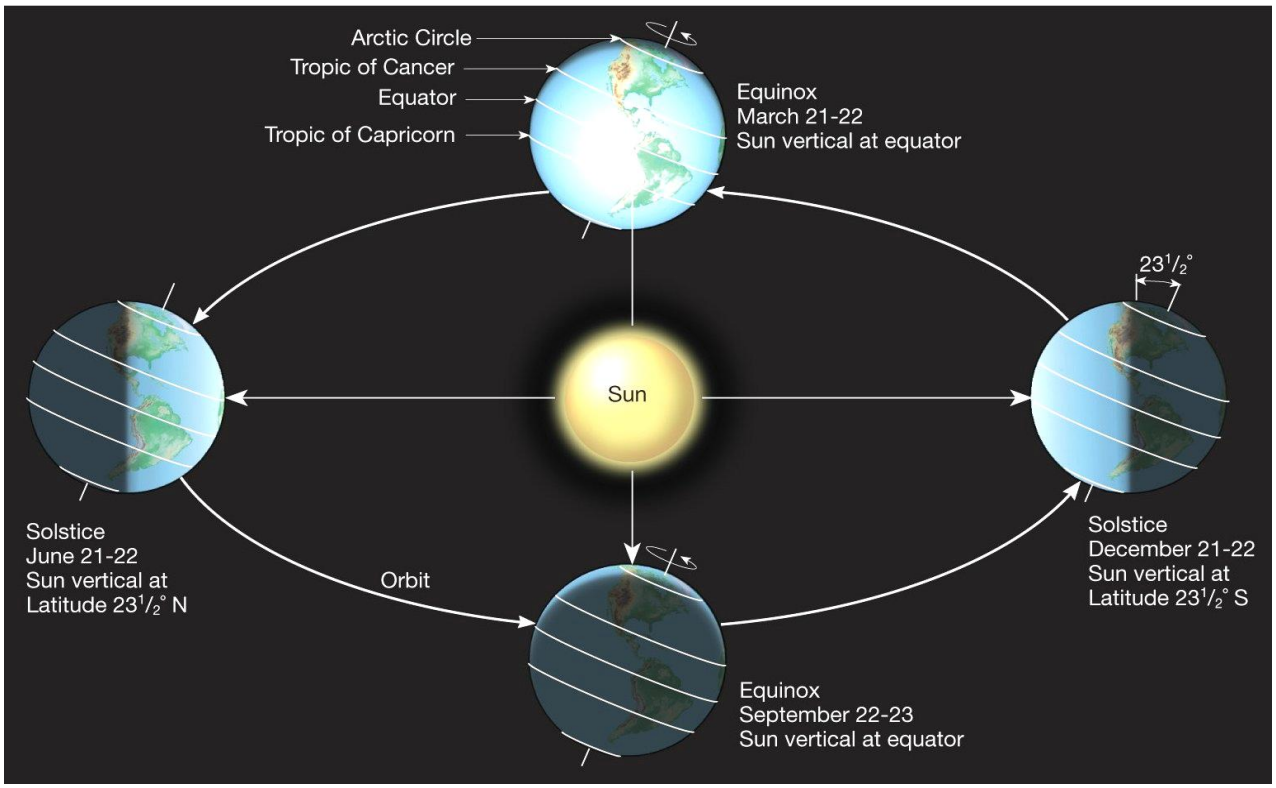
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – OCTOBER 2018

THE AUTUMN EQUINOX – 23rd SEPTEMBER 2018



The reason we have the seasons is because Earth's axis of spin is tilted 23.4º relative to the axis of the Solar System. This has had a major effect on the evolution of life on Earth and on our view of the sky. Looking at Earth's tilt from another angle, Earth's axis is tilted 66.6º from the plane (or equator) of the Solar System. This gives Earth somewhat odd view of space around us including the Sun, Moon and the planets. The first thing we need to do is understand how this tilt works.

The diagram above shows how Earth orbits the Sun and how Earth's axis is always tilted in the same direction. In fact an imaginary line projected into space, from the north of Earth's axis, points into space at a point in the constellation of Ursa Minor (the Little Bear) very close to the star Polaris. This is why we also call Polaris 'the North Star' or 'the Pole Star'. The tilt causes the Sun to appear to move up and down in the sky over the course of one orbit (our year) and produce our seasons.

If we start Earth's orbit at the left position on the diagram above the position of Britain, in the northern hemisphere is tilted towards the Sun and it will be midsummer. When Earth has completed half of its orbit, Britain will be tilted away from the Sun as shown in the right position on the diagram so it will be midwinter. We call the times when the Sun appears at its highest point in the sky the 'Summer Solstice' and its lowest the 'Winter Solstice'.

The imaginary line around Earth where the Sun will appear directly overhead on midsummer day, in the northern hemisphere, is called the 'Tropic of Cancer'. The lowest point at midwinter is the 'Tropic of Capricorn'.

