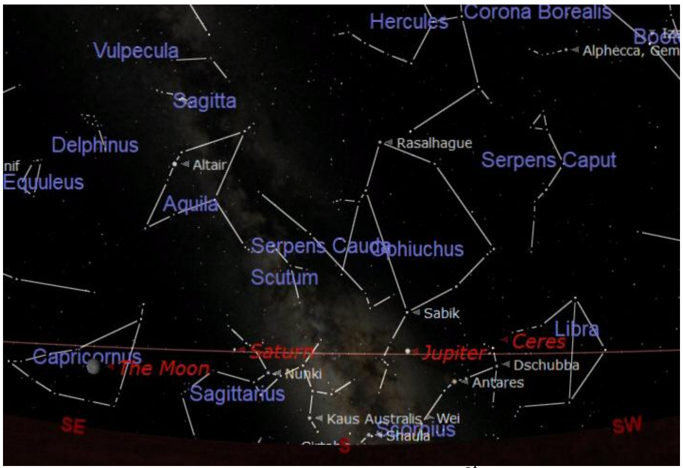
NEWBURY ASTRONOMICAL SOCIETY

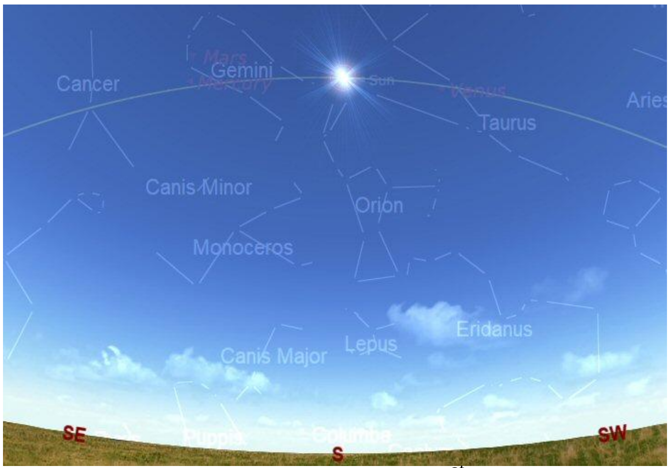
MONTHLY MAGAZINE – JUNE 2019

THIS WILL BE THE LAST MAGAZINE UNTIL SEPTEMBER

ASTRONOMY DURING THE SUMMER



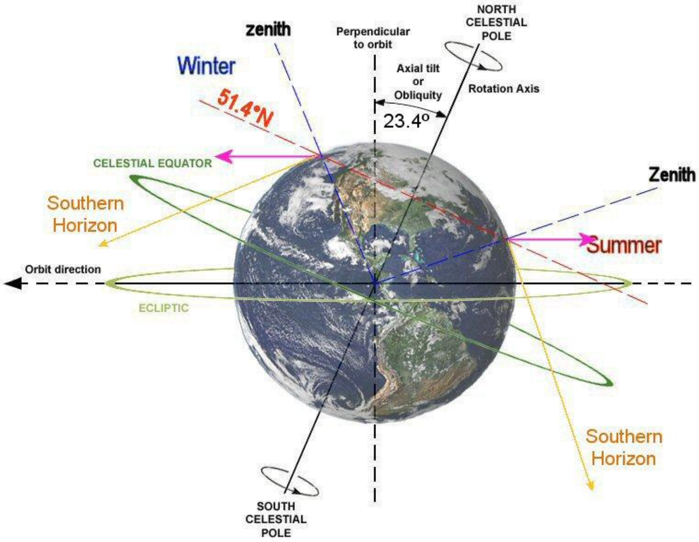
Midnight midsummer day 21st June



Midday midsummer day 21st June

The summer nights are short and the sky does not get completely dark from mid May to mid August so observing faint deep sky objects is quite difficult. Summer nights might be short but they are warmer so night time observing can be more comfortable and some observing can still be done.

The reason why the summer nights are short and the winter nights are long is due to Earth being tilted over at an angle of 23.4º to the plane of the rest of the Solar System.



The diagram above shows how Earth's axis of rotation is tilted. The dashed black line marked as 'Perpendicular to orbit' is the axis of rotation of the Solar System around which all the planets, including Earth, orbit the Sun. The solid black line marked as: 'North Celestial Pole' and 'South Celestial Pole' is the tilted axis of rotation of Earth.

The angle between Solar System axis and the Celestial Axis (Earth's axis of rotation) marked as: 'Axial tilt or Obliquity' is the 23.4° tilt as mentioned above. The Ecliptic or Equator of the Solar System is shown as the light green horizontal ellipse with the Celestial Equator (Earth's Equator shown in darker green) also tilted at 23.4°.

The pink arrows show the latitude of Newbury UK at midsummer and midwinter. If we imagine both sides of the diagram are at midday and we are looking towards the southern horizon (orange arrows). On the right side (Summer) the Ecliptic (light green) appears higher than the Celestial Equator. On the left (Winter) the Ecliptic appears lower than the Celestial Equator. The Ecliptic appears higher in summer than in the winter.

This means the Ecliptic appears low in the south at midnight in the summer and appears high during the day. This is manifested by the appearance of the Moon being close to the horizon at night and the Sun being high in the sky during the day. The two charts above show the night sky at midsummer and at midday on the same day. The Moon is slightly below the low Ecliptic in the south east (left) of the midnight chart. The Sun is in the south, on the high Ecliptic, on the midsummer chart at 13:00 BST 12:00 (GMT).

It can be seen on the midnight chart (on the left) the planets and Moon are located on or near the Ecliptic so they are in the more turbulent and contaminated air close the horizon. Therefore they will be difficult to observe due to movement of the air and its poorer quality. We are also looking at them through much more thick air close to the horizon (about 300 km) compared to the relatively shallow thickness of the atmosphere directly overhead (our Zenith). Our atmosphere starts to become very thin over an altitude of about 25 km. Also see page 10, 'length of days'.

