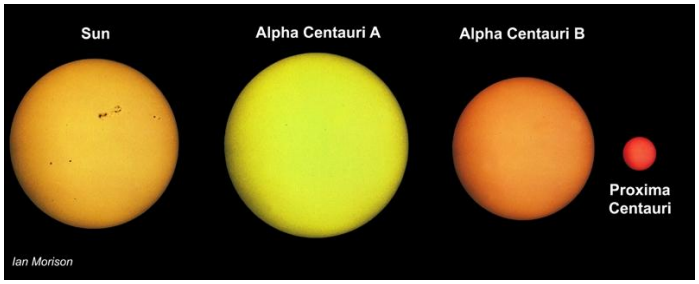
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – September 2016

An artist's impression of Proxima b orbiting Alpha Centauri C (Proxima)

A planet has been discovered orbiting our closest neighbour star and that planet could be at the right distance from its star and temperature for liquid water and the possibly of life to exist.

The star is called Proxima Centauri, a red dwarf that's part of the Alpha Centauri system. This triple star system is just 4.2 light-years away from our Solar System. The three stars in the Alpha Centauri system are Alpha Centauri A, Alpha Centauri B and Alpha Centauri C (Proxima). Alpha Centauri A and B are a close pair of stars similar to our Sun but Alpha Centauri C (Proxima) is a small Red Dwarf star that appears to be orbiting the A – B pair at a much greater distance. Proxima is the closest of the triplet to us and the closest known star to us.



The Alpha Centauri stars compared to our Sun

The newly discovered planet is called Proxima b and it is a terrestrial world (Earth like) whose existence has now been confirmed after 16 years of study. It is not yet known whether Proxima b has an atmosphere or liquid water. However the computer models don't rule out the possibility. That would make it the closest known exoplanet to us and the closest known exoplanet with the potential for life to exist.

The planet is at least 30 percent more massive than Earth and makes one circuit around Proxima Centauri every 11.2 Earth days. These figures imply that the planet comes as close as 7.4 million kilometres to its parent star. If Proxima Centauri were like our Sun, the planet would be blazingly hot but because red dwarfs are much dimmer, scientists estimate Proxima b should have an Earth-like range of temperatures, from -30°C on its dark side to +30°C on its light side. That would make it possible for water to exist in liquid form on the surface which astrobiologists regard as a key requirement for life.

The scientists' calculations assume that the planet might have an Earth like, heat-trapping atmosphere and that the planet's rotation is tidally locked so that one side is constantly facing the star. At the moment we don't know if the planet does have water but it does orbit at a distance from the star that would allow water to exist.

As new, more powerful and advanced telescopes come into service we should be able to determine if Proxima b has an atmosphere and even the composition of that atmosphere. Detailed analysis of the composition of the atmosphere could even reveal signs of life.

NEWBURY ASTRONOMICAL SOCIETY 2016 - 2017

2nd September What we don't know about the Universe
Website: **www.newburyastro.org.uk**

