Tau	01 58 10.7	+10 43 41	1.69	Ari	07 51 35.5	+22 50 48	1.63	Gem	19 35 43.8	-21 38 43	4.78	Sgr
May	3	03 47 43.4	+22 03 01	1.09	Tau	02 02 51.3	+11 10 23	1.70	Ari	07 53 48.3	+22 44 08	1.64	Gem	19 35 49.7	-21 38 37	4.77	Sgr
May	4	03 54 48.5	+22 30 54	1.07	Tau	02 07 32.8	+11 36 48	1.70	Ari	07 56 01.4	+22 37 21	1.65	Gem	19 35 54.9	-21 38 33	4.75	Sgr
May	5	04 01 41.8	+22 56 17	1.05	Tau	02 12 15.1	+12 02 58	1.70	Ari	07 58 14.8	+22 30 27	1.66	Gem	19 35 59.2	-21 38 31	4.74	Sgr
May	6	04 08 22.5	+23 19 10	1.03	Tau	02 16 58.3	+12 28 50	1.70	Ari	08 00 28.3	+22 23 25	1.67	Cnc	19 36 02.8	-21 38 31	4.72	Sgr
May	7	04 14 49.7	+23 39 37	1.00	Tau	02 21 42.4	+12 54 25	1.70	Ari	08 02 42.1	+22 16 16	1.68	Cnc	19 36 05.5	-21 38 33	4.71	Sgr
May	8	04 21 02.7	+23 57 40	0.98	Tau	02 26 27.5	+13 19 41	1.71	Ari	08 04 56.1	+22 08 60	1.69	Cnc	19 36 07.5	-21 38 37	4.69	Sgr
May	9	04 27 00.8	+24 13 22	0.96	Tau	02 31 13.4	+13 44 38	1.71	Ari	08 07 10.3	+22 01 36	1.70	Cnc	19 36 08.6	-21 38 42	4.68	Sgr
May	10	04 32 43.5	+24 26 48	0.93	Tau	02 36 00.3	+14 09 16	1.71	Ari	08 09 24.7	+21 54 05	1.70	Cnc	19 36 08.9	-21 38 50	4.66	Sgr
May	11	04 38 10.0	+24 38 02	0.91	Tau	02 40 48.2	+14 33 32	1.71	Ari	08 11 39.3	+21 46 26	1.71	Cnc	19 36 08.4	-21 38 59	4.65	Sgr
May	12	04 43 19.9	+24 47 07	0.89	Tau	02 45 37.1	+14 57 27	1.71	Ari	08 13 54.0	+21 38 41	1.72	Cnc	19 36 07.2	-21 39 10	4.63	Sgr
May	13	04 48 12.6	+24 54 08	0.87	Tau	02 50 27.0	+15 21 00	1.71	Ari	08 16 08.8	+21 30 48	1.73	Cnc	19 36 05.1	-21 39 23	4.62	Sgr

GEOCENTRIC PLANET POSITIONS (continued)

		MERCURY				VENUS				MARS				JUPITER			
MTH	DAY	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.
May	14	04 52 47.5	+24 59 10	0.85	Tau	02 55 18.0	+15 44 10	1.72	Ari	08 18 23.8	+21 22 48	1.74	Cnc	19 36 02.2	-21 39 38	4.61	Sgr
May	15	04 57 04.2	+25 02 17	0.83	Tau	03 00 10.0	+16 06 57	1.72	Ari	08 20 39.0	+21 14 40	1.75	Cnc	19 35 58.5	-21 39 55	4.59	Sgr
May	16	05 01 02.2	+25 03 33	0.81	Tau	03 05 03.1	+16 29 19	1.72	Ari	08 22 54.2	+21 06 26	1.76	Cnc	19 35 54.0	-21 40 14	4.58	Sgr
May	17	05 04 41.1	+25 03 04	0.79	Tau	03 09 57.2	+16 51 16	1.72	Ari	08 25 09.5	+20 58 04	1.77	Cnc	19 35 48.8	-21 40 34	4.57	Sgr
May	18	05 08 00.5	+25 00 52	0.77	Tau	03 14 52.5	+17 12 48	1.72	Ari	08 27 25.0	+20 49 35	1.77	Cnc	19 35 42.7	-21 40 57	4.55	Sgr
May	19	05 10 59.9	+24 57 03	0.75	Tau	03 19 48.9	+17 33 53	1.72	Ari	08 29 40.5	+20 40 60	1.78	Cnc	19 35 35.9	-21 41 21	4.54	Sgr
May	20	05 13 39.1	+24 51 40	0.73	Tau	03 24 46.3	+17 54 31	1.72	Tau	08 31 56.1	+20 32 17	1.79	Cnc	19 35 28.2	-21 41 47	4.53	Sgr
May	21	05 15 57.7	+24 44 47	0.71	Tau	03 29 44.9	+18 14 41	1.72	Tau	08 34 11.8	+20 23 27	1.80	Cnc	19 35 19.8	-21 42 15	4.51	Sgr
May	22	05 17 55.5	+24 36 28	0.69	Tau	03 34 44.7	+18 34 23	1.73	Tau	08 36 27.6	+20 14 30	1.81	Cnc	19 35 10.6	-21 42 44	4.50	Sgr
May	23	05 19 32.5	+24 26 48	0.68	Tau	03 39 45.5	+18 53 36	1.73	Tau	08 38 43.4	+20 05 26	1.82	Cnc	19 35 00.6	-21 43 16	4.49	Sgr
May	24	05 20 48.5	+24 15 49	0.66	Tau	03 44 47.5	+19 12 19	1.73	Tau	08 40 59.3	+19 56 15	1.82	Cnc	19 34 49.8	-21 43 49	4.48	Sgr
May	25	05 21 43.7	+24 03 37	0.65	Tau	03 49 50.6	+19 30 31	1.73	Tau	08 43 15.2	+19 46 57	1.83	Cnc	19 34 38.3	-21 44 23	4.46	Sgr
May	26	05 22 18.1	+23 50 14	0.64	Tau	03 54 54.8	+19 48 12	1.73	Tau	08 45 31.2	+19 37 32	1.84	Cnc	19 34 26.0	-21 44 60	4.45	Sgr
May	27	05 22 32.2	+23 35 47	0.62	Tau	04 00 00.1	+20 05 21	1.73	Tau	08 47 47.3	+19 28 01	1.85	Cnc	19 34 13.0	-21 45 38	4.44	Sgr
May	28	05 22 26.5	+23 20 19	0.61	Tau	04 05 06.5	+20 21 57	1.73	Tau	08 50 03.4	+19 18 22	1.86	Cnc	19 33 59.2	-21 46 18	4.43	Sgr
May	29	05 22 01.5	+23 03 56	0.60	Tau	04 10 13.9	+20 38 01	1.73	Tau	08 52 19.5	+19 08 37	1.87	Cnc	19 33 44.6	-21 46 59	4.42	Sgr
May	30	05 21 18.3	+22 46 44	0.59	Tau	04 15 22.5	+20 53 30	1.73	Tau	08 54 35.7	+18 58 44	1.87	Cnc	19 33 29.4	-21 47 42	4.41	Sgr
May	31	05 20 17.9	+22 28 49	0.58	Tau	04 20 32.1	+21 08 25	1.73	Tau	08 56 51.9	+18 48 45	1.88	Cnc	19 33 13.3	-21 48 27	4.40	Sgr
Jun	1	05 19 01.6	+22 10 19	0.57	Tau	04 25 42.7	+21 22 45	1.73	Tau	08 59 08.1	+18 38 40	1.89	Cnc	19 32 56.6	-21 49 13	4.38	Sgr
Jun	2	05 17 30.9	+21 51 21	0.57	Tau	04 30 54.3	+21 36 30	1.73	Tau	09 01 24.4	+18 28 27	1.90	Cnc	19 32 39.1	-21 50 00	4.37	Sgr
Jun	3	05 15 47.5	+21 32 04	0.56	Tau	04 36 06.8	+21 49 38	1.73	Tau	09 03 40.7	+18 18 08	1.91	Cnc	19 32 20.9	-21 50 49	4.36	Sgr
Jun	4	05 13 53.2	+21 12 37	0.56	Tau	04 41 20.3	+22 02 09	1.73	Tau	09 05 57.1	+18 07 42	1.91	Cnc	19 32 02.1	-21 51 40	4.35	Sgr
Jun	5	05 11 50.2	+20 53 11	0.55	Tau	04 46 34.7	+22 14 04	1.74	Tau	09 08 13.4	+17 57 10	1.92	Cnc	19 31 42.5	-21 52 32	4.34	Sgr
Jun	6	05 09 40.6	+20 33 57	0.55	Tau	04 51 49.9	+22 25 20	1.74	Tau	09 10 29.8	+17 46 31	1.93	Cnc	19 31 22.3	-21 53 25	4.33	Sgr
Jun	7	05 07 26.7	+20 15 05	0.55	Tau	04 57 06.0	+22 35 58	1.74	Tau	09 12 46.2	+17 35 45	1.94	Cnc	19 31 01.4	-21 54 20	4.32	Sgr
Jun	8	05 05 10.9	+19 56 47	0.55	Tau	05 02 22.9	+22 45 57	1.74	Tau	09 15 02.5	+17 24 53	1.95	Cnc	19 30 39.8	-21 55 15	4.32	Sgr
Jun	9	05 02 55.4	+19 39 13	0.55	Tau	05 07 40.4	+22 55 18	1.74	Tau	09 17 18.9	+17 13 55	1.95	Cnc	19 30 17.6	-21 56 12	4.31	Sgr
Jun	10	05 00 42.6	+19 22 36	0.55	Tau	05 12 58.7	+23 03 58	1.74	Tau	09 19 35.3	+17 02 51	1.96	Cnc	19 29 54.8	-21 57 11	4.30	Sgr
Jun	11	04 58 34.7	+19 07 06	0.56	Tau	05 18 17.6	+23 11 59	1.74	Tau	09 21 51.6	+16 51 40	1.97	Cnc	19 29 31.4	-21 58 10	4.29	Sgr
Jun	12	04 56 34.0	+18 52 52	0.56	Tau	05 23 37.1	+23 19 19	1.74	Tau	09 24 08.0	+16 40 23	1.98	Leo	19 29 07.4	-21 59 10	4.28	Sgr
Jun	13	04 54 42.3	+18 40 03	0.57	Tau	05 28 57.2	+23 25 58	1.74	Tau	09 26 24.3	+16 28 60	1.98	Leo	19 28 42.9	-22 00 11	4.27	Sgr
Jun	14	04 53 01.5	+18 28 46	0.57	Tau	05 34 17.8	+23 31 57	1.74	Tau	09 28 40.6	+16 17 31	1.99	Leo	19 28 17.7	-22 01 13	4.27	Sgr
Jun	15	04 51 33.2	+18 19 08	0.58	Tau	05 39 38.8	+23 37 14	1.73	Tau	09 30 56.9	+16 05 56	2.00	Leo	19 27 52.1	-22 02 16	4.26	Sgr
Jun	16	04 50 18.9	+18 11 14	0.59	Tau	05 45 00.2	+23 41 50	1.73	Tau	09 33 13.1	+15 54 15	2.01	Leo	19 27 25.9	-22 03 20	4.25	Sgr
Jun	17	04 49 19.8	+18 05 06	0.60	Tau	05 50 21.9	+23 45 44	1.73	Tau	09 35 29.4	+15 42 28	2.01	Leo	19 26 59.2	-22 04 25	4.24	Sgr
Jun	18	04 48 36.9	+18 00 47	0.61	Tau	05 55 44.0	+23 48 56	1.73	Tau	09 37 45.5	+15 30 36	2.02	Leo	19 26 32.0	-22 05 30	4.24	Sgr
Jun	19	04 48 11.1	+17 58 18	0.62	Tau	06 01 06.2	+23 51 26	1.73	Gem	09 40 01.7	+15 18 38	2.03	Leo	19 26 04.3	-22 06 36	4.23	Sgr
Jun	20	04 48 03.1	+17 57 38	0.63	Tau	06 06 28.7	+23 53 13	1.73	Gem	09 42 17.9	+15 06 34	2.03	Leo	19 25 36.1	-22 07 43	4.22	Sgr
Jun	21	04 48 13.4	+17 58 44	0.64	Tau	06 11 51.3	+23 54 18	1.73	Gem	09 44 34.0	+14 54 24	2.04	Leo	19 25 07.5	-22 08 50	4.22	Sgr
Jun	22	04 48 42.4	+18 01 35	0.66	Tau	06 17 13.9	+23 54 41	1.73	Gem	09 46 50.1	+14 42 09	2.05	Leo	19 24 38.5	-22 09 58	4.21	Sgr
Jun	23	04 49 30.3	+18 06 06	0.67	Tau	06 22 36.5	+23 54 21	1.73	Gem	09 49 06.1	+14 29 48	2.06	Leo	19 24 09.1	-22 11 06	4.21	Sgr
Jun	24	04 50 37.5	+18 12 13	0.69	Tau	06 27 59.1	+23 53 19	1.73	Gem	09 51 22.2	+14 17 22	2.06	Leo	19 23 39.3	-22 12 15	4.20	Sgr
Jun	25	04 52 03.9	+18 19 51	0.71	Tau	06 33 21.6	+23 51 34	1.73	Gem	09 53 38.2	+14 04 50	2.07	Leo	19 23 09.1	-22 13 24	4.20	Sgr
Jun	26	04 53 49.6	+18 28 53	0.72	Tau	06 38 44.0	+23 49 06	1.73	Gem	09 55 54.2	+13 52 13	2.08	Leo	19 22 38.6	-22 14 33	4.19	Sgr
Jun	27	04 55 54.7	+18 39 13	0.74	Tau	06 44 06.1	+23 45 56	1.73	Gem	09 58 10.2	+13 39 30	2.08	Leo	19 22 07.7	-22 15 43	4.19	Sgr
Jun	28	04 58 19.1	+18 50 45	0.76	Tau	06 49 27.9	+23 42 04	1.73	Gem	10 00 26.2	+13 26 42	2.09	Leo	19 21 36.5	-22 16 53	4.19	Sgr
Jun	29	05 01 02.7	+19 03 20	0.78	Tau	06 54 49.4	+23 37 29	1.72	Gem	10 02 42.1	+13 13 49	2.10	Leo	19 21 05.0	-22 18 03	4.18	Sgr
Jun	30	05 04 05.5	+19 16 51	0.80	Tau	07 00 10.5	+23 32 13	1.72	Gem	10 04 58.1	+13 00 51	2.10	Leo	19 20 33.3	-22 19 13	4.18	Sgr
Jul	1	05 07 27.4	+19 31 11	0.82	Tau	07 05 31.1	+23 26 14	1.72	Gem	10 07 14.0	+12 47 47	2.11	Leo	19 20 01.3	-22 20 23	4.18	Sgr
Jul	2	05 11 08.3	+19 46 11	0.84	Tau	07 10 51.2	+23 19 34	1.72	Gem	10 09 29.9	+12 34 39	2.12	Leo	19 19 29.1	-22 21 33	4.17	Sgr
Jul	3	05 15 08.1	+20 01 42	0.86	Tau	07 16 10.8	+23 12 13	1.72	Gem	10 11 45.9	+12 21 26	2.12	Leo	19 18 56.7	-22 22 43	4.17	Sgr
Jul	4	05 19 26.8	+20 17 35	0.88	Tau	07 21 29.8	+23 04 10	1.72	Gem	10 14 01.8	+12 08 07	2.13	Leo	19 18 24.2	-22 23 53	4.17	Sgr
Jul	5	05 24 04.3	+20 33 41	0.90	Tau	07 26 48.1	+22 55 27	1.72	Gem	10 16 17.7	+11 54 44	2.14	Leo	19 17 51.4	-22 25 02	4.17	Sgr
Jul	6	05 29 00.6	+20 49 51	0.92	Tau	07 32 05.6	+22 46 03	1.72	Gem	10 18 33.6	+11 41 16	2.14	Leo	19 17 18.6	-22 26 12	4.16	Sgr
Jul	7	05 34 15.5	+21 05 54	0.95	Tau	07 37 22.4	+22 35 59	1.71	Gem	10 20 49.6	+11 27 43	2.15	Leo	19 16 45.7	-22 27 21	4.16	Sgr
Jul	8	05 39 48.9	+21 21 41	0.97	Tau	07 42 38.4	+22 25 16	1.71	Gem	10 23 05.5	+11 14 06	2.15	Leo	19 16 12.7	-22 28 30	4.16	Sgr
Jul	9	05 45 40.8	+21 36 60	0.99	Tau	07 47 53.6	+22 13 53	1.71	Gem	10 25 21.4	+11 00 24	2.16	Leo	19 15 39.6	-22 29 38	4.16	Sgr
Jul	10	05 51 50.8	+21 51 40	1.02	Ori	07 53 07.8	+22 01 51	1.71	Gem	10 27 37.2	+10 46 38	2.17	Leo	19 15 06.5	-22 30 46	4.16	Sgr
Jul	11	05 58 18.8	+22 05 30	1.04	Ori	07 58 21.1	+21 49 12	1.71	Gem	10 29 53.1	+10 32 47	2.17	Leo	19 14 33.4	-22 31 54	4.16	Sgr
Jul	12	06 05 04.4	+22 18 18	1.06	Gem	08 03 33.4	+21 35 54	1.70	Cnc	10 32 09.0	+10 18 52	2.18	Leo	19 14 00.3	-22 33 01	4.16	Sgr
Jul	13	06 12 07.2	+22 29 53	1.08	Gem	08 08 44.8	+21 21 59	1.70	Cnc	10 34 24.9	+10 04 53	2.18	Leo	19 13 27.3	-22 34 07	4.16	Sgr
Jul	14	06 19 26.6	+22 40 02	1.11	Gem	08 13 55.1	+21 07 27	1.70	Cnc	10 36 40.8	+09 50 50	2.19	Leo	19 12 54.4	-22 35 13	4.16	Sgr
Jul	15	06 27 01.9	+22 48 33	1.13	Gem	08 19 04.3	+20 52 19	1.70	Cnc	10 38 56.7	+09 36 43	2.20	Leo	19 12 21.5	-22 36 18	4.16	Sgr
Jul	16	06 34 52.3	+22 55 16	1.15	Gem	08 24 12.5	+20 36 36	1.70	Cnc	10 41 12.6	+09 22 32	2.20	Leo	19 11 48.8	-22 37 22	4.16	Sgr
Jul	17	06 42 56.7	+22 59 58	1.17	Gem	08 29 19.5	+20 20 17	1.69	Cnc	10 43 28.5	+09 08 17	2.21	Leo	19 11 16.2	-22 38 26	4.17	Sgr
Jul	18	06 51 14.0	+23 02 29	1.19	Gem	08 34 25.5	+20 03 24	1.69	Cnc	10 45 44.4	+08 53 58	2.21	Leo	19 10 43.7	-22 39 29	4.17	Sgr
Jul	19	06 59 42.8	+23 02 41	1.21	Gem	08 39 30.3	+19 45 57	1.69	Cnc	10 48 00.3	+08 39 35	2.22	Leo	19 10 11.5	-22 40 31	4.17	Sgr

GEOCENTRIC PLANET POSITIONS (continued) Note: positions refer to 0000 WAST

		MERCURY				VENUS				MARS				JUPITER			
MTH	DAY	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.	RA h m s	Declination ° ′ ″	Dist. (AU)	Cnst.
Jul	20	07 08 21.5	+23 00 25	1.23	Gem	08 44 33.9	+19 27 56	1.69	Cnc	10 50 16.3	+08 25 08	2.22	Leo	19 09 39.4	-22 41 33	4.17	Sgr
Jul	21	07 17 08.6	+22 55 35	1.25	Gem	08 49 36.4	+19 09 23	1.69	Cnc	10 52 32.2	+08 10 38	2.23	Leo	19 09 07.6	-22 42 33	4.18	Sgr
Jul	22	07 26 02.2	+22 48 06	1.26	Gem	08 54 37.7	+18 50 17	1.68	Cnc	10 54 48.2	+07 56 05	2.24	Leo	19 08 36.0	-22 43 33	4.18	Sgr
Jul	23	07 35 00.6	+22 37 56	1.28	Gem	08 59 37.8	+18 30 40	1.68	Cnc	10 57 04.3	+07 41 27	2.24	Leo	19 08 04.7	-22 44 31	4.18	Sgr
Jul	24	07 44 02.0	+22 25 04	1.29	Gem	09 04 36.7	+18 10 33	1.68	Cnc	10 59 20.4	+07 26 47	2.25	Leo	19 07 33.7	-22 45 29	4.19	Sgr
Jul	25	07 53 04.5	+22 09 31	1.30	Gem	09 09 34.5	+17 49 55	1.68	Cnc	11 01 36.5	+07 12 02	2.25	Leo	19 07 03.0	-22 46 26	4.19	Sgr
Jul	26	08 02 06.4	+21 51 20	1.31	Cnc	09 14 31.0	+17 28 48	1.67	Cnc	11 03 52.7	+06 57 15	2.26	Leo	19 06 32.6	-22 47 22	4.19	Sgr
Jul	27	08 11 06.2	+21 30 37	1.32	Cnc	09 19 26.4	+17 07 12	1.67	Cnc	11 06 09.0	+06 42 24	2.26	Leo	19 06 02.6	-22 48 17	4.20	Sgr
Jul	28	08 20 02.4	+21 07 27	1.33	Cnc	09 24 20.6	+16 45 08	1.67	Leo	11 08 25.3	+06 27 30	2.27	Leo	19 05 32.9	-22 49 11	4.20	Sgr
Jul	29	08 28 53.6	+20 41 57	1.33	Cnc	09 29 13.7	+16 22 36	1.66	Leo	11 10 41.7	+06 12 33	2.27	Leo	19 05 03.7	-22 50 03	4.21	Sgr
Jul	30	08 37 38.7	+20 14 17	1.34	Cnc	09 34 05.5	+15 59 38	1.66	Leo	11 12 58.2	+05 57 33	2.28	Leo	19 04 34.9	-22 50 55	4.21	Sgr
Jul	31	08 46 16.9	+19 44 34	1.34	Cnc	09 38 56.2	+15 36 14	1.66	Leo	11 15 14.7	+05 42 30	2.28	Leo	19 04 06.5	-22 51 46	4.22	Sgr
Aug	1	08 54 47.2	+19 12 58	1.35	Cnc	09 43 45.8	+15 12 24	1.66	Leo	11 17 31.3	+05 27 24	2.29	Leo	19 03 38.5	-22 52 35	4.23	Sgr
Aug	2	09 03 09.2	+18 39 38	1.35	Cnc	09 48 34.2	+14 48 10	1.65	Leo	11 19 48.0	+05 12 15	2.29	Leo	19 03 11.1	-22 53 24	4.23	Sgr
Aug	3	09 11 22.3	+18 04 44	1.35	Cnc	09 53 21.5	+14 23 33	1.65	Leo	11 22 04.8	+04 57 04	2.30	Leo	19 02 44.2	-22 54 11	4.24	Sgr
Aug	4	09 19 26.3	+17 28 25	1.35	Cnc	09 58 07.7	+13 58 32	1.65	Leo	11 24 21.7	+04 41 50	2.30	Leo	19 02 17.8	-22 54 57	4.25	Sgr
Aug	5	09 27 21.0	+16 50 49	1.35	Leo	10 02 52.8	+13 33 09	1.64	Leo	11 26 38.7	+04 26 33	2.31	Leo	19 01 51.9	-22 55 43	4.25	Sgr
Aug	6	09 35 06.2	+16 12 05	1.34	Leo	10 07 36.9	+13 07 25	1.64	Leo	11 28 55.8	+04 11 14	2.31	Leo	19 01 26.6	-22 56 26	4.26	Sgr
Aug	7	09 42 42.0	+15 32 20	1.34	Leo	10 12 19.8	+12 41 19	1.64	Leo	11 31 13.0	+03 55 53	2.32	Leo	19 01 01.8	-22 57 09	4.27	Sgr
Aug	8	09 50 08.4	+14 51 42	1.34	Leo	10 17 01.8	+12 14 54	1.63	Leo	11 33 30.3	+03 40 29	2.32	Leo	19 00 37.7	-22 57 51	4.27	Sgr
Aug	9	09 57 25.6	+14 10 19	1.33	Leo	10 21 42.7	+11 48 09	1.63	Leo	11 35 47.7	+03 25 03	2.32	Leo	19 00 14.1	-22 58 31	4.28	Sgr
Aug	10	10 04 33.7	+13 28 16	1.33	Leo	10 26 22.7	+11 21 06	1.63	Leo	11 38 05.2	+03 09 36	2.33	Vir	18 59 51.2	-22 59 10	4.29	Sgr
Aug	11	10 11 32.9	+12 45 39	1.32	Leo	10 31 01.7	+10 53 45	1.62	Leo	11 40 22.8	+02 54 06	2.33	Vir	18 59 28.9	-22 59 48	4.30	Sgr
Aug	12	10 18 23.4	+12 02 35	1.31	Leo	10 35 39.8	+10 26 06	1.62	Leo	11 42 40.6	+02 38 34	2.34	Vir	18 59 07.3	-23 00 25	4.31	Sgr
Aug	13	10 25 05.5	+11 19 08	1.31	Leo	10 40 17.0	+09 58 12	1.62	Leo	11 44 58.5	+02 23 01	2.34	Vir	18 58 46.3	-23 01 01	4.32	Sgr
Aug	14	10 31 39.5	+10 35 24	1.30	Leo	10 44 53.3	+09 30 01	1.61	Leo	11 47 16.5	+02 07 26	2.35	Vir	18 58 26.0	-23 01 35	4.33	Sgr
Aug	15	10 38 05.5	+09 51 26	1.29	Leo	10 49 28.8	+09 01 36	1.61	Leo	11 49 34.7	+01 51 49	2.35	Vir	18 58 06.3	-23 02 08	4.34	Sgr
Aug	16	10 44 23.8	+09 07 18	1.28	Leo	10 54 03.5	+08 32 56	1.61	Leo	11 51 53.0	+01 36 11	2.35	Vir	18 57 47.4	-23 02 40	4.35	Sgr
Aug	17	10 50 34.7	+08 23 06	1.27	Leo	10 58 37.4	+08 04 03	1.60	Leo	11 54 11.4	+01 20 31	2.36	Vir	18 57 29.2	-23 03 11	4.35	Sgr
Aug	18	10 56 38.4	+07 38 51	1.27	Leo	11 03 10.6	+07 34 57	1.60	Leo	11 56 30.0	+01 04 50	2.36	Vir	18 57 11.7	-23 03 41	4.37	Sgr
Aug	19	11 02 35.1	+06 54 39	1.26	Leo	11 07 43.1	+07 05 39	1.59	Leo	11 58 48.8	+00 49 08	2.37	Vir	18 56 54.9	-23 04 09	4.38	Sgr
Aug	20	11 08 25.1	+06 10 30	1.25	Leo	11 12 15.0	+06 36 10	1.59	Leo	12 01 07.8	+00 33 24	2.37	Vir	18 56 38.8	-23 04 36	4.39	Sgr
Aug	21	11 14 08.5	+05 26 30	1.24	Leo	11 16 46.3	+06 06 30	1.59	Leo	12 03 26.9	+00 17 39	2.37	Vir	18 56 23.5	-23 05 02	4.40	Sgr
Aug	22	11 19 45.5	+04 42 40	1.23	Leo	11 21 17.0	+05 36 40	1.58	Leo	12 05 46.2	+00 01 54	2.38	Vir	18 56 08.9	-23 05 27	4.41	Sgr
Aug	23	11 25 16.3	+03 59 03	1.22	Leo	11 25 47.2	+05 06 40	1.58	Leo	12 08 05.7	-00 13 53	2.38	Vir	18 55 55.1	-23 05 51	4.42	Sgr
Aug	24	11 30 41.1	+03 15 42	1.20	Leo	11 30 16.9	+04 36 32	1.57	Leo	12 10 25.4	-00 29 41	2.38	Vir	18 55 42.1	-23 06 14	4.43	Sgr
Aug	25	11 35 59.9	+02 32 40	1.19	Leo	11 34 46.1	+04 06 16	1.57	Leo	12 12 45.4	-00 45 30	2.39	Vir	18 55 29.9	-23 06 35	4.44	Sgr
Aug	26	11 41 12.9	+01 49 58	1.18	Vir	11 39 15.0	+03 35 53	1.57	Vir	12 15 05.5	-01 01 19	2.39	Vir	18 55 18.4	-23 06 56	4.45	Sgr
Aug	27	11 46 20.1	+01 07 40	1.17	Vir	11 43 43.5	+03 05 23	1.56	Vir	12 17 25.9	-01 17 09	2.39	Vir	18 55 07.7	-23 07 15	4.46	Sgr
Aug	28	11 51 21.7	+00 25 47	1.16	Vir	11 48 11.6	+02 34 47	1.56	Vir	12 19 46.5	-01 32 59	2.40	Vir	18 54 57.8	-23 07 33	4.48	Sgr
Aug	29	11 56 17.6	-00 15 39	1.15	Vir	11 52 39.5	+02 04 07	1.55	Vir	12 22 07.3	-01 48 50	2.40	Vir	18 54 48.7	-23 07 50	4.49	Sgr
Aug	30	12 01 07.8	-00 56 33	1.13	Vir	11 57 07.2	+01 33 22	1.55	Vir	12 24 28.4	-02 04 42	2.40	Vir	18 54 40.5	-23 08 05	4.50	Sgr
Aug	31	12 05 52.4	-01 36 55	1.12	Vir	12 01 34.6	+01 02 33	1.54	Vir	12 26 49.7	-02 20 33	2.41	Vir	18 54 33.0	-23 08 20	4.51	Sgr
Sep	1	12 10 31.3	-02 16 41	1.11	Vir	12 06 01.9	+00 31 42	1.54	Vir	12 29 11.3	-02 36 25	2.41	Vir	18 54 26.4	-23 08 33	4.53	Sgr
Sep	2	12 15 04.3	-02 55 50	1.09	Vir	12 10 29.1	+00 00 48	1.54	Vir	12 31 33.1	-02 52 17	2.41	Vir	18 54 20.6	-23 08 45	4.54	Sgr
Sep	3	12 19 31.5	-03 34 18	1.08	Vir	12 14 56.1	-00 30 07	1.53	Vir	12 33 55.2	-03 08 08	2.42	Vir	18 54 15.6	-23 08 56	4.55	Sgr
Sep	4	12 23 52.6	-04 12 02	1.07	Vir	12 19 23.2	-01 01 02	1.53	Vir	12 36 17.6	-03 23 59	2.42	Vir	18 54 11.5	-23 09 06	4.56	Sgr
Sep	5	12 28 07.4	-04 49 00	1.05	Vir	12 23 50.2	-01 31 58	1.52	Vir	12 38 40.2	-03 39 50	2.42	Vir	18 54 08.1	-23 09 15	4.58	Sgr
Sep	6	12 32 15.7	-05 25 09	1.04	Vir	12 28 17.3	-02 02 53	1.52	Vir	12 41 03.1	-03 55 41	2.43	Vir	18 54 05.7	-23 09 23	4.59	Sgr
Sep	7	12 36 17.3	-06 00 25	1.02	Vir	12 32 44.5	-02 33 46	1.51	Vir	12 43 26.3	-04 11 31	2.43	Vir	18 54 04.0	-23 09 29	4.60	Sgr
Sep	8	12 40 11.8	-06 34 44	1.01	Vir	12 37 11.8	-03 04 37	1.51	Vir	12 45 49.8	-04 27 20	2.43	Vir	18 54 03.2	-23 09 35	4.62	Sgr
Sep	9	12 43 58.9	-07 08 03	1.00	Vir	12 41 39.2	-03 35 25	1.50	Vir	12 48 13.6	-04 43 09	2.43	Vir	18 54 03.2	-23 09 39	4.63	Sgr
Sep	10	12 47 38.1	-07 40 18	0.98	Vir	12 46 06.9	-04 06 10	1.50	Vir	12 50 37.6	-04 58 56	2.44	Vir	18 54 04.1	-23 09 42	4.65	Sgr
Sep	11	12 51 08.9	-08 11 25	0.97	Vir	12 50 34.8	-04 36 50	1.49	Vir	12 53 02.0	-05 14 43	2.44	Vir	18 54 05.8	-23 09 44	4.66	Sgr
Sep	12	12 54 30.7	-08 41 17	0.95	Vir	12 55 03.0	-05 07 25	1.49	Vir	12 55 26.7	-05 30 29	2.44	Vir	18 54 08.3	-23 09 45	4.67	Sgr
Sep	13	12 57 43.1	-09 09 50	0.93	Vir	12 59 31.5	-05 37 54	1.48	Vir	12 57 51.7	-05 46 13	2.44	Vir	18 54 11.7	-23 09 44	4.69	Sgr
Sep	14	13 00 45.1	-09 36 59	0.92	Vir	13 04 00.4	-06 08 17	1.48	Vir	13 00 17.1	-06 01 56	2.45	Vir	18 54 15.9	-23 09 43	4.70	Sgr
Sep	15	13 03 36.2	-10 02 36	0.90	Vir	13 08 29.7	-06 38 33	1.47	Vir	13 02 42.7	-06 17 38	2.45	Vir	18 54 20.9	-23 09 40	4.72	Sgr
Sep	16	13 06 15.4	-10 26 34	0.89	Vir	13 12 59.4	-07 08 41	1.47	Vir	13 05 08.8	-06 33 18	2.45	Vir	18 54 26.7	-23 09 37	4.73	Sgr
Sep	17	13 08 41.7	-10 48 46	0.87	Vir	13 17 29.7	-07 38 40	1.46	Vir	13 07 35.1	-06 48 57	2.45	Vir	18 54 33.3	-23 09 32	4.74	Sgr
Sep	18	13 10 54.2	-11 09 03	0.86	Vir	13 22 00.5	-08 08 29	1.46	Vir	13 10 01.8	-07 04 34	2.46	Vir	18 54 40.8	-23 09 26	4.76	Sgr
Sep	19	13 12 51.8	-11 27 16	0.84	Vir	13 26 31.8	-08 38 09	1.45	Vir	13 12 28.9	-07 20 09	2.46	Vir	18 54 49.1	-23 09 19	4.77	Sgr
Sep	20	13 14 33.2	-11 43 14	0.82	Vir	13 31 03.8	-09 07 38	1.45	Vir	13 14 56.4	-07 35 42	2.46	Vir	18 54 58.2	-23 09 11	4.79	Sgr
Sep	21	13 15 57.2	-11 56 46	0.81	Vir	13 35 36.5	-09 36 55	1.44	Vir	13 17 24.2	-07 51 13	2.46	Vir	18 55 08.0	-23 09 01	4.80	Sgr
Sep	22	13 17 02.6	-12 07 40	0.79	Vir	13 40 09.8	-10 06 00	1.44	Vir	13 19 52.5	-08 06 42	2.47	Vir	18 55 18.7	-23 08 51	4.82	Sgr
Sep	23	13 17 47.8	-12 15 42	0.78	Vir	13 44 43.9	-10 34 53	1.43	Vir	13 22 21.1	-08 22 09	2.47	Vir	18 55 30.3	-23 08 40	4.83	Sgr
Sep	24	13 18 11.8	-12 20 39	0.76	Vir	13 49 18.8	-11 03 31	1.43	Vir	13 24 50.1	-08 37 33	2.47	Vir	18 55 42.6	-23 08 27	4.85	Sgr