NEWBURY ASTRONOMICAL SOCIETY MEETINGS

7th June — The Colour of Science & AGM

Website: www.newburyastro.org.uk

NEXT NEWBURY BEGINNERS MEETING

19th June — 50th Anniversary of 1st Moon Landing

Website: www.naasbeginners.co.uk

OBSERVING OUR MOON

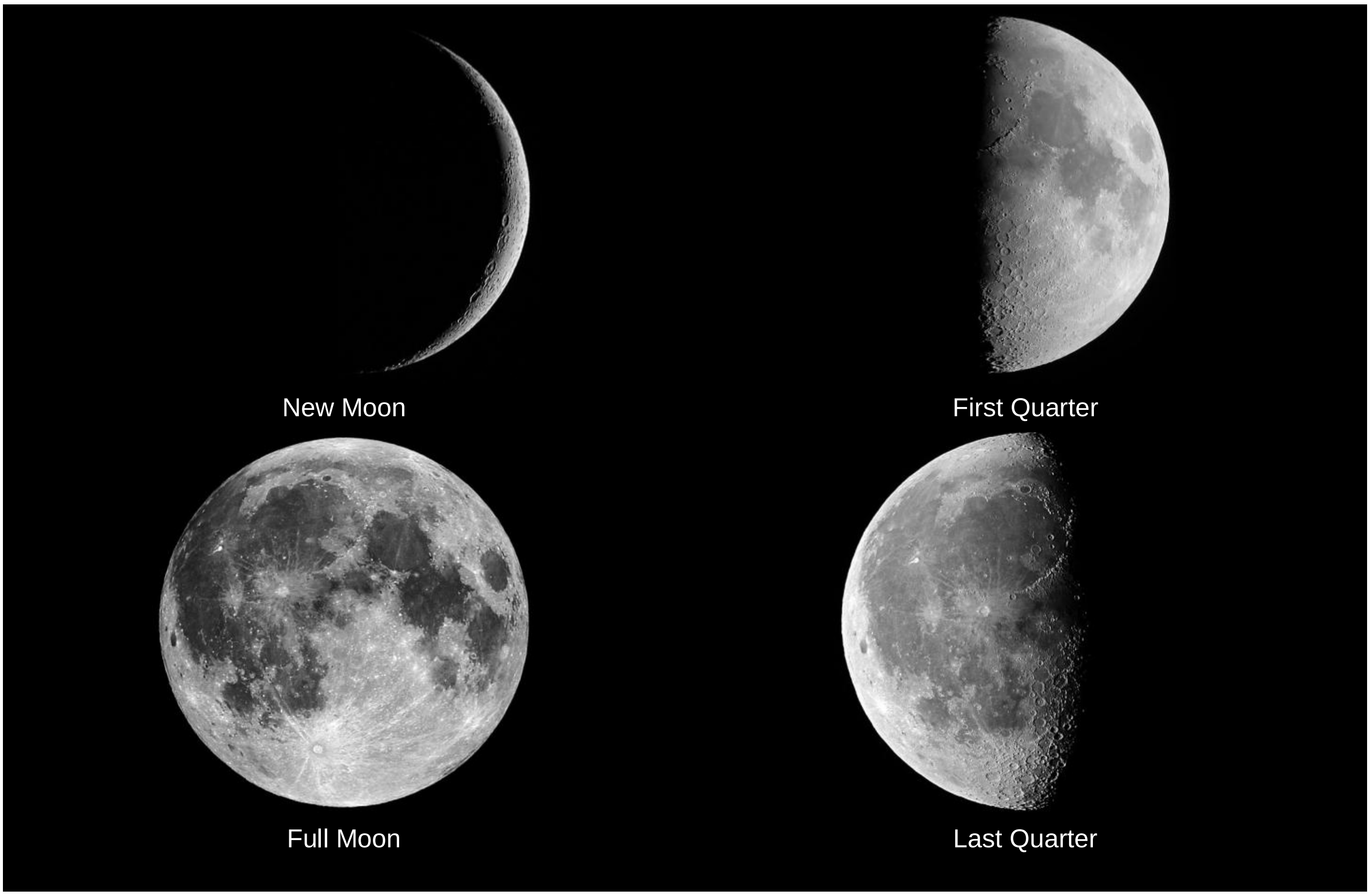


Chart showing the phases of the Moon

The images above show the four 'cardinal' phases of the Moon, known as: 'Quarters'. Each of the four quarters appears approximately seven days after the previous phase. So 'First Quarter' appears seven days after 'New Moon', 'Second Quarter known as 'Full Moon' appears another seven days later and 'Last Quarter seven days after Full Moon. The final quarter occurs seven days later when the Moon is in the same direction as the Sun and cannot be seen. This final quarter phase does not have a real name but is so close to the next New Moon that it is considered to be the next New Moon Phase.

It is no coincidence that the phase cycle of the Moon takes one month to complete and there are twelve months in a year. This time period was named after the ancient term 'moonth' obviously referring to the time the Moon takes to orbit Earth. We will discuss different terms used for a number of aspects of the actual orbit later.

Our observations of the Moon can begin when the 'New Moon' is first seen in the sky. Some keen Moon observers like to spot the New Moon at its very earliest appearance when it is a very narrow crescent. So this begs the question, Why do we get a New Moon?

For a start let's clear up one obvious point, the Moon is never new, it is over 4 billion years old and we see the same Moon every month. When the Moon is in direct line with the Sun in the sky we cannot see it. This is firstly because the sky close to the Sun is so bright we would not be able to see the Moon anyway. Also the side of the Moon facing the Sun is illuminated so the side facing us on Earth is in shadow and dark so we could not see it even if the sky around the Sun was not so bright.

As the Moon moves away from its conjunction (alignment) with the Sun it appears to be moving eastwards when viewed from the surface of Earth. It appears to move from west to east (to the left) about 12° each day. Therefore one day (24 hours) after conjunction with the Sun the Moon will have moved 12° east (left) of the Sun.

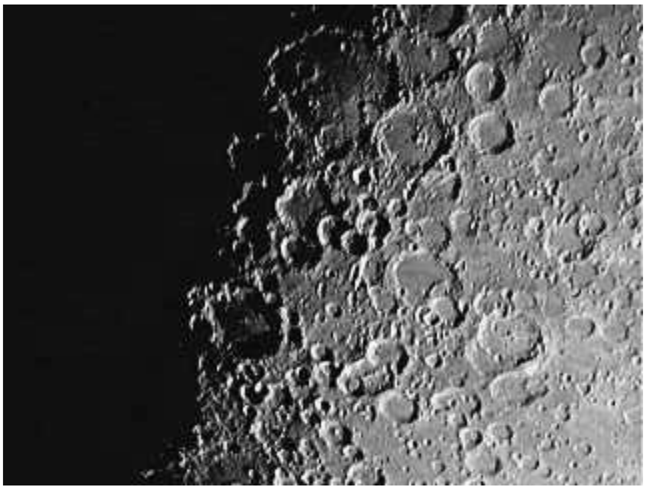
The New Moon would normally not be visible until the 2nd or 3rd day after conjunction with the Sun. This is because the Moon is too close to the Sun and the sky is too bright.

As the Moon continues to move from west to east around its orbit, more of the bright (day) side is revealed and the illuminated side appears as a wider 'Crescent' shape. When the Moon has reached approximately a quarter of the way around its orbit, in 7 days, it will appear as the 'Half Moon' or 'First Quarter'. The Half Moon will be located in the south as the Sun sets in the west.

After the first quarter, the 'Waxing' (widening) crescent shape gives way to the shape known as the 'Waxing Gibbous' phase. After 14 days the Moon is positioned directly opposite to the Sun the whole of the sunlit side is visible and we see the 'Full Moon'. The Full Moon will rise in the east as the Sun sets in the west. As the Moon continues on its orbit around Earth, the dark half of the Moon begins to appear and the sunlit side begins to move out of view. This is called the 'Waning Gibbous' phase.

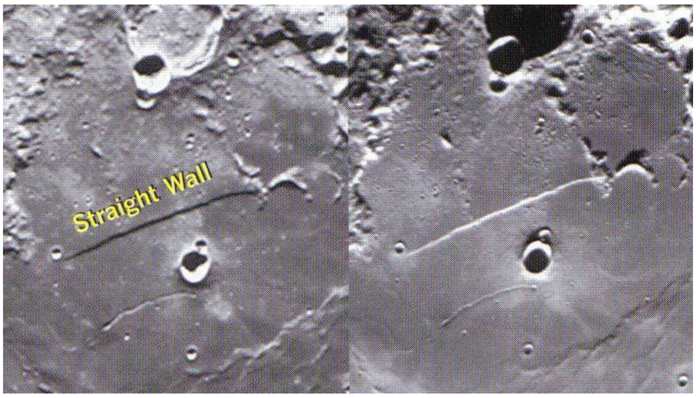
After 21 days, only half of the Moon appears illuminated and is called the 'Last Quarter' (the opposite side to First Quarter). The final phase is the 'Waning Crescent' as less and less of the sunlit side is visible from Earth. Finally after ~29 days the Moon moves back into direct line with the Sun and none of the sunlit side is visible.

Some areas of the Moon are more cratered than others. There are large areas that have so many craters that there appear to be no smooth areas at all. Other areas, particularly Maria, have almost no craters.