NEXT NEWBURY BEGINNERS MEETING

21st September Man and the Moon
Website: **www.naasbeginners.co.uk**

OUR MOON

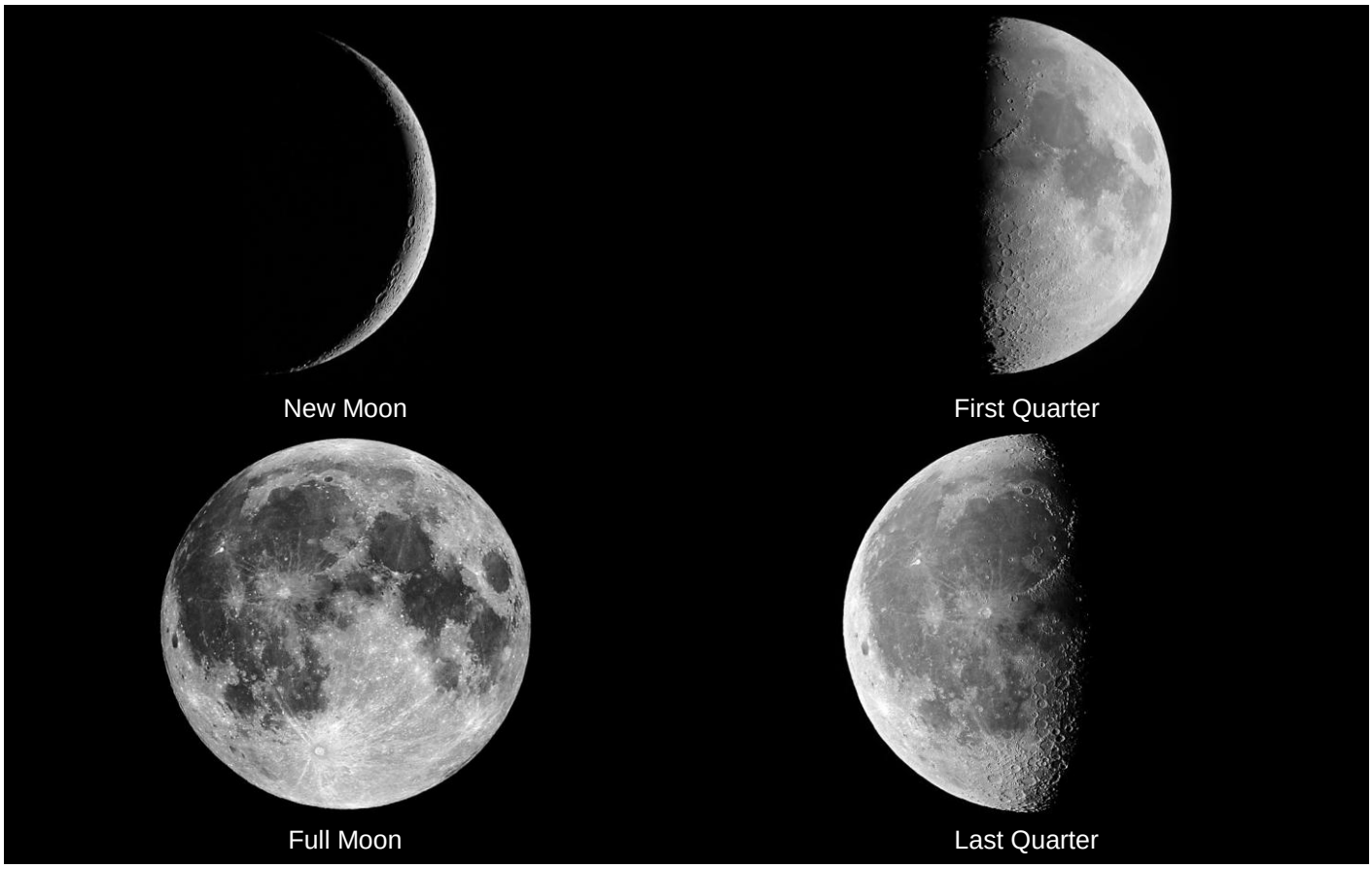


Chart showing the phases of the Moon

The images above show the four ‘cardinal’ phases of the Moon, known as: ‘Quarters’. The four quarters appear 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.

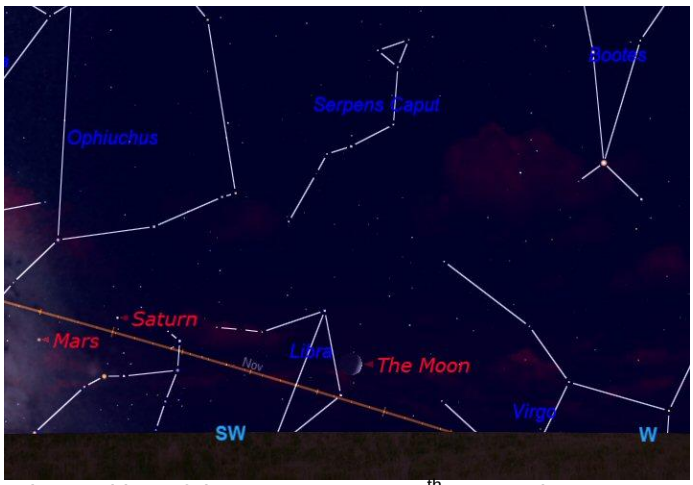
It is no coincidence that the phase cycle of the Moon takes about one month to complete and there are twelve months in a year. This time period was named after the ancient term ‘moonth’ obviously referring to the time the Moon takes to orbit Earth. We will discuss different terms used for a number of 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 not 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 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. 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 (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 3rd to 5th day after conjunction with the Sun. This is because the Moon is too close to the Sun and the sky being too bright. We would need to wait until the Sun is far enough below the horizon to enable the thin crescent Moon to be seen in the just darkening sky. It may just be possible to see the New Moon on 5th or 6th September.



The position of the New Moon on 6th September at 21:00

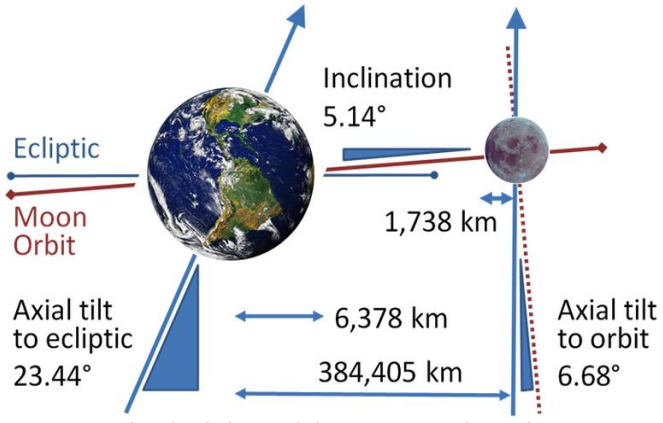
As the Moon continues to move west to east around its orbit, gradually more of the bright side is revealed and the illuminated side appears as a wider crescent shape. When the Moon has reached approximately a quarter of the way around its orbit then it will appear as the 'Half Moon' or 'First Quarter'. 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 of the Moon. When 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 be rising 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 20 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 as the Moon moves back into direct line between Earth and the Sun, 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 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 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 moves back towards Earth. However the 27.32 day rotation speed is constant causing the Moon to appear 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 the 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 at the poles is the 23.44º axial tilt of Earth. Somewhere like the UK has a variation in 'relative height' of about 4000 km 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

