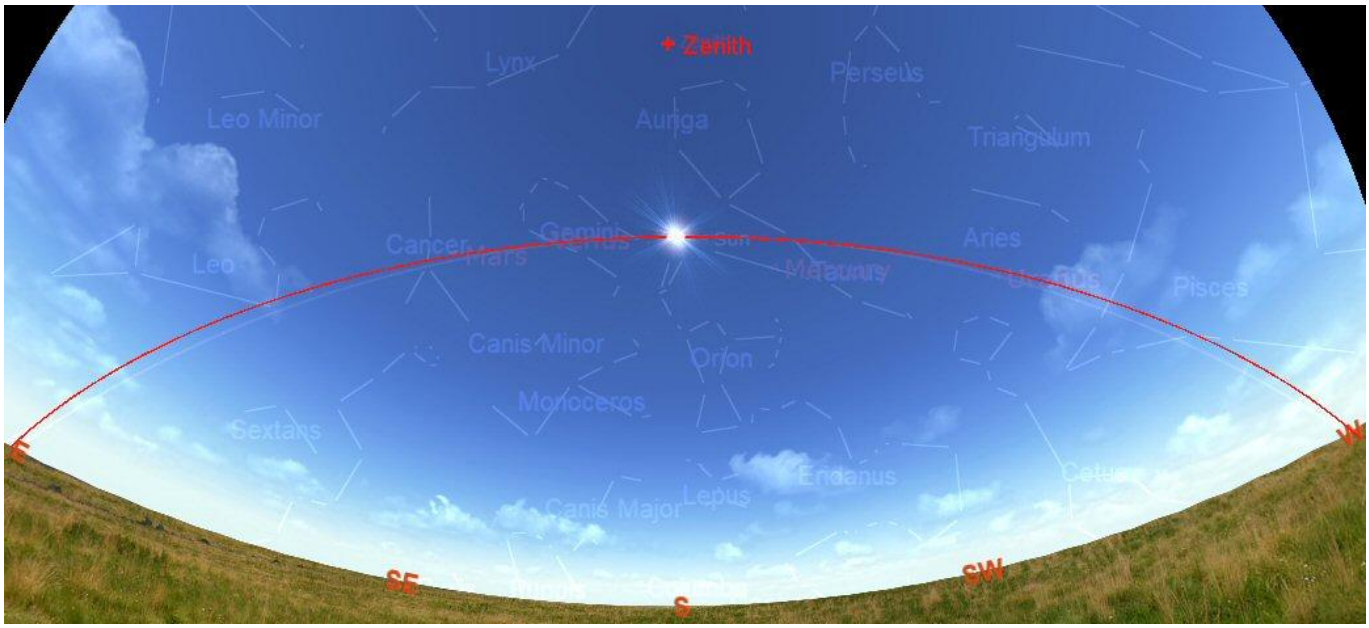
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – JUNE 2021

THE SUMMER SOLSTICE (Midsummer Day)

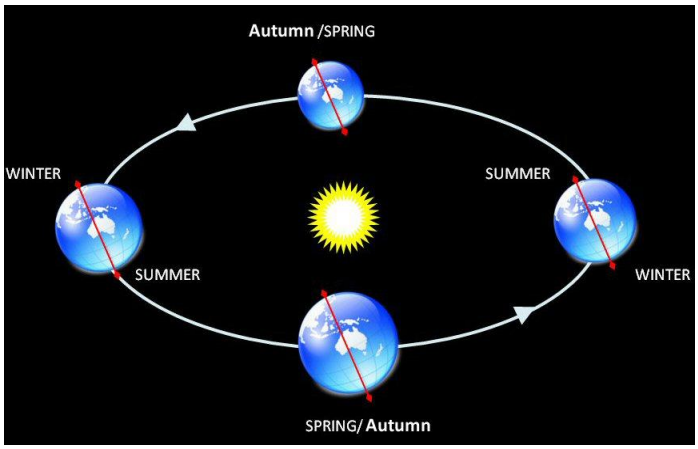


The Summer Solstice (Midsummer Day) 21st June

As astronomers we have a rather confusing view of the sky around us due to the tilt of Earth's axis. There are some very noticeable effects that we take for granted. The first is: how much the position of the Sun in the sky changes from summer to winter.

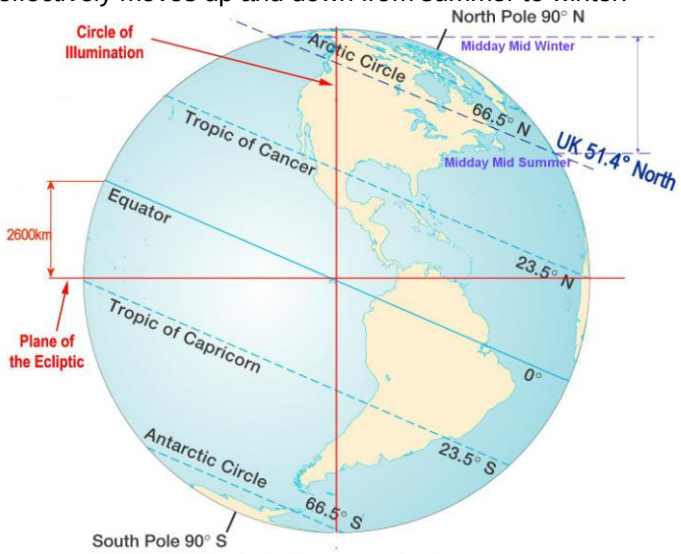
The chart above shows the sky at midday on Midsummer Day. The Sun appears at its highest point in the Sky on 21st June at 13:00 BST (12:00 GMT) so for the UK this the astronomical middle of summer. The Zenith is the point directly overhead from Newbury, England and is marked as a red cross on the chart above.

The Ecliptic (red arc) is the imaginary line that represents the equator of the Solar System. The Sun, Moon and planets appear to move along this imaginary line as Earth moves around its orbit about the Sun. As the tilt of Earth's axis always points to the same direction and towards the same point in the sky, the Ecliptic appears to rise and fall from our tilted point of view on Earth.



Earth is always tilted in the same direction

Another affect caused by the tilted Earth is that our sky appears to move up and down as Earth's Equator effectively moves up and down from summer to winter.



The movement of Earth's Equator

Our summer occurs when the Equator moves up to the Tropic of Cancer position or down to The Tropic of Capricorn for winter. Britain will be closest to the Equator on 21st June so the Sun will appear at its highest point in the sky at midday on 21st June, the Summer Solstice.