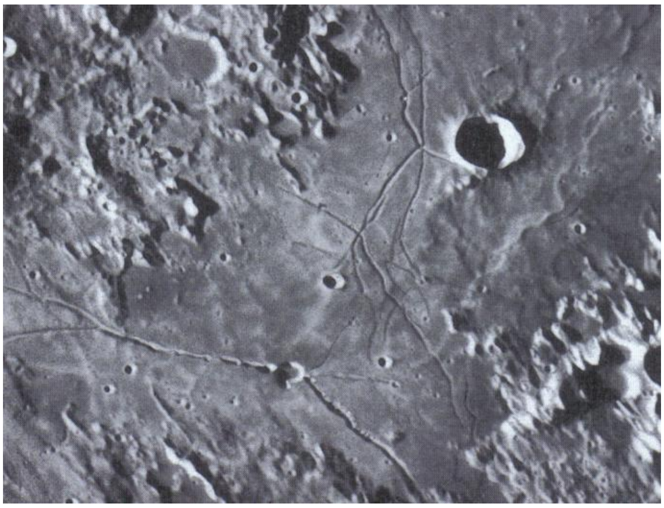


A heavily cratered area near the terminator image

There are also mountain ranges that are often named after mountain ranges on Earth. Most of these mountain ranges appear to be the walls of vast craters that have all but disappeared under ancient lava flows and the effect of later impacts. There are however some that appear to be natural mountain ranges.

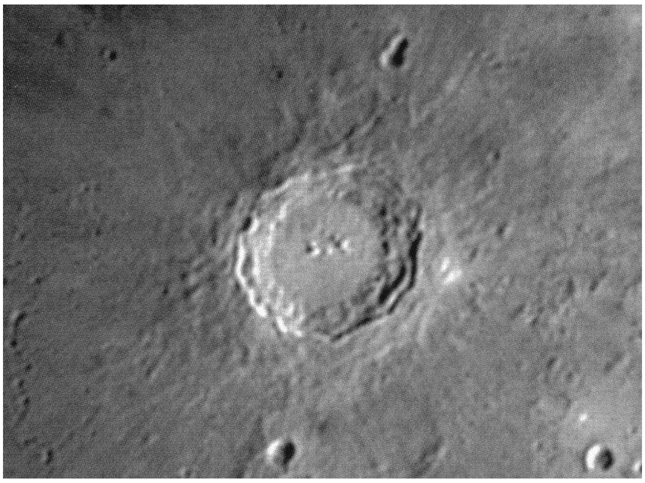


In the images above is a feature called the Straight Wall. This is a common type of feature known as a 'Rill' and appears to be a vast cliff face caused by a crack in the ground. In the left image the Sun is shining from the top casting a shadow towards the bottom but on the right image the Sun is shining from the direction of the bottom so the cliff face is illuminated and there is no shadow.



Cracks and rills on a smooth surface

Craters are especially spectacular when viewed using a telescope (see the images below). Some of the larger craters may have terraced walls both inside and outside the main rim. There may even be smaller craters on the floor of the large crater or another craters may cut through the wall of a large crater. It is possible to work out the relative age of some craters. If one crater has cut through the wall of another then it must be younger than the one that has had its wall damaged.

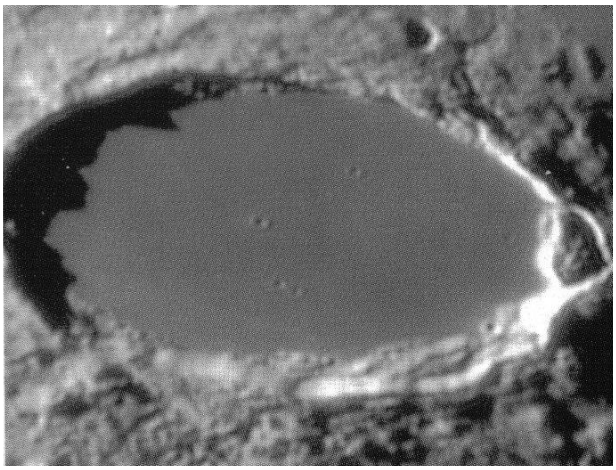


Copernicus showing the terraced walls and central peaks

Other craters have radial lines called 'Rays' stretching for many hundreds of kilometres where debris was thrown out by the impact when these craters were created.

Crater Tycho showing the prominent ray structure

Other interesting things to look for are smaller craters inside larger and impacts that have created craters on top of earlier craters.



The lava filled Crater Plato with the shadow of the rim

ADVICE FOR OBSERVING THE MOON

The Full Moon

The Moon is the brightest and largest object in the night sky so it is inevitable that it is usually the first thing a beginner to astronomy will choose to observe. This is actually a good plan because it is the easiest target to find and has many interesting things to see. It is also a great target to use when familiarizing ourselves with a new telescope and aligning the finder scope.

One of the great advantages of starting with observing the Moon is that it can be done using almost any telescope. One slight disadvantage is the Moon can be very bright especially when using a larger telescope to observe the full Moon or even half Moon. This is not really a problem because there are two ways to overcome this minor problem. We can use a Moon Filter to reduce the glare (see page 6) or we can fit a mask over the end of the telescope. Many telescopes are supplied with a Dust Cap used to cover the open tube and keep dust out. Most Dust Caps are supplied with a Moon Cap that can be removed from the Dust Cap to create a mask that will reduce the amount of light entering the tube. See below.

Dust Cap fitted

Moon Cap removed

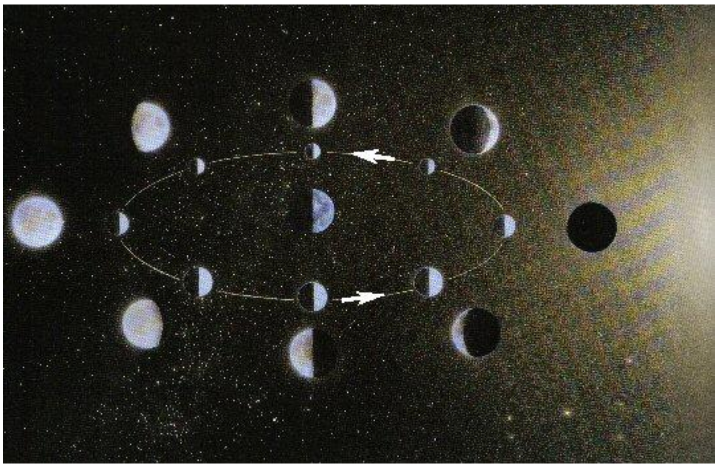
Binoculars can be used to observe the Moon and will provide a good overview of the Moon but they do only have a low magnification. A pair of binoculars will be marked with the ‘magnification’ and ‘aperture’ (diameter of the main lens) of the instrument in the form: 9x50. This example means the binocular has a magnification of 9 times (9x) and an aperture of 50mm. To see detail on the Moon surface needs a magnification of at least 25 to 30 times so it is obvious a telescope is required.

A new telescope is usually supplied with two eyepieces. These are small microscopes that fit into the telescope focusing unit to magnify the image produced by the telescope. The eyepieces supplied are usually marked: 25mm and 10mm, this is the focal length. The higher the number the lower magnification the eyepiece will provide. The magnification of the Moon can be calculated by dividing the focal length of the telescope by the focal length of the eyepiece being used. For example a telescope with a focal length of 1000mm and eyepiece focal length 10mm will produce: $1000 \div 10 = 100$x.

Observing should be started using a low power eyepiece (the 25mm) this will produce a magnification (based on the previous example) $1000 \div 25 = 40$x. This will provide a good overall view of the Moon. When a part of the Moon is selected for more detailed observation the eyepiece can be carefully replaced with the 10mm to increase the magnification to 100x. If further magnification is required the Barlow Lens supplied can be used to double the magnification of each eyepiece. Fitting a Barlow will magnify $(1000 \div 10) \times 2 = 200$x.