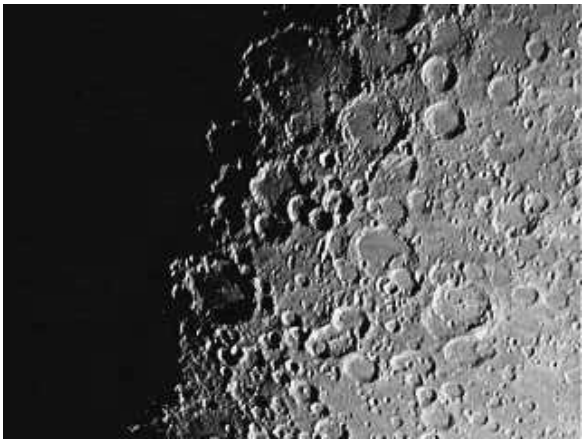
Many astronomers enjoy the challenge of looking for features that are normally hidden just over the edge of the Moon when they briefly appear thanks to the librations.

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.

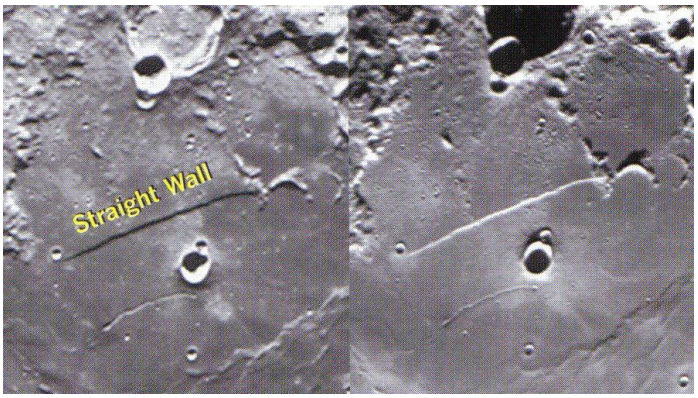
A small telescope will be needed to show any detail of the craters and the other interesting surface features such as Mountains, Cracks and ripples and rills on the smooth surfaces of the Maria. The Maria are very old giant impact craters that have filled with lava from below the surface when the interior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

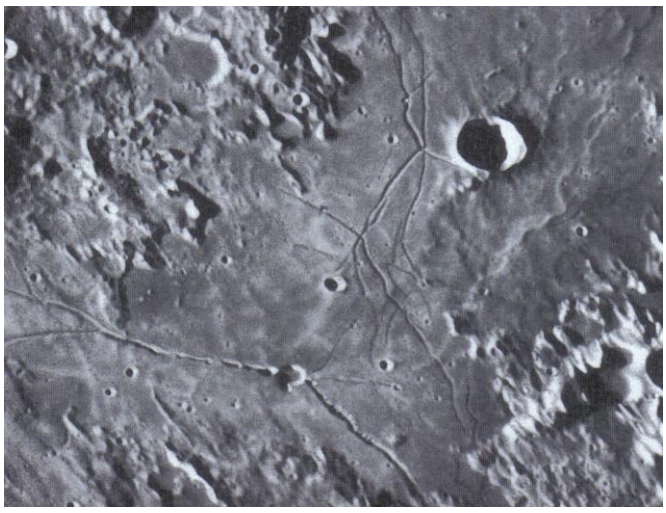


A heavily cratered area near the terminator image

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.

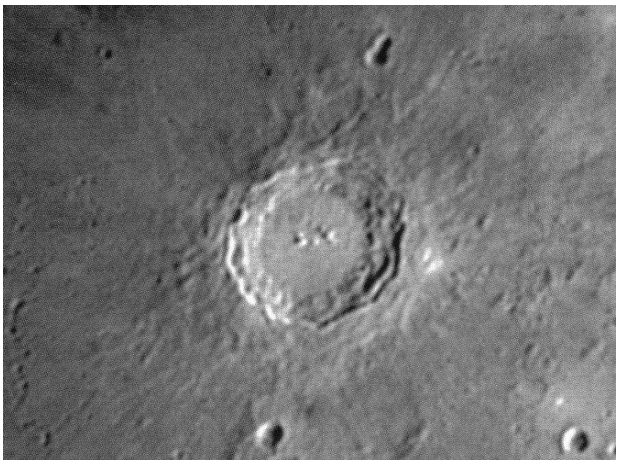


In the images above is a feature called the Straight Wall. This is a common type of feature known as a 'Rill' and appears to be a vast cliff face caused by a crack in the ground. In the left image the Sun is shining from the top casting a shadow towards the bottom but in the right image it is shining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



Cracks and rills on a smooth surface

Craters are especially spectacular on the terminator because sunlight will illuminate the outside of one wall and the inside of the wall on the other side of the crater, with the opposite side of each wall in shadow (see Plato 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 crater may cut through the wall of a large crater.