GEOCENTRIC PLANET POSITIONS (continued)

MTH	DAY	MERCURY RA h m s	MERCURY Declination ° ′ ″	MERCURY Dist. (AU)	MERCURY Cnst.	VENUS RA h m s	VENUS Declination ° ′ ″	VENUS Dist. (AU)	VENUS Cnst.	MARS RA h m s	MARS Declination ° ′ ″	MARS Dist. (AU)	MARS Cnst.	JUPITER RA h m s	JUPITER Declination ° ′ ″	JUPITER Dist. (AU)	JUPITER Cnst.
Sep	25	13 18 13.0	-12 22 16	0.75	Vir	13 53 54.5	-11 31 55	1.42	Vir	13 27 19.6	-08 52 55	2.47	Vir	18 55 55.7	-23 08 13	4.86	Sgr
Sep	26	13 17 50.4	-12 20 17	0.73	Vir	13 58 31.0	-12 00 04	1.42	Vir	13 29 49.5	-09 08 14	2.47	Vir	18 56 09.6	-23 07 58	4.88	Sgr
Sep	27	13 17 02.9	-12 14 29	0.72	Vir	14 03 08.4	-12 27 56	1.41	Vir	13 32 19.8	-09 23 31	2.47	Vir	18 56 24.2	-23 07 42	4.89	Sgr
Sep	28	13 15 50.0	-12 04 38	0.71	Vir	14 07 46.7	-12 55 32	1.41	Vir	13 34 50.5	-09 38 44	2.48	Vir	18 56 39.7	-23 07 24	4.91	Sgr
Sep	29	13 14 11.1	-11 50 32	0.70	Vir	14 12 26.0	-13 22 51	1.40	Vir	13 37 21.7	-09 53 55	2.48	Vir	18 56 56.0	-23 07 06	4.92	Sgr
Sep	30	13 12 06.6	-11 32 02	0.69	Vir	14 17 06.2	-13 49 51	1.40	Vir	13 39 53.3	-10 09 02	2.48	Vir	18 57 13.0	-23 06 46	4.94	Sgr
Oct	1	13 09 37.2	-11 09 04	0.68	Vir	14 21 47.4	-14 16 32	1.39	Vir	13 42 25.4	-10 24 06	2.48	Vir	18 57 30.8	-23 06 25	4.95	Sgr
Oct	2	13 06 44.7	-10 41 40	0.67	Vir	14 26 29.6	-14 42 53	1.39	Lib	13 44 57.9	-10 39 07	2.48	Vir	18 57 49.4	-23 06 03	4.97	Sgr
Oct	3	13 03 31.5	-10 10 00	0.66	Vir	14 31 12.8	-15 08 54	1.38	Lib	13 47 30.9	-10 54 04	2.48	Vir	18 58 08.7	-23 05 39	4.99	Sgr
Oct	4	13 00 01.1	-09 34 24	0.66	Vir	14 35 57.1	-15 34 33	1.37	Lib	13 50 04.3	-11 08 57	2.49	Vir	18 58 28.8	-23 05 15	5.00	Sgr
Oct	5	12 56 17.7	-08 55 21	0.66	Vir	14 40 42.5	-15 59 50	1.37	Lib	13 52 38.2	-11 23 47	2.49	Vir	18 58 49.6	-23 04 49	5.02	Sgr
Oct	6	12 52 26.7	-08 13 31	0.66	Vir	14 45 28.9	-16 24 43	1.36	Lib	13 55 12.5	-11 38 33	2.49	Vir	18 59 11.2	-23 04 22	5.03	Sgr
Oct	7	12 48 34.1	-07 29 46	0.66	Vir	14 50 16.4	-16 49 14	1.36	Lib	13 57 47.4	-11 53 14	2.49	Vir	18 59 33.5	-23 03 53	5.05	Sgr
Oct	8	12 44 46.1	-06 45 03	0.67	Vir	14 55 05.1	-17 13 19	1.35	Lib	14 00 22.7	-12 07 51	2.49	Vir	18 59 56.6	-23 03 24	5.06	Sgr
Oct	9	12 41 09.4	-06 00 28	0.67	Vir	14 59 54.9	-17 36 59	1.35	Lib	14 02 58.5	-12 22 24	2.49	Vir	19 00 20.3	-23 02 53	5.08	Sgr
Oct	10	12 37 50.5	-05 17 07	0.68	Vir	15 04 45.8	-18 00 14	1.34	Lib	14 05 34.8	-12 36 52	2.49	Vir	19 00 44.8	-23 02 21	5.09	Sgr
Oct	11	12 34 55.1	-04 36 05	0.70	Vir	15 09 37.9	-18 23 01	1.33	Lib	14 08 11.6	-12 51 15	2.49	Vir	19 01 10.0	-23 01 47	5.11	Sgr
Oct	12	12 32 28.5	-03 58 20	0.71	Vir	15 14 31.2	-18 45 21	1.33	Lib	14 10 48.9	-13 05 34	2.49	Vir	19 01 35.8	-23 01 12	5.12	Sgr
Oct	13	12 30 34.7	-03 24 44	0.73	Vir	15 19 25.6	-19 07 13	1.32	Lib	14 13 26.7	-13 19 47	2.50	Vir	19 02 02.4	-23 00 36	5.14	Sgr
Oct	14	12 29 16.8	-02 55 57	0.75	Vir	15 24 21.1	-19 28 35	1.32	Lib	14 16 05.1	-13 33 56	2.50	Vir	19 02 29.6	-22 59 59	5.15	Sgr
Oct	15	12 28 36.7	-02 32 29	0.77	Vir	15 29 17.8	-19 49 28	1.31	Lib	14 18 43.9	-13 47 59	2.50	Vir	19 02 57.5	-22 59 20	5.17	Sgr
Oct	16	12 28 35.0	-02 14 38	0.80	Vir	15 34 15.7	-20 09 50	1.31	Lib	14 21 23.3	-14 01 57	2.50	Vir	19 03 26.1	-22 58 40	5.18	Sgr
Oct	17	12 29 11.6	-02 02 30	0.82	Vir	15 39 14.7	-20 29 42	1.30	Lib	14 24 03.2	-14 15 50	2.50	Lib	19 03 55.3	-22 57 59	5.20	Sgr
Oct	18	12 30 25.3	-01 56 04	0.85	Vir	15 44 14.9	-20 49 01	1.29	Lib	14 26 43.7	-14 29 37	2.50	Lib	19 04 25.2	-22 57 16	5.21	Sgr
Oct	19	12 32 14.3	-01 55 09	0.87	Vir	15 49 16.2	-21 07 48	1.29	Sco	14 29 24.7	-14 43 18	2.50	Lib	19 04 55.7	-22 56 32	5.23	Sgr
Oct	20	12 34 36.2	-01 59 30	0.90	Vir	15 54 18.7	-21 26 01	1.28	Sco	14 32 06.2	-14 56 53	2.50	Lib	19 05 26.9	-22 55 47	5.25	Sgr
Oct	21	12 37 28.6	-02 08 45	0.93	Vir	15 59 22.3	-21 43 40	1.28	Sco	14 34 48.3	-15 10 22	2.50	Lib	19 05 58.7	-22 55 00	5.26	Sgr
Oct	22	12 40 48.5	-02 22 31	0.96	Vir	16 04 27.0	-22 00 45	1.27	Sco	14 37 31.0	-15 23 44	2.50	Lib	19 06 31.1	-22 54 12	5.28	Sgr
Oct	23	12 44 33.1	-02 40 23	0.99	Vir	16 09 32.8	-22 17 15	1.26	Sco	14 40 14.3	-15 37 01	2.50	Lib	19 07 04.2	-22 53 23	5.29	Sgr
Oct	24	12 48 39.6	-03 01 54	1.01	Vir	16 14 39.7	-22 33 08	1.26	Sco	14 42 58.1	-15 50 11	2.50	Lib	19 07 37.8	-22 52 32	5.30	Sgr
Oct	25	12 53 05.2	-03 26 39	1.04	Vir	16 19 47.6	-22 48 25	1.25	Sco	14 45 42.5	-16 03 14	2.50	Lib	19 08 12.1	-22 51 39	5.32	Sgr
Oct	26	12 57 47.5	-03 54 12	1.07	Vir	16 24 56.5	-23 03 05	1.25	Oph	14 48 27.5	-16 16 10	2.50	Lib	19 08 47.0	-22 50 45	5.33	Sgr
Oct	27	13 02 44.2	-04 24 11	1.09	Vir	16 30 06.3	-23 17 07	1.24	Oph	14 51 13.1	-16 28 60	2.50	Lib	19 09 22.4	-22 49 50	5.35	Sgr
Oct	28	13 07 53.2	-04 56 13	1.12	Vir	16 35 17.1	-23 30 31	1.23	Oph	14 53 59.3	-16 41 42	2.50	Lib	19 09 58.5	-22 48 53	5.36	Sgr
Oct	29	13 13 12.8	-05 29 57	1.14	Vir	16 40 28.8	-23 43 15	1.23	Oph	14 56 46.1	-16 54 17	2.50	Lib	19 10 35.1	-22 47 55	5.38	Sgr
Oct	30	13 18 41.2	-06 05 06	1.16	Vir	16 45 41.4	-23 55 20	1.22	Oph	14 59 33.4	-17 06 44	2.50	Lib	19 11 12.3	-22 46 55	5.39	Sgr
Oct	31	13 24 17.1	-06 41 21	1.18	Vir	16 50 54.7	-24 06 46	1.21	Oph	15 02 21.4	-17 19 04	2.50	Lib	19 11 50.1	-22 45 54	5.41	Sgr
Nov	1	13 29 59.4	-07 18 30	1.21	Vir	16 56 08.8	-24 17 30	1.21	Oph	15 05 09.9	-17 31 15	2.50	Lib	19 12 28.4	-22 44 51	5.42	Sgr
Nov	2	13 35 47.0	-07 56 17	1.23	Vir	17 01 23.6	-24 27 34	1.20	Oph	15 07 59.0	-17 43 19	2.50	Lib	19 13 07.2	-22 43 46	5.44	Sgr
Nov	3	13 41 39.1	-08 34 32	1.24	Vir	17 06 39.1	-24 36 56	1.20	Oph	15 10 48.7	-17 55 15	2.50	Lib	19 13 46.6	-22 42 40	5.45	Sgr
Nov	4	13 47 35.1	-09 13 04	1.26	Vir	17 11 55.1	-24 45 37	1.19	Oph	15 13 39.1	-18 07 02	2.50	Lib	19 14 26.5	-22 41 33	5.46	Sgr
Nov	5	13 53 34.3	-09 51 44	1.28	Vir	17 17 11.7	-24 53 35	1.18	Oph	15 16 30.0	-18 18 41	2.50	Lib	19 15 07.0	-22 40 24	5.48	Sgr
Nov	6	13 59 36.2	-10 30 23	1.30	Vir	17 22 28.7	-25 00 51	1.18	Oph	15 19 21.5	-18 30 11	2.50	Lib	19 15 47.9	-22 39 13	5.49	Sgr
Nov	7	14 05 40.6	-11 08 55	1.31	Vir	17 27 46.1	-25 07 24	1.17	Oph	15 22 13.6	-18 41 32	2.50	Lib	19 16 29.4	-22 38 01	5.51	Sgr
Nov	8	14 11 47.0	-11 47 14	1.32	Vir	17 33 03.8	-25 13 14	1.16	Oph	15 25 06.3	-18 52 44	2.50	Lib	19 17 11.3	-22 36 47	5.52	Sgr
Nov	9	14 17 55.3	-12 25 13	1.34	Vir	17 38 21.8	-25 18 20	1.16	Oph	15 27 59.6	-19 03 48	2.50	Lib	19 17 53.8	-22 35 32	5.53	Sgr
Nov	10	14 24 05.2	-13 02 48	1.35	Lib	17 43 40.0	-25 22 43	1.15	Oph	15 30 53.5	-19 14 41	2.50	Lib	19 18 36.7	-22 34 15	5.55	Sgr
Nov	11	14 30 16.7	-13 39 54	1.36	Lib	17 48 58.3	-25 26 22	1.14	Sgr	15 33 48.0	-19 25 26	2.50	Lib	19 19 20.1	-22 32 57	5.56	Sgr
Nov	12	14 36 29.7	-14 16 28	1.37	Lib	17 54 16.6	-25 29 18	1.14	Sgr	15 36 43.1	-19 36 01	2.50	Lib	19 20 03.9	-22 31 37	5.57	Sgr
Nov	13	14 42 44.0	-14 52 27	1.38	Lib	17 59 35.0	-25 31 29	1.13	Sgr	15 39 38.8	-19 46 26	2.50	Lib	19 20 48.2	-22 30 15	5.59	Sgr
Nov	14	14 48 59.7	-15 27 46	1.39	Lib	18 04 53.2	-25 32 56	1.13	Sgr	15 42 35.0	-19 56 41	2.50	Lib	19 21 33.0	-22 28 52	5.60	Sgr
Nov	15	14 55 16.7	-16 02 24	1.40	Lib	18 10 11.3	-25 33 39	1.12	Sgr	15 45 31.9	-20 06 46	2.50	Lib	19 22 18.1	-22 27 27	5.61	Sgr
Nov	16	15 01 35.0	-16 36 18	1.41	Lib	18 15 29.2	-25 33 38	1.11	Sgr	15 48 29.4	-20 16 40	2.50	Lib	19 23 03.8	-22 25 60	5.62	Sgr
Nov	17	15 07 54.6	-17 09 25	1.42	Lib	18 20 46.7	-25 32 53	1.11	Sgr	15 51 27.5	-20 26 25	2.50	Sco	19 23 49.8	-22 24 32	5.64	Sgr
Nov	18	15 14 15.7	-17 41 43	1.42	Lib	18 26 03.9	-25 31 24	1.10	Sgr	15 54 26.2	-20 35 59	2.50	Sco	19 24 36.2	-22 23 02	5.65	Sgr
Nov	19	15 20 38.0	-18 13 11	1.43	Lib	18 31 20.7	-25 29 10	1.09	Sgr	15 57 25.5	-20 45 22	2.50	Sco	19 25 23.1	-22 21 30	5.66	Sgr
Nov	20	15 27 01.8	-18 43 46	1.43	Lib	18 36 37.0	-25 26 13	1.09	Sgr	16 00 25.4	-20 54 34	2.50	Sco	19 26 10.4	-22 19 57	5.67	Sgr
Nov	21	15 33 27.1	-19 13 27	1.44	Lib	18 41 52.7	-25 22 32	1.08	Sgr	16 03 25.9	-21 03 35	2.49	Sco	19 26 58.1	-22 18 22	5.69	Sgr
Nov	22	15 39 53.8	-19 42 12	1.44	Lib	18 47 07.8	-25 18 08	1.07	Sgr	16 06 27.0	-21 12 25	2.49	Sco	19 27 46.1	-22 16 45	5.70	Sgr
Nov	23	15 46 22.1	-20 09 59	1.44	Lib	18 52 22.1	-25 13 00	1.07	Sgr	16 09 28.7	-21 21 04	2.49	Sco	19 28 34.6	-22 15 07	5.71	Sgr
Nov	24	15 52 51.9	-20 36 47	1.45	Sco	18 57 35.7	-25 07 10	1.06	Sgr	16 12 30.9	-21 29 31	2.49	Sco	19 29 23.4	-22 13 27	5.72	Sgr
Nov	25	15 59 23.3	-21 02 34	1.45	Sco	19 02 48.4	-25 00 36	1.05	Sgr	16 15 33.8	-21 37 46	2.49	Sco	19 30 12.6	-22 11 45	5.73	Sgr
Nov	26	16 05 56.3	-21 27 19	1.45	Sco	19 08 00.2	-24 53 20	1.05	Sgr	16 18 37.2	-21 45 50	2.49	Sco	19 31 02.2	-22 10 02	5.74	Sgr
Nov	27	16 12 30.9	-21 50 60	1.45	Sco	19 13 11.1	-24 45 22	1.04	Sgr	16 21 41.2	-21 53 42	2.49	Sco	19 31 52.1	-22 08 16	5.76	Sgr
Nov	28	16 19 07.1	-22 13 36	1.45	Sco	19 18 20.9	-24 36 42	1.03	Sgr	16 24 45.7	-22 01 21	2.49	Oph	19 32 42.4	-22 06 29	5.77	Sgr
Nov	29	16 25 45.0	-22 35 06	1.45	Oph	19 23 29.5	-24 27 21	1.02	Sgr	16 27 50.8	-22 08 48	2.49	Oph	19 33 33.0	-22 04 41	5.78	Sgr
Nov	30	16 32 24.5	-22 55 27	1.45	Oph	19 28 37.0	-24 17 19	1.02	Sgr	16 30 56.4	-22 16 03	2.48	Oph	19 34 23.9	-22 02 50	5.79	Sgr

GEOCENTRIC PLANET POSITIONS (continued) Note: positions refer to 0000 WAST

MTH	DAY	MERCURY RA h m s	MERCURY Declination ° ′ ″	MERCURY Dist. (AU)	MERCURY Cnst.	VENUS RA h m s	VENUS Declination ° ′ ″	VENUS Dist. (AU)	VENUS Cnst.	MARS RA h m s	MARS Declination ° ′ ″	MARS Dist. (AU)	MARS Cnst.	JUPITER RA h m s	JUPITER Declination ° ′ ″	JUPITER Dist. (AU)	JUPITER Cnst.
Dec	1	16 39 05.6	-23 14 40	1.45	Oph	19 33 43.3	-24 06 36	1.01	Sgr	16 34 02.6	-22 23 05	2.48	Oph	19 35 15.2	-22 00 58	5.80	Sgr
Dec	2	16 45 48.4	-23 32 42	1.45	Oph	19 38 48.3	-23 55 14	1.00	Sgr	16 37 09.2	-22 29 55	2.48	Oph	19 36 06.7	-21 59 04	5.81	Sgr
Dec	3	16 52 32.7	-23 49 31	1.44	Oph	19 43 51.9	-23 43 12	1.00	Sgr	16 40 16.4	-22 36 31	2.48	Oph	19 36 58.6	-21 57 09	5.82	Sgr
Dec	4	16 59 18.6	-24 05 08	1.44	Oph	19 48 54.1	-23 30 32	0.99	Sgr	16 43 24.2	-22 42 55	2.48	Oph	19 37 50.8	-21 55 11	5.83	Sgr
Dec	5	17 06 06.0	-24 19 29	1.44	Oph	19 53 54.8	-23 17 13	0.98	Sgr	16 46 32.4	-22 49 05	2.48	Oph	19 38 43.3	-21 53 12	5.84	Sgr
Dec	6	17 12 54.8	-24 32 35	1.43	Oph	19 58 54.1	-23 03 17	0.98	Sgr	16 49 41.1	-22 55 02	2.48	Oph	19 39 36.0	-21 51 11	5.85	Sgr
Dec	7	17 19 44.9	-24 44 23	1.43	Oph	20 03 51.7	-22 48 45	0.97	Sgr	16 52 50.3	-23 00 45	2.48	Oph	19 40 29.1	-21 49 09	5.86	Sgr
Dec	8	17 26 36.3	-24 54 52	1.42	Oph	20 08 47.8	-22 33 35	0.96	Cap	16 55 59.9	-23 06 15	2.47	Oph	19 41 22.4	-21 47 05	5.87	Sgr
Dec	9	17 33 28.8	-25 04 01	1.42	Oph	20 13 42.2	-22 17 51	0.96	Cap	16 59 10.0	-23 11 32	2.47	Oph	19 42 15.9	-21 44 59	5.88	Sgr
Dec	10	17 40 22.4	-25 11 49	1.41	Oph	20 18 34.9	-22 01 31	0.95	Cap	17 02 20.6	-23 16 34	2.47	Oph	19 43 09.8	-21 42 51	5.89	Sgr
Dec	11	17 47 16.8	-25 18 15	1.40	Sgr	20 23 25.9	-21 44 37	0.94	Cap	17 05 31.6	-23 21 23	2.47	Oph	19 44 03.8	-21 40 42	5.89	Sgr
Dec	12	17 54 12.0	-25 23 16	1.39	Sgr	20 28 15.2	-21 27 10	0.93	Cap	17 08 43.1	-23 25 58	2.47	Oph	19 44 58.1	-21 38 31	5.90	Sgr
Dec	13	18 01 07.7	-25 26 53	1.39	Sgr	20 33 02.6	-21 09 10	0.93	Cap	17 11 54.9	-23 30 18	2.47	Oph	19 45 52.7	-21 36 18	5.91	Sgr
Dec	14	18 08 03.7	-25 29 04	1.38	Sgr	20 37 48.2	-20 50 38	0.92	Cap	17 15 07.2	-23 34 24	2.46	Oph	19 46 47.4	-21 34 03	5.92	Sgr
Dec	15	18 14 59.8	-25 29 47	1.37	Sgr	20 42 32.0	-20 31 35	0.91	Cap	17 18 20.0	-23 38 16	2.46	Oph	19 47 42.4	-21 31 47	5.93	Sgr
Dec	16	18 21 55.7	-25 29 02	1.36	Sgr	20 47 14.0	-20 12 01	0.91	Cap	17 21 33.1	-23 41 54	2.46	Oph	19 48 37.6	-21 29 29	5.94	Sgr
Dec	17	18 28 51.2	-25 26 48	1.35	Sgr	20 51 54.0	-19 51 57	0.90	Cap	17 24 46.6	-23 45 16	2.46	Oph	19 49 33.1	-21 27 10	5.94	Sgr
Dec	18	18 35 45.9	-25 23 05	1.33	Sgr	20 56 32.2	-19 31 24	0.89	Cap	17 28 00.5	-23 48 24	2.46	Oph	19 50 28.7	-21 24 49	5.95	Sgr
Dec	19	18 42 39.4	-25 17 51	1.32	Sgr	21 01 08.4	-19 10 23	0.88	Cap	17 31 14.7	-23 51 18	2.46	Oph	19 51 24.5	-21 22 26	5.96	Sgr
Dec	20	18 49 31.3	-25 11 06	1.31	Sgr	21 05 42.8	-18 48 55	0.88	Cap	17 34 29.3	-23 53 56	2.45	Oph	19 52 20.5	-21 20 01	5.97	Sgr
Dec	21	18 56 21.1	-25 02 51	1.29	Sgr	21 10 15.2	-18 26 59	0.87	Cap	17 37 44.3	-23 56 20	2.45	Oph	19 53 16.7	-21 17 34	5.97	Sgr
Dec	22	19 03 08.3	-24 53 04	1.28	Sgr	21 14 45.7	-18 04 38	0.86	Cap	17 40 59.5	-23 58 28	2.45	Oph	19 54 13.1	-21 15 06	5.98	Sgr
Dec	23	19 09 52.4	-24 41 47	1.26	Sgr	21 19 14.2	-17 41 51	0.86	Cap	17 44 15.1	-24 00 21	2.45	Sgr	19 55 09.6	-21 12 37	5.99	Sgr
Dec	24	19 16 32.5	-24 29 00	1.25	Sgr	21 23 40.7	-17 18 40	0.85	Cap	17 47 31.0	-24 01 60	2.45	Sgr	19 56 06.4	-21 10 05	5.99	Sgr
Dec	25	19 23 08.0	-24 14 45	1.23	Sgr	21 28 05.3	-16 55 06	0.84	Cap	17 50 47.2	-24 03 22	2.44	Sgr	19 57 03.2	-21 07 32	6.00	Sgr
Dec	26	19 29 38.1	-23 59 02	1.21	Sgr	21 32 27.9	-16 31 09	0.83	Cap	17 54 03.7	-24 04 30	2.44	Sgr	19 58 00.3	-21 04 58	6.01	Sgr
Dec	27	19 36 01.6	-23 41 55	1.19	Sgr	21 36 48.5	-16 06 50	0.83	Cap	17 57 20.4	-24 05 22	2.44	Sgr	19 58 57.4	-21 02 21	6.01	Sgr
Dec	28	19 42 17.6	-23 23 26	1.17	Sgr	21 41 07.1	-15 42 10	0.82	Cap	18 00 37.3	-24 05 58	2.44	Sgr	19 59 54.8	-20 59 43	6.02	Sgr
Dec	29	19 48 24.8	-23 03 39	1.15	Sgr	21 45 23.6	-15 17 09	0.81	Cap	18 03 54.5	-24 06 19	2.44	Sgr	20 00 52.2	-20 57 04	6.02	Sgr
Dec	30	19 54 21.7	-22 42 38	1.13	Sgr	21 49 38.2	-14 51 49	0.81	Cap	18 07 11.8	-24 06 25	2.43	Sgr	20 01 49.8	-20 54 22	6.03	Sgr
Dec	31	20 00 06.9	-22 20 30	1.11	Sgr	21 53 50.7	-14 26 11	0.80	Cap	18 10 29.4	-24 06 14	2.43	Sgr	20 02 47.5	-20 51 40	6.03	Sgr