Perhaps one of the first things to do to help explore the Moon is to obtain a Moon Map. These can be obtained from most astronomy dealers and can be purchased on line. Books can also be purchased that will provide charts and detailed guidance about the interesting things to look for on the Moon. Another option is to use a computer application on a laptop. A good option is 'Virtual Moon Atlas' that can be down loaded free from the internet.

The key thing about observing the Moon is to choose the best time to see the feature to be studied. The reason for this is to do with the illumination of the surface of the Moon by the Sun. We know the Moon has phases caused by its movement around Earth on its monthly orbit. Each evening of every month we have a different view of the Moon and we see its shape change from a thin crescent to full Moon then a return to a thinner crescent after full Moon.



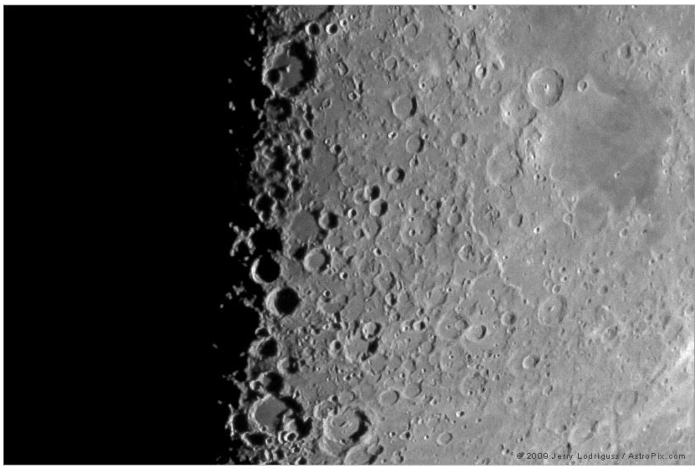
The phases of the Moon (Sun is off to the right)

In the diagram above the Sun is shining from the right. The inner Moon images demonstrate the orbit of the Moon around Earth and shows how the Moon is illuminated by the Sun. The outer Moon images show the view of the Moon as seen from Earth. From Earth the same side of the Moon is always facing us so the Moon appears not to rotate for us. However if viewed from the Sun the Moon can be seen orbiting around Earth and as it orbits it would appear to rotate once on every orbit. This means over the course of one orbit (about 29.5 days) the whole surface of the Moon will be illuminated at some time. In other words for a given point on the Moon, a day will last for one half of the month and it will be night for the other half of the month.

So the two Moon images on the right show the Moon positioned between the Sun and Earth. From Earth the dark side of the Moon is facing towards us so we cannot see it. As the Moon moves around its orbit some of the illuminated side begins to appear and we see the Moon as a New Moon (the growing crescent is called 'waxing'). After about seven days the Moon would reach the upper middle point of its orbit and half of the illuminated side of the Moon is visible from Earth, this is called 'First Quarter'. After a further seven days the Moon will have reached the left side of the diagram and the whole of the Moon facing Earth is illuminated so we call this the 'Full Moon'.

A further seven days takes the Moon to the lower positions on the diagram where the opposite side to the 'First Quarter' is illuminated, we call this 'Last Quarter'. The final phase (called waning) is rarely seen by people who sleep normal hours. This is because the Moon does not rise until after midnight in the east. The crescent becomes thinner as it draws closer to the Sun to start another New Moon.

The line between the light side (day) on the Moon and the dark side (night) is known as the 'Terminator'. The Terminator after New Moon and up until Full Moon is the sunrise line and the terminator after Full Moon until New Moon is sunset on the Moon. On the terminator the Sun casts long shadows as it does on Earth. Shadows near the terminator give relief to the lunar terrain and produce an almost 3D perspective. So it is always best to observe an object when it is in the twilight near the Terminator.



Craters on the Terminator

There are two ways of deciding what to observe on particular evening. The first is to check your Moon chart on the evening to see what is best placed, close to the terminator, at that time. If a computer generated chart is used a copy can be printed and used to identify all the things of interest on that observing session.

The other option is used when a particular feature is to be observed or studied in detail. On this occasion it might be better to use the chart to find which evenings would be best to see this feature. Depending on the particular feature it may be possible to predict two or three evenings when it is close to the terminator and good for observing. Then hope for a clear sky on one of those evenings.

Using a Moon Filter can make looking at the Moon more comfortable and give the Moon more contrast to improve the view. There are two types of Moon Filter: first a simple set darkening type that has a fixed light reducing glass. The second type is an adjustable Polaroid Moon Filter. This type has two Polaroid glasses that can be rotated to align or misalign the polarity of the two glasses. This filter has the ability to adjust the amount of light it allows to pass through the filter. Most types of filters can be attached to an eyepiece by screwing them into the thread on the eyepiece mounting barrel as shown below.

A Polaroid Moon Filter fitted to an eyepiece

OBSERVING THE SUN 'SAFELY'

The ideal thing to observe during the summer is the Sun. Of course we must take great care in how we observe the Sun as it can be very dangerous if not done correctly. A telescope or binocular must never be used to look directly at the Sun. The instrument is designed to gather as much light as possible from faint objects and direct that light into our eyes. However the Sun produces a lot of light and heat so directing all this extra light and heat into the eye will cause permanent damage to the eye and blindness.

There are two ways to observe the Sun safely these are to use a special Solar Filter or to project an image of the Sun on to a screen. If we do have a telescope or binoculars we can use a piece of white card as a screen and project the light from the Sun on to the card.

If binoculars are to be used, cover one of the lenses with the dust cap. Place the card in a suitable supported position so its flat surface is facing the Sun. Hold the binoculars about 300mm above the card in the direction of the Sun. Move the binoculars around until the projected image can be seen on the card. The process can be improved by supporting the binoculars using a stool or improvised stand to support the binoculars and screen.

A simple rig can be assembled to support a screen and attach it to a telescope to allow the image of the Sun to be projected on to a screen. The picture below shows such a homemade rig fitted to the author's refracting telescope.

A Solar Observing Screen attached to a telescope

There will probably be too much light so the Dust Cover can be fitted over the lens of the telescope and the small light reducing cap removed. This will reduce the glare on the screen and protect the eyepiece from overheating damage.

Venus Transit 8th June 2004 imaged using the rig above

For those who are fortunate to have access to a telescope, observing the Sun can be taken a step further. The telescope can be used 'safely' to observe the Sun in more detail. The telescope must be fitted with a fail-proof Solar Filter. This can be bought ready made from an astronomy shop or can be made at home.