NEWBURY ASTRONOMICAL SOCIETY MEETING

4th June	Hunting the Northern Lights
Website:	www.newburyastro.org.uk

NEXT NEWBURY BEGINNERS MEETING

16th June	Getting to know our Moon
Website:	www.naasbeginners.co.uk

GETTING TO KNOW OUR MOON WORKS

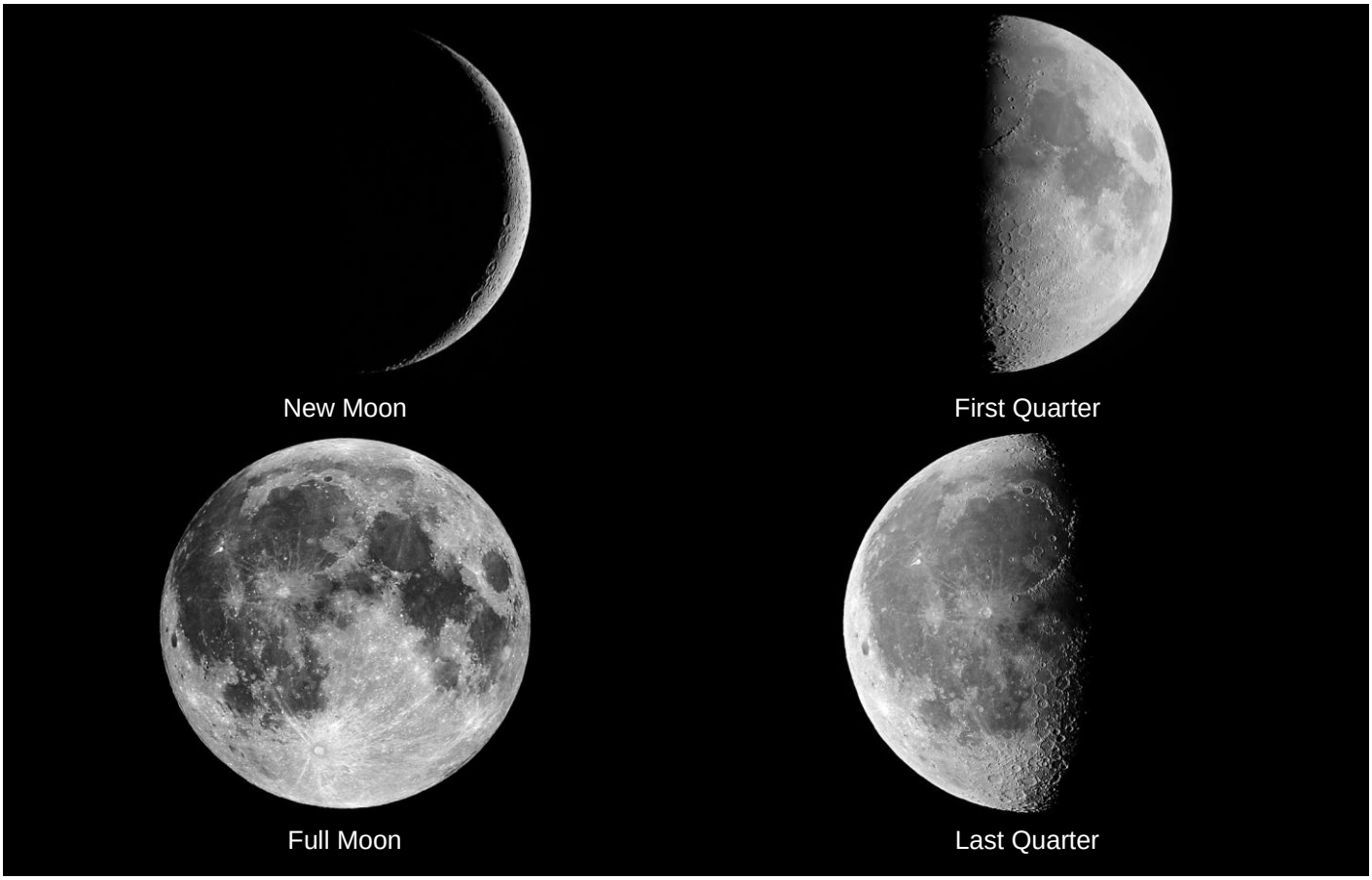


Chart showing the phases of the Moon

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 same phase.

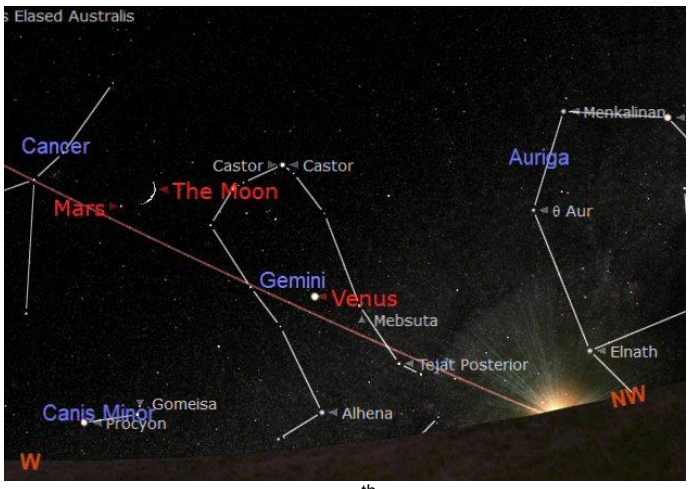
It is no coincidence that the phase cycle of the Moon takes one month to complete and there are twelve months in a year. This time period was named after the ancient term 'moonth' obviously referring to the time the Moon takes to orbit Earth. We will discuss different terms used for a number of aspects 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 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 (the night side of the Moon) 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 (to the left) when viewed from the surface of Earth. This is because the Moon moves along its orbit anticlockwise when viewed from above the North Pole. Therefore 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. We would need to wait until the Sun is below the horizon to enable the thin crescent Moon to be seen in the darkening sky. It may be possible to see the New Moon on 13th June just after the Sun has set.



The New Moon on 13th June at 21:15 BST

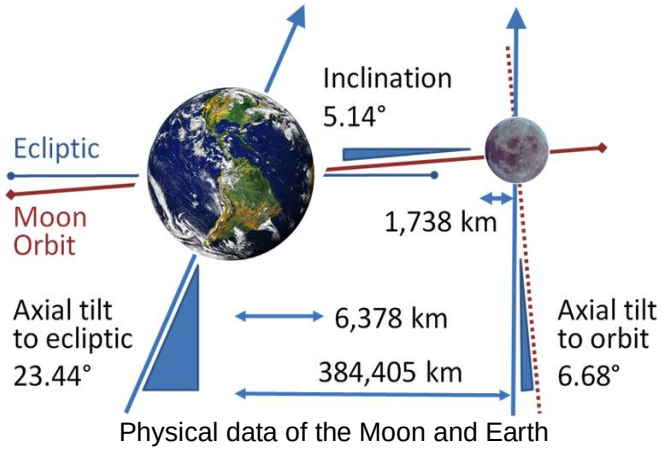
As the Moon continues to move from west to east around its orbit, more of the bright (day) side is revealed and the illuminated side appears as a wider crescent shape. When the Moon has reached approximately a quarter of the way around its orbit, in 7 days, it will appear as the 'Half Moon' or 'First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

After the first quarter, the crescent shape gives way to the shape known as the 'Waxing Gibbous' phase. This phase is produced when the Moon is positioned in its orbit where we can see between a quarter and all of the sunlit side (Full Moon). 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 about 21 days, only the left half of the Moon appears illuminated which is called the 'Last Quarter'. The final phase is the 'Waning Crescent' as less and less of the sunlit side is visible from Earth. Finally after 28 days the Moon moves back into direct line with the Sun and none of the sunlit side is visible.