GEOCENTRIC PLANET POSITIONS (EPOCH J2000.0) Note: positions refer to 0000 WAST

MTH	DAY	SATURN RA h m s	SATURN Declination ° ′ ″	SATURN Dist. (AU)	SATURN Cnst.	URANUS RA h m s	URANUS Declination ° ′ ″	URANUS Dist. (AU)	URANUS Cnst.	NEPTUNE RA h m s	NEPTUNE Declination ° ′ ″	NEPTUNE Dist. (AU)	NEPTUNE Cnst.
Jan	1	10 42 23.0	+10 00 38	8.7	Leo	23 06 50.3	-06 30 41	20.5	Aqr	21 30 32.7	-15 02 39	30.8	Cap
Jan	2	10 42 18.2	+10 01 22	8.7	Leo	23 06 57.2	-06 29 56	20.5	Aqr	21 30 39.9	-15 02 04	30.8	Cap
Jan	3	10 42 12.9	+10 02 10	8.7	Leo	23 07 04.2	-06 29 10	20.5	Aqr	21 30 47.3	-15 01 29	30.8	Cap
Jan	4	10 42 07.2	+10 02 59	8.7	Leo	23 07 11.3	-06 28 23	20.5	Aqr	21 30 54.7	-15 00 53	30.8	Cap
Jan	5	10 42 01.2	+10 03 51	8.7	Leo	23 07 18.6	-06 27 34	20.5	Aqr	21 31 02.2	-15 00 17	30.8	Cap
Jan	6	10 41 54.7	+10 04 45	8.7	Leo	23 07 26.1	-06 26 45	20.6	Aqr	21 31 09.7	-14 59 41	30.8	Cap
Jan	7	10 41 47.8	+10 05 41	8.6	Leo	23 07 33.8	-06 25 55	20.6	Aqr	21 31 17.4	-14 59 05	30.8	Cap
Jan	8	10 41 40.6	+10 06 39	8.6	Leo	23 07 41.6	-06 25 04	20.6	Aqr	21 31 25.1	-14 58 28	30.9	Cap
Jan	9	10 41 33.0	+10 07 40	8.6	Leo	23 07 49.5	-06 24 12	20.6	Aqr	21 31 32.9	-14 57 50	30.9	Cap
Jan	10	10 41 24.9	+10 08 43	8.6	Leo	23 07 57.6	-06 23 20	20.6	Aqr	21 31 40.7	-14 57 12	30.9	Cap
Jan	11	10 41 16.5	+10 09 48	8.6	Leo	23 08 05.8	-06 22 26	20.6	Aqr	21 31 48.6	-14 56 34	30.9	Cap
Jan	12	10 41 07.7	+10 10 55	8.6	Leo	23 08 14.2	-06 21 31	20.6	Aqr	21 31 56.6	-14 55 56	30.9	Cap
Jan	13	10 40 58.6	+10 12 04	8.6	Leo	23 08 22.7	-06 20 36	20.7	Aqr	21 32 04.6	-14 55 17	30.9	Cap
Jan	14	10 40 49.1	+10 13 15	8.5	Leo	23 08 31.4	-06 19 39	20.7	Aqr	21 32 12.7	-14 54 38	30.9	Cap
Jan	15	10 40 39.2	+10 14 29	8.5	Leo	23 08 40.2	-06 18 42	20.7	Aqr	21 32 20.9	-14 53 59	30.9	Cap
Jan	16	10 40 29.0	+10 15 44	8.5	Leo	23 08 49.2	-06 17 44	20.7	Aqr	21 32 29.1	-14 53 20	30.9	Cap
Jan	17	10 40 18.4	+10 17 01	8.5	Leo	23 08 58.2	-06 16 45	20.7	Aqr	21 32 37.3	-14 52 40	30.9	Cap
Jan	18	10 40 07.5	+10 18 20	8.5	Leo	23 09 07.5	-06 15 45	20.7	Aqr	21 32 45.6	-14 51 60	30.9	Cap
Jan	19	10 39 56.2	+10 19 40	8.5	Leo	23 09 16.8	-06 14 45	20.7	Aqr	21 32 54.0	-14 51 20	30.9	Cap
Jan	20	10 39 44.6	+10 21 03	8.5	Leo	23 09 26.3	-06 13 44	20.8	Aqr	21 33 02.4	-14 50 39	31.0	Cap
Jan	21	10 39 32.7	+10 22 27	8.5	Leo	23 09 35.9	-06 12 41	20.8	Aqr	21 33 10.9	-14 49 58	31.0	Cap
Jan	22	10 39 20.5	+10 23 53	8.5	Leo	23 09 45.6	-06 11 39	20.8	Aqr	21 33 19.4	-14 49 17	31.0	Cap
Jan	23	10 39 08.0	+10 25 20	8.5	Leo	23 09 55.4	-06 10 35	20.8	Aqr	21 33 27.9	-14 48 36	31.0	Cap
Jan	24	10 38 55.1	+10 26 49	8.4	Leo	23 10 05.4	-06 09 31	20.8	Aqr	21 33 36.5	-14 47 55	31.0	Cap
Jan	25	10 38 42.0	+10 28 20	8.4	Leo	23 10 15.4	-06 08 26	20.8	Aqr	21 33 45.1	-14 47 13	31.0	Cap
Jan	26	10 38 28.5	+10 29 52	8.4	Leo	23 10 25.6	-06 07 20	20.8	Aqr	21 33 53.7	-14 46 31	31.0	Cap
Jan	27	10 38 14.8	+10 31 26	8.4	Leo	23 10 35.9	-06 06 14	20.8	Aqr	21 34 02.4	-14 45 49	31.0	Cap
Jan	28	10 38 00.8	+10 33 01	8.4	Leo	23 10 46.3	-06 05 07	20.8	Aqr	21 34 11.1	-14 45 07	31.0	Cap
Jan	29	10 37 46.5	+10 34 37	8.4	Leo	23 10 56.8	-06 03 59	20.9	Aqr	21 34 19.9	-14 44 25	31.0	Cap
Jan	30	10 37 32.0	+10 36 15	8.4	Leo	23 11 07.5	-06 02 51	20.9	Aqr	21 34 28.6	-14 43 42	31.0	Cap
Jan	31	10 37 17.2	+10 37 54	8.4	Leo	23 11 18.2	-06 01 42	20.9	Aqr	21 34 37.4	-14 42 60	31.0	Cap

GEOCENTRIC PLANET POSITIONS (continued)

MTH	DAY	SATURN RA h	m	s	Declination °	′	″	Dist. (AU)	Cnst.	URANUS RA h	m	s	Declination °	′	″	Dist. (AU)	Cnst.	NEPTUNE RA h	m	s	Declination °	′	″	Dist. (AU)	Cnst.
Feb	1	10	37	02.1	+10	39	35	8.4	Leo	23	11	29.0	-06	00	32	20.9	Aqr	21	34	46.2	-14	42	17	31.0	Cap
Feb	2	10	36	46.8	+10	41	16	8.4	Leo	23	11	39.9	-05	59	22	20.9	Aqr	21	34	55.1	-14	41	34	31.0	Cap
Feb	3	10	36	31.3	+10	42	59	8.4	Leo	23	11	50.9	-05	58	11	20.9	Aqr	21	35	03.9	-14	40	51	31.0	Cap
Feb	4	10	36	15.5	+10	44	42	8.4	Leo	23	12	02.1	-05	56	60	20.9	Aqr	21	35	12.8	-14	40	08	31.0	Cap
Feb	5	10	35	59.6	+10	46	27	8.4	Leo	23	12	13.3	-05	55	48	20.9	Aqr	21	35	21.7	-14	39	25	31.0	Cap
Feb	6	10	35	43.4	+10	48	12	8.3	Leo	23	12	24.5	-05	54	35	20.9	Aqr	21	35	30.6	-14	38	42	31.0	Cap
Feb	7	10	35	27.0	+10	49	59	8.3	Leo	23	12	35.9	-05	53	22	20.9	Aqr	21	35	39.5	-14	37	58	31.0	Cap
Feb	8	10	35	10.5	+10	51	46	8.3	Leo	23	12	47.4	-05	52	09	21.0	Aqr	21	35	48.4	-14	37	15	31.0	Cap
Feb	9	10	34	53.7	+10	53	34	8.3	Leo	23	12	58.9	-05	50	55	21.0	Aqr	21	35	57.4	-14	36	32	31.0	Cap
Feb	10	10	34	36.8	+10	55	22	8.3	Leo	23	13	10.5	-05	49	40	21.0	Aqr	21	36	06.3	-14	35	48	31.0	Cap
Feb	11	10	34	19.8	+10	57	12	8.3	Leo	23	13	22.2	-05	48	26	21.0	Aqr	21	36	15.2	-14	35	05	31.0	Cap
Feb	12	10	34	02.5	+10	59	01	8.3	Leo	23	13	34.0	-05	47	10	21.0	Aqr	21	36	24.2	-14	34	21	31.0	Cap
Feb	13	10	33	45.2	+11	00	52	8.3	Leo	23	13	45.8	-05	45	54	21.0	Aqr	21	36	33.1	-14	33	38	31.0	Cap
Feb	14	10	33	27.7	+11	02	42	8.3	Leo	23	13	57.7	-05	44	38	21.0	Aqr	21	36	42.0	-14	32	54	31.0	Cap
Feb	15	10	33	10.1	+11	04	33	8.3	Leo	23	14	09.7	-05	43	22	21.0	Aqr	21	36	51.0	-14	32	11	31.0	Cap
Feb	16	10	32	52.4	+11	06	24	8.3	Leo	23	14	21.7	-05	42	05	21.0	Aqr	21	36	59.9	-14	31	28	31.0	Cap
Feb	17	10	32	34.6	+11	08	16	8.3	Leo	23	14	33.8	-05	40	48	21.0	Aqr	21	37	08.8	-14	30	44	31.0	Cap
Feb	18	10	32	16.7	+11	10	08	8.3	Leo	23	14	45.9	-05	39	30	21.0	Aqr	21	37	17.7	-14	30	01	31.0	Cap
Feb	19	10	31	58.8	+11	11	60	8.3	Leo	23	14	58.1	-05	38	12	21.0	Aqr	21	37	26.5	-14	29	18	31.0	Cap
Feb	20	10	31	40.7	+11	13	51	8.3	Leo	23	15	10.3	-05	36	54	21.0	Aqr	21	37	35.4	-14	28	34	31.0	Cap
Feb	21	10	31	22.6	+11	15	43	8.3	Leo	23	15	22.6	-05	35	36	21.0	Aqr	21	37	44.2	-14	27	51	31.0	Cap
Feb	22	10	31	04.5	+11	17	35	8.3	Leo	23	15	34.9	-05	34	17	21.0	Aqr	21	37	53.0	-14	27	08	31.0	Cap
Feb	23	10	30	46.3	+11	19	27	8.3	Leo	23	15	47.3	-05	32	58	21.1	Aqr	21	38	01.8	-14	26	25	31.0	Cap
Feb	24	10	30	28.1	+11	21	18	8.3	Leo	23	15	59.7	-05	31	39	21.1	Aqr	21	38	10.6	-14	25	43	31.0	Cap
Feb	25	10	30	09.9	+11	23	09	8.3	Leo	23	16	12.1	-05	30	19	21.1	Aqr	21	38	19.4	-14	24	60	31.0	Cap
Feb	26	10	29	51.7	+11	25	00	8.3	Leo	23	16	24.6	-05	28	60	21.1	Aqr	21	38	28.1	-14	24	17	31.0	Cap
Feb	27	10	29	33.4	+11	26	51	8.3	Leo	23	16	37.1	-05	27	40	21.1	Aqr	21	38	36.8	-14	23	35	31.0	Cap
Feb	28	10	29	15.2	+11	28	41	8.3	Leo	23	16	49.7	-05	26	20	21.1	Aqr	21	38	45.4	-14	22	52	31.0	Cap
Feb	29	10	28	57.0	+11	30	31	8.3	Leo	23	17	02.2	-05	24	60	21.1	Aqr	21	38	54.0	-14	22	10	31.0	Cap
Mar	1	10	28	38.8	+11	32	20	8.3	Leo	23	17	14.8	-05	23	40	21.1	Aqr	21	39	02.6	-14	21	28	31.0	Cap
Mar	2	10	28	20.7	+11	34	08	8.3	Leo	23	17	27.5	-05	22	19	21.1	Aqr	21	39	11.2	-14	20	46	31.0	Cap
Mar	3	10	28	02.6	+11	35	56	8.3	Leo	23	17	40.1	-05	20	59	21.1	Aqr	21	39	19.7	-14	20	05	31.0	Cap
Mar	4	10	27	44.6	+11	37	43	8.3	Leo	23	17	52.7	-05	19	38	21.1	Aqr	21	39	28.1	-14	19	23	31.0	Cap
Mar	5	10	27	26.7	+11	39	30	8.3	Leo	23	18	05.4	-05	18	17	21.1	Aqr	21	39	36.6	-14	18	42	31.0	Cap
Mar	6	10	27	08.8	+11	41	15	8.3	Leo	23	18	18.1	-05	16	57	21.1	Aqr	21	39	44.9	-14	18	01	31.0	Cap
Mar	7	10	26	51.1	+11	42	60	8.3	Leo	23	18	30.8	-05	15	36	21.1	Aqr	21	39	53.3	-14	17	20	30.9	Cap
Mar	8	10	26	33.4	+11	44	44	8.3	Leo	23	18	43.5	-05	14	15	21.1	Aqr	21	40	01.6	-14	16	40	30.9	Cap
Mar	9	10	26	15.9	+11	46	26	8.3	Leo	23	18	56.2	-05	12	54	21.1	Aqr	21	40	09.8	-14	15	60	30.9	Cap
Mar	10	10	25	58.5	+11	48	08	8.3	Leo	23	19	08.9	-05	11	34	21.1	Aqr	21	40	18.0	-14	15	19	30.9	Cap
Mar	11	10	25	41.2	+11	49	49	8.3	Leo	23	19	21.6	-05	10	13	21.1	Aqr	21	40	26.1	-14	14	40	30.9	Cap
Mar	12	10	25	24.1	+11	51	28	8.3	Leo	23	19	34.3	-05	08	52	21.1	Aqr	21	40	34.1	-14	14	00	30.9	Cap
Mar	13	10	25	07.1	+11	53	06	8.3	Leo	23	19	46.9	-05	07	32	21.1	Aqr	21	40	42.1	-14	13	21	30.9	Cap
Mar	14	10	24	50.3	+11	54	43	8.3	Leo	23	19	59.6	-05	06	11	21.1	Aqr	21	40	50.1	-14	12	42	30.9	Cap
Mar	15	10	24	33.7	+11	56	18	8.3	Leo	23	20	12.3	-05	04	51	21.1	Aqr	21	40	58.0	-14	12	04	30.9	Cap
Mar	16	10	24	17.3	+11	57	52	8.4	Leo	23	20	24.9	-05	03	30	21.1	Aqr	21	41	05.8	-14	11	25	30.9	Cap
Mar	17	10	24	01.0	+11	59	25	8.4	Leo	23	20	37.5	-05	02	10	21.1	Aqr	21	41	13.5	-14	10	47	30.9	Cap
Mar	18	10	23	45.0	+12	00	56	8.4	Leo	23	20	50.1	-05	00	50	21.1	Aqr	21	41	21.2	-14	10	10	30.9	Cap
Mar	19	10	23	29.1	+12	02	26	8.4	Leo	23	21	02.7	-04	59	31	21.1	Aqr	21	41	28.8	-14	09	32	30.8	Cap
Mar	20	10	23	13.5	+12	03	54	8.4	Leo	23	21	15.3	-04	58	11	21.1	Aqr	21	41	36.3	-14	08	55	30.8	Cap
Mar	21	10	22	58.1	+12	05	21	8.4	Leo	23	21	27.8	-04	56	52	21.1	Aqr	21	41	43.8	-14	08	19	30.8	Cap
Mar	22	10	22	42.9	+12	06	46	8.4	Leo	23	21	40.3	-04	55	32	21.1	Aqr	21	41	51.2	-14	07	43	30.8	Cap
Mar	23	10	22	28.0	+12	08	09	8.4	Leo	23	21	52.7	-04	54	13	21.1	Aqr	21	41	58.5	-14	07	07	30.8	Cap
Mar	24	10	22	13.3	+12	09	31	8.4	Leo	23	22	05.1	-04	52	55	21.1	Aqr	21	42	05.8	-14	06	31	30.8	Cap
Mar	25	10	21	58.9	+12	10	51	8.4	Leo	23	22	17.5	-04	51	36	21.1	Aqr	21	42	12.9	-14	05	56	30.8	Cap
Mar	26	10	21	44.7	+12	12	09	8.4	Leo	23	22	29.9	-04	50	18	21.1	Aqr	21	42	20.0	-14	05	22	30.8	Cap
Mar	27	10	21	30.8	+12	13	25	8.4	Leo	23	22	42.2	-04	49	00	21.1	Aqr	21	42	27.0	-14	04	47	30.8	Cap
Mar	28	10	21	17.2	+12	14	40	8.5	Leo	23	22	54.4	-04	47	43	21.0	Aqr	21	42	33.9	-14	04	13	30.7	Cap
Mar	29	10	21	03.8	+12	15	53	8.5	Leo	23	23	06.6	-04	46	25	21.0	Aqr	21	42	40.8	-14	03	40	30.7	Cap
Mar	30	10	20	50.8	+12	17	04	8.5	Leo	23	23	18.8	-04	45	08	21.0	Aqr	21	42	47.5	-14	03	07	30.7	Cap
Mar	31	10	20	38.0	+12	18	12	8.5	Leo	23	23	30.9	-04	43	52	21.0	Aqr	21	42	54.2	-14	02	34	30.7	Cap
Apr	1	10	20	25.6	+12	19	19	8.5	Leo	23	23	42.9	-04	42	36	21.0	Aqr	21	43	00.7	-14	02	02	30.7	Cap
Apr	2	10	20	13.4	+12	20	24	8.5	Leo	23	23	54.9	-04	41	20	21.0	Aqr	21	43	07.2	-14	01	31	30.7	Cap
Apr	3	10	20	01.6	+12	21	27	8.5	Leo	23	24	06.9	-04	40	04	21.0	Aqr	21	43	13.6	-14	00	59	30.7	Cap
Apr	4	10	19	50.1	+12	22	28	8.5	Leo	23	24	18.7	-04	38	49	21.0	Aqr	21	43	19.9	-14	00	29	30.7	Cap
Apr	5	10	19	38.9	+12	23	27	8.5	Leo	23	24	30.5	-04	37	35	21.0	Aqr	21	43	26.1	-13	59	58	30.6	Cap
Apr	6	10	19	28.1	+12	24	24	8.5	Leo	23	24	42.3	-04	36	21	21.0	Aqr	21	43	32.2	-13	59	29	30.6	Cap
Apr	7	10	19	17.6	+12	25	19	8.6	Leo	23	24	53.9	-04	35	07	21.0	Aqr	21	43	38.2	-13	58	59	30.6	Cap

GEOCENTRIC PLANET POSITIONS (EPOCH J2000.0) Note: positions refer to 0000 WAST

MTH	DAY	SATURN RA h	m	s	Declination °	′	″	Dist. (AU)	Cnst.	URANUS RA h	m	s	Declination °	′	″	Dist. (AU)	Cnst.	NEPTUNE RA h	m	s	Declination °	′	″	Dist. (AU)	Cnst.
Apr	8	10	19	07.4	+12	26	11	8.6	Leo	23	25	05.5	-04	33	54	21.0	Aqr	21	43	44.1	-13	58	30	30.6	Cap
Apr	9	10	18	57.6	+12	27	01	8.6	Leo	23	25	17.0	-04	32	42	21.0	Aqr	21	43	49.9	-13	58	02	30.6	Cap
Apr	10	10	18	48.1	+12	27	50	8.6	Leo	23	25	28.5	-04	31	29	21.0	Aqr	21	43	55.6	-13	57	34	30.6	Cap
Apr	11	10	18	39.0	+12	28	35	8.6	Leo	23	25	39.8	-04	30	18	21.0	Aqr	21	44	01.2	-13	57	07	30.6	Cap
Apr	12	10	18	30.3	+12	29	19	8.6	Leo	23	25	51.1	-04	29	07	20.9	Aqr	21	44	06.7	-13	56	41	30.6	Cap
Apr	13	10	18	21.9	+12	30	01	8.6	Leo	23	26	02.3	-04	27	56	20.9	Aqr	21	44	12.1	-13	56	14	30.5	Cap
Apr	14	10	18	13.9	+12	30	40	8.6	Leo	23	26	13.4	-04	26	47	20.9	Aqr	21	44	17.4	-13	55	49	30.5	Cap
Apr	15	10	18	06.3	+12	31	17	8.7	Leo	23	26	24.4	-04	25	37	20.9	Aqr	21	44	22.5	-13	55	24	30.5	Cap
Apr	16	10	17	59.1	+12	31	52	8.7	Leo	23	26	35.3	-04	24	29	20.9	Aqr	21	44	27.6	-13	54	59	30.5	Cap
Apr	17	10	17	52.2	+12	32	24	8.7	Leo	23	26	46.2	-04	23	21	20.9	Aqr	21	44	32.6	-13	54	35	30.5	Cap
Apr	18	10	17	45.7	+12	32	54	8.7	Leo	23	26	56.9	-04	22	13	20.9	Aqr	21	44	37.4	-13	54	12	30.5	Cap
Apr	19	10	17	39.6	+12	33	22	8.7	Leo	23	27	07.5	-04	21	06	20.9	Aqr	21	44	42.1	-13	53	49	30.4	Cap
Apr	20	10	17	33.9	+12	33	48	8.7	Leo	23	27	18.1	-04	20	00	20.9	Aqr	21	44	46.8	-13	53	27	30.4	Cap
Apr	21	10	17	28.6	+12	34	11	8.7	Leo	23	27	28.5	-04	18	55	20.9	Aqr	21	44	51.3	-13	53	05	30.4	Cap
Apr	22	10	17	23.6	+12	34	32	8.8	Leo	23	27	38.9	-04	17	50	20.8	Aqr	21	44	55.7	-13	52	44	30.4	Cap
Apr	23	10	17	19.1	+12	34	51	8.8	Leo	23	27	49.1	-04	16	46	20.8	Aqr	21	44	60.0	-13	52	23	30.4	Cap
Apr	24	10	17	14.9	+12	35	07	8.8	Leo	23	27	59.2	-04	15	43	20.8	Aqr	21	45	04.1	-13	52	03	30.4	Cap
Apr	25	10	17	11.2	+12	35	21	8.8	Leo	23	28	09.2	-04	14	40	20.8	Aqr	21	45	08.2	-13	51	44	30.4	Cap
Apr	26	10	17	07.8	+12	35	33	8.8	Leo	23	28	19.1	-04	13	38	20.8	Aqr	21	45	12.1	-13	51	25	30.3	Cap
Apr	27	10	17	04.9	+12	35	43	8.8	Leo	23	28	28.9	-04	12	37	20.8	Aqr	21	45	15.9	-13	51	07	30.3	Cap
Apr	28	10	17	02.3	+12	35	50	8.8	Leo	23	28	38.6	-04	11	37	20.8	Aqr	21	45	19.6	-13	50	49	30.3	Cap
Apr	29	10	17	00.1	+12	35	55	8.9	Leo	23	28	48.1	-04	10	37	20.8	Aqr	21	45	23.2	-13	50	32	30.3	Cap
Apr	30	10	16	58.4	+12	35	57	8.9	Leo	23	28	57.6	-04	09	38	20.8	Aqr	21	45	26.7	-13	50	16	30.3	Cap
May	1	10	16	57.0	+12	35	57	8.9	Leo	23	29	06.9	-04	08	40	20.7	Aqr	21	45	30.0	-13	50	00	30.3	Cap
May	2	10	16	56.1	+12	35	55	8.9	Leo	23	29	16.1	-04	07	43	20.7	Aqr	21	45	33.2	-13	49	45	30.2	Cap
May	3	10	16	55.5	+12	35	51	8.9	Leo	23	29	25.2	-04	06	46	20.7	Aqr	21	45	36.3	-13	49	31	30.2	Cap
May	4	10	16	55.4	+12	35	44	8.9	Leo	23	29	34.1	-04	05	51	20.7	Aqr	21	45	39.3	-13	49	17	30.2	Cap
May	5	10	16	55.6	+12	35	35	9.0	Leo	23	29	42.9	-04	04	56	20.7	Aqr	21	45	42.1	-13	49	04	30.2	Cap
May	6	10	16	56.3	+12	35	23	9.0	Leo	23	29	51.6	-04	04	02	20.7	Aqr	21	45	44.8	-13	48	51	30.2	Cap
May	7	10	16	57.4	+12	35	09	9.0	Leo	23	30	00.1	-04	03	09	20.7	Aqr	21	45	47.4	-13	48	39	30.2	Cap
May	8	10	16	58.9	+12	34	53	9.0	Leo	23	30	08.5	-04	02	17	20.6	Aqr	21	45	49.9	-13	48	28	30.1	Cap
May	9	10	17	00.8	+12	34	35	9.0	Leo	23	30	16.8	-04	01	26	20.6	Aqr	21	45	52.2	-13	48	17	30.1	Cap
May	10	10	17	03.1	+12	34	14	9.0	Leo	23	30	25.0	-04	00	35	20.6	Aqr	21	45	54.5	-13	48	07	30.1	Cap
May	11	10	17	05.8	+12	33	51	9.0	Leo	23	30	33.0	-03	59	46	20.6	Aqr	21	45	56.6	-13	47	58	30.1	Cap
May	12	10	17	08.9	+12	33	26	9.1	Leo	23	30	40.8	-03	58	58	20.6	Aqr	21	45	58.5	-13	47	49	30.1	Cap
May	13	10	17	12.4	+12	32	58	9.1	Leo	23	30	48.5	-03	58	10	20.6	Aqr	21	46	00.4	-13	47	41	30.1	Cap
May	14	10	17	16.3	+12	32	28	9.1	Leo	23	30	56.1	-03	57	23	20.6	Aqr	21	46	02.1	-13	47	34	30.0	Cap
May	15	10	17	20.6	+12	31	56	9.1	Leo	23	31	03.5	-03	56	38	20.5	Aqr	21	46	03.7	-13	47	27	30.0	Cap
May	16	10	17	25.3	+12	31	22	9.1	Leo	23	31	10.8	-03	55	53	20.5	Aqr	21	46	05.1	-13	47	21	30.0	Cap
May	17	10	17	30.4	+12	30	45	9.1	Leo	23	31	17.9	-03	55	09	20.5	Aqr	21	46	06.4	-13	47	16	30.0	Cap
May	18	10	17	35.9	+12	30	07	9.2	Leo	23	31	24.9	-03	54	27	20.5	Aqr	21	46	07.6	-13	47	11	30.0	Cap
May	19	10	17	41.7	+12	29	26	9.2	Leo	23	31	31.7	-03	53	45	20.5	Aqr	21	46	08.7	-13	47	07	30.0	Cap
May	20	10	17	48.0	+12	28	43	9.2	Leo	23	31	38.4	-03	53	04	20.5	Aqr	21	46	09.7	-13	47	03	29.9	Cap
May	21	10	17	54.7	+12	27	57	9.2	Leo	23	31	44.9	-03	52	25	20.5	Aqr	21	46	10.5	-13	47	01	29.9	Cap
May	22	10	18	01.7	+12	27	10	9.2	Leo	23	31	51.3	-03	51	46	20.4	Aqr	21	46	11.2	-13	46	58	29.9	Cap
May	23	10	18	09.1	+12	26	20	9.2	Leo	23	31	57.5	-03	51	08	20.4	Aqr	21	46	11.8	-13	46	57	29.9	Cap
May	24	10	18	16.9	+12	25	29	9.3	Leo	23	32	03.5	-03	50	31	20.4	Aqr	21	46	12.2	-13	46	56	29.9	Cap
May	25	10	18	25.1	+12	24	35	9.3	Leo	23	32	09.4	-03	49	56	20.4	Aqr	21	46	12.5	-13	46	56	29.9	Cap
May	26	10	18	33.6	+12	23	39	9.3	Leo	23	32	15.1	-03	49	21	20.4	Aqr	21	46	12.7	-13	46	56	29.8	Cap
May	27	10	18	42.5	+12	22	41	9.3	Leo	23	32	20.7	-03	48	48	20.4	Aqr	21	46	12.8	-13	46	57	29.8	Cap
May	28	10	18	51.8	+12	21	41	9.3	Leo	23	32	26.1	-03	48	15	20.3	Aqr	21	46	12.7	-13	46	59	29.8	Cap
May	29	10	19	01.5	+12	20	39	9.3	Leo	23	32	31.4	-03	47	44	20.3	Aqr	21	46	12.5	-13	47	01	29.8	Cap
May	30	10	19	11.5	+12	19	34	9.4	Leo	23	32	36.4	-03	47	13	20.3	Aqr	21	46	12.2	-13	47	04	29.8	Cap
May	31	10	19	21.9	+12	18	28	9.4	Leo	23	32	41.3	-03	46	44	20.3	Aqr	21	46	11.8	-13	47	08	29.8	Cap
Jun	1	10	19	32.6	+12	17	20	9.4	Leo	23	32	46.1	-03	46	16	20.3	Aqr	21	46	11.2	-13	47	12	29.7	Cap
Jun	2	10	19	43.8	+12	16	09	9.4	Leo	23	32	50.7	-03	45	49	20.3	Aqr	21	46	10.5	-13	47	17	29.7	Cap
Jun	3	10	19	55.2	+12	14	57	9.4	Leo	23	32	55.1	-03	45	23	20.2	Aqr	21	46	09.7	-13	47	23	29.7	Cap
Jun	4	10	20	07.1	+12	13	43	9.4	Leo	23	32	59.3	-03	44	58	20.2	Aqr	21	46	08.7	-13	47	29	29.7	Cap
Jun	5	10	20	19.2	+12	12	26	9.5	Leo	23	33	03.4	-03	44	34	20.2	Aqr	21	46	07.7	-13	47	36	29.7	Cap
Jun	6	10	20	31.8	+12	11	08	9.5	Leo	23	33	07.3	-03	44	12	20.2	Aqr	21	46	06.5	-13	47	43	29.7	Cap
Jun	7	10	20	44.6	+12	09	48	9.5	Leo	23	33	11.0	-03	43	50	20.2	Aqr	21	46	05.2	-13	47	51	29.6	Cap
Jun	8	10	20	57.8	+12	08	26	9.5	Leo	23	33	14.5	-03	43	30	20.2	Aqr	21	46	03.7	-13	48	00	29.6	Cap
Jun	9	10	21	11.4	+12	07	02	9.5	Leo	23	33	17.9	-03	43	10	20.1	Aqr	21	46	02.2	-13	48	09	29.6	Cap
Jun	10	10	21	25.3	+12	05	36	9.5	Leo	23	33	21.1	-03	42	52	20.1	Aqr	21	46	00.5	-13	48	19	29.6	Cap
Jun	11	10	21	39.5	+12	04	08	9.6	Leo	23	33	24.1	-03	42	35	20.1	Aqr	21	45	58.7	-13	48	30	29.6	Cap
Jun	12	10	21	54.0	+12	02	38	9.6	Leo	23	33	26.9	-03	42	20	20.1	Aqr	21	45	56.8	-13	48	41	29.6	Cap
Jun	13	10	22	08.9	+12	01	07	9.6	Leo	23	33	29.6	-03	42	05	20.1	Aqr	21	45	54.8	-13	48	53	29.6	Cap