Mylar Solar Filter fitted to a Reflecting telescope

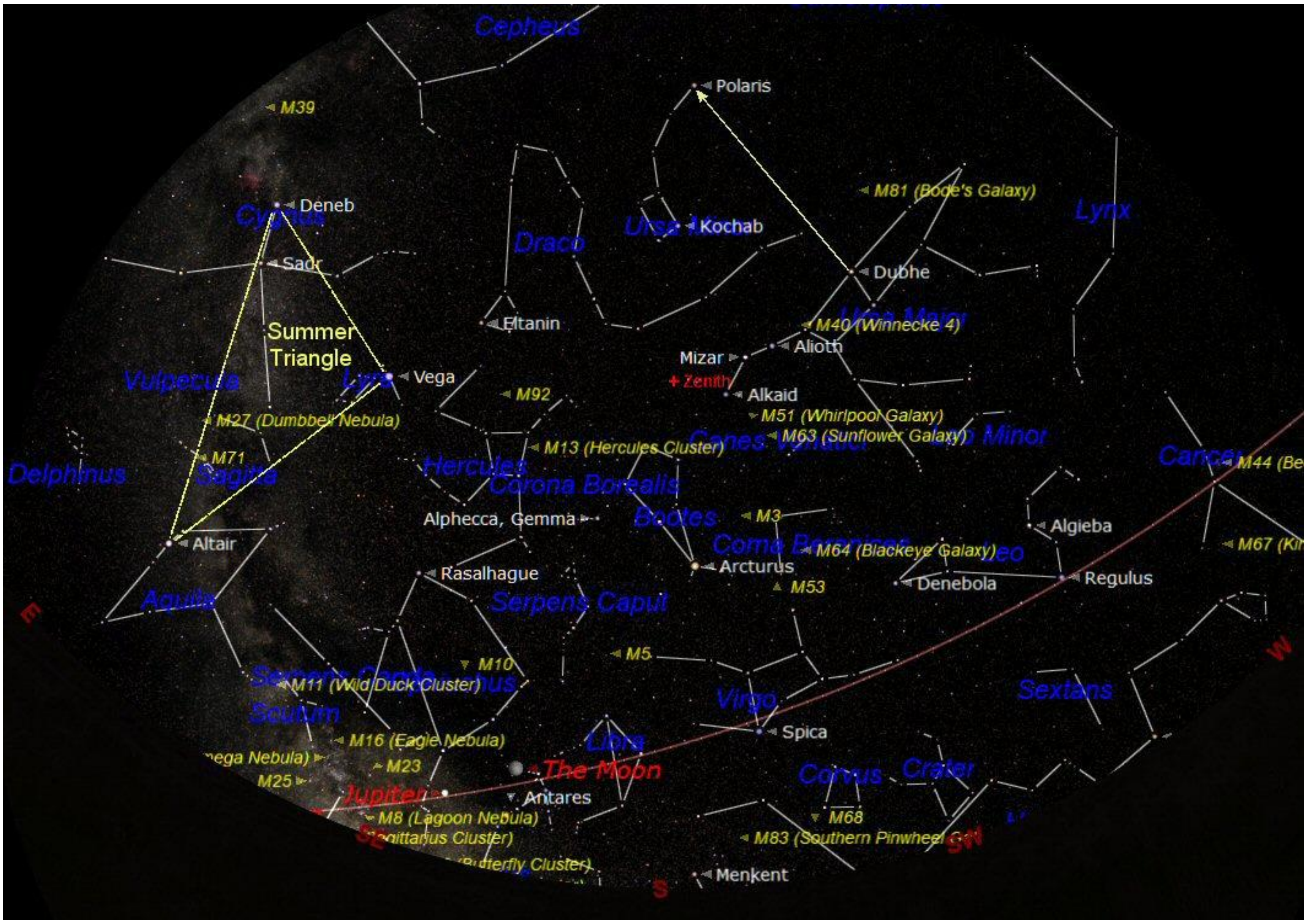
The 'solar' filtered telescope shown above will allow just a tiny amount of sunlight to enter the telescope but it will be the full spectrum (all wavelengths of light) so it will be white light. This will allow any sunspots to be seen in very good detail. It will also show the 'mottled' surface of the Sun, looking like the texture of orange peel.

A word of warning. If the telescope has a finder fitted, it must be securely covered or the finder completely removed to avoid burns.

A more advanced type of filter can be bought that will show the activity on the surface and atmosphere of the Sun to be seen. These are called Hydrogen alpha filters that will allow just one very narrow wavelength of light to pass through. This is the red light emitted by excited Hydrogen gas on the Sun. The Hydrogen atoms are able to absorb photons (mainly Ultraviolet light) but this causes the electron in the atom to jump out of its orbit into a higher orbit. The electron will quickly jump back to its natural orbit but to do this it must release the energy from the photon. It does this by releasing a flash of light that is at a discrete wavelength and is always deep red in colour.

A Personal Solar Telescope (PST) Hα telescope
Approximate purchase price £800

THE NIGHT SKY - JUNE 2019



The night Sky June 2019 at 22:00 BST (10 o'clock pm)

The chart above shows the night sky looking south at about 22:00 BST on 15th June. West is to the right and east to the left. The point in the sky directly overhead is known as the Zenith and is shown in the upper centre of the chart. The curved brown line across the sky at the bottom is the Ecliptic or Zodiac. This is the imaginary line along which the Sun, Moon and planets appear to move across the sky. The constellations through which the ecliptic passes are known as the constellations of the 'Zodiac'.

Constellations through which the ecliptic passes this month are: Gemini (the Twins), Cancer (the Crab), Leo (the Lion), Virgo (the Virgin), Libra (the Scales) and Sagittarius (the Goat) rising over the South Eastern horizon.

Ursa Major is very easy to find and because it is 'circumpolar' (never sets below the horizon) it is always somewhere in our night sky. As it is so easy to find it is a good place to start exploring the night sky. The two stars of the 'pan' opposite the 'saucepan handle' (known as the Pointers) can be used to find Polaris the Pole Star (or North Star) in Ursa Minor. Just follow the 'Pointers' up out of the pan to find Polaris. By following an imaginary line off the end of the saucepan handle will show the way to Arctaurus the bright red star (it looks more orange) in Boötes.

The constellation of Boötes does not have anything interesting to search out but the bright star Arctaurus is very beautiful. It is a Red Giant and appears distinctly orange to the naked eye and even more so when using binoculars or a telescope. If the binocular or telescope is moved slightly out of focus Arctaurus will look even more orange.

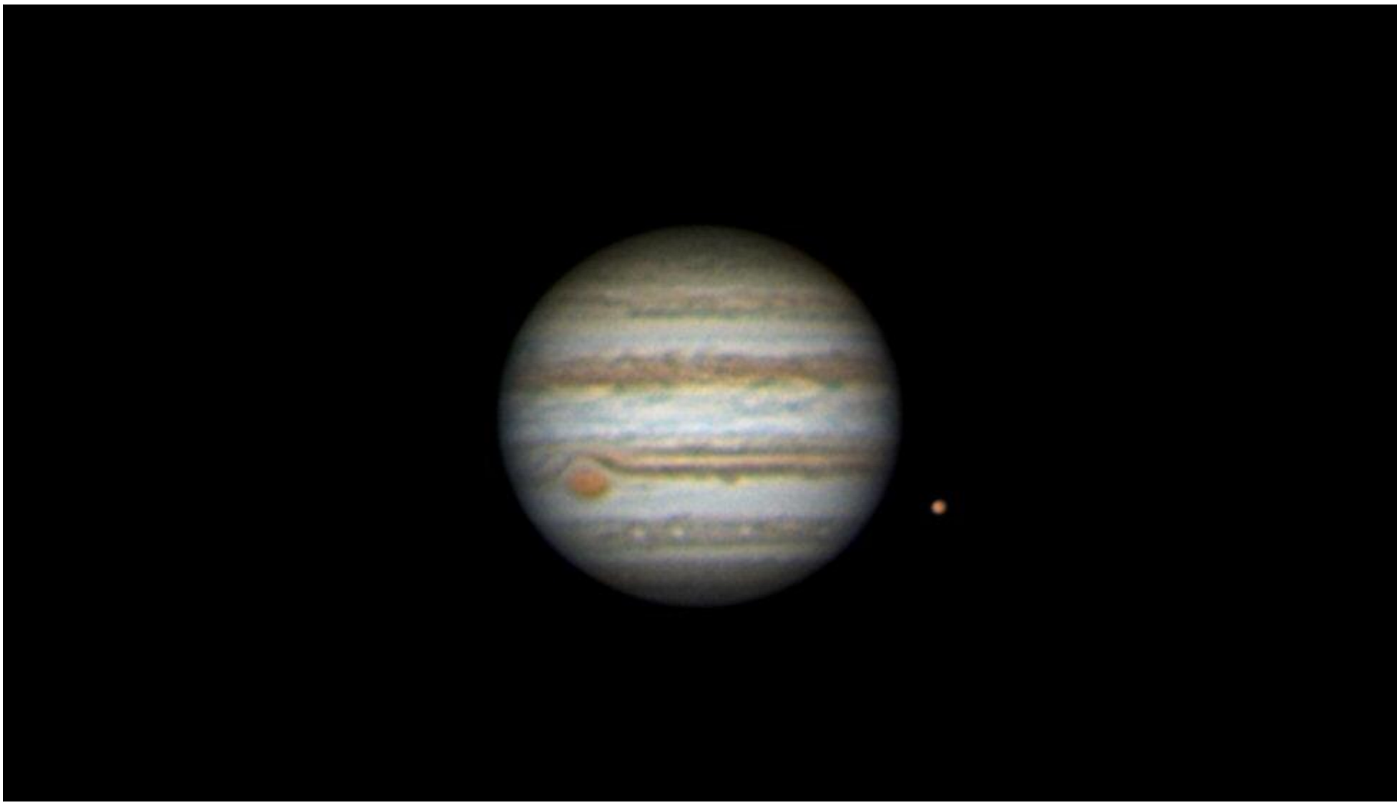
The chart above shows the sky around the Summer Triangle. The term 'Summer Triangle' was suggested by Sir Patrick Moore and has now become the best known feature of the summer night sky. The corners of the imaginary triangle are positioned on the three obvious bright stars: Deneb in the constellation of Cygnus, Vega in Lyra, and Altair in Aquila. The Milky Way (our Galaxy) flows through the Summer Triangle and passes through Aquila and Cygnus.