The Moon takes approximately one month to complete its orbit around Earth; this is where the unit of time we call the month was derived from. The Moon takes 27.32 days to complete one orbit which is called a Sidereal Month. However, because Earth is also moving around the Sun, the Moon actually travels further and takes slightly longer to complete its cycle from one new moon to the next. The actual period it takes is 29.53 days and this is called a Synodic Month or Lunar Cycle.

The Orbit of the Moon is tilted at 5.14° to Earth's orbit so eclipses do not occur every month. Most months the Moon passes above or below the Sun and only occasionally passes in front of the Sun. Solar eclipses always occur when the Moon is directly between Earth and the Sun and the dark side of the Moon is facing Earth. The opposite is the case for Lunar Eclipses. These occur when the Moon is on the opposite side of Earth to the Sun and passes through Earth's shadow. The Moon will always be full during Lunar Eclipses and they always occur at night. The diagram below shows the relative tilts of Earth and the Moon. It also shows the Earth – Moon average distance at 384,405 km and the equatorial radii of the two bodies.



Physical data of the Moon and Earth

We can only see one side of the Moon from Earth because the rotation of the Moon has been locked due to the gravity of Earth. However, the Moon does rotate once every Month when seen from outside of the Earth / Moon system. A number of factors enable us to actually see about 59% of the surface of the Moon in a process called 'Librations'.

The major part of the effect is due to the orbit of the Moon being slightly elliptical (oval). As the Moon passes through the major axis of its orbit (most distant) it moves slower around the orbit. This is rather like throwing a ball high into the air. As the ball rises it slows at the top of its arc then begins to accelerate as it falls back to Earth. The Moon slows as it moves further from Earth then accelerates as it is pulled back towards Earth. However the 27.32 day rotation time is constant causing the Moon to appear [from Earth] to rock back and forth as it moves around its orbit.

Other minor effects that allow a little more of the 'far side' of the Moon to be seen are due to the relative tilts in the orbits of Earth and the Moon. This allows us to see a little further over the poles of the Moon. When the Moon is at the lowest point on its tilt, the Moon appears slightly lower from Earth and we can see a little further over the top of the Moon. Conversely when the Moon is at the highest point on the tilt, the Moon appears slightly higher from Earth and we can see a little further around the bottom of the Moon.

Another effect that helps see the poles is the 23.44º axial tilt of Earth. Somewhere like the UK has a variation in 'relative height' of about 4000km due to the change of position on the sphere of Earth from summer to winter. This gives us a slightly higher and lower vantage point from summer to winter.

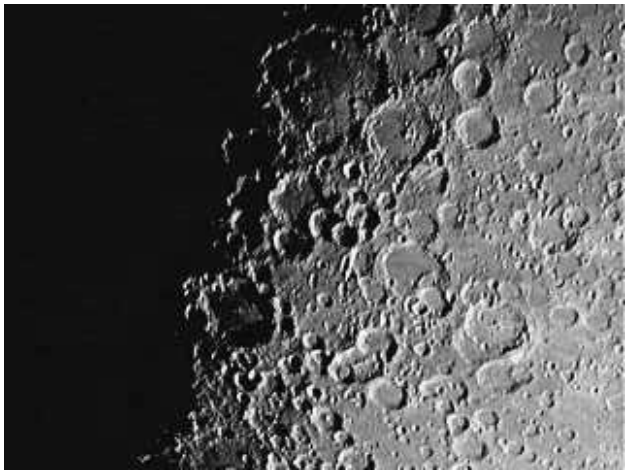
Many astronomers enjoy the challenge of looking for features that are normally hidden just over the edge of the Moon when they briefly appear thanks to the librations.

The 'far side' of the Moon had never been seen until early space flights took cameras around the Moon and transmitted the images back to Earth. Strangely the far side looks quite different to the near side. The far side has almost no Maria (seas) but does have an enormous multi ringed crater that looks like an eye. It is interesting to wonder what our ancestors would have made of this 'eye' like feature looking down from the sky, if it had been on the near side.

Observing the phases of the Moon does not need any optical aid and can be followed just using the naked eye. At full Moon the Maria (seas) can also be seen but to see the true shapes and some detail, binoculars or a telescope must be used. Binoculars will reveal the shape of the Maria and allow the smaller Maria to be seen. A larger pair of binoculars will show the larger craters and mountain ranges.

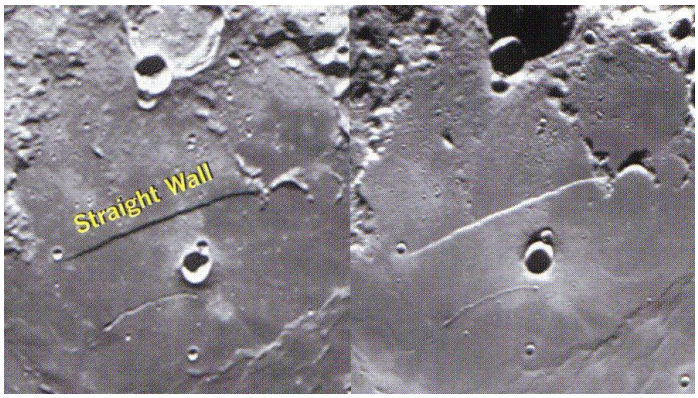
A small telescope will be needed to show any detail of the craters and the other interesting surface features such as Mountains, Cracks and ripples and rills on the smooth surfaces of the Maria. The Maria are very old giant impact craters that have filled with lava from below the surface when the interior was still molten.

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.

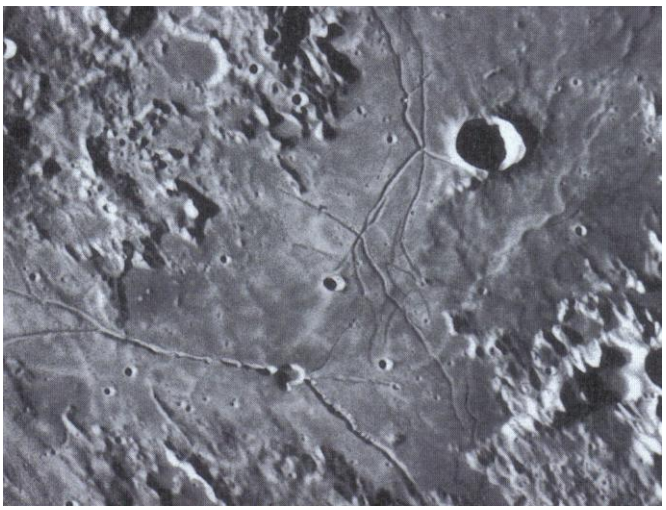


A heavily cratered area near the terminator image

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 meteor impacts. There are however some that appear to be natural mountain ranges.