GEOCENTRIC PLANET POSITIONS (continued)

MTH	DAY	SATURN								URANUS								NEPTUNE							
		RA h	m	s	Declination °	′	″	Dist. (AU)	Cnst.	RA h	m	s	Declination °	′	″	Dist. (AU)	Cnst.	RA h	m	s	Declination °	′	″	Dist. (AU)	Cnst.
Jun	14	10	22	24.1	+11	59	34	9.6	Leo	23	33	32.1	-03	41	51	20.1	Aqr	21	45	52.6	-13	49	05	29.5	Cap
Jun	15	10	22	39.6	+11	57	59	9.6	Leo	23	33	34.4	-03	41	39	20.0	Aqr	21	45	50.3	-13	49	18	29.5	Cap
Jun	16	10	22	55.4	+11	56	22	9.6	Leo	23	33	36.6	-03	41	28	20.0	Aqr	21	45	48.0	-13	49	32	29.5	Cap
Jun	17	10	23	11.5	+11	54	44	9.7	Leo	23	33	38.5	-03	41	17	20.0	Aqr	21	45	45.5	-13	49	46	29.5	Cap
Jun	18	10	23	27.9	+11	53	03	9.7	Leo	23	33	40.3	-03	41	08	20.0	Aqr	21	45	42.9	-13	50	00	29.5	Cap
Jun	19	10	23	44.6	+11	51	22	9.7	Leo	23	33	41.9	-03	41	00	20.0	Aqr	21	45	40.2	-13	50	15	29.5	Cap
Jun	20	10	24	01.6	+11	49	38	9.7	Leo	23	33	43.3	-03	40	54	20.0	Aqr	21	45	37.3	-13	50	31	29.4	Cap
Jun	21	10	24	18.9	+11	47	53	9.7	Leo	23	33	44.6	-03	40	48	19.9	Aqr	21	45	34.4	-13	50	48	29.4	Cap
Jun	22	10	24	36.5	+11	46	06	9.7	Leo	23	33	45.7	-03	40	44	19.9	Aqr	21	45	31.4	-13	51	04	29.4	Cap
Jun	23	10	24	54.4	+11	44	18	9.7	Leo	23	33	46.6	-03	40	40	19.9	Aqr	21	45	28.2	-13	51	22	29.4	Cap
Jun	24	10	25	12.6	+11	42	27	9.8	Leo	23	33	47.3	-03	40	38	19.9	Aqr	21	45	24.9	-13	51	40	29.4	Cap
Jun	25	10	25	31.0	+11	40	36	9.8	Leo	23	33	47.8	-03	40	37	19.9	Aqr	21	45	21.6	-13	51	58	29.4	Cap
Jun	26	10	25	49.7	+11	38	42	9.8	Leo	23	33	48.2	-03	40	37	19.9	Aqr	21	45	18.1	-13	52	17	29.4	Cap
Jun	27	10	26	08.7	+11	36	48	9.8	Leo	23	33	48.4	-03	40	39	19.8	Aqr	21	45	14.5	-13	52	37	29.4	Cap
Jun	28	10	26	28.0	+11	34	51	9.8	Leo	23	33	48.4	-03	40	41	19.8	Aqr	21	45	10.9	-13	52	57	29.3	Cap
Jun	29	10	26	47.5	+11	32	53	9.8	Leo	23	33	48.2	-03	40	45	19.8	Aqr	21	45	07.1	-13	53	17	29.3	Cap
Jun	30	10	27	07.3	+11	30	54	9.8	Leo	23	33	47.8	-03	40	49	19.8	Aqr	21	45	03.2	-13	53	38	29.3	Cap
Jul	1	10	27	27.4	+11	28	53	9.9	Leo	23	33	47.3	-03	40	55	19.8	Aqr	21	44	59.3	-13	53	60	29.3	Cap
Jul	2	10	27	47.7	+11	26	51	9.9	Leo	23	33	46.6	-03	41	02	19.8	Aqr	21	44	55.2	-13	54	22	29.3	Cap
Jul	3	10	28	08.2	+11	24	47	9.9	Leo	23	33	45.7	-03	41	10	19.8	Aqr	21	44	51.0	-13	54	44	29.3	Cap
Jul	4	10	28	29.0	+11	22	42	9.9	Leo	23	33	44.6	-03	41	19	19.7	Aqr	21	44	46.8	-13	55	07	29.3	Cap
Jul	5	10	28	50.1	+11	20	35	9.9	Leo	23	33	43.4	-03	41	30	19.7	Aqr	21	44	42.4	-13	55	30	29.3	Cap
Jul	6	10	29	11.4	+11	18	27	9.9	Leo	23	33	42.0	-03	41	41	19.7	Aqr	21	44	38.0	-13	55	54	29.3	Cap
Jul	7	10	29	32.9	+11	16	18	9.9	Leo	23	33	40.4	-03	41	54	19.7	Aqr	21	44	33.5	-13	56	18	29.2	Cap
Jul	8	10	29	54.6	+11	14	07	9.9	Leo	23	33	38.6	-03	42	08	19.7	Aqr	21	44	28.9	-13	56	43	29.2	Cap
Jul	9	10	30	16.6	+11	11	55	10.0	Leo	23	33	36.7	-03	42	22	19.7	Aqr	21	44	24.2	-13	57	08	29.2	Cap
Jul	10	10	30	38.8	+11	09	42	10.0	Leo	23	33	34.6	-03	42	38	19.6	Aqr	21	44	19.4	-13	57	34	29.2	Cap
Jul	11	10	31	01.2	+11	07	27	10.0	Leo	23	33	32.3	-03	42	55	19.6	Aqr	21	44	14.6	-13	57	59	29.2	Cap
Jul	12	10	31	23.8	+11	05	11	10.0	Leo	23	33	29.9	-03	43	13	19.6	Aqr	21	44	09.6	-13	58	26	29.2	Cap
Jul	13	10	31	46.7	+11	02	54	10.0	Leo	23	33	27.2	-03	43	33	19.6	Aqr	21	44	04.6	-13	58	52	29.2	Cap
Jul	14	10	32	09.7	+11	00	36	10.0	Leo	23	33	24.5	-03	43	53	19.6	Aqr	21	43	59.5	-13	59	19	29.2	Cap
Jul	15	10	32	32.9	+10	58	17	10.0	Leo	23	33	21.5	-03	44	14	19.6	Aqr	21	43	54.4	-13	59	47	29.2	Cap
Jul	16	10	32	56.4	+10	55	56	10.0	Leo	23	33	18.4	-03	44	36	19.6	Aqr	21	43	49.1	-14	00	14	29.2	Cap
Jul	17	10	33	20.0	+10	53	34	10.1	Leo	23	33	15.1	-03	44	59	19.5	Aqr	21	43	43.8	-14	00	42	29.1	Cap
Jul	18	10	33	43.8	+10	51	12	10.1	Leo	23	33	11.7	-03	45	24	19.5	Aqr	21	43	38.5	-14	01	10	29.1	Cap
Jul	19	10	34	07.8	+10	48	48	10.1	Leo	23	33	08.1	-03	45	49	19.5	Aqr	21	43	33.1	-14	01	39	29.1	Cap
Jul	20	10	34	32.0	+10	46	23	10.1	Leo	23	33	04.3	-03	46	15	19.5	Aqr	21	43	27.6	-14	02	08	29.1	Cap
Jul	21	10	34	56.4	+10	43	57	10.1	Leo	23	33	00.4	-03	46	43	19.5	Aqr	21	43	22.0	-14	02	37	29.1	Cap
Jul	22	10	35	20.9	+10	41	30	10.1	Leo	23	32	56.3	-03	47	11	19.5	Aqr	21	43	16.4	-14	03	07	29.1	Cap
Jul	23	10	35	45.6	+10	39	02	10.1	Leo	23	32	52.1	-03	47	40	19.5	Aqr	21	43	10.7	-14	03	36	29.1	Cap
Jul	24	10	36	10.5	+10	36	33	10.1	Leo	23	32	47.7	-03	48	10	19.4	Aqr	21	43	05.0	-14	04	06	29.1	Cap
Jul	25	10	36	35.5	+10	34	03	10.1	Leo	23	32	43.2	-03	48	42	19.4	Aqr	21	42	59.2	-14	04	37	29.1	Cap
Jul	26	10	37	00.7	+10	31	32	10.1	Leo	23	32	38.5	-03	49	14	19.4	Aqr	21	42	53.4	-14	05	07	29.1	Cap
Jul	27	10	37	26.0	+10	28	60	10.2	Leo	23	32	33.7	-03	49	47	19.4	Aqr	21	42	47.5	-14	05	38	29.1	Cap
Jul	28	10	37	51.5	+10	26	27	10.2	Leo	23	32	28.7	-03	50	21	19.4	Aqr	21	42	41.6	-14	06	09	29.1	Cap
Jul	29	10	38	17.2	+10	23	53	10.2	Leo	23	32	23.6	-03	50	56	19.4	Aqr	21	42	35.6	-14	06	40	29.1	Cap
Jul	30	10	38	43.0	+10	21	18	10.2	Leo	23	32	18.3	-03	51	31	19.4	Aqr	21	42	29.6	-14	07	11	29.1	Cap
Jul	31	10	39	08.9	+10	18	43	10.2	Leo	23	32	12.9	-03	52	08	19.4	Aqr	21	42	23.5	-14	07	43	29.1	Cap
Aug	1	10	39	35.0	+10	16	07	10.2	Leo	23	32	07.3	-03	52	46	19.3	Aqr	21	42	17.4	-14	08	15	29.1	Cap
Aug	2	10	40	01.2	+10	13	30	10.2	Leo	23	32	01.6	-03	53	24	19.3	Aqr	21	42	11.3	-14	08	47	29.0	Cap
Aug	3	10	40	27.6	+10	10	52	10.2	Leo	23	31	55.8	-03	54	03	19.3	Aqr	21	42	05.1	-14	09	19	29.0	Cap
Aug	4	10	40	54.0	+10	08	13	10.2	Leo	23	31	49.9	-03	54	43	19.3	Aqr	21	41	58.9	-14	09	51	29.0	Cap
Aug	5	10	41	20.6	+10	05	34	10.2	Leo	23	31	43.8	-03	55	24	19.3	Aqr	21	41	52.7	-14	10	23	29.0	Cap
Aug	6	10	41	47.3	+10	02	54	10.2	Leo	23	31	37.5	-03	56	06	19.3	Aqr	21	41	46.5	-14	10	55	29.0	Cap
Aug	7	10	42	14.1	+10	00	13	10.2	Leo	23	31	31.2	-03	56	48	19.3	Aqr	21	41	40.2	-14	11	28	29.0	Cap
Aug	8	10	42	41.0	+09	57	31	10.3	Leo	23	31	24.7	-03	57	31	19.3	Aqr	21	41	33.9	-14	12	00	29.0	Cap
Aug	9	10	43	08.1	+09	54	49	10.3	Leo	23	31	18.2	-03	58	15	19.3	Aqr	21	41	27.6	-14	12	33	29.0	Cap
Aug	10	10	43	35.2	+09	52	07	10.3	Leo	23	31	11.5	-03	58	59	19.3	Aqr	21	41	21.3	-14	13	06	29.0	Cap
Aug	11	10	44	02.4	+09	49	24	10.3	Leo	23	31	04.6	-03	59	45	19.2	Aqr	21	41	14.9	-14	13	38	29.0	Cap
Aug	12	10	44	29.7	+09	46	40	10.3	Leo	23	30	57.7	-04	00	31	19.2	Aqr	21	41	08.6	-14	14	11	29.0	Cap
Aug	13	10	44	57.1	+09	43	56	10.3	Leo	23	30	50.7	-04	01	17	19.2	Aqr	21	41	02.2	-14	14	44	29.0	Cap
Aug	14	10	45	24.6	+09	41	11	10.3	Leo	23	30	43.5	-04	02	04	19.2	Aqr	21	40	55.8	-14	15	17	29.0	Cap
Aug	15	10	45	52.1	+09	38	26	10.3	Leo	23	30	36.3	-04	02	52	19.2	Aqr	21	40	49.5	-14	15	49	29.0	Cap
Aug	16	10	46	19.7	+09	35	40	10.3	Leo	23	30	28.9	-04	03	41	19.2	Aqr	21	40	43.1	-14	16	22	29.0	Cap
Aug	17	10	46	47.4	+09	32	54	10.3	Leo	23	30	21.5	-04	04	30	19.2	Aqr	21	40	36.7	-14	16	55	29.0	Cap
Aug	18	10	47	15.2	+09	30	07	10.3	Leo	23	30	14.0	-04	05	19	19.2	Aqr	21	40	30.3	-14	17	27	29.0	Cap
Aug	19	10	47	43.0	+09	27	20	10.3	Leo	23	30	06.3	-04	06	09	19.2	Aqr	21	40	24.0	-14	17	60	29.0	Cap

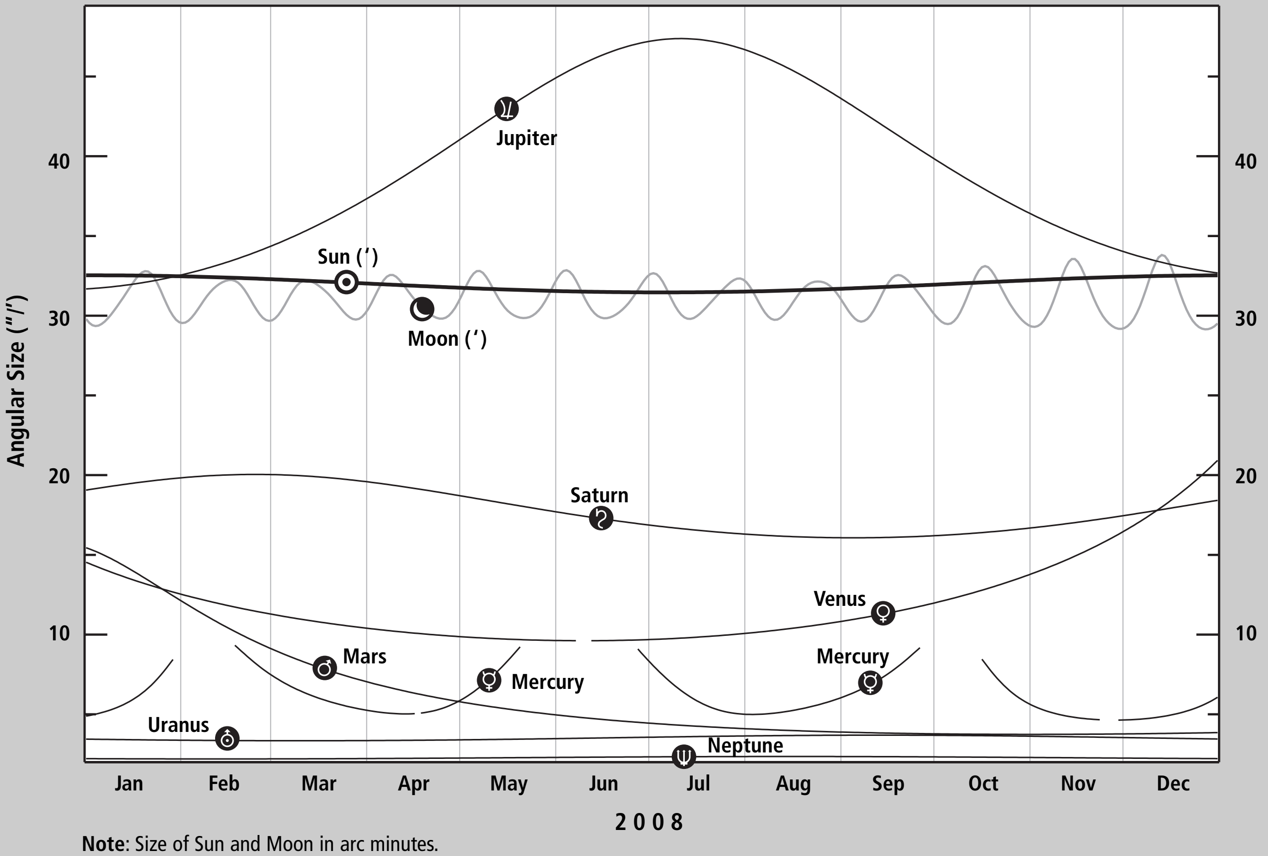
GEOCENTRIC PLANET POSITIONS (EPOCH J2000.0) Note: positions refer to 0000 WAST

MTH	DAY	SATURN RA h m s	SATURN Declination ° ′ ″	SATURN Dist. (AU)	SATURN Cnst.	URANUS RA h m s	URANUS Declination ° ′ ″	URANUS Dist. (AU)	URANUS Cnst.	NEPTUNE RA h m s	NEPTUNE Declination ° ′ ″	NEPTUNE Dist. (AU)	NEPTUNE Cnst.
Aug	20	10 48 10.9	+09 24 33	10.3	Leo	23 29 58.6	-04 06 60	19.2	Aqr	21 40 17.6	-14 18 33	29.0	Cap
Aug	21	10 48 38.9	+09 21 45	10.3	Leo	23 29 50.8	-04 07 51	19.2	Aqr	21 40 11.3	-14 19 05	29.0	Cap
Aug	22	10 49 06.9	+09 18 57	10.3	Leo	23 29 42.9	-04 08 43	19.2	Aqr	21 40 04.9	-14 19 37	29.0	Cap
Aug	23	10 49 34.9	+09 16 09	10.3	Leo	23 29 35.0	-04 09 35	19.2	Aqr	21 39 58.6	-14 20 10	29.0	Cap
Aug	24	10 50 03.0	+09 13 20	10.3	Leo	23 29 26.9	-04 10 27	19.1	Aqr	21 39 52.3	-14 20 42	29.0	Cap
Aug	25	10 50 31.2	+09 10 31	10.3	Leo	23 29 18.8	-04 11 20	19.1	Aqr	21 39 46.0	-14 21 14	29.0	Cap
Aug	26	10 50 59.4	+09 07 42	10.3	Leo	23 29 10.6	-04 12 14	19.1	Aqr	21 39 39.7	-14 21 46	29.0	Cap
Aug	27	10 51 27.6	+09 04 52	10.3	Leo	23 29 02.3	-04 13 07	19.1	Aqr	21 39 33.5	-14 22 18	29.0	Cap
Aug	28	10 51 55.9	+09 02 03	10.3	Leo	23 28 54.0	-04 14 02	19.1	Aqr	21 39 27.3	-14 22 49	29.0	Cap
Aug	29	10 52 24.1	+08 59 13	10.3	Leo	23 28 45.6	-04 14 56	19.1	Aqr	21 39 21.1	-14 23 21	29.1	Cap
Aug	30	10 52 52.4	+08 56 23	10.3	Leo	23 28 37.2	-04 15 51	19.1	Aqr	21 39 14.9	-14 23 52	29.1	Cap
Aug	31	10 53 20.8	+08 53 33	10.3	Leo	23 28 28.7	-04 16 46	19.1	Aqr	21 39 08.8	-14 24 23	29.1	Cap
Sep	1	10 53 49.1	+08 50 43	10.3	Leo	23 28 20.1	-04 17 41	19.1	Aqr	21 39 02.7	-14 24 54	29.1	Cap
Sep	2	10 54 17.5	+08 47 53	10.3	Leo	23 28 11.5	-04 18 37	19.1	Aqr	21 38 56.6	-14 25 25	29.1	Cap
Sep	3	10 54 45.8	+08 45 02	10.3	Leo	23 28 02.9	-04 19 33	19.1	Aqr	21 38 50.6	-14 25 55	29.1	Cap
Sep	4	10 55 14.2	+08 42 12	10.3	Leo	23 27 54.2	-04 20 29	19.1	Aqr	21 38 44.7	-14 26 25	29.1	Cap
Sep	5	10 55 42.5	+08 39 22	10.3	Leo	23 27 45.5	-04 21 25	19.1	Aqr	21 38 38.8	-14 26 55	29.1	Cap
Sep	6	10 56 10.9	+08 36 32	10.3	Leo	23 27 36.8	-04 22 21	19.1	Aqr	21 38 32.9	-14 27 25	29.1	Cap
Sep	7	10 56 39.2	+08 33 42	10.3	Leo	23 27 28.0	-04 23 18	19.1	Aqr	21 38 27.1	-14 27 54	29.1	Cap
Sep	8	10 57 07.5	+08 30 52	10.3	Leo	23 27 19.2	-04 24 14	19.1	Aqr	21 38 21.3	-14 28 23	29.1	Cap
Sep	9	10 57 35.8	+08 28 02	10.3	Leo	23 27 10.4	-04 25 11	19.1	Aqr	21 38 15.6	-14 28 52	29.1	Cap
Sep	10	10 58 04.1	+08 25 12	10.3	Leo	23 27 01.6	-04 26 07	19.1	Aqr	21 38 10.0	-14 29 21	29.1	Cap
Sep	11	10 58 32.4	+08 22 23	10.3	Leo	23 26 52.7	-04 27 04	19.1	Aqr	21 38 04.4	-14 29 49	29.1	Cap
Sep	12	10 59 00.6	+08 19 34	10.3	Leo	23 26 43.9	-04 28 01	19.1	Aqr	21 37 58.8	-14 30 17	29.1	Cap
Sep	13	10 59 28.8	+08 16 45	10.3	Leo	23 26 35.0	-04 28 57	19.1	Aqr	21 37 53.4	-14 30 44	29.1	Cap
Sep	14	10 59 56.9	+08 13 56	10.3	Leo	23 26 26.2	-04 29 54	19.1	Aqr	21 37 48.0	-14 31 11	29.2	Cap
Sep	15	11 00 25.1	+08 11 07	10.3	Leo	23 26 17.3	-04 30 50	19.1	Aqr	21 37 42.6	-14 31 38	29.2	Cap
Sep	16	11 00 53.1	+08 08 19	10.3	Leo	23 26 08.4	-04 31 47	19.1	Aqr	21 37 37.4	-14 32 05	29.2	Cap
Sep	17	11 01 21.1	+08 05 31	10.3	Leo	23 25 59.6	-04 32 43	19.1	Aqr	21 37 32.2	-14 32 31	29.2	Cap
Sep	18	11 01 49.1	+08 02 44	10.3	Leo	23 25 50.8	-04 33 39	19.1	Aqr	21 37 27.1	-14 32 56	29.2	Cap
Sep	19	11 02 17.0	+07 59 56	10.3	Leo	23 25 41.9	-04 34 35	19.1	Aqr	21 37 22.0	-14 33 21	29.2	Cap
Sep	20	11 02 44.9	+07 57 10	10.3	Leo	23 25 33.1	-04 35 31	19.1	Aqr	21 37 17.1	-14 33 46	29.2	Cap
Sep	21	11 03 12.7	+07 54 23	10.3	Leo	23 25 24.4	-04 36 27	19.1	Aqr	21 37 12.2	-14 34 11	29.2	Cap
Sep	22	11 03 40.4	+07 51 37	10.3	Leo	23 25 15.6	-04 37 22	19.1	Aqr	21 37 07.4	-14 34 35	29.2	Cap
Sep	23	11 04 08.0	+07 48 52	10.3	Leo	23 25 06.9	-04 38 18	19.1	Aqr	21 37 02.7	-14 34 58	29.2	Cap
Sep	24	11 04 35.6	+07 46 07	10.3	Leo	23 24 58.2	-04 39 13	19.1	Aqr	21 36 58.1	-14 35 21	29.3	Cap
Sep	25	11 05 03.1	+07 43 23	10.3	Leo	23 24 49.5	-04 40 07	19.1	Aqr	21 36 53.5	-14 35 44	29.3	Cap
Sep	26	11 05 30.5	+07 40 39	10.3	Leo	23 24 40.9	-04 41 02	19.1	Aqr	21 36 49.1	-14 36 06	29.3	Cap
Sep	27	11 05 57.8	+07 37 55	10.3	Leo	23 24 32.3	-04 41 56	19.1	Aqr	21 36 44.7	-14 36 28	29.3	Cap
Sep	28	11 06 25.1	+07 35 13	10.3	Leo	23 24 23.8	-04 42 49	19.1	Aqr	21 36 40.4	-14 36 49	29.3	Cap
Sep	29	11 06 52.2	+07 32 31	10.3	Leo	23 24 15.4	-04 43 43	19.1	Aqr	21 36 36.3	-14 37 10	29.3	Cap
Sep	30	11 07 19.2	+07 29 50	10.3	Leo	23 24 06.9	-04 44 35	19.1	Aqr	21 36 32.2	-14 37 30	29.3	Cap
Oct	1	11 07 46.2	+07 27 09	10.3	Leo	23 23 58.6	-04 45 28	19.1	Aqr	21 36 28.2	-14 37 50	29.3	Cap
Oct	2	11 08 13.0	+07 24 29	10.2	Leo	23 23 50.3	-04 46 20	19.1	Aqr	21 36 24.3	-14 38 10	29.3	Cap
Oct	3	11 08 39.7	+07 21 50	10.2	Leo	23 23 42.1	-04 47 11	19.2	Aqr	21 36 20.6	-14 38 28	29.4	Cap
Oct	4	11 09 06.3	+07 19 12	10.2	Leo	23 23 33.9	-04 48 02	19.2	Aqr	21 36 16.9	-14 38 46	29.4	Cap
Oct	5	11 09 32.7	+07 16 34	10.2	Leo	23 23 25.9	-04 48 53	19.2	Aqr	21 36 13.3	-14 39 04	29.4	Cap
Oct	6	11 09 59.1	+07 13 58	10.2	Leo	23 23 17.9	-04 49 42	19.2	Aqr	21 36 09.9	-14 39 21	29.4	Cap
Oct	7	11 10 25.3	+07 11 22	10.2	Leo	23 23 10.0	-04 50 32	19.2	Aqr	21 36 06.6	-14 39 38	29.4	Cap
Oct	8	11 10 51.3	+07 08 47	10.2	Leo	23 23 02.1	-04 51 20	19.2	Aqr	21 36 03.3	-14 39 54	29.4	Cap
Oct	9	11 11 17.3	+07 06 14	10.2	Leo	23 22 54.4	-04 52 08	19.2	Aqr	21 36 00.2	-14 40 09	29.4	Cap
Oct	10	11 11 43.0	+07 03 41	10.2	Leo	23 22 46.7	-04 52 56	19.2	Aqr	21 35 57.2	-14 40 24	29.5	Cap
Oct	11	11 12 08.7	+07 01 09	10.2	Leo	23 22 39.2	-04 53 43	19.2	Aqr	21 35 54.3	-14 40 39	29.5	Cap
Oct	12	11 12 34.2	+06 58 38	10.2	Leo	23 22 31.7	-04 54 29	19.2	Aqr	21 35 51.5	-14 40 52	29.5	Cap
Oct	13	11 12 59.5	+06 56 08	10.2	Leo	23 22 24.4	-04 55 14	19.2	Aqr	21 35 48.9	-14 41 05	29.5	Cap
Oct	14	11 13 24.6	+06 53 40	10.2	Leo	23 22 17.1	-04 55 59	19.2	Aqr	21 35 46.3	-14 41 18	29.5	Cap
Oct	15	11 13 49.7	+06 51 12	10.1	Leo	23 22 10.0	-04 56 43	19.2	Aqr	21 35 43.9	-14 41 30	29.5	Cap
Oct	16	11 14 14.5	+06 48 46	10.1	Leo	23 22 02.9	-04 57 26	19.3	Aqr	21 35 41.6	-14 41 41	29.5	Cap
Oct	17	11 14 39.2	+06 46 20	10.1	Leo	23 21 56.0	-04 58 08	19.3	Aqr	21 35 39.4	-14 41 52	29.6	Cap
Oct	18	11 15 03.7	+06 43 56	10.1	Leo	23 21 49.2	-04 58 50	19.3	Aqr	21 35 37.3	-14 42 02	29.6	Cap
Oct	19	11 15 28.0	+06 41 33	10.1	Leo	23 21 42.5	-04 59 31	19.3	Aqr	21 35 35.4	-14 42 12	29.6	Cap
Oct	20	11 15 52.1	+06 39 11	10.1	Leo	23 21 36.0	-05 00 11	19.3	Aqr	21 35 33.5	-14 42 21	29.6	Cap
Oct	21	11 16 16.1	+06 36 51	10.1	Leo	23 21 29.5	-05 00 50	19.3	Aqr	21 35 31.8	-14 42 29	29.6	Cap
Oct	22	11 16 39.8	+06 34 32	10.1	Leo	23 21 23.2	-05 01 29	19.3	Aqr	21 35 30.3	-14 42 37	29.6	Cap
Oct	23	11 17 03.4	+06 32 14	10.1	Leo	23 21 17.0	-05 02 06	19.3	Aqr	21 35 28.8	-14 42 44	29.7	Cap
Oct	24	11 17 26.8	+06 29 57	10.1	Leo	23 21 11.0	-05 02 43	19.3	Aqr	21 35 27.5	-14 42 51	29.7	Cap
Oct	25	11 17 49.9	+06 27 42	10.0	Leo	23 21 05.0	-05 03 19	19.4	Aqr	21 35 26.3	-14 42 56	29.7	Cap