By following the 'Pointers' in Ursa Major down (instead of up for Polaris) they point the way to the constellation of Leo (the Lion). The stick figure of Leo does actually look a little like a lion. The bright star Regulus in Leo sits right on the Ecliptic and is often seen close to the Moon and sometimes the planets as they appear to move along the Ecliptic.

To the east of Leo is the quite indistinct constellation of Virgo. It does have one fairly bright star called Spica. It is classified as a Class B1 Giant but is in fact a very close binary star. The two stars are very close and orbit the common centre of gravity every four Earth days. Powerful gravity at close proximity is pulling on each star and has made them 'egg' shaped.

Following Leo to the east (left) is the constellation of Virgo with its lovely bright star Spica then following on is Libra. Just appearing over the horizon is Jupiter looking very bright and easy to find. The King of the Planets is in the constellation of Ophiuchus which is the 13th and normally unmentioned constellation on the Zodiac.

THE KING OF THE PLANETS IS COMING INTO VIEW



Jupiter imaged by John Napper (Newbury Astronomical Society)

Jupiter is now moving into view in the late evening and will be in perfect position for observing. Jupiter will reach Opposition on 10th June when it will be at its very best. Opposition is the exact time that Earth will be overtaking Jupiter on the respective orbits of the two planets. Earth's angular speed is much greater so travels faster on its smaller orbit around the Sun. It therefore catches up and overtakes Jupiter about every 13 months.

At this time of year the 'Ecliptic' (the imaginary line along which the Sun, Moon and planets appear to move across the sky) is low in the sky during the night due to the 23.4º tilt of Earth's axis. The ecliptic is high during the day which is why the Sun appears high in the summer sky. With the ecliptic low at night Jupiter appears low in the sky and in the relatively thick, misty and turbulent air closer to the southern horizon.

Jupiter is visible most of the night, rising in the east at about 20:30. It will be observable in the east about an hour or so later at around 21:30 when it is higher in the sky. Jupiter is easy to find as it is very bright, in fact it is the third brightest object in the night sky after the Moon and Venus. By about 22:30 Jupiter will have risen high enough in the south to be in a good position for observing in the constellation of Ophiuchus (the Serpent Bearer).

A good pair of 9 x 50 binoculars will just about show the four bright moons known as the Galilean Moons. These four bright moons are called the 'Galilean Moons' after Galileo who first recorded seeing them.

Jupiter and the Galilean Moons imaged by Steve Harris

OBSERVING JUPITER USING BINOCULARS

Using binoculars to observe Jupiter is better if you prepare first. There are two things that can help improve the view. The first is to set up the binocular to suit your eyes.

The right hand eyepiece can be rotated to adjust the focus of each optical body to suit each eye this is called 'dioptre adjustment'. The way to do this is to find a bright star in the binocular (or any distant object can be used during the day). Close the right eye and adjust the focus to suit the left eye using the central focusing barrel. When the sharpest image is achieved (a star is the smallest point of light) open the right eye and close the left. Now rotate the right eyepiece by turning the dioptre adjuster [on the right eyepiece] each way until the sharpest image is achieved in the right eye. Now open both eyes and adjust the focus to suit both eyes, using the central focusing barrel only, to check the quality of the view. The binocular is now adjusted to suit both your eyes and it should look clearer.

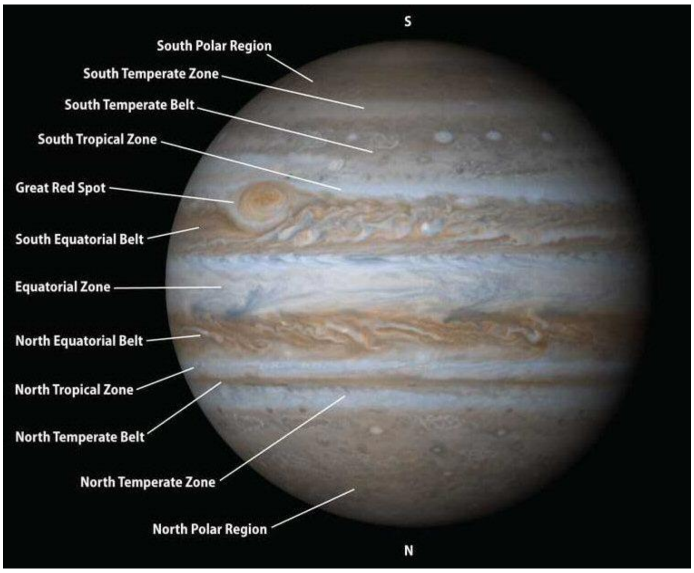
The second thing to try is to provide extra support for the binoculars. Resting your elbows on a solid object such as a wall or fence. If this is not possible stand against a wall and steady the binocular or your hand against the wall to stop shaking movements.

The best possible answer is to support the binocular on a stand of some sort. Even a cheap camera tripod can be used perhaps utilising an elastic strap (Aerolastic) or any other means to secure the binocular to the support. This will help steady the binocular. It may even be found that the view is improved by sitting in a reclined garden lounger and somehow supporting the elbows.

Binoculars will show the moons and may just reveal the two darker equatorial belts if using larger binoculars.

Jupiter always displays an almost full disc but can lose a tiny amount from the edge when it is at greatest elongation (at 90° from the Sun as we view it from Earth). However Jupiter will appear full to the untrained eye. For these reasons Jupiter will be as good as it gets, subject to clear skies, from midsummer until later in the year.

The Belts and Zones are regions of higher and lower atmospheric pressure. The lighter coloured 'Zones' are regions of rising gas caused by convection of heat from the core of Jupiter. The darker 'Belts' are regions of falling gas and are approximately 20 kilometres lower in altitude than the Zones. In the regions where the belts and zones meet huge storms are created as the belts and zones move at different speeds and directions. A larger telescope will allow some detail of the storm patterns to be seen.