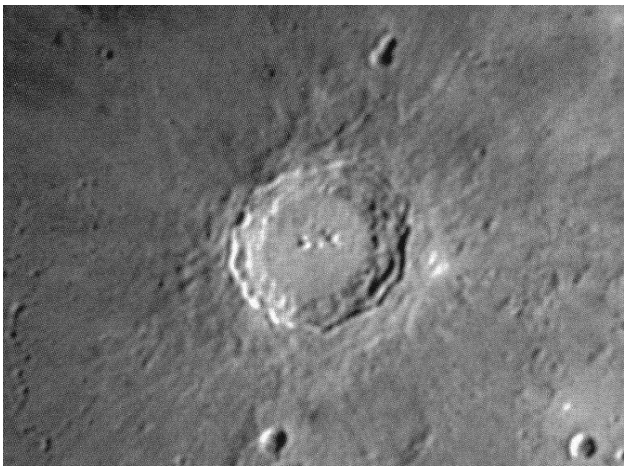


In the images above is a feature called the Straight Wall. This is a common type of feature known as a 'Rill' and appears to be a vast cliff face caused by a crack in the ground. In the left image the Sun is shining from the top casting a shadow towards the bottom but in the right image it is shining 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.

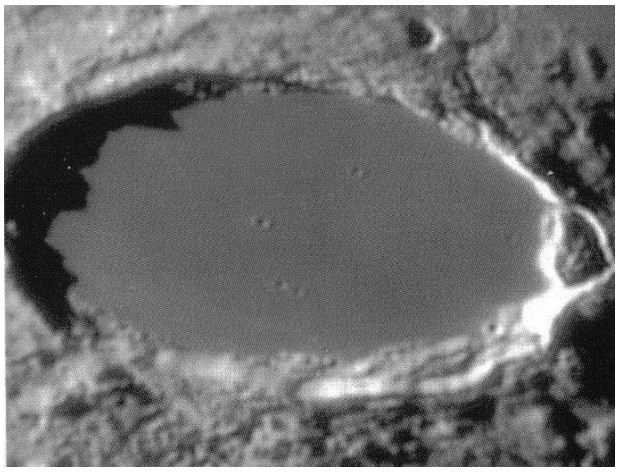


Copernicus showing the terraced walls and central peaks

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 craters and impacts that have created craters on top of earlier craters.



The lava filled Plato with the shadow of the rim.

INTRODUCTION TO 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 as a hobby 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 familiarising 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 (that is 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

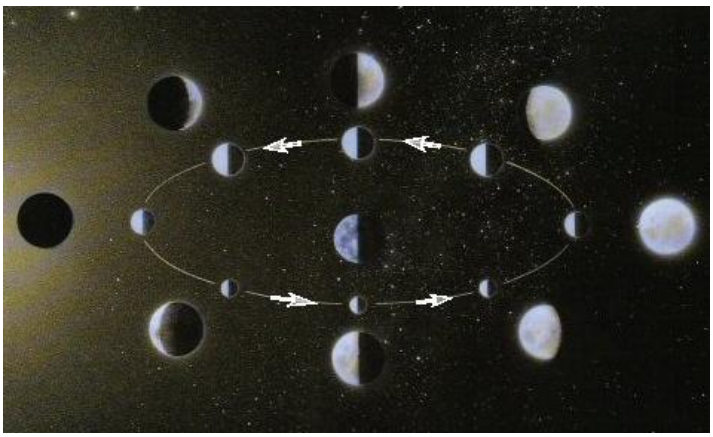
Binoculars can be used to observe the Moon and will provide a good overview of the Moon but they do only have a low magnification. A pair of binoculars will be marked with the 'magnification' and 'aperture' (diameter of the main lens) of the instrument in the form: 9x50. This example means the binocular has a magnification of 9 times 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 Telescope focal length 1000mm and eyepiece focal length 10mm will produce: 1000 ÷ 10 = 100x.

Observing should be started using a low power eyepiece (the 25mm) this will produce a magnification (based on the previous example) 1000 ÷ 25 = 40x. 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 the Barlow will magnify (1000 ÷ 10) x 2 = 200x but some trial and error is necessary.

Perhaps one of the first things to do to help explore the Moon is to obtain a Moon Chart. 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.

The key thing about observing the Moon is to choose the best time to see 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 the 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.



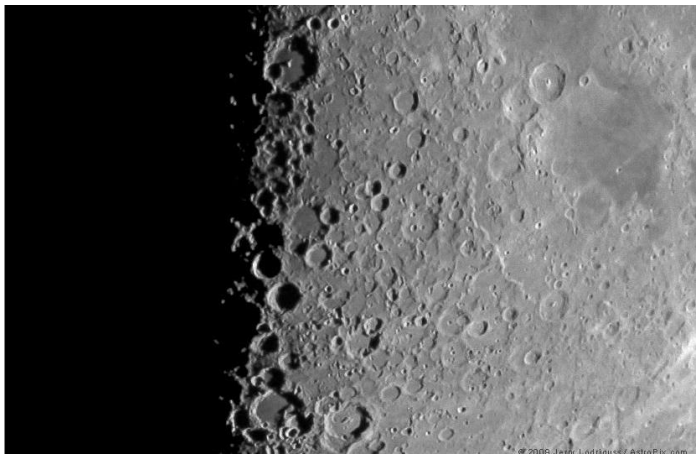
The phases of the Moon (Sun is off to the left)

In the diagram above the Sun is shining from the left. 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. Therefore 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 rest of the month.

So the two Moon images on the left 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 lower 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 right 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 upper position 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 daylight near the Terminator.