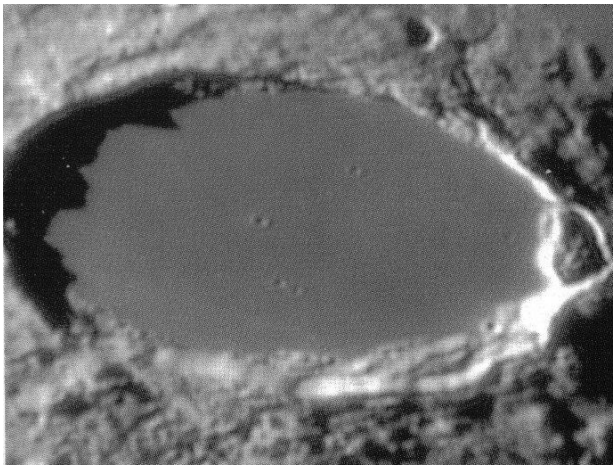


Copernicus showing the terraced walls and central peaks

Other craters have radial lines called rays stretching for many hundreds of kilometres where debris was thrown out on impact when these craters were created.

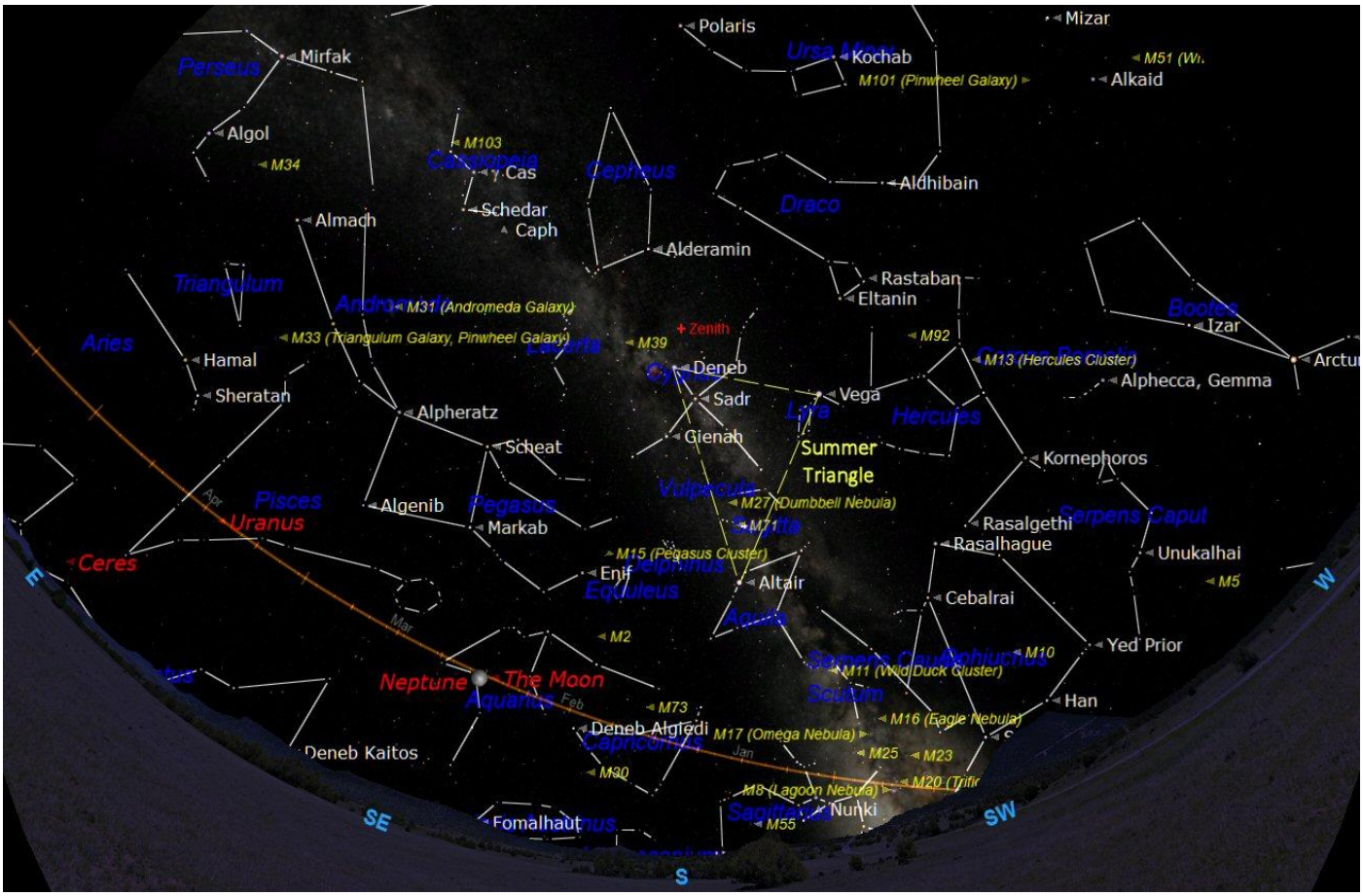
Crater Tycho showing the prominent ray structure

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

THE NIGHT SKY - SEPTEMBER 2016



The chart above shows the night sky looking south at about 22:00 BST on 15th September. West is to the right and east to the left. The point in the sky directly overhead is known as the Zenith or Nadir and is shown 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 constellations through which the ecliptic passes are known as the constellations of the 'Zodiac'.

Constellations through which the ecliptic passes this month are Sagittarius (the Archer), Capricornus (the Goat), Aquarius (the Water Carrier), Piscis (the Fishes), Aries (the Ram) and Taurus (the Bull) is about to rise over the eastern horizon.