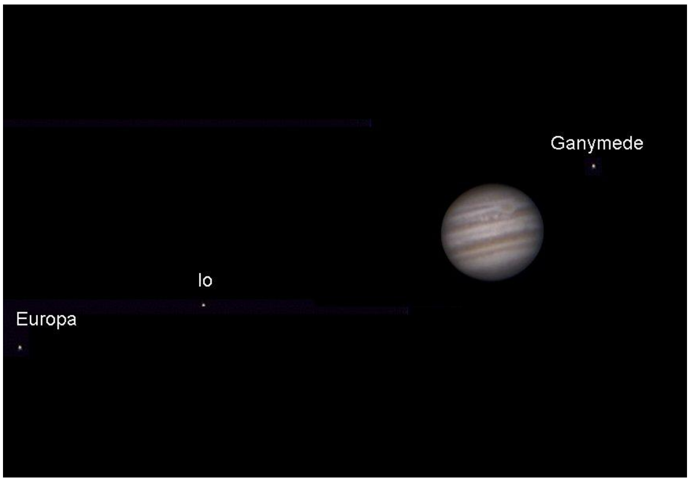
The cloud markings on Jupiter

The most famous feature in the cloud system is the 'Great Red Spot' (GRS). This huge storm has been raging for over 350 years. We know this because it was recorded by astronomers in 1664 using some of the earliest telescopes. The GRS does change its colour, size and shape but it is always there. Its colour may fade from the normal pink to nearly white when it may almost disappear. The colour is thought to be caused by Phosphorus welling up from deep regions in Jupiter's atmosphere.

The GRS is not the only storm feature to be seen. There are white spots, dark spots and even mini red spots. These tend to be transient and last from just a few days to weeks but others may persist for up to fifty years. Spots can combine with other spots as they move along the boundaries between the belts and zones. Some larger spots have even been swallowed up by the GRS. Over the last few years there was a lot of turbulence around the GRS with eddies running along the South Tropical Zone and around the GRS.

As Jupiter is so large (for a planet) it is the easiest planet to image through a telescope. The cheapest way to do this is to use a modified computer web camera. This used to be done by removing the lens of the webcam and replacing it with a special adaptor but can now be bought ready to use. These webcams can be mounted in place of the eyepiece. With the webcam connected to a computer via a USB port a short video of Jupiter (1 to 2 minutes) can be recorded on to the hard drive.

It is then necessary to download a free piece of software from the internet called 'registax'. This application can automatically align each frame of the video then stack all the images from each frame on top of each other. The result is all the features on the surface of the planet that are in the same place on the images are added and the features become clearer on the finished single image. The final image can even be enhanced using the built in processing screen in registax. The image below was taken using a webcam on 14th November 2012 and shows some of the turbulence around the Great Red Spot in the South Tropical Belt. The Tropical Belts are mentioned on the previous page (South is at the top of the image). The moons Europa, Io and Ganymede are labeled and can be seen to the right and left of Jupiter.



Jupiter imaged on 14th November 2012 by Steve Harris

Another computer application that can be downloaded free from the internet is a computer planetarium application. The events happening around Jupiter can be predicted using these applications and then followed using a telescope. One of the best and most popular free computer planetarium applications to download is 'Stellarium'. This and other applications can be used to predict what is going to happen around Jupiter during any clear night before observing is started.

Sometimes we can see the moons pass in front or behind Jupiter on every orbit and not above or below as they do for a lot of the time. This makes observing Jupiter very interesting. We can watch the moons approach the planet to disappear behind or in front of Jupiter and then watch them reappear an hour or two later. We can also see their shadows as they pass in front and project their shadow on to the planet. These events can be predicted using a planetarium application and the events can then be followed and timed using a fairly modest telescope.

Eclipse occurs when a moon casts its shadow on to Jupiter. It is quite easy to see because the eclipse shadow looks like a black full stop against the bright glare of the surface of the planet. Moons can also be eclipsed and disappear as they pass through the very large shadow cast by Jupiter.

Transit occurs when a moon passes in front of Jupiter. The moon is actually very difficult to see while it is in front of the planet as it is lost in the glare from the surface.

Occultation occurs when a moon passes behind the planet. An Occultation or Transit is easy to follow with a telescope as the moon approaches Jupiter.

THE SOLAR SYSTEM JUNE 2019

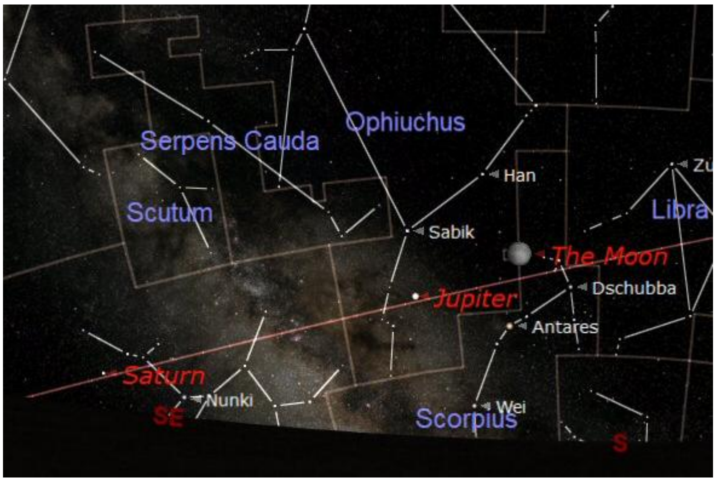
MERCURY will be very difficult to see in the bright sky after the Sun sets over the western horizon. It will be very close to Mars in mid June. See the chart below.

Mercury, and Mars at sunset on 15th June

VENUS will be very low in the east as the sky brightens before the Sun rises and will not be easy to observe.

MARS is now looking rather small as Earth moves further ahead of the Red Planet along their separate orbits. Mars is also moving closer towards the Sun as we view it from Earth and will become increasingly difficult to see. See the Mercury chart above.

JUPITER is now a good late evening object in the east. It rises over the eastern horizon at about 20:30 mid month and will be observable in the south east from 21:30. See the chart below. A pair of binoculars will reveal the four brightest of Jupiter's moons, Io, Europa, Ganymede and Callisto. A small telescope will allow the moons to be seen very clearly. Jupiter is observable all night and in the early morning sky until the sky brightens. It actually sets in the west at about 05:00 as the sky brightens in the east. See more details on pages 8 and 9.



Jupiter and Saturn at 23:00 on 15th June

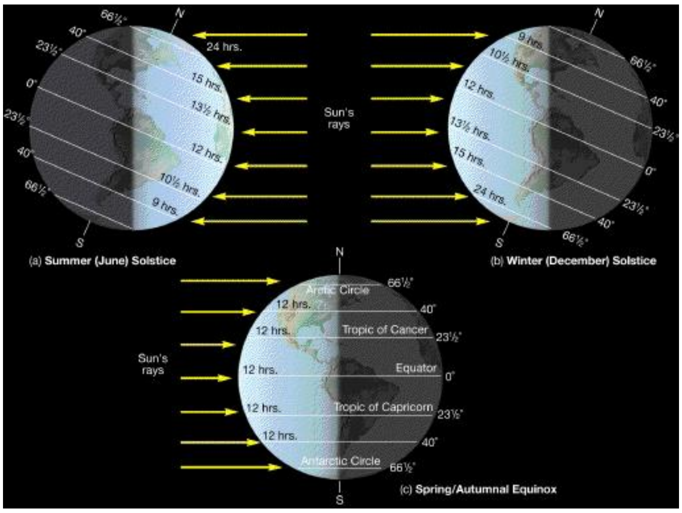
SATURN will be visible in the late evening rising over the eastern horizon at 23:30 at the beginning of June and 22:00 at the end of the month. It will be best observed about one hour after these times as it rises higher above the horizon. The view of Saturn will not be good this year as it (and Jupiter) will be close to the horizon. Both of the gas giants will be in the thick, murky and turbulent air close to the horizon. Saturn will be observable, in the south, through the rest of the night until sunrise.