Craters close to the Terminator

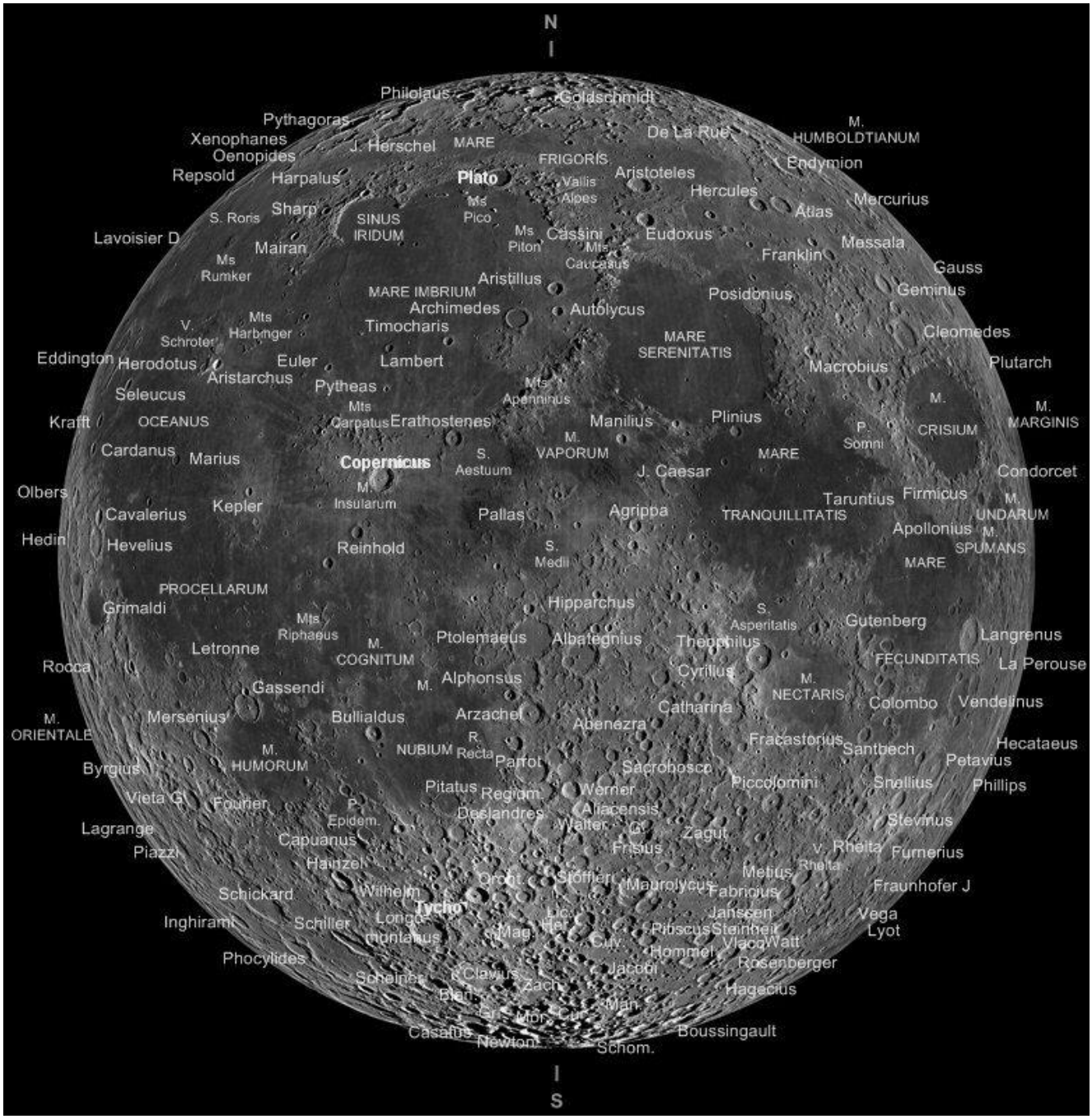
There are two ways of deciding what to observe on particular evening. The first is to check your Moon chart on the evening to see what is best placed, close to the terminator, at that time. If a computer generated chart is used a copy can be printed and used to identify all the things of interest on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

FEATURES ON THE MOON



A map of the Moon with Maria (Seas) and Craters labelled

With our unaided (naked) eyes we can see darker patches on the surface of the Moon. These are called 'Maria' (Mare single) the Latin word for Sea because they were mistakenly thought to be seas on the Moon. The Maria are particularly obvious on the Full Moon and are marked on the map above as Mare Serenitatis (Sea of Serenity) for example. Using binoculars will show the shapes of the Maria in more detail and also reveal the smaller dark areas that may be parts of larger seas or separate areas.

A telescope will reveal the Moon in a completely different view. Probably the most noticeable feature will be the thousands of large and small craters. It is interesting to distinguish the different types of craters and how they appear. Some large craters have a central mountain and often have terraced walls (Copernicus and Tycho). Some have smaller craters inside their walls that help to work out the sequence of how they were formed.

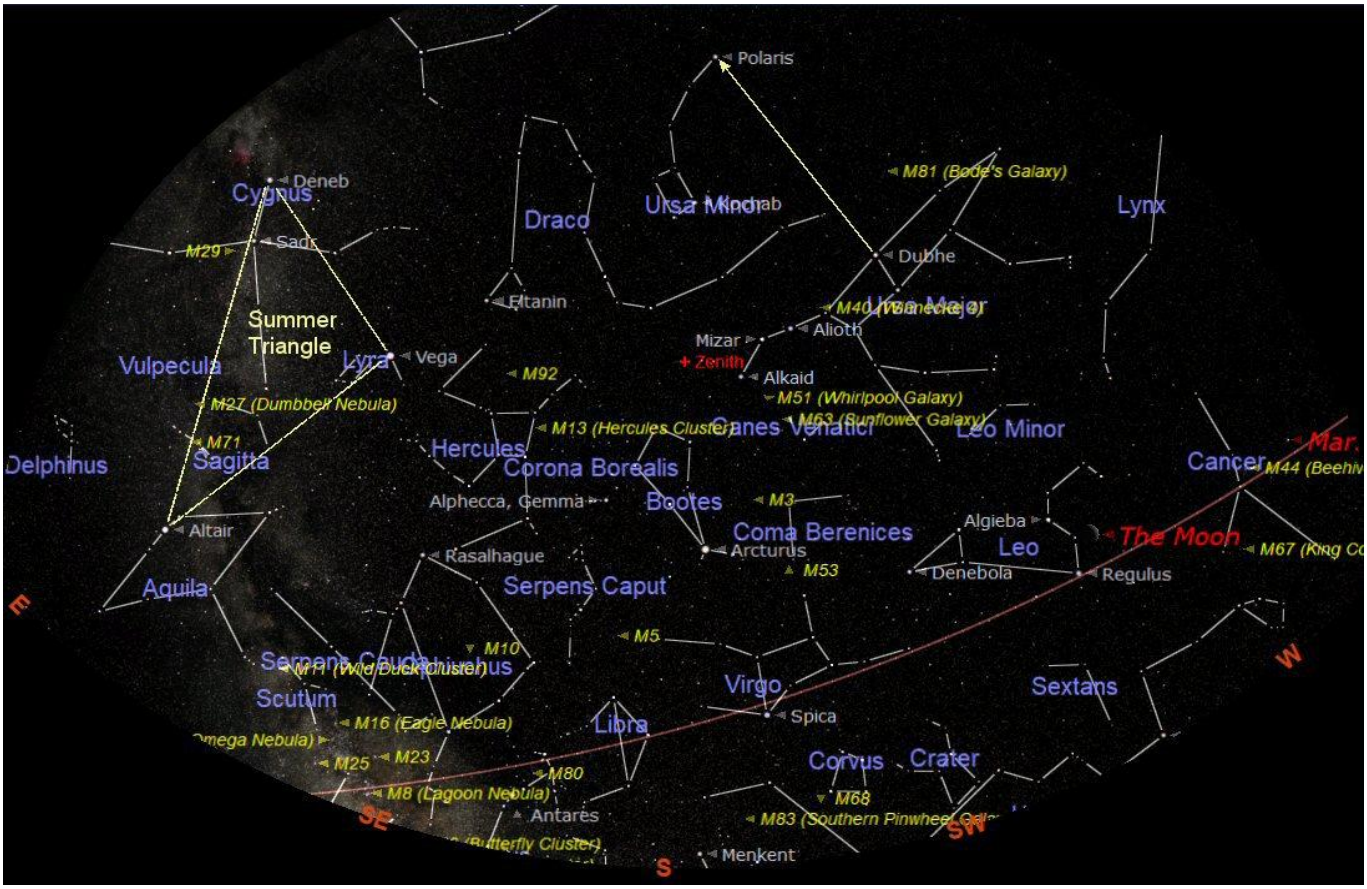
Some areas of the Moon are more cratered than others. There are large areas that have so many craters that there appear to be no smooth areas at all. Other areas, particularly Maria, have almost no craters.