Just disappearing over the south western horizon is the constellation of Sagittarius (the Archer). It is really a southern constellation but we can see the upper part creep along the horizon during the summer. The central bulge of our galaxy is located in Sagittarius so the richest star fields can be found in the constellation along with many of the deep sky objects that we seek out.

The summer constellations are still prominent in the night sky lead by Hercules (the Hunter). Following Hercules is the Summer Triangle with its three corners marked by the bright stars: Deneb in the constellation of Cygnus, Vega in Lyra, and Altair in Aquila. The Summer Triangle is very prominent and can be used as the starting point to find our way around the night sky. The Milky Way (our Galaxy) flows through the Summer Triangle passing through Cygnus, down through Aquila to the horizon in Sagittarius.

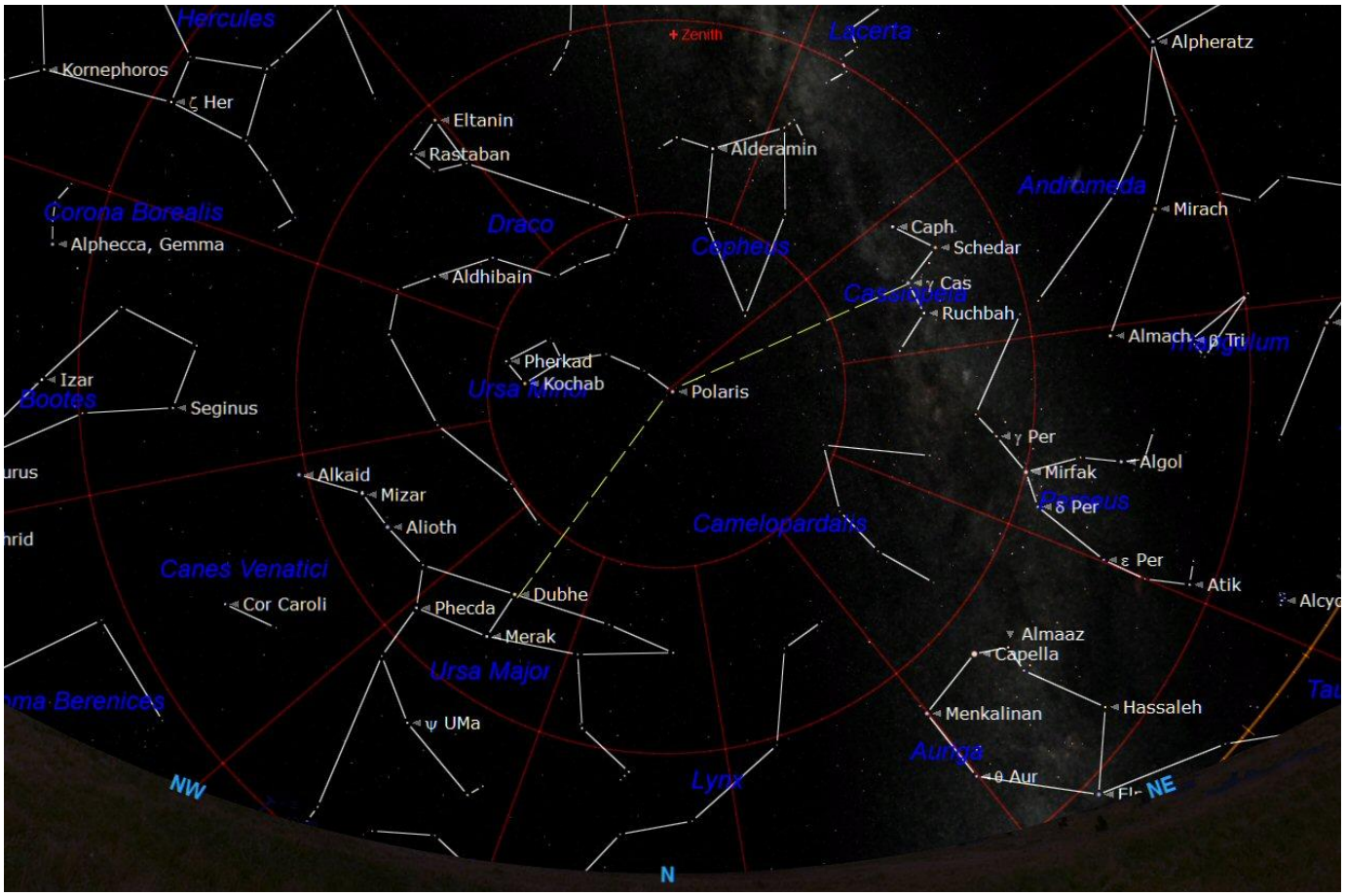
The Milky Way flows north from the Summer Triangle through the rather indistinct constellation of Lacerta (the Lizard), past the pentagon shape of Cepheus and on through the 'W' shape of Cassiopeia (the Queen).

At the top, centre of the chart above is the fairly faint constellation of Ursa Minor (the Little Bear) also called the Little Dipper by the Americans. Although Ursa Minor may be a little difficult to find in a light polluted sky it is one of the most important constellations. This is because Polaris the North Star is located in Ursa Major. Polaris is the star that is located at the approximate point in the sky where an imaginary line projected from Earth's north pole would point to. As the Earth rotates on its axis the sky appears to rotate around Polaris every 24 hours. This means Polaris is the only bright star that appears to remain stationary in the sky.