URANUS will not be observable this month as it is too close to the Sun and close to the horizon at sunrise.

NEPTUNE will not be easily visible this month as it will also be very close to the horizon before sunrise.

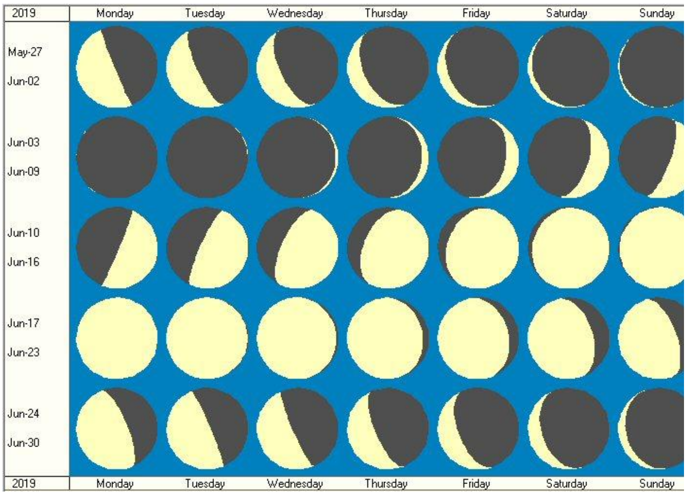
THE SUN

The Sun rises at about 04:45 throughout the month as it will be midsummer. Midsummer day (the Summer Solstice) will be on 21st June. This is the time when the Sun appears to reach its maximum height above the southern horizon. This will actually occur at 16:00 on 21st June. Until this exact time the Sun will appear to be getting higher in the sky and then after 16:00 it will appear to start to get lower as we begin to head back towards WINTER (What! already? We may ask).



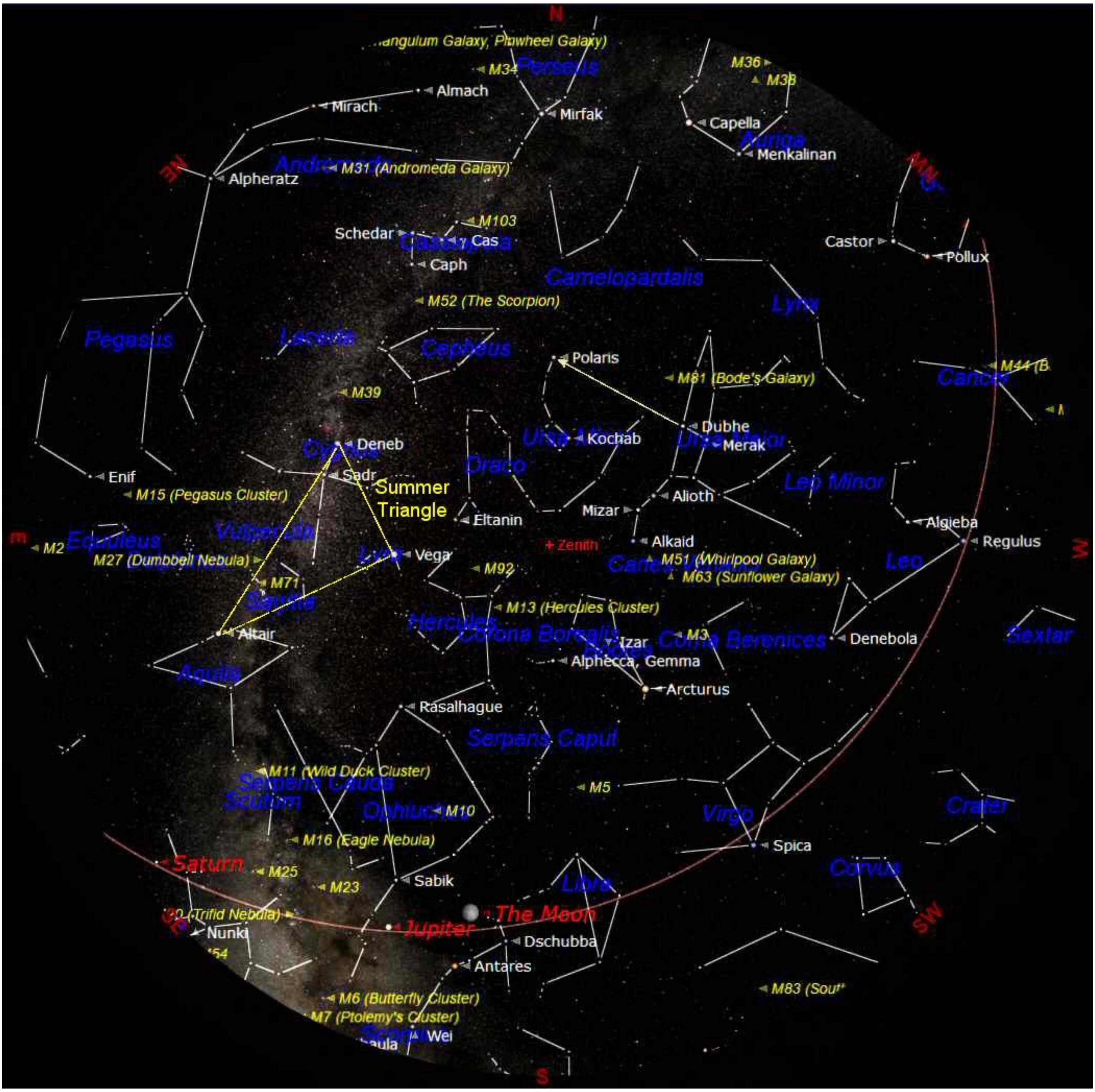
The diagram above shows how the length of the day changes due to the tilt of Earth's axis of rotation. The top left diagram shows how the north is tilted towards the Sun in summer and the days are longer (up to 16 hours long for us). During the winter the north is tilted away from the Sun (top right diagram) and days are shorter. As short as 8 hours for us on midwinter day 21st December. For more details see page 1.

THE MOON PHASES DURING JUNE



New Moon will be on 3rd June
First Quarter will be on 10th June
Full Moon will be on 17th June
Last Quarter will be on 25th June

THE NIGHT SKY THIS MONTH



The chart above shows the whole night sky as it appears on 15th June at 22:00 (10 o'clock) in the British Summer Time (BST). As the Earth orbits the Sun and we look out into space each night the stars will appear to have moved across the sky by a small amount. Every month Earth moves one twelfth of its circuit around the Sun, this amounts to 30 degrees each month. There are about 30 days in each month so each night the stars appear to move about 1 degree. The sky will therefore appear the same as shown on the chart above at 11 o'clock BST at the beginning of the month and at 9 o'clock BST at the end of the month. The stars also appear to move 15º (360º divided by 24) each hour from east to west, due to the Earth rotating once every 24 hours.

The centre of the chart will be the position in the sky directly overhead, called the Zenith. First we need to find some familiar objects so we can get our bearings. The Pole Star **Polaris** can be easily found by first finding the familiar shape of the Great Bear 'Ursa Major' that is also sometimes called the Plough or even the Big Dipper by the Americans. Ursa Major is visible throughout the year from Britain and is always quite easy to find. This month it is high in the west. Look for the distinctive saucepan shape, four stars forming the bowl and three stars forming the handle. Follow an imaginary line, up from the two stars in the bowl furthest from the handle. These will point the way to Polaris which will be to the north of overhead at about 50º above the northern horizon. Polaris is the only moderately bright star in a fairly empty patch of sky. When you have found Polaris turn completely around and you will be facing south. To use this chart, position yourself looking south and hold the chart above your eyes.

Planets observable in the evening sky: Jupiter and Saturn.