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 do appear to be natural mountain ranges.

There are features known as 'Rills' that appear to be gullies and creases or cliff faces caused by cracking of the surface as the Moon cooled billions of years ago.

Craters, Mountains and rills are best viewed when they are close to the 'Terminator', the line between night and day. Here the shadows cast by the setting Sun cause long shadows that give relief and clarity to the view.

A TOUR OF THE NIGHT SKY - JUNE 2021



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 red) at 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 brightest stars often appear to form a group or recognisable pattern; we call these 'Constellations'.

Constellations through which the ecliptic passes this month are Gemini (the Twins), Cancer (the Crab), Leo (the Lion), Virgo (the Virgin), Libra (the Scales), Scorpio (the Scorpion) and Sagittarius (the Archer) just coming into view in the east.

The constellation of Gemini (the Twins) is moving over the western horizon. The two brightest stars in Gemini are Castor and Pollux that are named after mythological twins. Auriga (the Charioteer) is also moving west. The brightest star in Auriga is the brilliant white star Capella which is still visible in the west in the early evening.

To the east (left) of Gemini is the rather indistinct constellation of Cancer (the Crab). The stars of Cancer are quite faint and can be difficult to discern especially in a light polluted sky. It is worth searching out Cancer using binoculars or a small telescope to see the Open Cluster M44 Praesepe (the Beehive Cluster). M44 is older and further away than M45 (the Seven Sisters) so is fainter but still looks lovely. It has a group of stars that resemble an old straw Beehive with bees around it.

The constellation of Leo (the Lion) follows Cancer along the Ecliptic and is a very interesting constellation. It does actually look a little like a lion or the Sphinx in Egypt. Around and between Leo and the neighboring constellation of Virgo is a cluster of galaxies. Our Milky Way galaxy and our local group of galaxies are members of this larger group of galaxies called the Virgo Cluster. A medium sized telescope (150mm to 200mm) and a dark sky is required to see these faint objects.

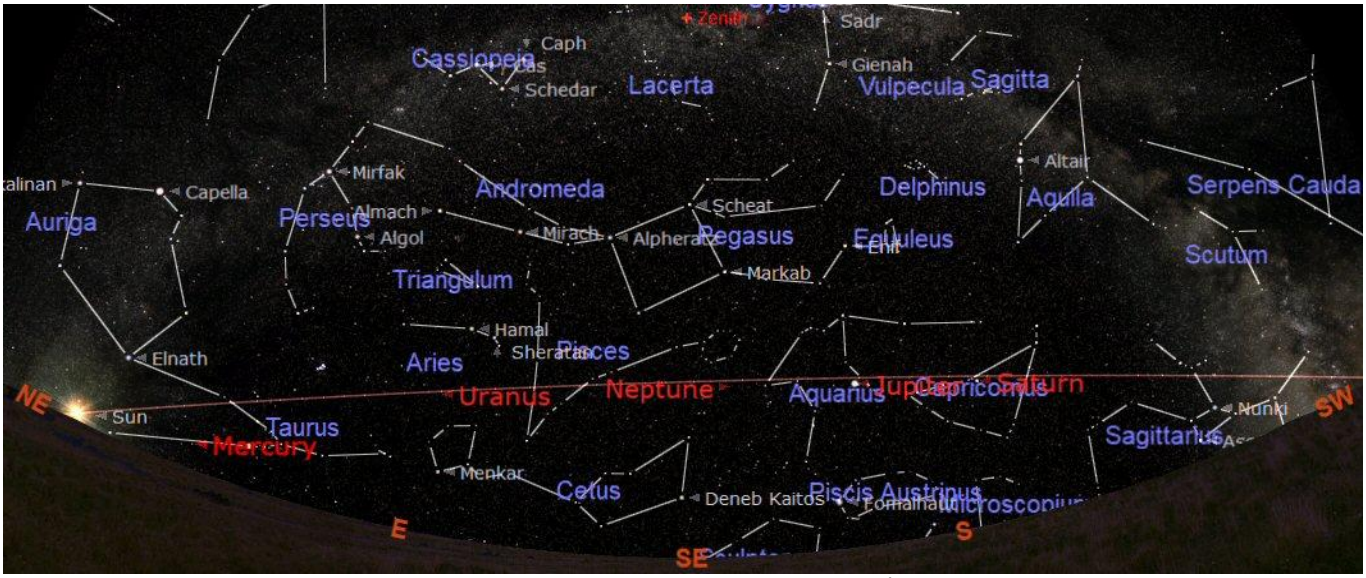
Following Leo is the less obvious constellation of Virgo but it does have one fairly bright star called Spica. Virgo gives its name to a large cluster of Galaxies that is also spread over into the neighbouring constellations of Coma Berenices (Berenices' Hair) and into Leo.

To the north of Virgo is the bright orange coloured star called Arcturus in the constellation of Boötes. Arctaurus is a Red Giant star that is nearing the end of its 'life' as a normal star. It has used almost all of its Hydrogen fuel and has expanded to become a Red Giant, 25 times the diameter of our Sun. At the moment it shines 115 times brighter than our Sun but it is destined to collapse and become a White Dwarf.

Higher in the south east is the constellation of Hercules (the Strong Man). Hercules has a rather distinctive distorted square shape, at its centre, called the 'Keystone'. This is due to its resemblance to the centre stone of an arch or bridge. The jewel of Hercules is without doubt is the Great Globular Cluster, Messier 13 (M13). M13 can be found in the western (right) vertical imaginary line of the 'Keystone'. It is just visible using a good pair of 9 x 50 binoculars. The spherical cluster, of about a million stars that can be seen using a 90mm *f*10 telescope but will look even more impressive when using a larger telescope.

Just moving into the eastern sky is the Summer Triangle that will begin to dominate the Summer Sky.

THE SOLAR SYSTEM - JUNE 2021



The planets at sunrise 05:00 on 19th June

The chart above shows the location of the planets relative to the Sun. The sky has been darkened to make the planets visible. The planets to the west of the Sun (right) will be visible in the early morning sky before sunrise. The planets to the east of the Sun (left) will be visible in the early evening sky after sunset.

MERCURY will be in the early morning sky as the Sun is rising. It will be very difficult to find in the bright sky and will require a clear view to the western horizon.

Mars and Venus in the early evening sky

VENUS will be visible in the early evening sky as soon as possible after sunset. It will be easy to find but will it require a clear view to the western horizon. Venus is emerging from its excursion behind the Sun when it was in 'Conjunction' with the Sun. It will appear at its smallest diameter and will be fully illuminated because it is still beyond the Sun from our point of view.

MARS is still well positioned in the evening sky moving through Taurus and will be in the south as the sky darkens. It is getting smaller at about 4.0 arc-seconds as Earth pulls further away. Mars will be around until mid June but will be moving closer to the south western horizon.

JUPITER will be rising in the east from about around midnight and will be visible in the south east before sunrise. Jupiter will be at opposition on 20th August. See page 11 for more advice on observing Jupiter.

SATURN will be even more difficult to see than Jupiter in the bright early morning sky. The ringed planet rises just before Jupiter in the south east at about 02:00. Saturn will be at its best this year on 2nd August when it will be at opposition and will be due south at midnight.