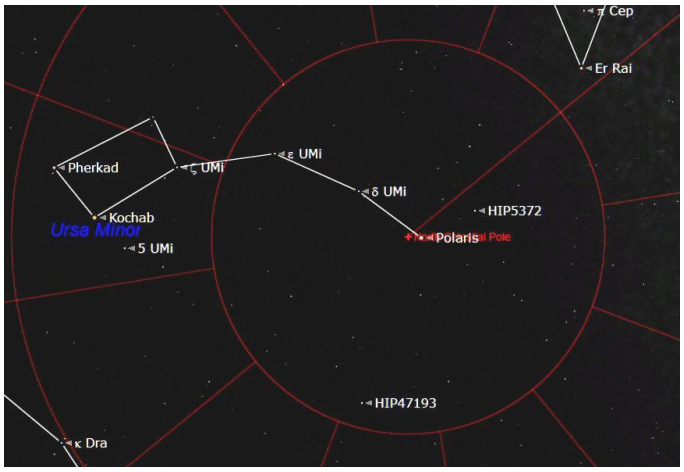
Just appearing in the top right corner of the chart (north west) are the stars Alkaid and Mizar. These are the stars at the end of the handle of the saucepan shape of the constellation of Ursa Major (the Great Bear). It is often called the Plough in the UK but is also known as the Big Dipper in the USA. It does actually look remarkably like a saucepan. Four bright stars represent the pan and three stars represent the handle. See page 6 for a closer look at Ursa Major and Ursa Minor.

To the East of the Summer Triangle is the constellation of Pegasus (the Winged Horse). The main feature of Pegasus is the square formed by the four brightest stars. This asterism (shape) is known as the Great Square of Pegasus. The square is larger than might be expected but once found is easier to find again.

CONSTELLATIONS OF THE MONTH – URSA MAJOR AND URSA MINOR



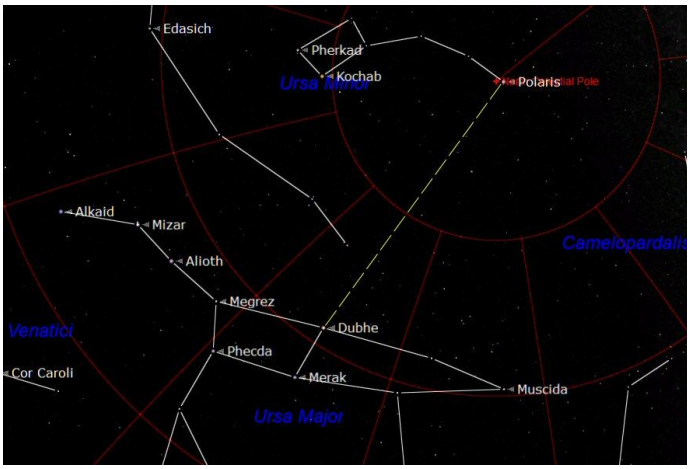
The chart above shows the view of the night sky looking towards the northern horizon. The north point on the horizon is marked as '**N**'. At the centre of the chart is Polaris (the Pole Star also known as the North Star). Polaris is the brightest star in the constellation of Ursa Minor (the Little Bear).



The constellation of Ursa Minor (the Little Bear)

Ursa Minor has the shape of a saucepan with a bent handle but does look more like the 'dipper cup' that was used in the past to draw water out of a barrel to drink. The actual location of the Celestial Pole, the point in the sky where an imaginary line projected from Earth's north pole would point to, is marked in red on the chart above. This point is actually just 44 arc-seconds from Polaris. Over a period of 24 hours the saucepan will appear to rotate around Polaris at the end of the handle as Earth rotates on its axis.

The easiest way to locate the Pole Star is to use Ursa Major (the Great Bear) as a pointer. Ursa Major does look remarkably like a traditional saucepan with the pan defined by four bright stars and the handle comprised of three bright stars.

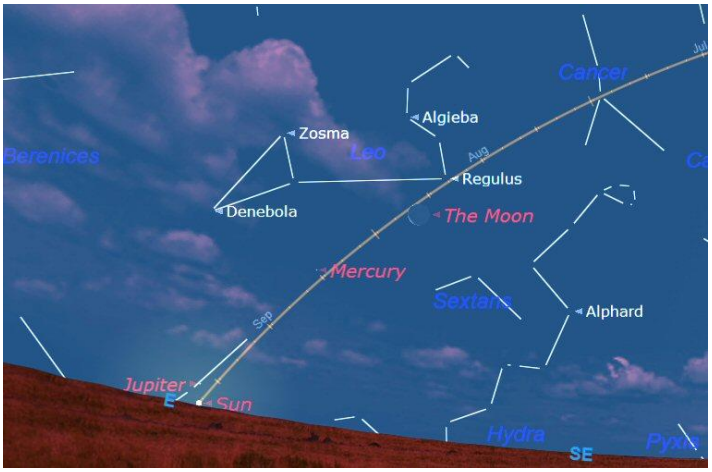


The constellations of Ursa Major and Ursa Minor

To locate Polaris (the Pole Star) first locate Ursa Major. Ursa Major is a circumpolar constellation this means it never disappears below the horizon and is always in the sky somewhere. At this time of the year it is located in the north western sky. Its asterism (shape) is large and comprised of bright stars. Find the two stars Merak and Dubhe (known as the 'Pointers') that are located in the pan on the side opposite to the handle. Follow an imaginary line up out of the pan about four times the distance between the two pointer stars. Polaris is the only moderately bright star in a relatively empty space.