GEOCENTRIC PLANET POSITIONS (continued)

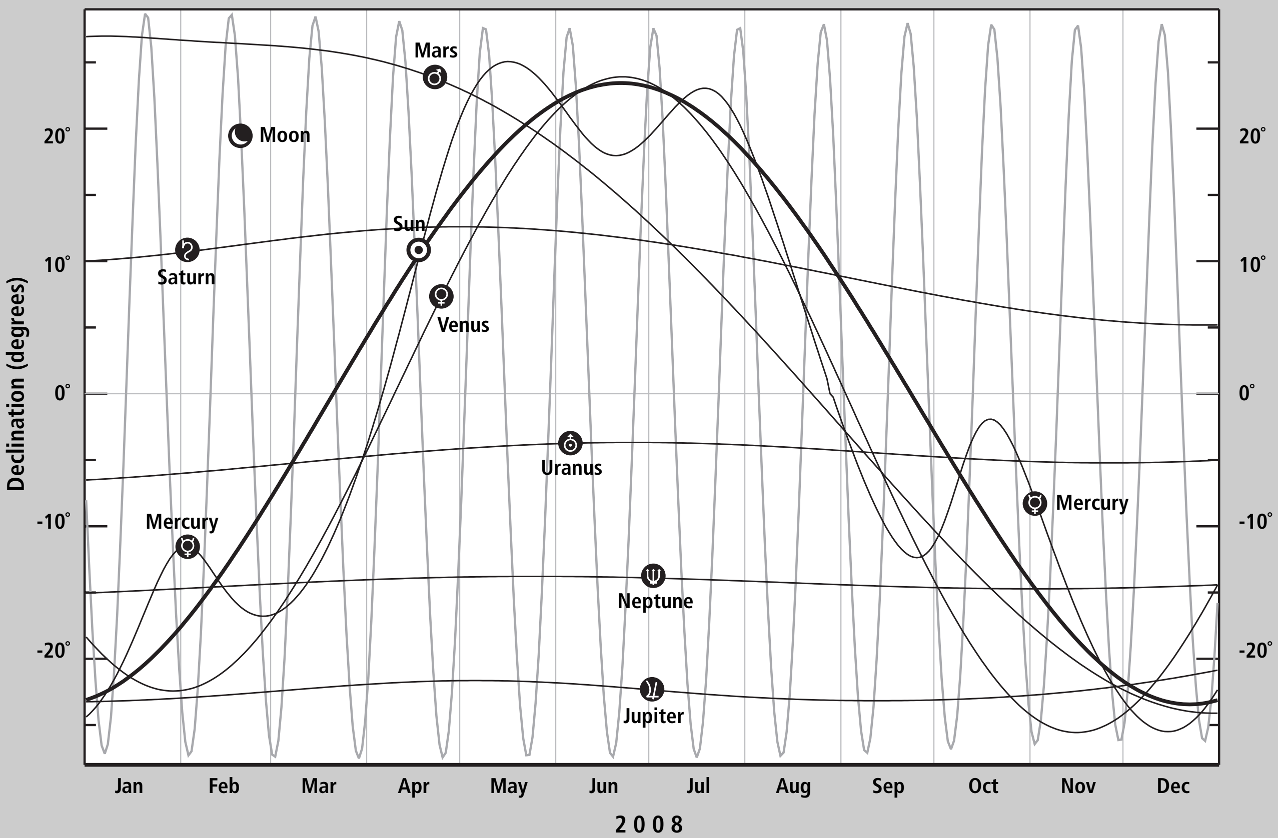
MTH	DAY	SATURN RA (h m s)	SATURN Declination (° ′ ″)	SATURN Dist. (AU)	SATURN Cnst.	URANUS RA (h m s)	URANUS Declination (° ′ ″)	URANUS Dist. (AU)	URANUS Cnst.	NEPTUNE RA (h m s)	NEPTUNE Declination (° ′ ″)	NEPTUNE Dist. (AU)	NEPTUNE Cnst.
Oct	26	11 18 12.9	+06 25 28	10.0	Leo	23 20 59.3	-05 03 54	19.4	Aqr	21 35 25.2	-14 43 02	29.7	Cap
Oct	27	11 18 35.6	+06 23 16	10.0	Leo	23 20 53.6	-05 04 27	19.4	Aqr	21 35 24.3	-14 43 06	29.7	Cap
Oct	28	11 18 58.1	+06 21 05	10.0	Leo	23 20 48.1	-05 05 00	19.4	Aqr	21 35 23.5	-14 43 10	29.7	Cap
Oct	29	11 19 20.4	+06 18 56	10.0	Leo	23 20 42.8	-05 05 32	19.4	Aqr	21 35 22.8	-14 43 13	29.7	Cap
Oct	30	11 19 42.5	+06 16 48	10.0	Leo	23 20 37.6	-05 06 03	19.4	Aqr	21 35 22.3	-14 43 16	29.8	Cap
Oct	31	11 20 04.3	+06 14 42	10.0	Leo	23 20 32.5	-05 06 33	19.4	Aqr	21 35 21.9	-14 43 18	29.8	Cap
Nov	1	11 20 25.9	+06 12 37	10.0	Leo	23 20 27.6	-05 07 02	19.4	Aqr	21 35 21.6	-14 43 19	29.8	Cap
Nov	2	11 20 47.3	+06 10 34	9.9	Leo	23 20 22.9	-05 07 30	19.5	Aqr	21 35 21.5	-14 43 20	29.8	Cap
Nov	3	11 21 08.4	+06 08 33	9.9	Leo	23 20 18.3	-05 07 57	19.5	Aqr	21 35 21.5	-14 43 20	29.8	Cap
Nov	4	11 21 29.3	+06 06 33	9.9	Leo	23 20 13.9	-05 08 23	19.5	Aqr	21 35 21.6	-14 43 19	29.8	Cap
Nov	5	11 21 49.9	+06 04 35	9.9	Leo	23 20 09.6	-05 08 48	19.5	Aqr	21 35 21.9	-14 43 18	29.9	Cap
Nov	6	11 22 10.3	+06 02 39	9.9	Leo	23 20 05.5	-05 09 12	19.5	Aqr	21 35 22.2	-14 43 16	29.9	Cap
Nov	7	11 22 30.4	+06 00 45	9.9	Leo	23 20 01.6	-05 09 34	19.5	Aqr	21 35 22.8	-14 43 13	29.9	Cap
Nov	8	11 22 50.2	+05 58 52	9.9	Leo	23 19 57.9	-05 09 56	19.5	Aqr	21 35 23.4	-14 43 10	29.9	Cap
Nov	9	11 23 09.8	+05 57 01	9.8	Leo	23 19 54.3	-05 10 16	19.6	Aqr	21 35 24.2	-14 43 06	29.9	Cap
Nov	10	11 23 29.1	+05 55 12	9.8	Leo	23 19 50.8	-05 10 36	19.6	Aqr	21 35 25.2	-14 43 01	30.0	Cap
Nov	11	11 23 48.1	+05 53 25	9.8	Leo	23 19 47.6	-05 10 54	19.6	Aqr	21 35 26.2	-14 42 56	30.0	Cap
Nov	12	11 24 06.8	+05 51 40	9.8	Leo	23 19 44.5	-05 11 11	19.6	Aqr	21 35 27.4	-14 42 50	30.0	Cap
Nov	13	11 24 25.3	+05 49 56	9.8	Leo	23 19 41.6	-05 11 27	19.6	Aqr	21 35 28.8	-14 42 43	30.0	Cap
Nov	14	11 24 43.4	+05 48 15	9.8	Leo	23 19 38.9	-05 11 42	19.6	Aqr	21 35 30.2	-14 42 36	30.0	Cap
Nov	15	11 25 01.3	+05 46 35	9.8	Leo	23 19 36.3	-05 11 56	19.6	Aqr	21 35 31.8	-14 42 28	30.0	Cap
Nov	16	11 25 18.9	+05 44 58	9.7	Leo	23 19 34.0	-05 12 08	19.7	Aqr	21 35 33.5	-14 42 19	30.1	Cap
Nov	17	11 25 36.2	+05 43 22	9.7	Leo	23 19 31.8	-05 12 20	19.7	Aqr	21 35 35.4	-14 42 10	30.1	Cap
Nov	18	11 25 53.2	+05 41 49	9.7	Leo	23 19 29.7	-05 12 30	19.7	Aqr	21 35 37.4	-14 42 00	30.1	Cap
Nov	19	11 26 09.9	+05 40 17	9.7	Leo	23 19 27.9	-05 12 39	19.7	Aqr	21 35 39.5	-14 41 50	30.1	Cap
Nov	20	11 26 26.3	+05 38 48	9.7	Leo	23 19 26.3	-05 12 47	19.7	Aqr	21 35 41.8	-14 41 38	30.1	Cap
Nov	21	11 26 42.3	+05 37 21	9.7	Leo	23 19 24.8	-05 12 54	19.7	Aqr	21 35 44.2	-14 41 27	30.1	Cap
Nov	22	11 26 58.1	+05 35 55	9.7	Leo	23 19 23.5	-05 12 59	19.8	Aqr	21 35 46.7	-14 41 14	30.2	Cap
Nov	23	11 27 13.5	+05 34 32	9.6	Leo	23 19 22.4	-05 13 04	19.8	Aqr	21 35 49.3	-14 41 01	30.2	Cap
Nov	24	11 27 28.6	+05 33 12	9.6	Leo	23 19 21.5	-05 13 07	19.8	Aqr	21 35 52.1	-14 40 47	30.2	Cap
Nov	25	11 27 43.4	+05 31 53	9.6	Leo	23 19 20.8	-05 13 09	19.8	Aqr	21 35 55.0	-14 40 33	30.2	Cap
Nov	26	11 27 57.8	+05 30 37	9.6	Leo	23 19 20.3	-05 13 10	19.8	Aqr	21 35 58.1	-14 40 18	30.2	Cap
Nov	27	11 28 11.9	+05 29 22	9.6	Leo	23 19 19.9	-05 13 09	19.8	Aqr	21 36 01.3	-14 40 02	30.2	Cap
Nov	28	11 28 25.7	+05 28 11	9.6	Leo	23 19 19.8	-05 13 07	19.9	Aqr	21 36 04.6	-14 39 45	30.3	Cap
Nov	29	11 28 39.1	+05 27 01	9.5	Leo	23 19 19.8	-05 13 05	19.9	Aqr	21 36 08.0	-14 39 28	30.3	Cap
Nov	30	11 28 52.1	+05 25 54	9.5	Leo	23 19 20.0	-05 13 00	19.9	Aqr	21 36 11.6	-14 39 11	30.3	Cap
Dec	1	11 29 04.8	+05 24 49	9.5	Leo	23 19 20.4	-05 12 55	19.9	Aqr	21 36 15.2	-14 38 53	30.3	Cap
Dec	2	11 29 17.2	+05 23 47	9.5	Leo	23 19 21.1	-05 12 49	19.9	Aqr	21 36 19.1	-14 38 34	30.3	Cap
Dec	3	11 29 29.2	+05 22 46	9.5	Leo	23 19 21.9	-05 12 41	19.9	Aqr	21 36 23.0	-14 38 14	30.3	Cap
Dec	4	11 29 40.8	+05 21 49	9.5	Leo	23 19 22.8	-05 12 32	20.0	Aqr	21 36 27.0	-14 37 54	30.4	Cap
Dec	5	11 29 52.1	+05 20 53	9.4	Leo	23 19 24.0	-05 12 22	20.0	Aqr	21 36 31.2	-14 37 34	30.4	Cap
Dec	6	11 30 03.0	+05 20 01	9.4	Leo	23 19 25.4	-05 12 10	20.0	Aqr	21 36 35.5	-14 37 12	30.4	Cap
Dec	7	11 30 13.5	+05 19 10	9.4	Leo	23 19 27.0	-05 11 58	20.0	Aqr	21 36 39.9	-14 36 50	30.4	Cap
Dec	8	11 30 23.7	+05 18 22	9.4	Leo	23 19 28.7	-05 11 44	20.0	Aqr	21 36 44.5	-14 36 28	30.4	Cap
Dec	9	11 30 33.5	+05 17 37	9.4	Leo	23 19 30.7	-05 11 29	20.0	Aqr	21 36 49.1	-14 36 05	30.4	Cap
Dec	10	11 30 42.9	+05 16 54	9.4	Leo	23 19 32.8	-05 11 13	20.1	Aqr	21 36 53.9	-14 35 41	30.5	Cap
Dec	11	11 30 51.9	+05 16 13	9.3	Leo	23 19 35.1	-05 10 55	20.1	Aqr	21 36 58.8	-14 35 17	30.5	Cap
Dec	12	11 31 00.6	+05 15 35	9.3	Leo	23 19 37.6	-05 10 36	20.1	Aqr	21 37 03.8	-14 34 52	30.5	Cap
Dec	13	11 31 08.8	+05 14 59	9.3	Leo	23 19 40.3	-05 10 17	20.1	Aqr	21 37 08.9	-14 34 27	30.5	Cap
Dec	14	11 31 16.7	+05 14 26	9.3	Leo	23 19 43.2	-05 09 56	20.1	Aqr	21 37 14.1	-14 34 01	30.5	Cap
Dec	15	11 31 24.2	+05 13 56	9.3	Leo	23 19 46.3	-05 09 34	20.1	Aqr	21 37 19.5	-14 33 35	30.5	Cap
Dec	16	11 31 31.3	+05 13 28	9.3	Leo	23 19 49.5	-05 09 10	20.2	Aqr	21 37 24.9	-14 33 08	30.5	Cap
Dec	17	11 31 38.1	+05 13 02	9.3	Leo	23 19 53.0	-05 08 46	20.2	Aqr	21 37 30.5	-14 32 40	30.6	Cap
Dec	18	11 31 44.4	+05 12 40	9.2	Leo	23 19 56.6	-05 08 20	20.2	Aqr	21 37 36.2	-14 32 12	30.6	Cap
Dec	19	11 31 50.3	+05 12 19	9.2	Leo	23 20 00.4	-05 07 53	20.2	Aqr	21 37 41.9	-14 31 43	30.6	Cap
Dec	20	11 31 55.9	+05 12 02	9.2	Leo	23 20 04.4	-05 07 25	20.2	Aqr	21 37 47.8	-14 31 14	30.6	Cap
Dec	21	11 32 01.0	+05 11 47	9.2	Leo	23 20 08.6	-05 06 56	20.2	Aqr	21 37 53.8	-14 30 45	30.6	Cap
Dec	22	11 32 05.7	+05 11 34	9.2	Leo	23 20 12.9	-05 06 26	20.3	Aqr	21 37 59.8	-14 30 15	30.6	Cap
Dec	23	11 32 10.1	+05 11 25	9.2	Leo	23 20 17.5	-05 05 54	20.3	Aqr	21 38 06.0	-14 29 44	30.6	Cap
Dec	24	11 32 14.0	+05 11 17	9.1	Leo	23 20 22.2	-05 05 22	20.3	Aqr	21 38 12.3	-14 29 13	30.7	Cap
Dec	25	11 32 17.5	+05 11 13	9.1	Leo	23 20 27.1	-05 04 48	20.3	Aqr	21 38 18.7	-14 28 41	30.7	Cap
Dec	26	11 32 20.6	+05 11 11	9.1	Leo	23 20 32.2	-05 04 13	20.3	Aqr	21 38 25.2	-14 28 09	30.7	Cap
Dec	27	11 32 23.3	+05 11 12	9.1	Leo	23 20 37.4	-05 03 37	20.4	Aqr	21 38 31.7	-14 27 37	30.7	Cap
Dec	28	11 32 25.6	+05 11 15	9.1	Leo	23 20 42.9	-05 03 00	20.4	Aqr	21 38 38.4	-14 27 04	30.7	Cap
Dec	29	11 32 27.5	+05 11 21	9.1	Leo	23 20 48.5	-05 02 22	20.4	Aqr	21 38 45.1	-14 26 30	30.7	Cap
Dec	30	11 32 28.9	+05 11 30	9.0	Leo	23 20 54.2	-05 01 43	20.4	Aqr	21 38 52.0	-14 25 56	30.7	Cap
Dec	31	11 32 30.0	+05 11 41	9.0	Leo	23 21 00.2	-05 01 03	20.4	Aqr	21 38 58.9	-14 25 22	30.7	Cap

ANGULAR SIZES OF THE PLANETS 2008

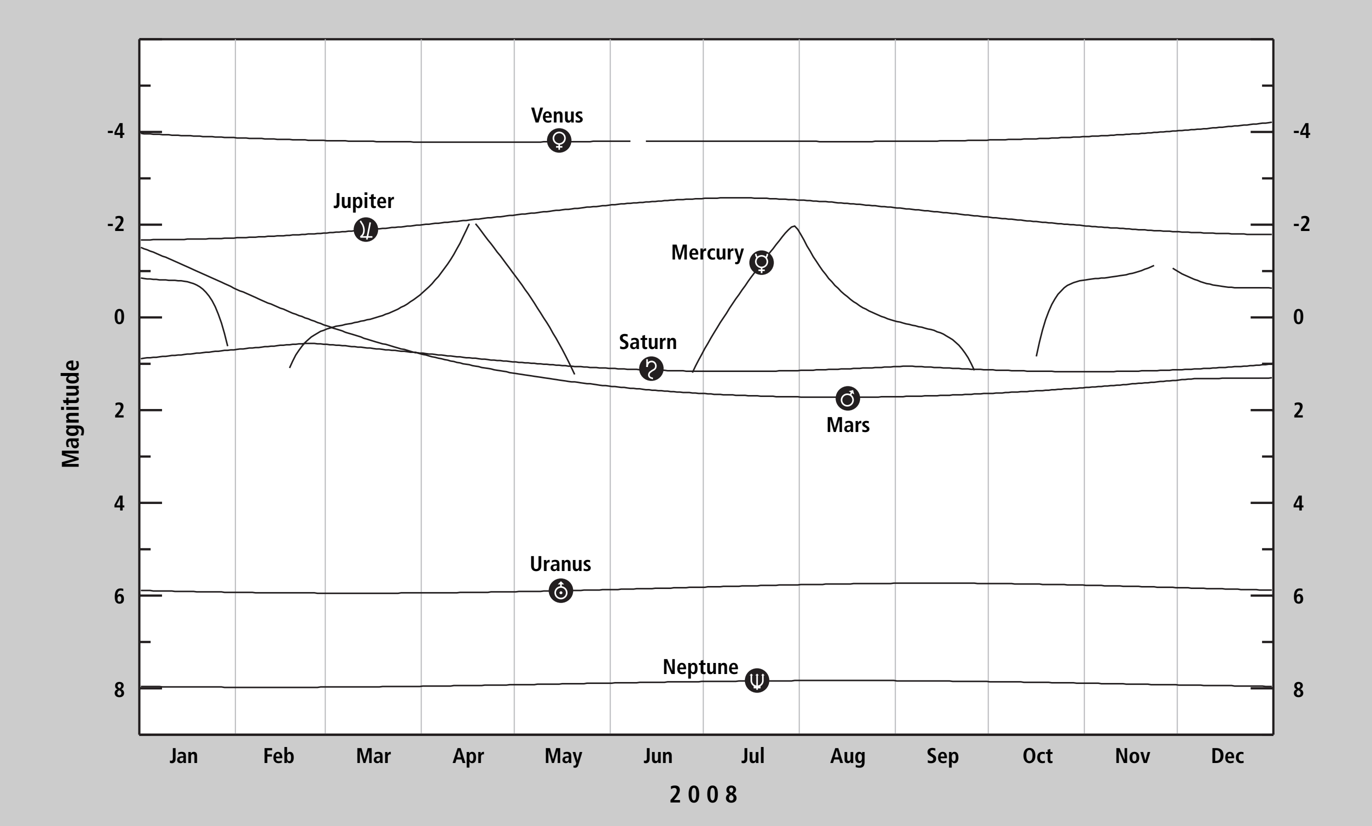


Note: Size of Sun and Moon in arc minutes.

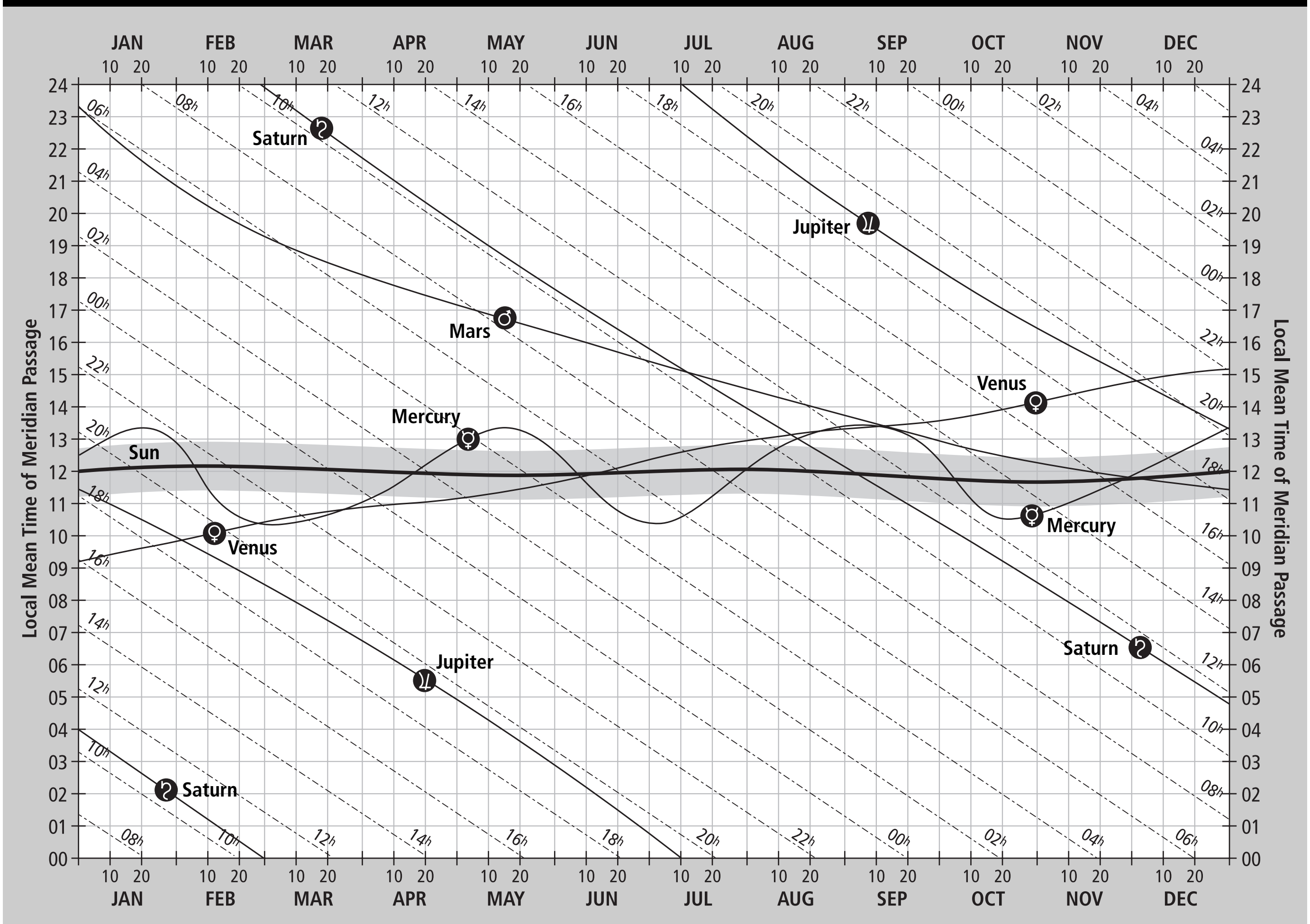
DECLINATIONS OF THE PLANETS 2008



MAGNITUDES OF THE PLANETS 2008



MERIDIAN TRANSIT OF PLANETS 2008



Geocentric positions of comets

Ephemerides are provided for known comets with V brighter than 10 and Declination less than +30º. Please note that comet brightness is notoriously unpredictable!

GEOCENTRIC POSITIONS OF COMETS 2008

Note: positions refer to 0000 WAST

DATE Mnth	Day	RA h	m	DECLINATION °	′	V	r (AU)	Δ (AU)	CONST.
Comet 46P/Wirtanen									
Jan	1	23	33.0	-11	60	1.03	1.14	9.9	Tau
Jan	5	23	43.7	-09	59	1.01	1.13	9.8	Tau
Jan	9	23	54.9	-07	53	1.00	1.11	9.7	Tau
Jan	13	00	06.5	-05	41	0.99	1.09	9.6	Tau
Jan	17	00	18.6	-03	24	0.98	1.08	9.5	Tau
Jan	21	00	31.2	-01	00	0.97	1.07	9.4	Tau
Jan	25	00	44.3	+01	28	0.96	1.06	9.3	Tau
Jan	29	00	57.9	+03	60	0.94	1.06	9.3	Tau
Feb	2	01	12.1	+06	36	0.94	1.06	9.2	Tau
Feb	6	01	26.9	+09	14	0.93	1.06	9.2	Tau
Feb	10	01	42.4	+11	53	0.92	1.06	9.2	Tau
Feb	14	01	58.5	+14	31	0.92	1.07	9.3	Tau
Feb	18	02	15.3	+17	08	0.92	1.08	9.3	Tau
Feb	22	02	32.8	+19	40	0.92	1.09	9.4	Tau
Feb	26	02	51.1	+22	06	0.93	1.10	9.5	Tau
Mar	1	03	10.0	+24	24	0.93	1.12	9.6	Tau
Mar	5	03	29.6	+26	31	0.94	1.14	9.7	Tau
Mar	9	03	49.7	+28	27	0.96	1.16	9.9	Gem
Mar	13	04	10.4	+30	09	0.98	1.18	10.0	Gem
Comet 8P/Tuttle									
Jan	1	01	36.3	+26	16	0.25	1.10	5.9	Psc
Jan	4	01	46.9	+14	04	0.26	1.09	5.8	Psc
Jan	7	01	56.4	+02	38	0.27	1.07	5.8	Psc
Jan	10	02	05.0	-07	19	0.29	1.06	5.8	Cet
Jan	13	02	12.8	-15	34	0.32	1.05	6.0	Cet
Jan	16	02	20.0	-22	14	0.36	1.04	6.1	Cet
Jan	19	02	26.6	-27	38	0.40	1.03	6.3	For
Jan	22	02	32.7	-32	01	0.44	1.03	6.5	For
Jan	25	02	38.4	-35	36	0.48	1.03	6.6	For
Jan	28	02	43.8	-38	35	0.52	1.03	6.8	For
Jan	31	02	48.8	-41	06	0.56	1.03	7.0	Eri
Feb	3	02	53.7	-43	14	0.61	1.03	7.2	Eri
Feb	6	02	58.4	-45	05	0.65	1.04	7.4	Eri
Feb	9	03	03.0	-46	42	0.69	1.05	7.6	Eri
Feb	12	03	07.5	-48	07	0.73	1.06	7.8	Hor
Feb	15	03	12.0	-49	23	0.77	1.07	8.0	Hor
Feb	18	03	16.5	-50	31	0.80	1.08	8.2	Hor
Feb	21	03	21.1	-51	33	0.84	1.10	8.4	Hor
Feb	24	03	25.8	-52	29	0.87	1.11	8.6	Hor
Feb	27	03	30.7	-53	21	0.90	1.13	8.8	Hor
Mar	1	03	35.7	-54	09	0.93	1.15	9.1	Ret
Mar	4	03	41.1	-54	54	0.96	1.17	9.3	Ret
Mar	7	03	46.7	-55	36	0.99	1.19	9.5	Ret
Mar	10	03	52.6	-56	16	1.02	1.22	9.7	Ret
Mar	13	03	58.9	-56	54	1.04	1.24	9.9	Ret
Comet C/2007 N3 (Lulin)									
Nov	20	16	11.9	-20	08	2.42	1.45	10.0	Sco
Nov	22	16	11.5	-20	07	2.41	1.43	10.0	Sco
Nov	24	16	11.2	-20	07	2.40	1.42	9.9	Sco
Nov	26	16	10.8	-20	06	2.39	1.40	9.9	Sco
Nov	28	16	10.5	-20	05	2.37	1.39	9.8	Sco
Nov	30	16	10.1	-20	05	2.35	1.37	9.7	Sco
Dec	2	16	09.7	-20	04	2.33	1.36	9.7	Sco
Dec	4	16	09.3	-20	04	2.31	1.34	9.6	Sco
Dec	6	16	08.9	-20	03	2.29	1.33	9.5	Sco
Dec	8	16	08.5	-20	02	2.27	1.32	9.5	Sco
Dec	10	16	08.1	-20	01	2.24	1.31	9.4	Sco
Dec	12	16	07.6	-20	00	2.21	1.30	9.3	Sco
Dec	14	16	07.1	-19	59	2.18	1.29	9.3	Sco
Dec	16	16	06.5	-19	58	2.15	1.28	9.2	Sco
Dec	18	16	05.9	-19	56	2.11	1.27	9.1	Sco
Dec	20	16	05.3	-19	55	2.08	1.26	9.1	Sco
Dec	22	16	04.6	-19	53	2.04	1.25	9.0	Sco
Dec	24	16	03.8	-19	51	2.00	1.24	8.9	Sco
Dec	26	16	03.0	-19	49	1.96	1.24	8.9	Sco
Dec	28	16	02.1	-19	47	1.91	1.23	8.8	Lib
Dec	30	16	01.1	-19	44	1.87	1.22	8.7	Lib

Legend:

RA and DECLINATION Astrometric right ascension and declination of target (J2000.0). Corrected for light-time. These positions refer to the geocentre.