URANUS will be very difficult to find in the brightening early morning sky and will need a telescope. This month it will rise in the south west at about 04:45.

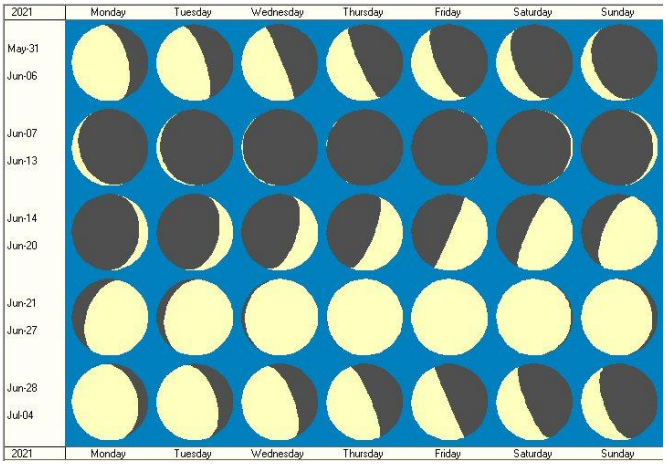
NEPTUNE will be just visible this month to the east of Jupiter. It will be difficult to see in the brightening morning sky as it is only magnitude +7.8.

THE SUN

The Sun rises at about 05:25 at the beginning of the month and 04:50 at the end. It sets at 20:30 at the beginning of the month and 21:00 at the end. It will reach its highest point in the sky on 21st June the Summer Solstice, see page 1. There have been a few small Sunspots during April and May.

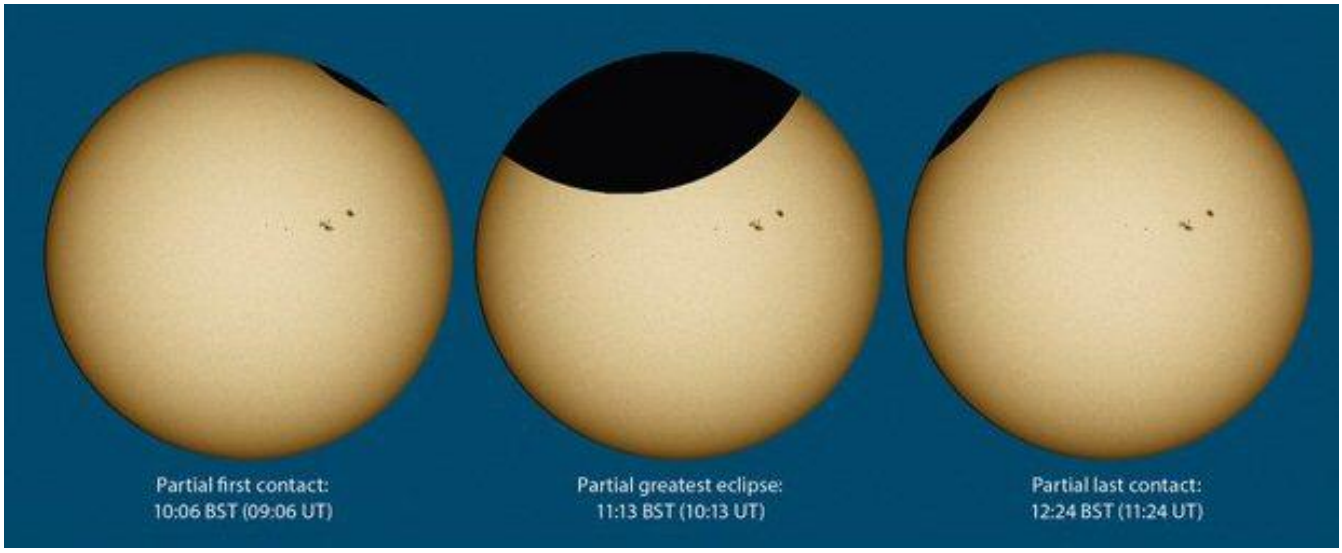
There will be a Partial Solar Eclipse see page 10.

THE MOON PHASES DURING JUNE



Last Quarter will be on 2nd June
New Moon will be on 10th June
First Quarter will be on 18th June
Full Moon will be on 24th June

PARTIAL SOLAR ECLIPSE 10th JUNE 2021

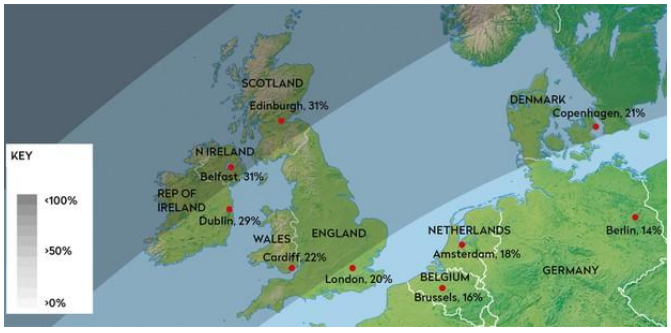


Phases of the eclipse as seen from UK

On 10th June 2021 a Partial Solar Eclipse will be visible from the UK. From Newbury UK we will see about 20% of the Sun covered by the Moon at 11:13 BST. The cover will be greater further north as the eclipse begins in northern Canada then moves across Greenland and the North Pole and finishes over Siberia.

From these more northerly areas there will be an Annular Eclipse. An Annular Eclipse occurs because the Moon's orbit isn't entirely circular but elliptical so it moves closer and further from Earth. On 8th June 2021 the Moon reaches its furthest point from Earth on its orbit that we call 'apogee'. Consequently the Moon will appear smaller in the sky than normal.

The Moon will still be smaller on 10th June (the day of the eclipse) and will appear slightly smaller than the Sun so it will not completely cover the Sun. Therefore at the midpoint of the eclipse the outer edge of the Sun will be visible around the silhouette of the Moon. This is sometimes called the 'Ring of Fire' effect.



Maps showing Moon coverage over the Sun

From the south of the UK we will first see the edge of the Moon start to 'cut' into the edge of the Sun at 10:06 this will be 'First Contact'. At 11:13 we will see almost 20% of the Moon in front of the Sun so this will be the maximum of our eclipse. The Moon's silhouette will then begin to move off the Sun until it will have moved completely off the edge of the Sun at 12:24 and the Partial Eclipse will be over.

During the 10th June Partial Eclipse it will not become noticeably darker in the UK as happens during a total Eclipse. The remaining 80% of the Sun will still be bright and appear as normal daylight.

OBSERVING THE ECLIPSE

We must remember it is very dangerous to look directly at the Sun without eye protection. Starring at the Sun may cause permanent damage to the eyes.

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 we can use a piece of white card as a screen and project the light from the Sun on to the card.

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 a refracting telescope.

A Solar Observing Screen attached to a telescope

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 using a sheet of special Mylar Solar Film.

This type of filter removes the vast majority of the light from the Sun to a safe level that will not damage the eye of the observer. The light available is the same 'white' light that is naturally emitted by the Sun but vastly reduced in intensity. There is more advice on the Beginners website in the June What's Up.