THE SOLAR SYSTEM THIS MONTH

MERCURY rises in the east at 08:00 at the beginning of the month and at 05:00 at the end of the month. It will rise before the Sun earlier towards the end of the month until 28th September when it will be at its greatest western elongation (greatest distance from the Sun) and best position for observing. The Sun will at rise at 07:00 at the end of the month so to catch Mercury before the sky becomes too bright, observing must start at about 06:00.



Mercury in the west at 07:00 BST on 28th September

VENUS is moving out from conjunction with the Sun and will just be visible towards the western horizon as the Sun sets. It will be just above the horizon so a very clear view to the western horizon will be required to see Venus. See the Mars chart below

MARS will be in the south east as the Sun is setting and the sky begins to darken. The Red Planet appears small at just 9.5 arc-seconds in diameter but is quite bright at magnitude -0.1. Mars is fairly low so will be in the turbulent air near the horizon. See the chart below.

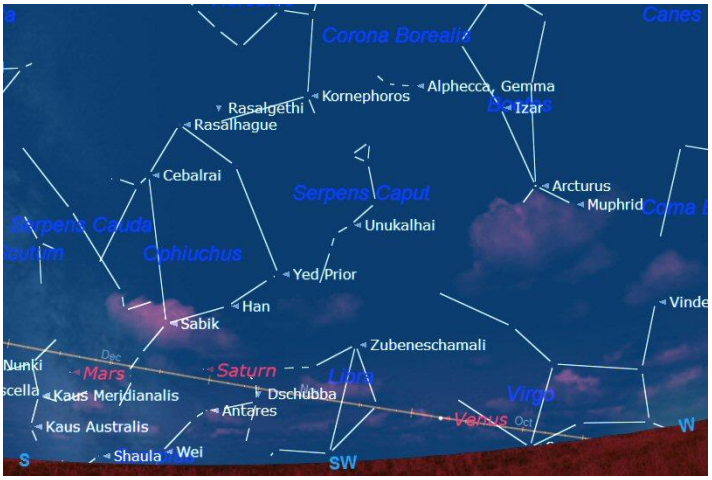
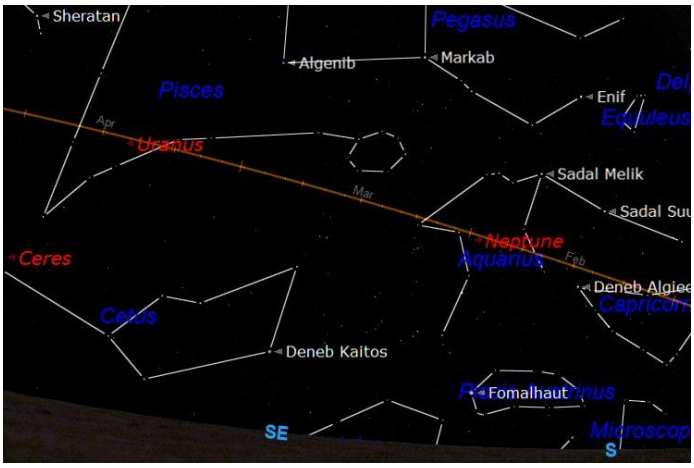


Chart showing Mars, Saturn and Venus during September

JUPITER will be in conjunction with the Sun on 26th September so will not be visible this month. See the Mercury chart above.

SATURN will be in the south east as the Sun is setting and the sky begins to darken. The Ringed Planet appears small at 16.5 arc-seconds in diameter but is quite bright at magnitude +0.2. Jupiter is quite low so will be in the turbulent air near the horizon. Unfortunately it will only rise to about 15º above the horizon so will be low and in quite turbulent air. See the chart above.

URANUS will be in a good observable position this month. It will be quite high in the south east as the sky darkens. It will be visible using a good pair of 10x50 binoculars as a slightly fuzzy blue, star like, object. A telescope at a magnification of 100x will show it as a small blue/green disc.



Uranus and Neptune in the south at 22:00

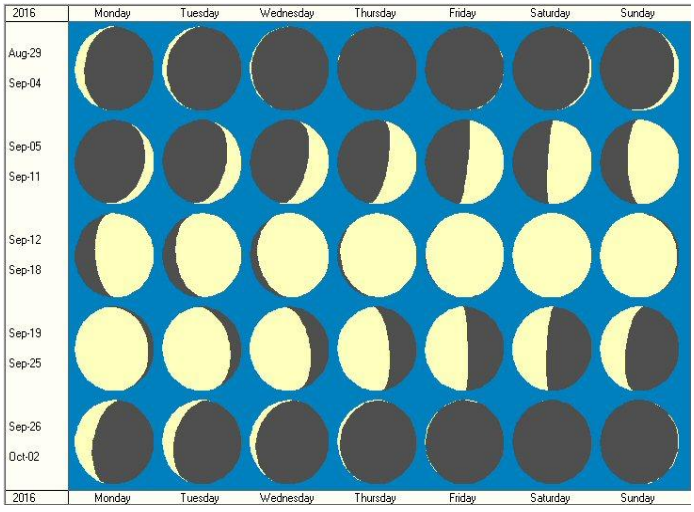
NEPTUNE will be visible in the south as soon as the sky is dark. It will be at opposition (due south at midnight – 01:00 BST) on 2nd September so at its best position for observation this year. A telescope will be needed to show Neptune as a small blue/green disc using a magnification of 100x but it is small and difficult to find.