V Comet's approximate apparent visual total magnitude

r Apparent heliocentric range (distance between comet and Sun)

Δ Apparent range (distance between comet and Earth)

CLOSE APPROACHES BY HISTORIC COMETS

COMET NAME	Designation	DATE Year	Mnth	Day	DISTANCE (AU)	(LD)
Comet of 1491	C/1491 B1	1491	Feb	20.0	0.0094	3.7*
Lexell	D/1770 L1	1770	Jul	01.7	0.0151	5.9
Tempel-Tuttle	55P/1366 U1	1366	Oct	26.4	0.0229	8.9
IRAS-Araki-Alcock	C/1983 H1	1983	May	11.5	0.0313	12.2
Halley	1P/ 837 F1	837	Apr	10.5	0.0334	13.0
Biela	3D/1805 V1	1805	Dec	09.9	0.0366	14.2
Comet of 1743	C/1743 C1	1743	Feb	08.9	0.0390	15.2
Pons-Winnecke	7P/	1927	Jun	26.8	0.0394	15.3
Comet of 1014	C/1014 C1	1014	Feb	24.9	0.0407	15.8*
Comet of 1702	C/1702 H1	1702	Apr	20.2	0.0437	17.0
Comet of 1132	C/1132 T1	1132	Oct	07.2	0.0447	17.4*
Comet of 1351	C/1351 W1	1351	Nov	29.4	0.0479	18.6*
Comet of 1345	C/1345 O1	1345	Jul	31.9	0.0485	18.9*
Comet of 1499	C/1499 Q1	1499	Aug	17.1	0.0588	22.9*
Schwassmann-Wachmann 3	73P/1930 J1	1930	May	31.7	0.0617	24.0
Sugano-Saigusa-Fujikawa	C/1983 J1	1983	Jun	12.8	0.0628	24.4
Comet of 1080	C/1080 P1	1080	Aug	05.7	0.0641	24.9*
Great comet	C/1760 A1	1760	Jan	08.2	0.0681	26.5
Comet of 1472	C/1471 Y1	1472	Jan	22.9	0.0690	26.9*
Comet of 400	C/ 400 F1	400	Mar	31.1	0.0767	29.8*
Comet of 1556	C/1556 D1	1556	Mar	13.0	0.0835	32.5*
Schweizer	C/1853 G1	1853	Apr	29.1	0.0839	32.7
Bouvard-Herschel	C/1797 P1	1797	Aug	16.5	0.0879	34.2
Halley	1P/ 374 E1	374	Apr	01.9	0.0884	34.4
Halley	1P/ 607 H1	607	Apr	19.2	0.0898	34.9
Comet of 568	C/ 568 O1	568	Sep	25.7	0.0918	35.7*
Messier	C/1763 S1	1763	Sep	23.7	0.0934	36.3
Tempel	C/1864 N1	1864	Aug	08.4	0.0964	37.5
LINEAR	P/2000 G1	2000	Mar	04.7	0.0974	37.9
Schmidt	C/1862 N1	1862	Jul	04.6	0.0982	38.2
Comet of 390	C/ 390 Q1	390	Aug	18.9	0.1002	39.0*
Hyakutake	C/1996 B2	1996	Mar	25.3	0.1018	39.6
Seki	C/1961 T1	1961	Nov	15.2	0.1019	39.7

Notes:

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

Near-Earth Objects

Near-Earth objects (NEOs) are comets and asteroids that have been nudged by the gravitational attraction of nearby planets into orbits that allow them to enter the Earth's neighbourhood. Composed mostly of water ice with embedded dust particles, comets originally formed in the cold outer planetary system while most of the rocky asteroids formed in the warmer inner solar system between the orbits of Mars and Jupiter. The scientific interest in comets and asteroids is due largely to their status as the relatively unchanged remnant debris from the solar system formation process some 4.6 billion years ago. The giant outer planets (Jupiter, Saturn, Uranus, and Neptune) formed from an agglomeration of billions of comets and the leftovers from this formation process are the comets we see today. Likewise, today's asteroids are the leftovers from the initial agglomeration of the inner planets that include Mercury, Venus, Earth, and Mars. As the primitive, leftover building blocks of the solar system formation process, comets and asteroids offer clues to the chemical mixture from which the planets formed some 4.6 billion years ago. If we wish to know the composition of the primordial mixture from which the planets formed, then we must determine the chemical constituents of the debris from this formation process – the comets and asteroids.

NEO Groups: In terms of orbital elements, NEOs are asteroids and comets with perihelion distance q less than 1.3 AU. Near-Earth Comets (NECs) are further restricted to include only short-period comets (i.e orbital period P less than 200 years). The vast majority of NEOs are asteroids, referred to as Near-Earth Asteroids (NEAs). NEAs are divided into groups (Aten, Apollo, Amor) according to their perihelion distance (q), aphelion distance (Q) and their semi-major axes (a).

Potentially hazardous asteroids (PHAs) are currently defined based on parameters that measure the asteroid's potential to make threatening close approaches to the Earth. Specifically, all asteroids with an Earth Minimum Orbit Intersection Distance (MOID) of 0.05 AU or less and an absolute magnitude (H) of 22.0 or less are considered PHAs. In other words, asteroids that can't get any closer to the Earth (i.e. MOID) than 0.05 AU (roughly 7,480,000 km or 4,650,000 mi) or are smaller than about 150 m in diameter are not considered PHAs. There are currently more than 900 known PHAs. This "potential" to make close Earth approaches does ***not*** mean a PHA ***will*** impact the Earth. It only means there is a possibility for such a threat. By monitoring these PHAs and updating their orbits as new observations become available, we can better predict the close-approach statistics and thus their Earth-impact threat.

(Adapted from http://neo.jpl.nasa.gov/neo/)

NEO GROUPS

Group	Description Definition:
NECs	Near-Earth Comets. q<1.3 AU, P<200 yrs
NEAs	Near-Earth Asteroids. q<1.3 AU
Atens	Earth-crossing NEAs with semi-major axes smaller than Earth's (named after asteroid 2062 Aten). a<1.0 AU, Q>0.983 AU
Apollos	Earth-crossing NEAs with semi-major axes larger than Earth's (named after asteroid 1862 Apollo). a>1.0 AU, q<1.017 AU
Amors	Earth-approaching NEAs with orbits exterior to Earth's but interior to Mars' (named after asteroid 1221 Amor). a>1.0 AU, 1.017<q<1.3 AU
PHAs	Potentially Hazardous Asteroids: NEAs whose Minimum Orbit Intersection Distance (MOID) with the Earth is 0.05 AU or less and whose absolute magnitude (H) is 22.0 or brighter. MOID<=0.05 AU, H<=22.0

FUTURE KNOWN CLOSEST ENCOUNTERS

DESIGNATION		DATE			DISTANCE		
Permanent	Provisional	Year	Month	Day (UT)	(AU)	(LD)	($R_\oplus$)
EXPECTED CLOSE ENCOUNTERS 2008 (time order)							
	2005 WJ56	2008	Jan	10.43	0.0279	10.9	
	2007 TU24	2008	Jan	31.44	0.0146	5.7	
	2007 DA	2008	Feb	12.31	0.0256	10.0	
(4450)	Pan	2008	Feb	19.93	0.0408	15.9	
	2002 TD66	2008	Feb	26.17	0.0428	16.7	
	2003 FY6	2008	Mar	21.84	0.0161	6.3	
	2005 NB7	2008	Apr	17.12	0.0422	16.4	
	2002 AZ1	2008	Jul	8.29	0.0231	9.0	
(90403)	2003 YE45	2008	Jul	13.39	0.0424	16.5	
	2005 RC34	2008	Jul	21.43	0.0373	14.5	
	2007 RT12	2008	Aug	6.75	0.0462	18.0	
(35107)	1991 VH	2008	Aug	15.54	0.0458	17.8	
	2006 BJ55	2008	Aug	15.69	0.0437	17.0	
	1998 SD9	2008	Sep	1.67	0.0236	9.2	
	2003 WT153	2008	Sep	7.81	0.0145	5.6	
	2003 SW130	2008	Sep	19.18	0.0236	9.2	
	2005 TQ45	2008	Oct	7.09	0.0443	17.2	
	2005 VN	2008	Oct	31.06	0.0106	4.1	
	2004 XK3	2008	Nov	21.22	0.0323	12.6	
	2006 US216	2008	Nov	25.65	0.0457	17.8	
EXPECTED CLOSE ENCOUNTERS 2009 (time order)							
	2002 AO11	2009	Jan	15.41	0.0200	7.8	
	1998 CS1	2009	Jan	17.75	0.0291	11.3	
	2006 AS2	2009	Feb	10.57	0.0235	9.2	
	1999 AQ10	2009	Feb	18.64	0.0113	4.4	
	2007 FS3	2009	Mar	11.68	0.0156	6.1	
	2003 WP25	2009	Mar	11.68	0.0363	14.1	
	2002 GG8	2009	Apr	3.07	0.0404	15.7	
	2001 SG286	2009	May	17.31	0.0308	12.0	
	1994 CC	2009	Jun	10.26	0.0168	6.5	
	2001 FE90	2009	Jun	28.6	0.0185	7.2	
	2006 MV1	2009	Jun	30.91	0.0247	9.6	
	2006 TU7	2009	Jul	20.71	0.0368	14.3	
	2002 EU11	2009	Aug	24.78	0.0248	9.7	
	2006 SV217	2009	Sep	1.01	0.0313	12.2	
	1998 FW4	2009	Sep	29.78	0.0222	8.6	
(68216)	2001 CV26	2009	Oct	8.66	0.0252	9.8	
	2006 JY26	2009	Nov	2.49	0.0164	6.4	
	1998 VF32	2009	Nov	22.02	0.0426	16.6	
	2006 WQ127	2009	Dec	1.27	0.0349	13.6	
	2003 YL118	2009	Dec	22.48	0.0323	12.6	
TWENTY FUTURE KNOWN CLOSEST ENCOUNTERS (ranked by distance)							
(99942)	Apophis	2029	Apr	13.91	0.00023	0.09	5.4
	2005 YU55	2011	Nov	8.98	0.00107	0.41	25.0
(85640)	1998 OX4	2148	Jan	22.14	0.00200	0.78	47.1
(35396)	1997 XF11	2136	Oct	28.49	0.00276	1.07	64.9
	2003 QC10	2066	Sep	24.86	0.00340	1.32	79.7
	2001 GQ2	2100	Apr	27.71	0.00340	1.32	79.9
	2002 AJ129	2172	Feb	8.5	0.00483	1.88	113.4
	2004 HD2	2093	Apr	8.62	0.00488	1.90	114.6
	2006 GC1	2095	Apr	1.96	0.00500	1.95	117.4
	2002 AW	2103	Oct	6.9	0.00517	2.01	121.3
	2007 JY2	2101	Nov	10.47	0.00534	2.08	125.3
	1999 MN	2137	Jun	4.26	0.00548	2.13	128.7
	2005 GC120	2122	Nov	30.75	0.00557	2.17	130.8
	1994 WR12	2080	Nov	23.61	0.00564	2.19	132.4
	2002 AW	2132	Oct	6.39	0.00576	2.24	135.1
(2340)	Hathor	2086	Oct	21.67	0.00597	2.32	140.3
	2007 JY2	2033	Nov	8.28	0.00602	2.34	141.3
	1994 WR12	2021	Nov	23.94	0.00612	2.38	143.8
	2005 WY55	2065	May	28.69	0.00615	2.39	144.3
(35396)	1997 XF11	2028	Oct	26.28	0.00624	2.43	146.5

CLOSE APPROACHES BY ASTEROIDS (Known closest approaches to the Earth)

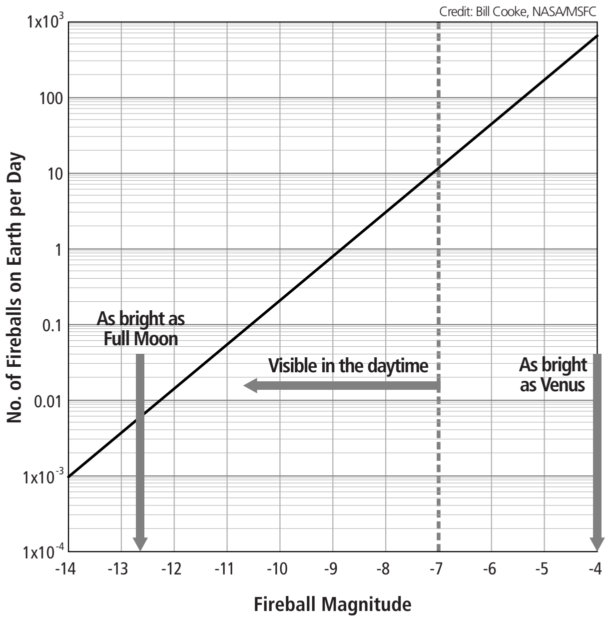
DISTANCE (AU)	(LD)	($R_\oplus$)	DATE (TT) Year	Mnth	Day	DESIGNATION (Permanent) Provisional
0.00008*	0.03	1.9	2004	Mar	31.65	2004 FU162
0.00023	0.09	5.3	2004	Dec	19.86	2004 YD5
0.00033	0.13	7.7	2004	Mar	18.92	2004 FH
0.00049	0.19	11.6	2007	Sep	5.05	2007 RS1
0.00056	0.22	13.1	2005	Nov	26.02	2005 WN3
0.00056	0.22	13.2	2003	Sep	27.96	2003 SQ222
0.00072	0.28	16.9	1994	Dec	9.79	1994 XM1
0.00079	0.31	18.4	2006	Feb	23.29	2006 DD1
0.00079	0.31	18.5	2002	Dec	11.35	2002 XV90
0.00080	0.31	18.8	2002	Jun	14.09	2002 MN
0.00082	0.32	19.3	2005	Oct	10.18	2005 TK50
0.00096	0.37	22.5	2007	Oct	12.42	2007 TX22
0.00096	0.37	22.6	2005	Mar	18.91	2005 FN
0.00099	0.39	23.3	2003	Dec	6.79	2003 XJ7
0.00099	0.39	23.2	1993	May	20.86	1993 KA2
0.00107	0.42	25.1	2006	Aug	31.9	2006 QM111
0.00108	0.42	25.4	2003	Sep	19.24	2003 SW130
0.00111	0.43	26.1	2004	Jul	16.21	2004 OD4
0.00113	0.44	26.5	1994	Mar	15.72	1994 ES1
0.00114	0.44	26.8	1991	Jan	18.72	1991 BA
0.00120	0.47	28.2	2007	Mar	11.07	2007 EH
0.00122	0.47	28.6	2006	Oct	21.11	2006 UE64
0.00125	0.49	29.4	2005	Oct	30.01	2005 UW5
0.00137	0.53	32.2	2006	Jan	29.44	2006 BF56
0.00146	0.57	34.3	2005	Dec	5.47	2005 XA8
0.00147	0.57	34.5	2007	Apr	24.86	2007 HB15
0.00155	0.60	36.4	2006	Feb	24.17	2006 DM63
0.00160	0.62	37.6	2004	Mar	27.85	2004 FY15
0.00177	0.69	41.6	2007	Mar	13.23	2007 EK
0.00177	0.69	41.6	2005	Jan	13.43	2005 BS1
0.00179	0.70	42.0	2006	Oct	30.7	2006 UJ185
0.00181	0.70	42.5	2006	Mar	8.64	2006 EC
0.00185	0.72	43.4	2004	Apr	18.01	2004 HE
0.00188	0.73	44.1	2003	Oct	12.07	2003 UM3
0.00188	0.73	44.1	2006	Jul	23.45	2006 OK3
0.00198	0.77	46.5	2004	Oct	24.73	2004 UH1
0.00205	0.80	48.1	2007	Feb	21.41	2007 DN41
0.00205++	0.80	48.1	2001	Jan	15.85	2001 BA16
0.00216	0.84	50.7	2006	Nov	16.65	2006 WP1
0.00217	0.84	51.0	2007	Jan	18.12	2007 BD
0.00217	0.84	51.0	2004	Dec	16.8	2004 XB45
0.00221	0.86	51.9	2003	Apr	29.27	2003 HW10
0.00222	0.86	52.1	2007	Feb	11.53	2007 CC27
0.00222	0.86	52.1	2006	Nov	20.24	2006 WX29
0.00225	0.88	52.8	2006	Jan	28.31	2006 BV39
0.00233	0.91	54.7	2006	Nov	21.42	2006 WV
0.00246	0.96	57.8	2004	Sep	21.98	2004 ST26
0.00246	0.96	57.8	2004	Sep	13.65	2004 RU109
0.00259	1.01	60.8	2007	Jan	19.64	2007 BB
0.00282	1.10	66.2	2002	Mar	31.15	2002 GQ
0.00289+	1.12	67.9	1995	Mar	27.15	1995 FF
0.00289	1.12	67.9	2006	Jul	3.18	2004 XP14
0.00290	1.13	68.1	2006	May	10.01	2006 JY26
0.00303	1.18	71.1	1996	May	19.69	1996 JA1
0.00303	1.18	71.1	2006	Jan	31.52	2006 BH99
0.00306	1.19	71.9	2003	Dec	6.95	2003 XV
0.00306**	1.19	71.9	1991	Dec	5.39	1991 VG
0.00309	1.20	72.6	2006	Sep	24.26	2006 SR131
0.00311	1.21	73.0	2002	Mar	8.04	2002 EM7
0.00318	1.24	74.7	2006	Oct	2.98	2006 SO198
0.00321	1.25	75.4	2002	Feb	8.8	2002 CB26
0.00323	1.26	75.8	2007	Mar	18.84	2007 EO88
0.00326	1.27	76.5	2004	Feb	24.3	2004 DA53
0.00331	1.29	77.7	2003	Jun	1.22	2003 LW2
0.00332	1.29	78.0	2000	Jun	2.9	2000 LG6
0.00340	1.32	79.8	2006	Jan	22.14	2006 BA
0.00346	1.35	81.2	2005	Nov	12.15	2005 VN5
0.00353	1.37	82.9	2002	Aug	18.33	2002 NY40
0.00362	1.41	85.0	2003	Mar	3.26	2003 DW10
0.00367	1.43	86.2	2003	Mar	5.85	2003 DY15
0.00371	1.44	87.1	2007	Apr	22.68	2007 HV4
0.00376	1.46	88.3	2005	Oct	14.85	2005 TC51
0.00378	1.47	88.8	2004	Jun	21.86	2004 MR1
0.00380	1.48	89.2	1999	May	6.14	2000 SG344
0.00401	1.56	94.2	2006	Dec	16.26	2006 XR4
0.00411	1.60	96.5	2004	Aug	11.84	2004 PZ19
0.00416	1.62	97.7	2007	Feb	8.24	2007 DC
0.00416	1.62	97.7	2007	May	9	2007 JB21
0.00418	1.63	98.2	2007	Oct	5.88	2007 TL16
0.00423	1.65	99.3	2003	Dec	27	2003 YS70
0.00445	1.73	104.5	2004	Feb	1.99	2004 BK86
0.00448	1.74	105.2	2006	Jun	28.31	2006 MB14
0.00454	1.77	106.6	2003	Nov	30.8	2003 WT153
0.00457	1.78	107.3	1989	Mar	22.9	**(4581) Asclepius** 1989 FC
0.00458	1.78	107.5	2007	Mar	10.04	2007 EK26
0.00460	1.79	108.0	2007	Feb	18.21	2007 DS7
0.00464	1.81	109.0	2004	Mar	25.79	2004 FM32
0.00466	1.81	109.4	2004	May	31.88	2004 KF17
0.00474	1.84	111.3	1994	Nov	24.85	1994 WR12
0.00474	1.84	111.3	2007	Feb	12.86	2007 CC19
0.00484	1.88	113.6	2001	Nov	29.33	2001 WM15
0.00486	1.89	114.1	2005	Jun	21.48	2005 MA
0.00490	1.91	115.1	2006	Apr	18.35	2006 HF6
0.00495	1.93	116.2	2000	Dec	22.29	2000 YA
0.00495	1.93	116.2	1937	Oct	30.71	**(69230) Hermes** 1937 UB
0.00500	1.95	117.4	1995	Oct	17.2	1995 UB
0.00501	1.95	117.6	2006	Jan	25.62	2006 BO7
0.00503	1.96	118.1	2006	Mar	7.5	2006 EH1
0.00509	1.98	119.5	2005	Nov	27.92	2005 WY
0.00509	1.98	119.5	2005	Oct	3.73	2005 TA
0.00510	1.98	119.8	2002	Oct	2.08	2002 TY59
0.00511	1.99	120.0	2005	Oct	26.22	2005 UE1
0.00512	1.99	120.2	2005	Jul	10.06	2005 ND63
0.00519	2.02	121.9	2006	Sep	13.64	2006 SC

Notes:

* This approach is to about 12,900 km from the centre of the earth!
** 1991 VG may be a returning piece of man-made space debris.
\+ Closest approach to the moon was 0.0013 AU (0.51 LD) on 1995 Mar. 27.0.
\++ Closest approach to the moon was 0.00053 AU (0.21 LD) 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).
$R_\oplus$ Radius of the Earth (see Sun & Planet Data table)

Meteors and meteor showers

Meteors, or shooting stars, are commonly observed in the night sky. However, they are not stars at all – they are a phenomenon that occurs during the entry into the Earth's atmosphere of a solid particle from space. Even though the upper atmosphere is very thin it is effectively solid for a high-speed particle entering it, and the particle's energy of motion is rapidly converted into heat energy (that may cause it to shatter or melt) and light energy – an ionisation trail in the atmosphere – the phenomenon that we observe. Most objects entering the Earth's atmosphere do so at high speed simply because the Earth is moving at around 30 kilometres per second (108,000 km/h!) in its orbit around the Sun.



Most meteors are random events. They occur at any time, at any trajectory, with any speed and with a range of brightness. Naturally, the larger the object (called a meteoroid before entry into the atmosphere) the brighter the meteor and the longer its trail across the sky. The meteors brighter than the planet Venus (magnitude -4) are called fireballs, and can persist long enough to create sonic booms or rumbles as they travel super-sonically through the atmosphere. Man-made material also can have a fiery re-entry into the atmosphere. The trails of this material can be much extended because they enter the Earth in essentially tangential trajectories as their orbit decays.

Meteoroids are debris left over from the formation of the solar system, or debris resulting from collisions between asteroids, or material ejected from comets or asteroids. Most visible meteors are the result of meteoroids the size of a grain of sand. Approximately 100 of these bodies impact the upper atmosphere every second. The accompanying graph shows that bright meteors are rare, which means that the meteor population rapidly decreases with size. It should be noted that every day about 5 meteors are potentially visible in daylight hours. However, most of the Earth is uninhabited and these events pass unreported. Also, it should be noted that objects up to 10 metres in size disintegrate on entering the atmosphere.

Sometimes, over the course of a week or so, meteors appear to preferentially emanate from a point in space. This is an effect of perspective and what is actually happening is that the Earth is passing through a stream of meteoroids released from a parent body such as a comet or asteroid. These events are called meteor streams, or when their rate is particularly high they are called a meteor shower. The point where the meteors appear to emanate from is called the radiant of the meteor stream. Various ejection directions and velocities for individual meteoroids from the parent body cause the width of a stream and the gradual distribution of meteoroids over the entire average orbit. Some meteor streams are associated with a known comet, for example the eta-Aquarid meteor stream of early May and the Orionid meteor stream of late October are associated with Comet 1P/Halley.

METEOR SHOWERS visible from the Southern Hemisphere

SHOWER NAME	DURATION	MAX. ACTIVITY DATE	MAX COUNT PER HOUR	RADIANT RA. (h m)	Dec. (°)	Size (°)
alpha-Centaurids	Jan 28 - Feb 21	Feb 08	5	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	4	16 36	-51	5
pi-Puppids	Apr 15 - Apr 28	Apr 22	variable	07 20	-45	5
eta-Aquarids	Apr 19 - May 28	May 05	70	22 32	-01	4
Pisces Austrinids	Jul 15 - Aug 10	Jul 27	5	22 44	-30	10 - 15
Southern delta-Aquarids	Jul 12 - Aug 19	Jul 27	20	22 36	-16	5
alpha-Capricornids	Jul 03 - Aug 15	Jul 29	4	20 28	-10	8
epsilon-Geminids	Oct 14 - Oct 27	Oct 18	2	06 48	+27	5
Orionids	Oct 02 - Nov 07	Oct 21	30	06 20	+16	20
Southern Taurids	Sep 25 - Nov 25	Nov 05	5	03 28	+15	5 - 10
Northern Taurids	Sep 25 - Nov 25	Nov 12	5	03 52	+22	5 - 10
Leonids	Nov 10 - Nov 23	Nov 17	20+	10 12	+22	5
alpha-Monocerotids	Nov 15 - Nov 25	Nov 21	variable	07 48	+01	5
December Phoenicids	Nov 28 - Dec 09	Dec 06	variable	01 12	-53	5
Puppid/Velids	Dec 01 - Dec 15	Dec 06	10	08 12	-45	10
Monocerotids	Nov 27 - Dec 17	Dec 08	2	06 40	+08	5
sigma-Hydrids	Dec 03 - Dec 15	Dec 11	3	08 28	+02	5
Geminids	Dec 07 – Dec 17	Dec 13	120	07 28	+33	5
Coma Berenicids	Dec 12 - Jan 23	Dec 20	5	11 40	+25	5

STARS & NON-STELLAR OBJECTS

BRIGHT STARS (EPOCH J2000.0)

DESIGNATION	NAME	CONSTELLATION	RA h m s	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	F0II	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	0.15	-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	Achernar	Eridanus	01 37 42.8	-57 14 12	0.45	-2.7	B3Vpe	0.023	143	44
11 α Ori	Betelgeuse	Orion	05 55 10.3	+07 24 25	0.50 var	-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 Cru	Acrux	Crux	12 26 35.9	-63 05 56	0.75	-4.2	B0.5IV+B1V	0.010	330	100
14 α Aql	Altair	Aquila	19 50 47.0	+08 52 06	0.77	2.2	A7V	0.194	16.8	5.2
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	0.98	-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	490	150
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	Fomalhaut	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	Elnath	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	1.68	-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 **apparent magnitude** by astronomers. 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 our sky is the Sun. It is not a particularly big or bright star, but it is very close to us so it looks very bright.

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 we receive 100 times more energy from a magnitude 1 star than from 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.

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

The magnitude system can also be applied to the brightness of the planets. The very brightest planets have a magnitude of -1 to -4. Consult the Magnitudes of the Planets graph in the Solar System Information Section for planet magnitudes throughout the year.

CLOSE STARS (EPOCH J2000.0)

DESIGNATION	NAME	CONSTELLATION	RA h m s	DEC. ° ′ ″	APP. MAG*	ABS. MAG**	SPECTRAL TYPE	PARALLAX ″	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

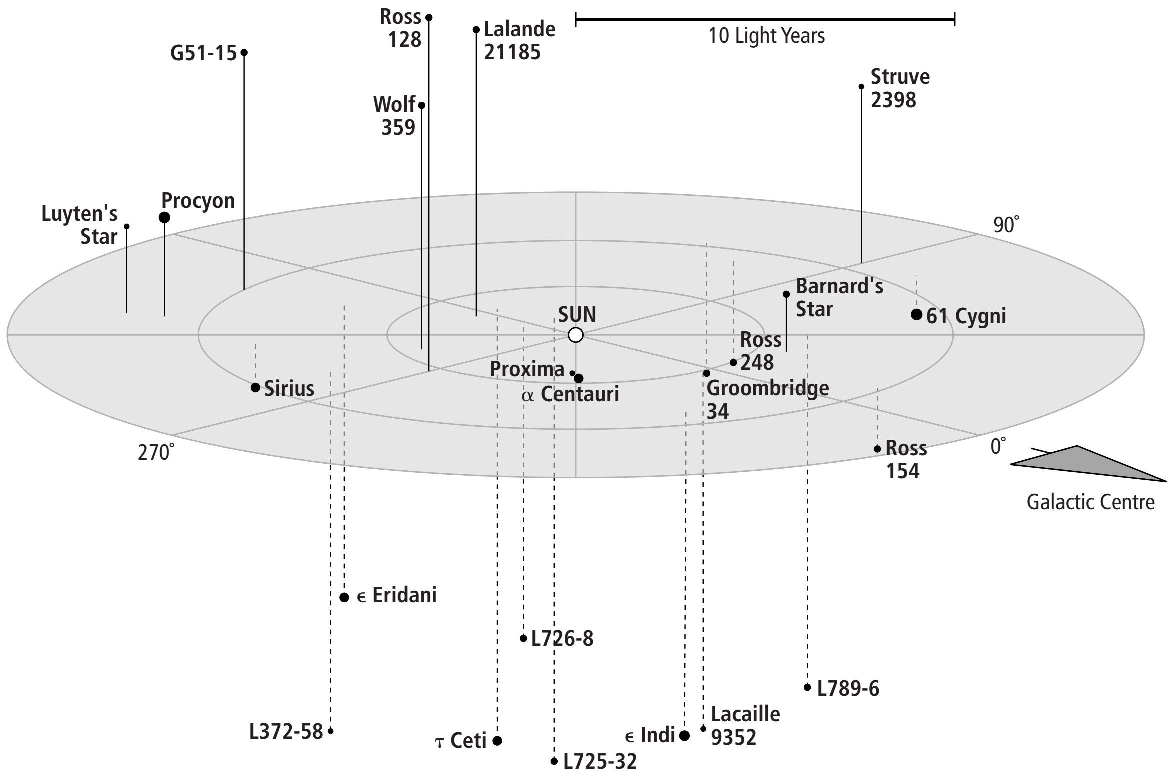
Many of the brighter stars were named in ancient times. Usually, the name referred to its place or association in its constellation. About 1,000 years ago Arab scholars kept the science of astronomy progressing and many star names are derived from their work.