OBSERVING THE PLANET JUPITER AND ITS MOONS

The sort of view of Jupiter as seen through a small telescope

The image shown above shows the sort of view that can be expected using a small telescope (90mm refractor or a 130mm reflector). The image also shows the four brightest (Galilean) moons of Saturn. These moons were recorded by Galileo Galilei using his first telescope in 1610. Jupiter and its moons can just about be seen using a good pair of 9x50 binoculars.

Jupiter is now appearing low in the sky and in the brightening pre-sunrise dawn sky so it will not be at the best time for observing it. However on 20th August Jupiter will be at opposition. This means it will be directly opposite the Sun in our sky and therefore due south at midnight Greenwich Mean Time (GMT) 01:00 BST. When at opposition Jupiter will be at its highest point above the horizon and at its largest apparent diameter therefore looking very bright and at its best.

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

For those who are lucky enough to have a larger telescope, a closer study of the features in Jupiter's cloud system can be achieved. The darker bands on the clouds are known as 'Belts' and the lighter ones known as 'Zones'. The belts are shown on the image of Jupiter above and the most prominent (North and South Equatorial Belts) can be seen using a small telescope. A larger telescope is required to make out the details and the other less prominent belts.

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 of detail of the storm patterns to be seen. Swirls and waves can be seen in the Belts and zones and the whole system is very active and interesting to monitor as it changes. Spots also appear and disappear and can be monitored as they develop and move along through the belts. The spots can be dark or lighter and can merge with other spots.

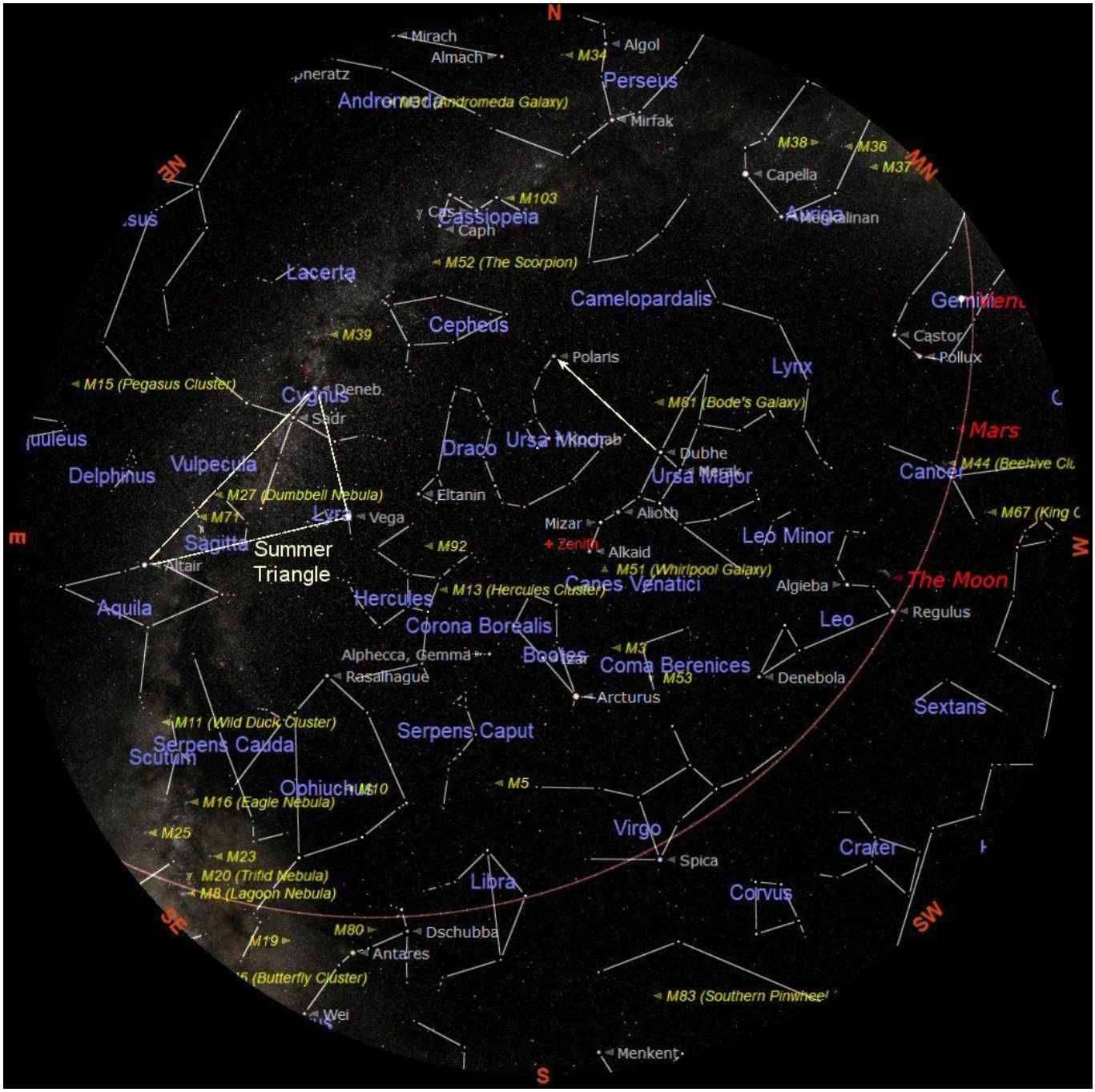
The most famous [spot] feature in the cloud system is the 'Great Red Spot' (GRS). This huge storm has been raging for at least 350 years. We know this because it was recorded by astronomers in 1664 using some of the earliest telescopes. The GRS does change colour and shape but it is always there. Its colour may fade from its pink (not actually red) to nearly white when it may almost disappear. The colour is thought to be caused by Phosphorus welling up from other layers deep in Jupiter's atmosphere.

A good pair of 9 x 50 binoculars will show Jupiter as a small but bright disc and the four brightest moons will be just visible, depending on their position in their orbit around Jupiter. Jupiter's four largest and brightest moons: **Io, Europa, Ganymede and Callisto** were first recorded by Galileo and are called the 'Galilean moons'.

Observing the Jovian System (Jupiter and its Moons) is quite easy but does need a pair of binoculars or better still a telescope. Using standard binoculars (9x50) shows Jupiter as an extended fuzzy star like object and if good quality may show the four Galilean moons. A telescope will be required to see detail on the surface of Jupiter and a clear view of the moons.

It is good fun and interesting to monitor the movement of the four moons from 'clear' night to night. Sketches can be made to record the positions of the moons and a telescope will allow the time when a moon passes behind the planet (occultation) and when a moon passes in front of Jupiter (transit) to be recorded. Photographic images can also be taken but Jupiter will be overexposed if it is intended to use the images to monitor the positions of the moons.

THE NIGHT SKY – JUNE 2021



The chart above shows the whole night sky as it appears on 15th June at 22:00 (10 o'clock) 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 9 o'clock BST at the beginning of the month and at 11 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 almost directly over head. 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: Venus and Mars.

The Summer Solstice (Midsummer Day) will be on 21st June – The Sun at its highest point at midday 13:00 BST.