THE SUN

There are still some sunspots to see even though the active phase of the Solar Cycle is drawing to a close.

The Sun rises at 06:10 at the beginning of the month and at 07:00 by the end of the month. It will be setting at 18:45 at the beginning and 20:20 by the end of the month. Sunspots and other activity on the Sun can be followed live and day to day by visiting the SOHO website at: http://sohowww.nascom.nasa.gov/ .

THE MOON PHASES IN SEPTEMBER



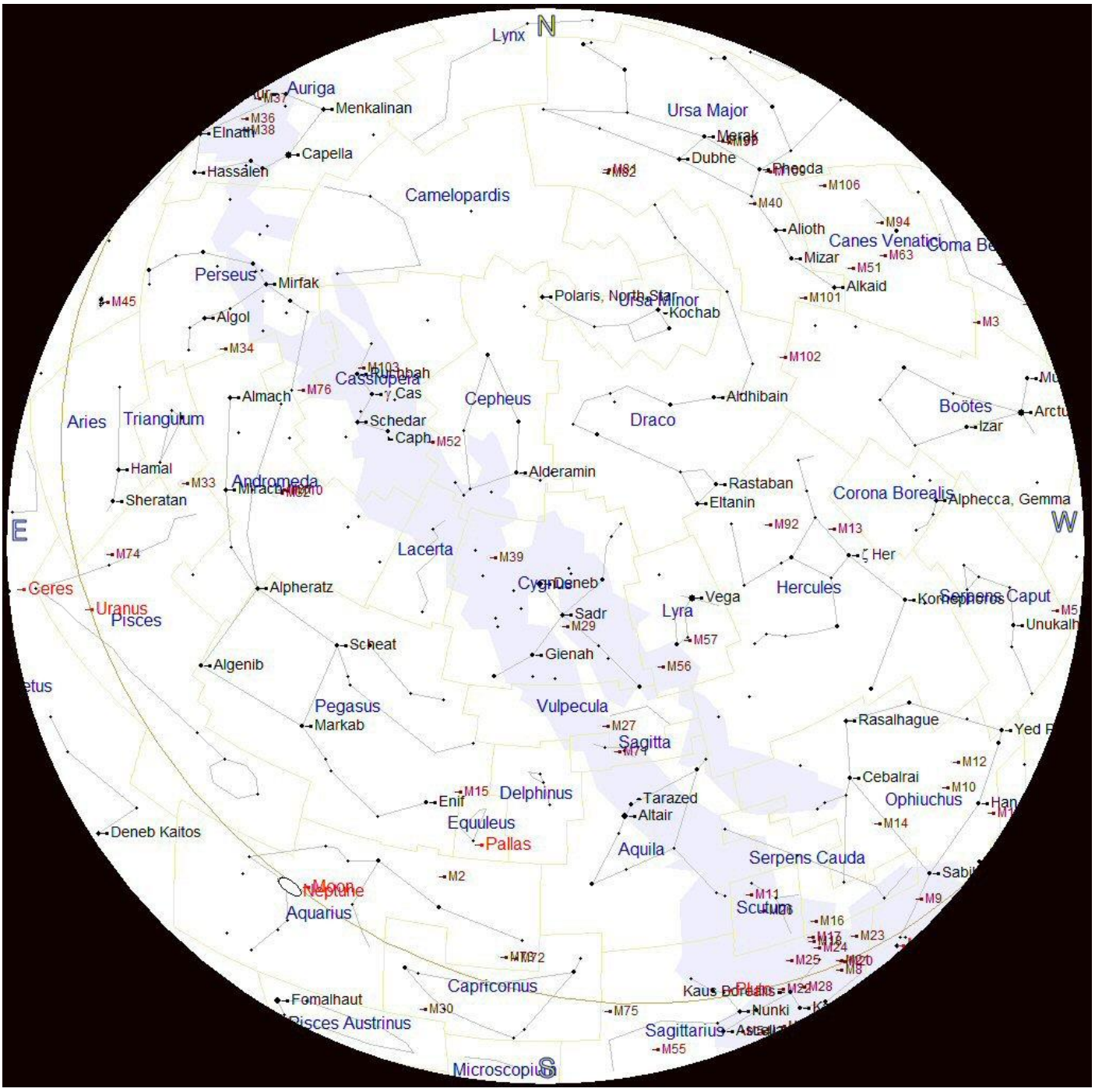
New Moon will be on the 1st September

First Quarter will be on 9th September

Full Moon will be on 16th September

Last Quarter will be on 23rd September

THE NIGHT SKY THIS MONTH



The chart above shows the night sky as it appears on 15th September at 21:00 (9 o'clock) in the evening 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 10 o'clock BST at the beginning of the month and at 8 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 easy to find. This month it is in the north 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 this month: Mars and Saturn (early evening) with Uranus and Neptune all night.