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 generallly 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 Colour
O	Blue	50,000K	20	10	0.01	Mintaka
B	Blue	30,000K	7	4	0.2	Achernar, Rigel, Acrux
A	White	10,000K	2	2	0.6	Sirius, Fomalhaut
F	White-Yellow	7,000K	1.5	1.2	1.1	Procyon, Canopus
G	Yellow	6,000K	1	1	1.6	Sun, Capella, α Centauri
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 approximately 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), respectively. 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 h m	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 site
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, 'V' 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 site
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

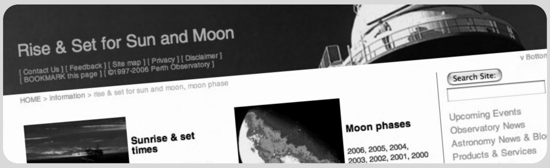
There are many Internet sites available for those interested in astronomy, most of which are very user friendly, and full of information. The following list of sites has been found by Observatory staff to be quite useful. Please note that the Internet is a dynamic medium so access to sites can change 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.perthobservatory.wa.gov.au

- ***Astronomy News***: Updated regularly, this section contains a weekly night sky column, plus notification of current phenomena and topical events.
- ***Information***: This gives information (small images) of planets, comets, stars etc. All of this information is taken from the Perth Observatory Project Kit. Also Sun and Moon rise/set times for Perth.

Rise and set times for Perth and Moon phases for WA:
http://www.perthobservatory.wa.gov.au/information/rise_set_times_phases.html



- ***Education and Outreach***: Details of services for the public. For availability, contact Perth Observatory. Daytime guided tours and evening star viewing available.
- ***Astronomy Links***: This section links the user to many areas of astronomical interest.

NASA Homepage

http://www.nasa.gov/

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.

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 also provides some basic astronomical information.

Sun

http://sohowww.nascom.nasa.gov/

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

Sunrise/set times

http://www.ga.gov.au/geodesy/astro/

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

Moon Phases

http://sunearth.gsfc.nasa.gov/eclipse/phase/phase2001gmt.html

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

http://www.perthobservatory.wa.gov.au/information/rise_set_times_phases.html

Moon phases for WA.

Eclipses

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

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.nineplanets.org

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.

http://www.perthobservatory.wa.gov.au//information/po_weather.html

Weather conditions at Perth Observatory.

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 area on the celestial sphere. 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 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 (AD 73 - AD 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 Chained Maiden
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	Comae Berenices	Com	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 Sea 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 Mariner’s Compass
Reticulum	Reticuli	Ret	Jan 03	The Eyepiece Reticle
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 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

2008 CALENDAR WITH JULIAN DATE AND DAY NUMBERS

DAY OF MONTH	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000
1	Tue	1	466.5	Fri	32	497.5	Sat	61	526.5	Tue	92	557.5	Thu	122	587.5	Sun	153	618.5
2	Wed	2	467.5	Sat	33	498.5	Sun	62	527.5	Wed	93	558.5	Fri	123	588.5	Mon	154	619.5
3	Thu	3	468.5	Sun	34	499.5	Mon	63	528.5	Thu	94	559.5	Sat	124	589.5	Tue	155	620.5
4	Fri	4	469.5	Mon	35	500.5	Tue	64	529.5	Fri	95	560.5	Sun	125	590.5	Wed	156	621.5
5	Sat	5	470.5	Tue	36	501.5	Wed	65	530.5	Sat	96	561.5	Mon	126	591.5	Thu	157	622.5
6	Sun	6	471.5	Wed	37	502.5	Thu	66	531.5	Sun	97	562.5	Tue	127	592.5	Fri	158	623.5
7	Mon	7	472.5	Thu	38	503.5	Fri	67	532.5	Mon	98	563.5	Wed	128	593.5	Sat	159	624.5
8	Tue	8	473.5	Fri	39	504.5	Sat	68	533.5	Tue	99	564.5	Thu	129	594.5	Sun	160	625.5
9	Wed	9	474.5	Sat	40	505.5	Sun	69	534.5	Wed	100	565.5	Fri	130	595.5	Mon	161	626.5
10	Thu	10	475.5	Sun	41	506.5	Mon	70	535.5	Thu	101	566.5	Sat	131	596.5	Tue	162	627.5
11	Fri	11	476.5	Mon	42	507.5	Tue	71	536.5	Fri	102	567.5	Sun	132	597.5	Wed	163	628.5
12	Sat	12	477.5	Tue	43	508.5	Wed	72	537.5	Sat	103	568.5	Mon	133	598.5	Thu	164	629.5
13	Sun	13	478.5	Wed	44	509.5	Thu	73	538.5	Sun	104	569.5	Tue	134	599.5	Fri	165	630.5
14	Mon	14	479.5	Thu	45	510.5	Fri	74	539.5	Mon	105	570.5	Wed	135	600.5	Sat	166	631.5
15	Tue	15	480.5	Fri	46	511.5	Sat	75	540.5	Tue	106	571.5	Thu	136	601.5	Sun	167	632.5
16	Wed	16	481.5	Sat	47	512.5	Sun	76	541.5	Wed	107	572.5	Fri	137	602.5	Mon	168	633.5
17	Thu	17	482.5	Sun	48	513.5	Mon	77	542.5	Thu	108	573.5	Sat	138	603.5	Tue	169	634.5
18	Fri	18	483.5	Mon	49	514.5	Tue	78	543.5	Fri	109	574.5	Sun	139	604.5	Wed	170	635.5
19	Sat	19	484.5	Tue	50	515.5	Wed	79	544.5	Sat	110	575.5	Mon	140	605.5	Thu	171	636.5
20	Sun	20	485.5	Wed	51	516.5	Thu	80	545.5	Sun	111	576.5	Tue	141	606.5	Fri	172	637.5
21	Mon	21	486.5	Thu	52	517.5	Fri	81	546.5	Mon	112	577.5	Wed	142	607.5	Sat	173	638.5
22	Tue	22	487.5	Fri	53	518.5	Sat	82	547.5	Tue	113	578.5	Thu	143	608.5	Sun	174	639.5
23	Wed	23	488.5	Sat	54	519.5	Sun	83	548.5	Wed	114	579.5	Fri	144	609.5	Mon	175	640.5
24	Thu	24	489.5	Sun	55	520.5	Mon	84	549.5	Thu	115	580.5	Sat	145	610.5	Tue	176	641.5
25	Fri	25	490.5	Mon	56	521.5	Tue	85	550.5	Fri	116	581.5	Sun	146	611.5	Wed	177	642.5
26	Sat	26	491.5	Tue	57	522.5	Wed	86	551.5	Sat	117	582.5	Mon	147	612.5	Thu	178	643.5
27	Sun	27	492.5	Wed	58	523.5	Thu	87	552.5	Sun	118	583.5	Tue	148	613.5	Fri	179	644.5
28	Mon	28	493.5	Thu	59	524.5	Fri	88	553.5	Mon	119	584.5	Wed	149	614.5	Sat	180	645.5
29	Tue	29	494.5	Fri	60	525.5	Sat	89	554.5	Tue	120	585.5	Thu	150	615.5	Sun	181	646.5
30	Wed	30	495.5				Sun	90	555.5	Wed	121	586.5	Fri	151	616.5	Mon	182	647.5
31	Thu	31	496.5				Mon	91	556.5				Sat	152	617.5			

DAY OF MONTH	JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000	Day of: Week	Day of: Year	Julian Date -2,454,000
1	Tue	183	648.5	Fri	214	679.5	Mon	245	710.5	Wed	275	740.5	Sat	306	771.5	Mon	336	801.5
2	Wed	184	649.5	Sat	215	680.5	Tue	246	711.5	Thu	276	741.5	Sun	307	772.5	Tue	337	802.5
3	Thu	185	650.5	Sun	216	681.5	Wed	247	712.5	Fri	277	742.5	Mon	308	773.5	Wed	338	803.5
4	Fri	186	651.5	Mon	217	682.5	Thu	248	713.5	Sat	278	743.5	Tue	309	774.5	Thu	339	804.5
5	Sat	187	652.5	Tue	218	683.5	Fri	249	714.5	Sun	279	744.5	Wed	310	775.5	Fri	340	805.5
6	Sun	188	653.5	Wed	219	684.5	Sat	250	715.5	Mon	280	745.5	Thu	311	776.5	Sat	341	806.5
7	Mon	189	654.5	Thu	220	685.5	Sun	251	716.5	Tue	281	746.5	Fri	312	777.5	Sun	342	807.5
8	Tue	190	655.5	Fri	221	686.5	Mon	252	717.5	Wed	282	747.5	Sat	313	778.5	Mon	343	808.5
9	Wed	191	656.5	Sat	222	687.5	Tue	253	718.5	Thu	283	748.5	Sun	314	779.5	Tue	344	809.5
10	Thu	192	657.5	Sun	223	688.5	Wed	254	719.5	Fri	284	749.5	Mon	315	780.5	Wed	345	810.5
11	Fri	193	658.5	Mon	224	689.5	Thu	255	720.5	Sat	285	750.5	Tue	316	781.5	Thu	346	811.5
12	Sat	194	659.5	Tue	225	690.5	Fri	256	721.5	Sun	286	751.5	Wed	317	782.5	Fri	347	812.5
13	Sun	195	660.5	Wed	226	691.5	Sat	257	722.5	Mon	287	752.5	Thu	318	783.5	Sat	348	813.5
14	Mon	196	661.5	Thu	227	692.5	Sun	258	723.5	Tue	288	753.5	Fri	319	784.5	Sun	349	814.5
15	Tue	197	662.5	Fri	228	693.5	Mon	259	724.5	Wed	289	754.5	Sat	320	785.5	Mon	350	815.5
16	Wed	198	663.5	Sat	229	694.5	Tue	260	725.5	Thu	290	755.5	Sun	321	786.5	Tue	351	816.5
17	Thu	199	664.5	Sun	230	695.5	Wed	261	726.5	Fri	291	756.5	Mon	322	787.5	Wed	352	817.5
18	Fri	200	665.5	Mon	231	696.5	Thu	262	727.5	Sat	292	757.5	Tue	323	788.5	Thu	353	818.5
19	Sat	201	666.5	Tue	232	697.5	Fri	263	728.5	Sun	293	758.5	Wed	324	789.5	Fri	354	819.5
20	Sun	202	667.5	Wed	233	698.5	Sat	264	729.5	Mon	294	759.5	Thu	325	790.5	Sat	355	820.5
21	Mon	203	668.5	Thu	234	699.5	Sun	265	730.5	Tue	295	760.5	Fri	326	791.5	Sun	356	821.5
22	Tue	204	669.5	Fri	235	700.5	Mon	266	731.5	Wed	296	761.5	Sat	327	792.5	Mon	357	822.5
23	Wed	205	670.5	Sat	236	701.5	Tue	267	732.5	Thu	297	762.5	Sun	328	793.5	Tue	358	823.5
24	Thu	206	671.5	Sun	237	702.5	Wed	268	733.5	Fri	298	763.5	Mon	329	794.5	Wed	359	824.5
25	Fri	207	672.5	Mon	238	703.5	Thu	269	734.5	Sat	299	764.5	Tue	330	795.5	Thu	360	825.5
26	Sat	208	673.5	Tue	239	704.5	Fri	270	735.5	Sun	300	765.5	Wed	331	796.5	Fri	361	826.5
27	Sun	209	674.5	Wed	240	705.5	Sat	271	736.5	Mon	301	766.5	Thu	332	797.5	Sat	362	827.5
28	Mon	210	675.5	Thu	241	706.5	Sun	272	737.5	Tue	302	767.5	Fri	333	798.5	Sun	363	828.5
29	Tue	211	676.5	Fri	242	707.5	Mon	273	738.5	Wed	303	768.5	Sat	334	799.5	Mon	364	829.5
30	Wed	212	677.5	Sat	243	708.5	Tue	274	739.5	Thu	304	769.5	Sun	335	800.5	Tue	365	830.5
31	Thu	213	678.5	Sun	244	709.5				Fri	305	770.5				Wed	366	831.5

What's an Era?

An era is a start point for chronological calculations and those in the accompanying table relater to different calendar systems. A calendar is a system of time reckoning over long durations and different cultures start their calendars at an era that has significance to them. Currently, there are about 40 calendars in use around the world.

The calendar in common use in Australia (and all developed countries) is associated with the Christian Church and its starting epoch is the estimated first year of the life of Christ. However, its correct name is the Gregorian calendar because in 1582 Pope Gregory XIII reformed the rule of Leap Years in order to better keep the months in synchronism with the seasons. Therefore this calendar is a solar calendar – it is based on the orbital motion of the Earth about the Sun. The Gregorian calendar is an improvement of the earlier Julian calendar (initiated by Julius Caesar around BC46). Most countries use the Gregorian calendar for the conduct of trade.

In Byzantium, their era started from the Biblical Creation and not from Christ's birth. The number of elapsed years between the events was deemed to be 5508 years.

The Chinese calendar is a combined lunar and solar (lunisolar) calendar and is mainly used to determine the dates of traditional Chinese holidays. Its start epoch is that for the birth of Emporor Huang Di.

The Coptic calendar, also called the Diocletian calendar, is used by the Coptic Orthodox Church. This calendar is based on the ancient Egyptian (solar) calendar. Coptic years are counted from AD 284, the year the notorious persecutor of christians Diocletian became Roman Emperor.

The Buddhist calendar used in Cambodia, Thailand, and Myanmar is a lunisolar calendar. Thailand uses the Buddhasakarat era, Cambodia uses the Mahasakarat era (that happens to be the same as the Saka Era in the Indian Saka calendar) and Myanmar uses the Chulasakarat era.

The Islamic (Hegira) calendar in a lunar calendar (based on the orbit of the Moon about the Earth) and its starting year is that for the birth of the Prophet Muhammad.

The Japanese calendar is based on the mythical founding of Japan by Emperor Jimmu in 660BCE.

The Jewish calendar is a lunisolar calendar and starts at the date of Creation as outlined in the Old Testament.

The Greek astronomer Claudius Ptolemaeus defined an era that started from the first year of the reign of Nabonassar the founder of a kingdom in Babylon. This system was used by Ptolemy and later astronomers, but not by the Babylonians themselves.

In the later Roman Republic, historians and scholars began to count years from the founding of the city of Rome. Different scholars used different dates for this event. The date most widely used today is that calculated by Varro, 753 BC, but other systems varied by up to several decades. Dates given by this method are numbered ab urbe condita (meaning after the founding of the city, and abbreviated AUC).

ERAS (2008)

ERA NAME	YEAR	BEGINS
Byzantine	7517	Sep 14
Chinese (Ding-Hai)	(4645)	Feb 7
Diocletian	1725	Sep 11
Grecian (Seleucidae)	2320	Sep 14 (or Oct 14)
GREGORIAN	**2008**	**Jan 1**
Indian (Saka)	1930	Mar 21
Islamic (Hegira)*	1429	Jan 9
Islamic (Hegira)*	1430	Dec 28
Japanese	2668	Jan 1
Jewish (A.M)*	5769	Sep 29
Nabonassar	2757	Apr 21
Roman (A.U.C.)	2761	Jan 14

* Year begins at sunset.

All dates are given in terms of the Gregorian calendar in which 2008 January 14 corresponds to 2008 January 1 of the Julian Calendar.

RELIGIOUS CALENDAR (2008)

EVENT	DATE
Epiphany	Jan 6
Islamic New Year (tabular)	Jan 10
Ash Wednesday	Feb 6
Palm Sunday	Mar 16
Good Friday	Mar 21
Easter Day	Mar 23
First Day of Passover (Pesach)	Apr 20
Ascension Day	May 1
Whit Sunday - Pentecost	May 11
Trinity Sunday	May 18
Feast of Weeks (Shavuot)	Jun 9
First Day of Ramadan (tabular)	Sep 2
Jewish New Year (tabular) (Rosh Hashanah)	Sep 30
Day of Atonement (Yom Kippur)	Oct 9
First Day of Tabernacles (Succoth)	Oct 14
First Sunday in Advent	Nov 30
Festival of Lights (Hanukkah)	Dec 22
Christmas Day (Sunday)	**Dec 25**
Islamic New Year (tabular)	Dec 29

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.

CHRONOLOGICAL CYCLES (2008)

Dominical Letter	FE	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 is used in constructing the ecclesiastical calendar (and determining Easter) for any year.
Epact	22	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. It is used in constructing the ecclesiastical calendar for any year.
Golden Number (Lunar Cycle)	XIV	Year within a 19-year cycle after which moon phases repeat (approximately) on the same calendar day in the Julian Calendar. It used to be used in constructing the ecclesiastical calendar for any year.
Julian Period (year of)	6721	Number of Julian years from Julian Day 0.
Roman Indiction	1	Year within a 15-year cycle based on a Roman taxation cycle. (This, in turn, was based on the maximum length of military service, at the end of which taxation had to be finalised.)
Solar Cycle	1	Year within a 28-year cycle after which weekdays and calendar dates repeat in the Julian Calendar. It used to be used in constructing the ecclesiastical calendar for any year..

Calculation of Easter

The calculation of the Easter date has the ecclesiastical name of the comput. It is somewhat complicated because it is linked to the Hebrew calendar.

Jesus was crucified immediately before the Jewish Passover, which is a celebration of the Exodus from Egypt under Moses. Celebration of Passover started on the 15th day of the (spring) month of Nisan. Jewish months start when the Moon is new, therefore the 15th day of the month must be immediately after a Full Moon.

It was therefore decided to make Easter Sunday the first Sunday after the first Full Moon after March equinox. Or more precisely: Easter Sunday is determined using the *ecclesiastical Moon*, the fictitious average Moon, as the first Sunday after the ecclesiastical Full Moon on or after the ecclesiastical March equinox.

The ecclesiastical March equinox is always 21 March. The ecclesiastical Full Moon may differ from the astronomical Full Moon by one or two days.

The Full Moon that precedes Easter is called the Paschal Full Moon. Two constructs play an important role when calculating the Paschal Full Moon: The Golden Number and the Epact.

The following table shows the date for the Paschal Full Moon for a given Epact: Easter Sunday is the Sunday following the above Full Moon date. If the Full Moon falls on a Sunday, Easter Sunday is the following Sunday. An Epact of 25 requires special treatment, as it has two dates in the above table. There are two equivalent methods for choosing the correct Paschal Full Moon date, either:

Epact	Paschal Full Moon	Epact	Paschal Full Moon
1	12 April	16	28 March
2	11 April	17	27 March
3	10 April	18	26 March
4	9 April	19	25 March
5	8 April	20	24 March
6	7 April	21	23 March
7	6 April	22	22 March
8	5 April	23	21 March
9	4 April	24	18 April
10	3 April	25	18 or 17 April
11	2 April	26	17 April
12	1 April	27	16 April
13	31 March	28	15 April
14	30 March	29	14 April
15	29 March	30	13 April

a) Choose 18 April, unless the current century contains years with an Epact of 24, in which case 17 April should be used.

b) If the Golden Number is > 11 choose 17 April, otherwise choose 18 April.

(Adapted from 'Frequently Asked Questions About Calendars' by Claus Tondering, 2005.)

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 in the process of 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. Find 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.

6. 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:

Sunrise time at Leonora on 2008 Dec 21st (the December Solstice of 2008).

1 The sunrise time at Perth on that date is 0607 WDT (WA daylight saving time, from December Sun and Moon rise and set table, see section: *December*).

2. The declination of the Sun on that date is -23° 26′ 05″ = -(23+26/60+5/3600)° = -23.°43 (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.

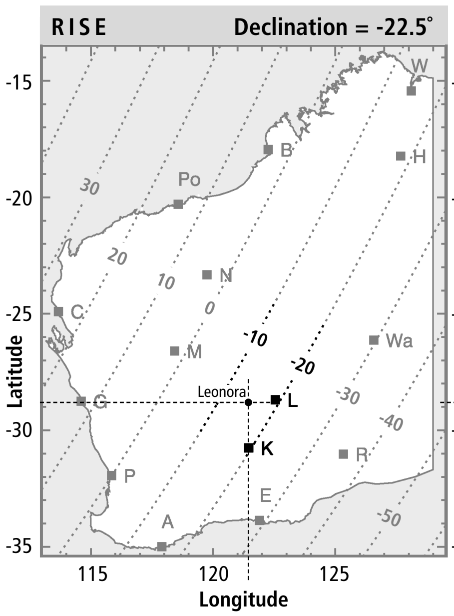
4. Use the rise maps, with declinations –22.°5 and –30.°0. From the rise correction maps the corrections are –16 minutes and –13 minutes, respectively.

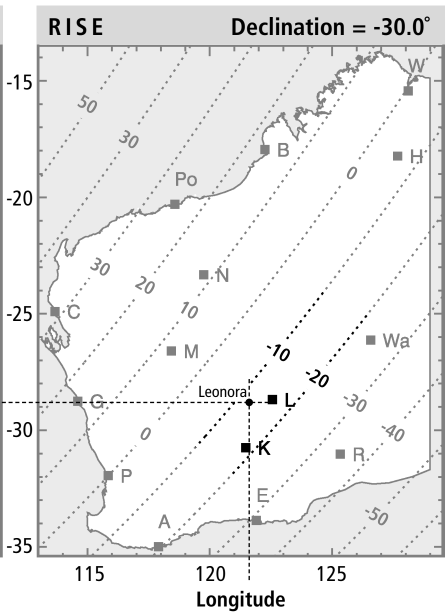
5. Interpolate between maps: -23.°43 is 0.°93 from –22.°5 toward –30.°0. So we must add 0.93/7.5 of the difference between the estimates, from the estimate at –22.°5.

   The interpolation 'correction' = 0.93/7.5 * (-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.

Sunrise time at Leonora
= Sunrise time at Perth + correction = 0607 WDT –16 minutes = 0551 WDT.





Notes for maps

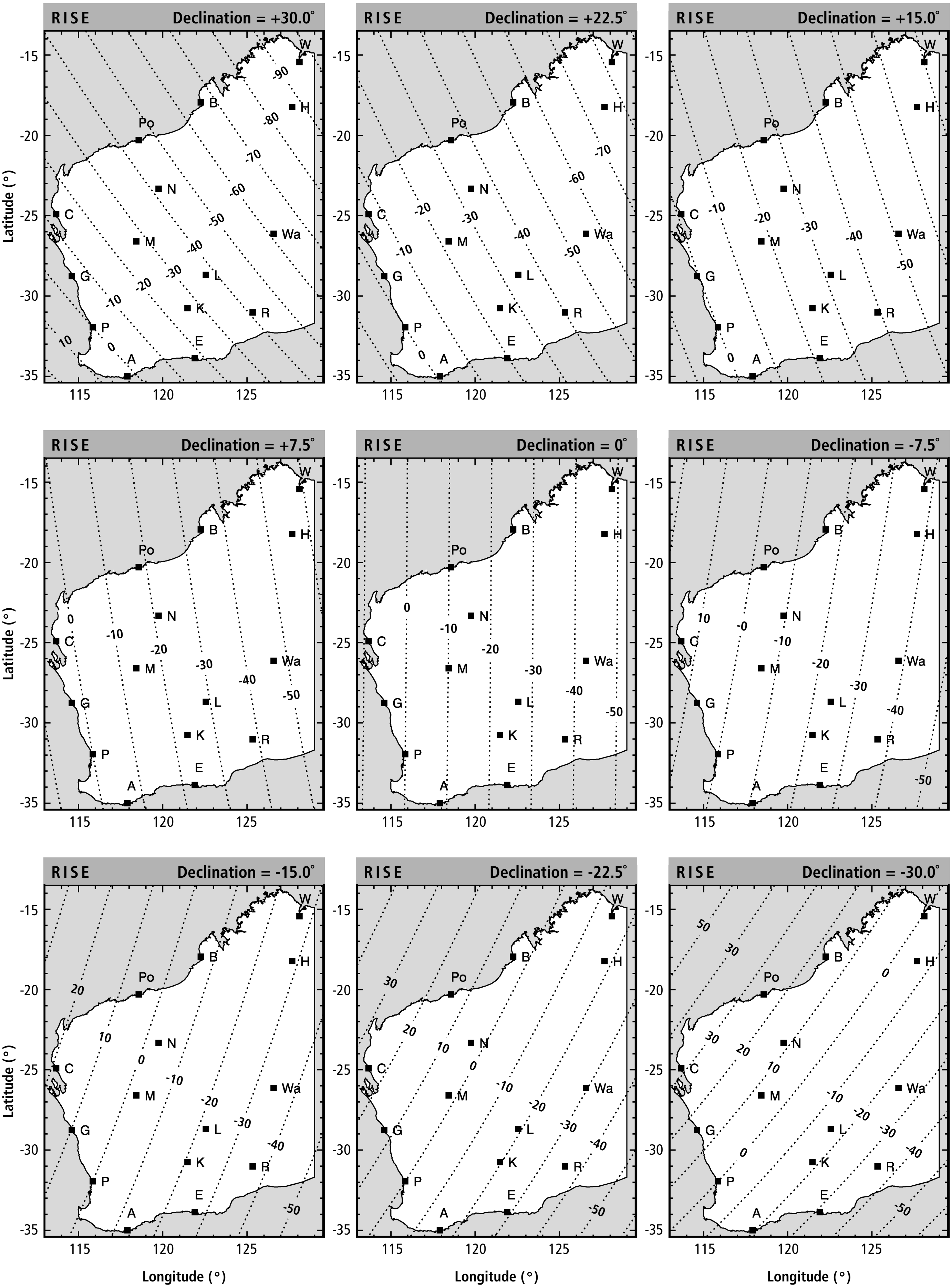
All corrections are the number of minutes to be added to the rise or set time at Perth. The cities and towns indicated are:

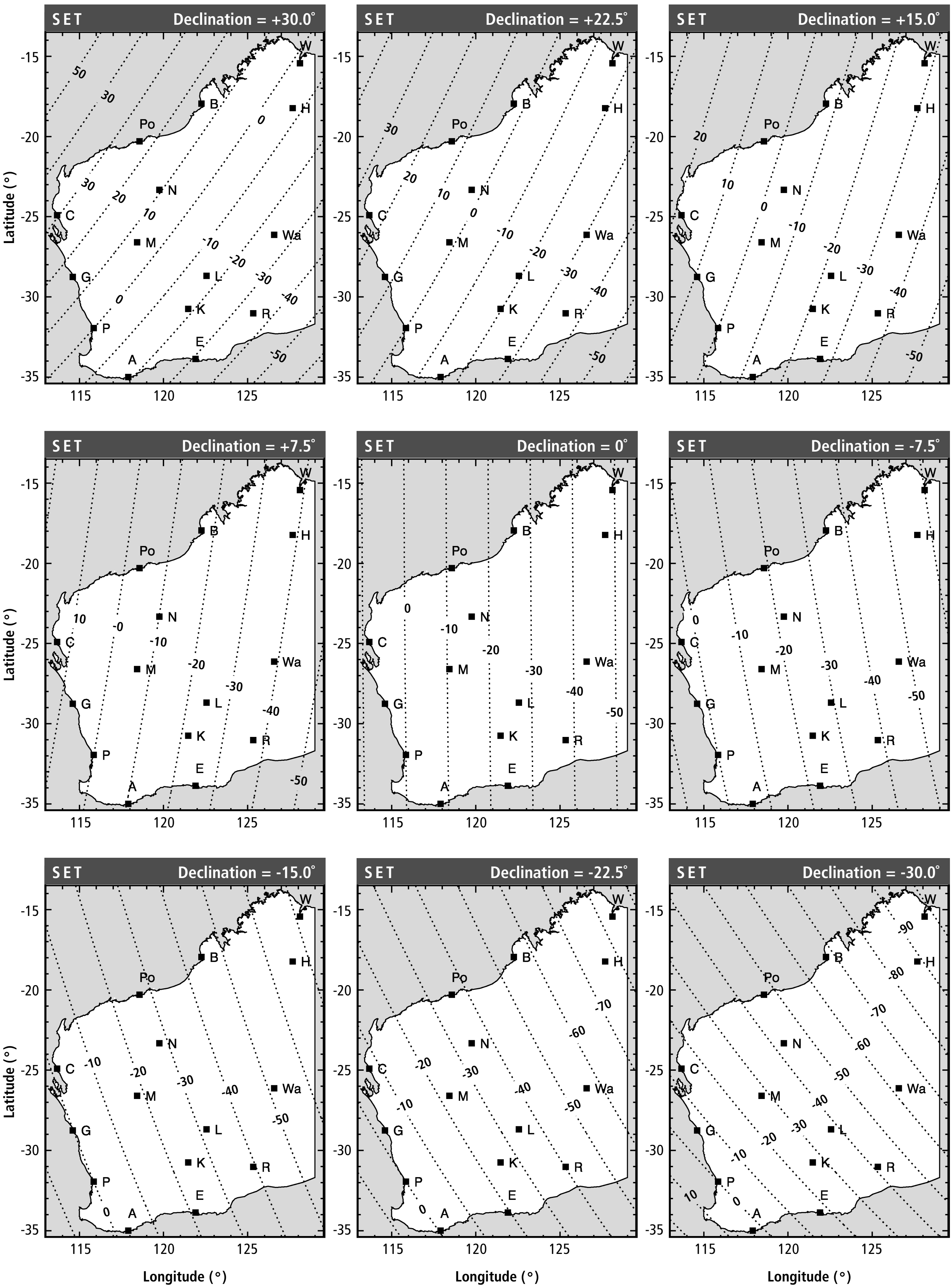
A	Albany	B	Broome	C	Carnarvon	E	Esperance
G	Geraldton	H	Halls Creek	K	Kalgoorlie	L	Laverton
M	Meekatharra	N	Newman	P	Perth	Po	Port Hedland
R	Rawlinna	Wa	Warburton Community			W	Wyndham

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
Northam	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
Southern Cross	31.227	119.327
Tom Price	22.694	117.793
Warburton Community	26.132	126.571
Wiluna	26.595	120.225
Wyndham	15.486	128.120
Yampi Sound	16.129	123.656

RISE/SET CORRECTION DIAGRAMS FOR WESTERN AUSTRALIA





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

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 or cable, which is also handy to control the long time exposures sometimes required.

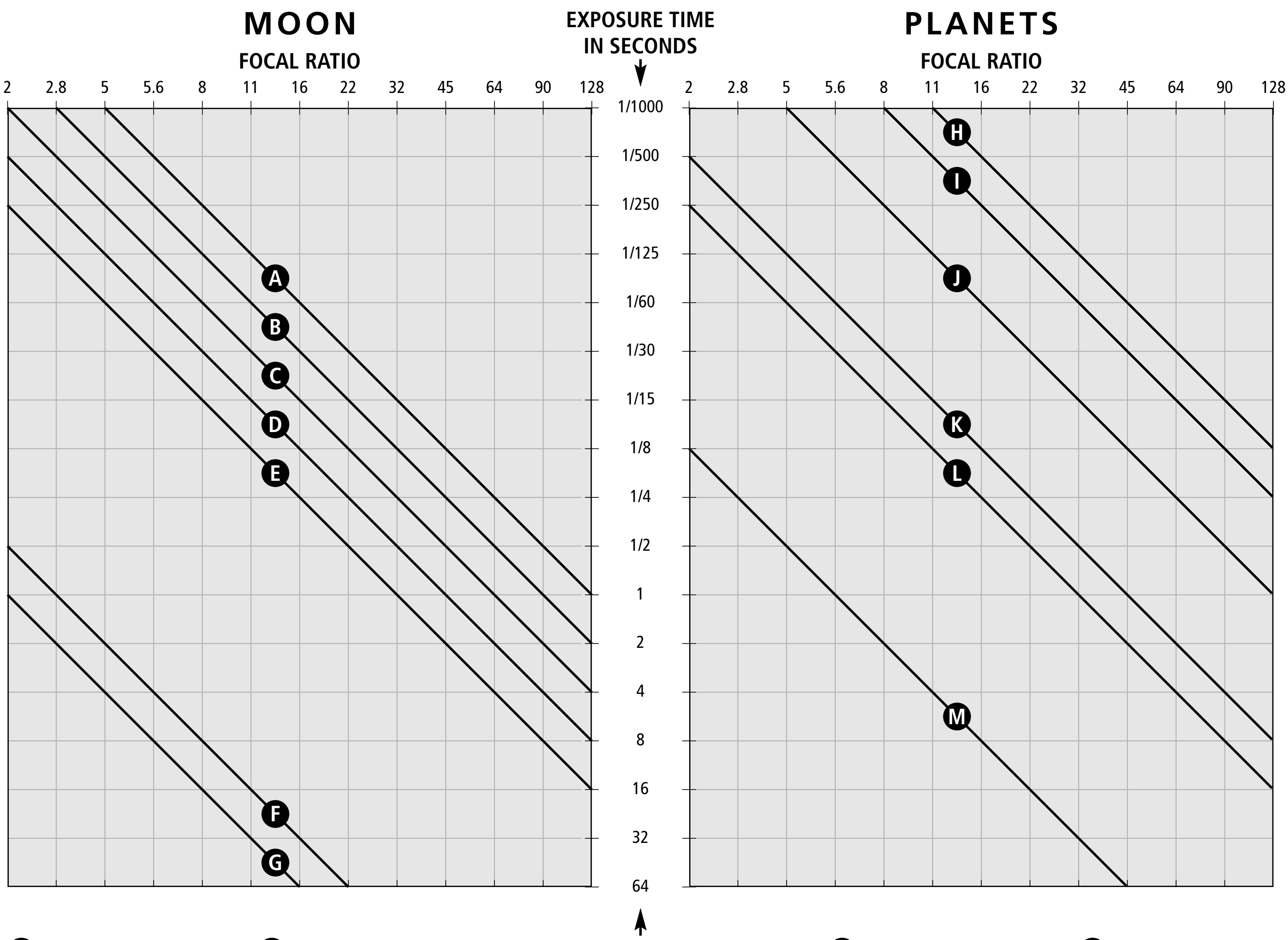
The graphs show the recommended exposure times for the Moon and planets using 100 ISO film. They should only be used as a guide because many factors influence the exposure time.

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, secular: the component of stellar aberration resulting from the essentially uniform and rectilinear motion of the entire Solar System in space. Secular aberration is usually disregarded.

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, friction 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.

fireball: A bright meteor with an apparent visual magnitude the same as Venus (-4 magnitude) or brighter.

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 20º 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 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 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: Two galaxies close 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 hypothetical 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.

meteor: The light phenomenon which results from the entry into the Earth's atmosphere of a solid particle from space. The very thin atmosphere is effectively solid for a high-speed particle entering it, and so the particle's energy of motion is rapidly converted into heat energy (that may cause it to shatter or melt) and light energy – an ionisation trail in the atmosphere – that is the phenomenon we observe.

meteor shower: A number of meteors with approximately parallel trajectories. The meteors belonging to one shower appear to emanate from a point in space called their radiant.

meteorite: A natural object of extraterrestrial origin (meteoroid) that survives passage through the atmosphere and hits the ground.

meteoroid: A solid object moving in interplanetary space, of a size considerably smaller than a asteroid and considerably larger than an atom or molecule.

meteoroid stream: Stream of solid particles released from a parent body such as a comet or asteroid, moving on similar orbits. Various ejection directions and velocities for individual meteoroids cause the width of a stream and the gradual distribution of meteoroids over the entire average orbit.

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.

micrometeorite: A small extraterrestrial particle that has survived entry into the Earth's atmosphere. Micrometeorites found on the Earth's surface are smaller than 1mm, those collected in the Stratosphere are rarely as large as 50μm.

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 μm. 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 0, 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 UT0; it is slightly dependent on the place of observation. When UT0 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 taxpayers of Western Australia is by answering enquiries from the public. 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 from temporate latitudes. 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.

Artificial Satellites

Artificial 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.

December, a long time ago:
The **Bethlehem Observatory Sighting Report Form**
gets its first real workout.

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 gain 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 copy of the Sighting Report Form from Perth Observatory's website at **www.perthobservatory.wa.gov.au/information/unusual_sightings.html**

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

The Deep Foundations of Astronomy in Everyday Life – Units of Time

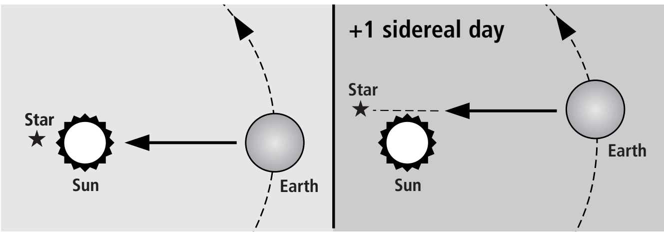
Knowledge accumulated over the ages shapes and influences our culture. Astronomy, being one of the oldest sciences, is particularly pervasive in our everyday lives. However this is often overlooked or not well appreciated by us all. In particular, our many units of time, and ultimately our systems of long-term time reckoning, calendars, have profound roots in astronomy.

Day

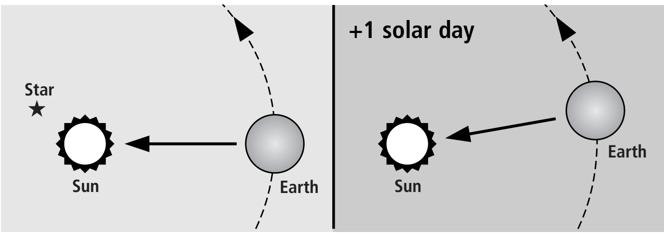
One of the most pervasive units of time is the day. This light and dark cycle is inherently astronomical in basis as it corresponds to one rotation of the Earth about its axis.

However, the day does not readily provide a straightforward standard of time keeping. First, the day is a local phenomenon because the precise position of the Sun varies across the Earth. Second, the exact definition of the day depends on the reference system used to count one complete rotation. Finally, the flow of time is only as constant as the rotation of the Earth.

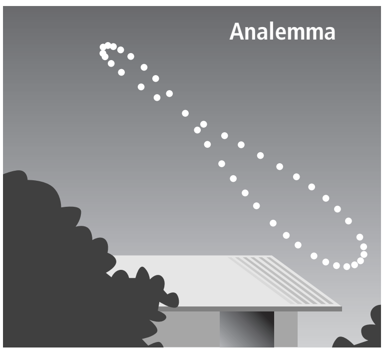
A **sidereal day** is defined as the time between successive passages of a given stellar background across the observer's meridian (the imaginary line in the sky joining the north and south poles). In this definition the distant stars are used as the external reference.



The **apparent solar day** is another definition of the day and is measured by the Sun's diurnal (day) movement across sky. That is, it is defined as the time it takes for successive passages of the Sun across the observer's meridian (or some other locally fixed reference).



Unfortunately, this definition produces a day whose length varies throughout the year, and is thus not a very accurate time standard (especially when compared to the sidereal day). This variability is apparent when one considers the **Analemma** – a plot of the Sun's position at a given local time across the days of one year. It is clear that the Sun's position at a given time moves about through the year, and so the time between meridian passages must vary throughout the year. The azimuth (parallel to the horizon) movement results for the elliptical orbit of the Earth about the Sun, and the altitude (perpendicular to the horizon) movement results from the tilt of the Earth's rotation axis with respect to its orbital axis.



In order to overcome the variability in the apparent solar day, the **mean solar day** was defined by astronomers. This definition uses a fictitious body, the **mean sun**, which moves along the Celestial Equator with constant angular speed. This angular speed is equal to the mean angular speed of the real Sun along the ecliptic, that is, approximately 1°/day. The mean solar day is defined as the average time between successive passages of the Mean Sun over observer's meridian. It is 3 minutes 56 seconds longer than the Sidereal Day because of the Earth's orbital motion about the Sun. Another manifestation of this is that a given star rises 3 minutes 56 seconds earlier each day.

Hour

The division of the day into twenty-four hours is derived from ancient Egypt. At that time the Egyptians thought that the day was the manifestation of the motion across the sky of Ra the sun god in his boat. Early in Egyptian history the day (including night) was divided into 36 decans. However, they noticed that in the summer months in Lower Egypt (the region closest to the Nile delta) there was only twelve decans during the night. So in order to maintain a balance it was decreed that there were only twelve decans in the daylight time. Eventually the Egyptians divided the entire day into twenty-four intervals and these have descended to us as the way we divide the day by hours.

Minutes and Seconds

Division of the hour into sixty minutes and the minute, in turn, divided into sixty seconds results from the work of the famous astronomer Hipparchus of Rhodes (BCE 194 - 120). His work on the positions of the stars and, in particular, the motion of the planets was based on observations acquired earlier by the Babylonians. The Babylonians had a very well developed mathematics based on the sexagesimal (base 60) system, that is, they had a distinct symbol for each number from one to 59. Their system also incorporated the concept of placeholders which made mathematical operations such as addition and subtraction more straightforward. The placeholder concept is implicit in our decimal (base 10) system, for example, the ordering of the 3, 4 and 5 in the number 345 means 3 hundreds + 4 tens + 5 units. In the Babylonian system the number 345 would represent 3 60x60s + 4 60s + 5 units.

Today, the second is defined in a manner independent of the motion of the Solar System (and irregularities in the rotation and orbit of the Earth). It is based on the frequency of oscillation associated with ^{133}Cs isotope. In fact, the second is now the fundamental unit of time in the international standards system (System Internationale, SI). It is formally defined in terms of the quantum mechanical manifestation of an atom, namely, as 9,192,631,770 periods of the hyperfine transition of ^{133}Cs ground state.

Week

There is no direct astronomical basis for the definition of the week. However, it is still related to astronomy. The Babylonians assigned planet names to the days of week. This was important to them because each of the objects they defined as planets was graced with the name of a god. At that time they knew of seven celestial objects that 'wandered' (the word planet is derived from the Greek for wander) through the skies.

'Planet'	Ancient planet gods				Modern		
	Babylonian	Greek	Roman	Anglo-Saxon	English	French	Spanish
Sun	Shamash	Helios	Sol	Sun	Sunday	Dimanche	Domingo
Moon	Sin	Selene	Luna	Moon	Monday	Lundi	Lunes
Mars	Nergal	Ares	Mars	Tiw	Tuesday	Mardi	Martes
Mercury	Nabu	Hermes	Mercurius	Woden	Wednesday	Mercredi	Miercoles
Jupiter	Marduk	Zeus	Jupiter	Thor	Thursday	Jeudi	Jueves
Venus	Ishtar	Aphrodite	Venus	Freya	Friday	Vendredi	Viernes
Saturn	Ninurta	Cronus	Saturnus	Saturn	Saturday	Samedi	Sabato

These seven 'planets' were (from closest to most distant as determined by the Babylonians) the Moon, Mercury, Venus, Sun, Mars, Jupiter and Saturn. The table shows that the days of the week essentially retain the names of these gods even though they have been affected by changes in culture and language. The romance languages of French and Spanish retain a great similarity to their root language of Latin (the language of the Romans), whilst the English names are expressions of the equivalent Anglo-Saxons gods.

The days are not ordered with the Babylonian system of closest to most distant planet. This arose in response to the further association of the hours in each day with a planet. This association was organised in a cyclic order with the further constraint that a day had to have the same planet name for both the day and the first hour of the day.

Month

The very conspicuous change in the appearance of the Moon in its orbit about Earth is the astronomical basis of the month. In coastal regions this interval is also associated with the periodic behaviour of the tides. The length of the lunar month, the time between repetitions of a given phase, is 29.5306 days. Thus 12 repetitions of a given phase, i.e. months, corresponds to 354 days, nearly as long as one year.

Our current system of twelve months in a year is descended from the Romans. Early on the Roman year only contained 10 months. This led to a year that was too short and this was corrected around BCE 700 when further months were added. In order to make the year keep track with the seasons the number of days in February was changed and the inter-calendar month was either included or omitted from a given year in order to keep the months in track with the seasons.

In BCE 46 Julius Caesar made changes to the Roman calendar, as the old system was open to abuse by the religious and political authorities that controlled it. His introduction of the leap year (an additional day in February for any year divisible by four) also assisted the calendar at better keeping the seasons in synchronism with the year. He was rewarded for this innovation by the naming of the month of July for him.

Augustus, during his reign, reminded the authorities that Julius had decreed that the interval between leap years was four years, and not three, as some thought. For this accomplishment he was rewarded around BCE 8 by the naming of the month of August after him. Also, in order that he not be slighted the number of days in August was increased to 31 as for July, and February lost one day in this process.

Year

The astronomical basis of the year is Earth's orbit about the Sun. The following sections discuss the many definitions of the year that have arisen from scientific and civil needs.

A **calendar year** contains 365 or 366 mean solar days. This is the simplest form of the year we encounter in everyday life. A specific type of calendar year is the **leap year** that contains 366 mean solar days with the addition of an extra day in February. The **mean civil year** gives an estimate of the long-term average length of the calendar year. However, the mean civil year's length depends upon which calendar is in use. In the Julian calendar there are on average 365.25 mean solar days. Today, most countries use the Gregorian calendar and the mean civil year's length is 365.2425 mean solar days. The difference between these two figures arises from the different ways in which leap years are defined and this is discussed in more detail in the calendars section below.

A more astronomically related time interval is the **sidereal year** that is defined as the time it takes for Sun to complete one hypothetical "orbit about the Earth" with respect to the fixed background stars. This time interval is 365.2565 mean solar days.

Arguably the most important definition of the year is the **tropical year**. This is the time interval between successive passages of Sun across the celestial equator from the southern sky to the northern sky (this point in the sky is called the First Point of Aries). This passage occurs at the March Equinox and assists track the seasons that are the climatic response to the position of the Sun in the sky and the attendant amount of daily sunshine. The time interval of the tropical year is 365.2422 mean solar days. The Gregorian calendar with its mean civil year of 365.2425 mean solar days is specifically constructed for the purpose of assisting ongoing civil activities by keeping the months in synchronism with the seasons.

The difference between the duration of the sidereal and tropical years arises from the effect called precession. The rotation axis of the Earth slowly moves and this makes the position of the first point of Aries also move, thus shortening the tropical year compared to the sidereal year.

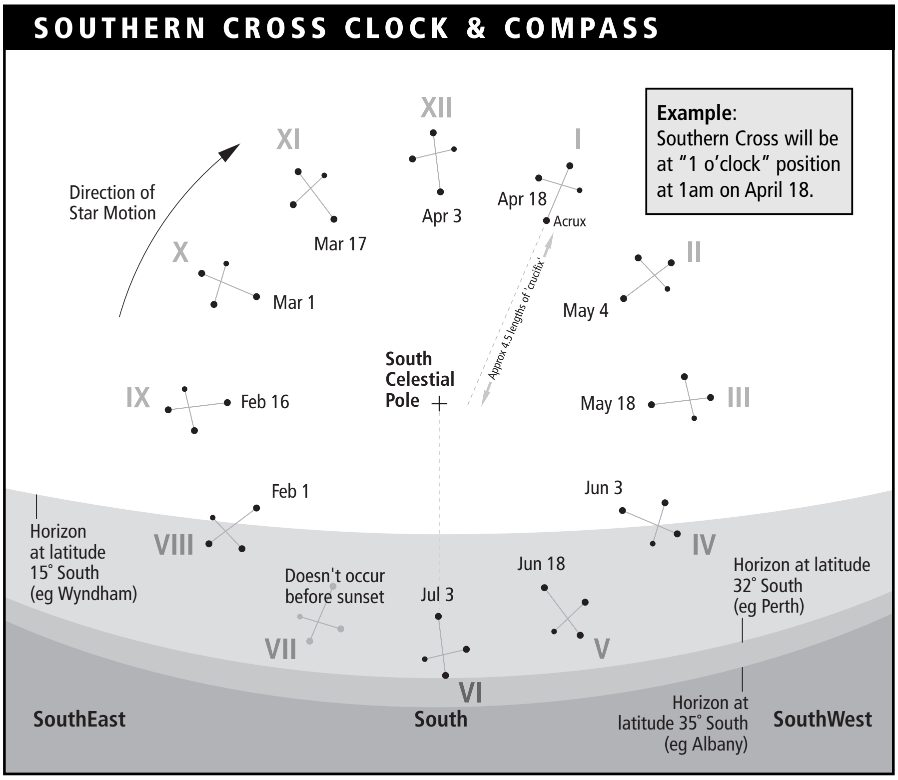
Calendars

A calendar is a system of organising units of time for the purpose of reckoning time over extended periods. Some calendars replicate astronomical cycles according to fixed rules, while others are based on abstract, perpetually repeating cycles of no astronomical significance. Our calendar, the Gregorian calendar, has an astronomical basis in the day, month and year. Complexity automatically arises for calendars based on astronomical cycles because the basic units of time are; not perfectly commensurable with each other, and, not constant.

Pope Gregory XIII instituted the Gregorian calendar in CE1582. It involved having calendar years of 365 days in length and 366 days in a leap year, and a redefinition of the leap year being any year divisible by 4, except those divisible by 100, unless they were divisible by 400. (For example, 1900 and 1901 are not leap years, 2000 and 2004 are leap years). This leap year rule was created in order to make a better long term average approximation for the number of days per year and thus keep the seasons fixed appropriately to the months. However, the fine leap year adjustments in the Gregorian calendar are not perfect and after about 3,300 years it will be one day out of synchronism with the tropical year.

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

The Southern Cross (Crux) is one of the brightest constellations in the sky. Its formal boundaries give it the least area on the sky, but because it contains two first magnitude stars, one second and one third magnitude star, it is the brightest constellation (per unit area). It is also one of the most easily identified constellations – just join the dots and the pattern resembles a diamond, kite, or, 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° S 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 are 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, $4\frac{1}{2}$ 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 closest to the South Celestial Pole, independent of the orientation of the Southern Cross. Note that there is no bright star at the pole. (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's education and public outreach programme, several large telescopes including one with a 30inch (76cm) aperture – the **largest telescope in regular public use** in the Southern Hemisphere – 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 also regularly conduct many astronomy talks and lectures. Perth Observatory has also established a museum to inform visitors about the history of the Observatory and to educate them in the science of astronomy.

Generous assistance from the Perth Observatory Volunteer Group and LotteryWest has facilitated acquisition of equipment to assist the disabled participate in star viewing activities.

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. October to May inclusive – Bookings essential. Session lasts approximately 1.5 hours.

Daytime Guided Tours
10am, 12.30pm, or by appointment – Bookings essential.

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.perthobservatory.wa.gov.au
Email: perth.observatory@perthobservatory.wa.gov.au

Pingelly Heights Observatory

(Astro Ventures)

The Pingelly Heights 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 25 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. They are open from October 1 to April 30, the following year; on Friday and Saturday nights only.

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 ranging from a 25 inch Obsession to an 8 inch Schmidt Cassegrains. 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

AMATEUR ASTRONOMICAL SOCIETIES & ASSOCIATED GROUPS

The Astronomical Society of WA Inc. (ASWA)

Established in 1950, the Astronomical Society of WA strives to promote and popularise astronomy – as both a modern-day science and an exciting and rewarding hobby, providing many activities for members and the public – particularly encouraging beginners.

Classes precede the monthly General Meeting, which features a scientific guest speaker. Special interest groups – Deep sky observing, Lunar observing, Workshops, a night at a central observatory with viewing and speakers and Club nights with speakers all meet monthly.

Astrocamps are held at least twice yearly at locations with dark skies and accommodation within 2 hours' drive of Perth. The Seriously Deep Sky Section approximately every 2nd new moon and camp out or farmstay. The society offers the use of its library and equipment. The ASWA has free members' email newsgroup and a bi-monthly journal, The Sidereal Times.

The society meets at 8pm on the second Monday of every month (except January) at the South Perth Bridge Club, cnr Brittain St and Barker Ave, Como. ASWA promotes public awareness by holding regular observing nights and offering viewing nights/speakers to schools and community groups.

Fees
Ordinary Member $25 nomination, $50 subscription, discounts for Associate, Junior, Student and Country memberships.

Phone: (08) 9299 6347 (Val Semmler)
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 Murdoch Astronomical Society merged with the Astronomical Society of Western Australia in March 2004. If you would like to know more about current activities at the Murdoch Observatory please contact the Astronomical Society of Western Australia (see entry above).

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 Group that 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 Volunteer 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:

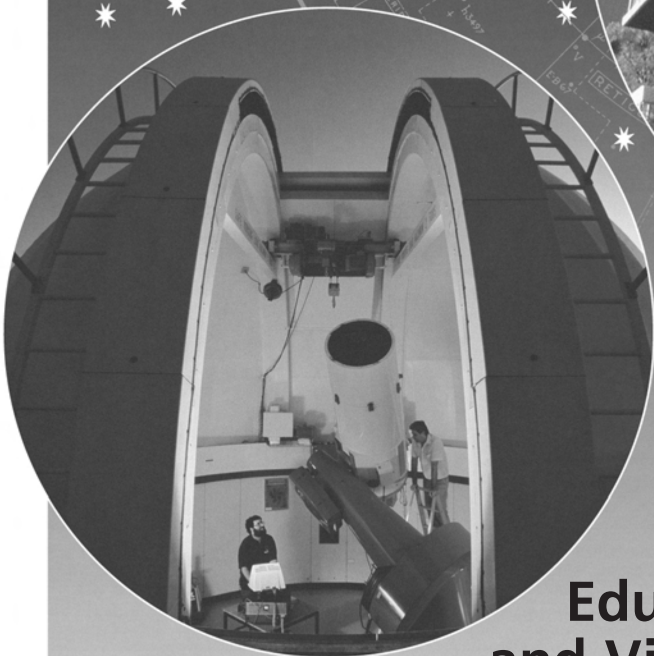
- why they wish to become part of the program,
- what skills, qualifications or experience they possess,
- what realistic amount of time they can contribute, and
- anything else that they think is relevant.

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.perthobservatory.wa.gov.au**

Government of Western Australia Department of Environment and Conservation

WESTERN AUSTRALIAN

ASTRONOMY ALMANAC

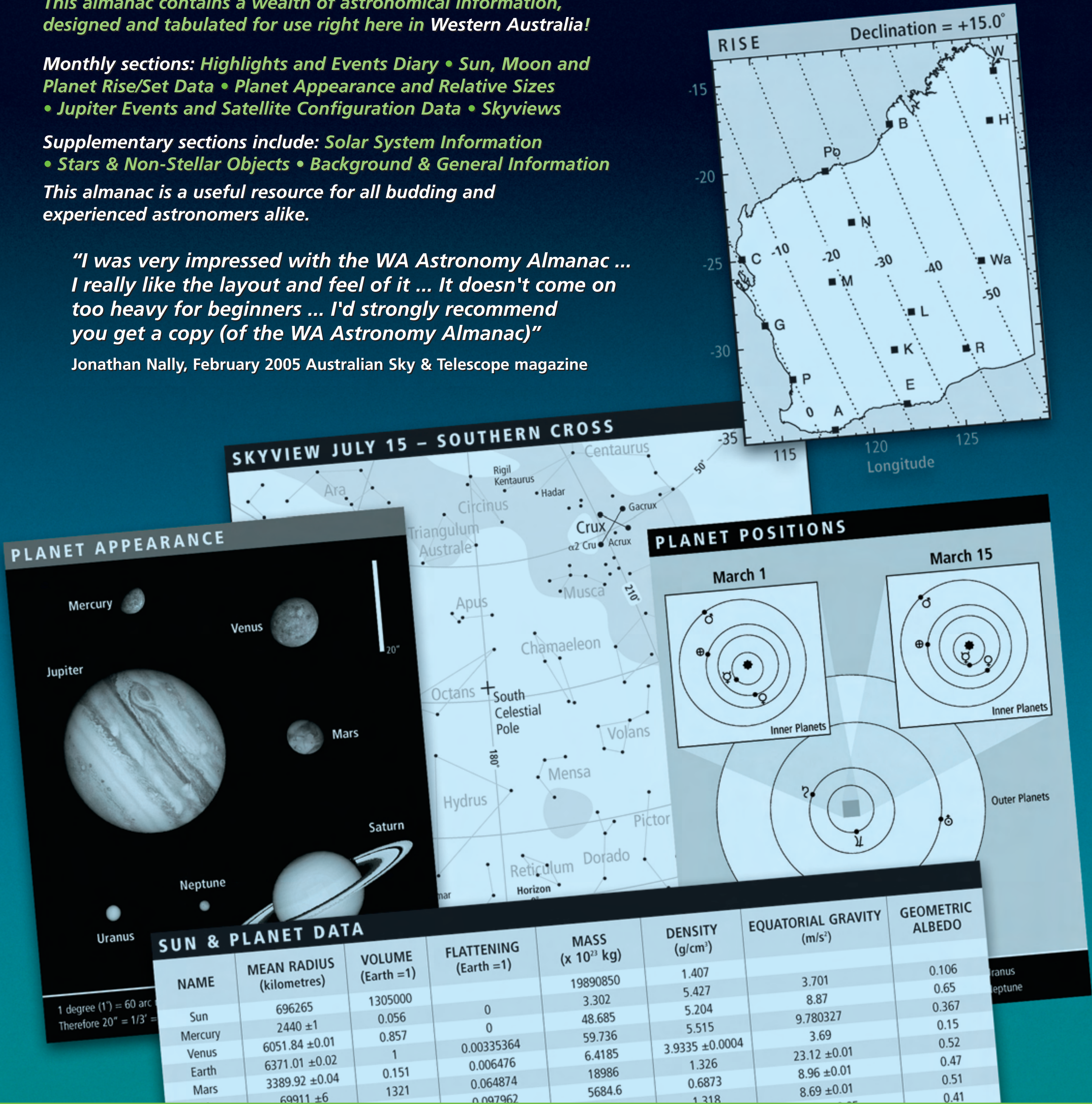
This almanac contains a wealth of astronomical information, designed and tabulated for use right here in Western Australia!

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.

> *"I was very impressed with the WA Astronomy Almanac ... I really like the layout and feel of it ... It doesn't come on too heavy for beginners ... I'd strongly recommend you get a copy (of the WA Astronomy Almanac)"*
>
> Jonathan Nally, February 2005 Australian Sky & Telescope magazine



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