Half way between the Summer and Winter Solstices the Sun will be directly overhead on Earth's equator as it appears to move south or north. We call these times The 'Autumn Equinox' and 'Spring Equinox'. The Autumn Equinox occurred at 02:00 on 23rd September. This was the official 'meteorological' start of Autumn.

In the northern hemisphere the North Pole of Earth's axis is tilted towards the Sun during the summer. This gives the effect of a point on the surface, such as the UK, appearing closer to the equator of the Solar System, called 'the Ecliptic'. As a consequence the Sun will appear much higher in the sky during the summer with the Moon and planets appearing lower at night.

During the winter nights the Ecliptic appears very high in the night sky. In the northern hemisphere the North Pole of Earth's axis is tilted away from the Sun during the winter season. As the Moon and planets appear to move along the Ecliptic they are seen through less of Earth's atmosphere so they appear clearer and steadier. During the summer they appear lower and close to the horizon in dirty and turbulent air.

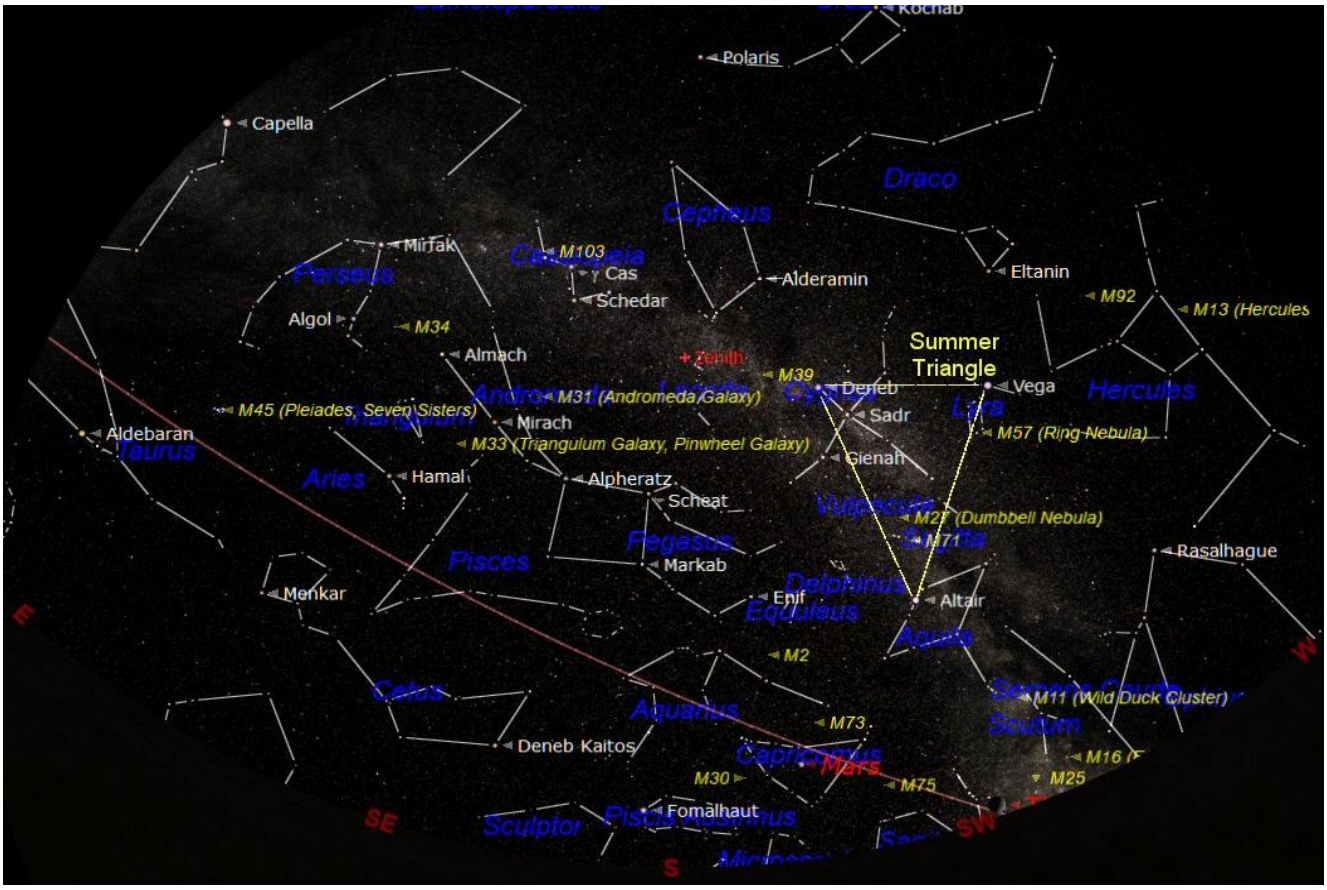
NEWBURY ASTRONOMICAL SOCIETY

5th October Beyond the Moon and Mars
Website: **www.newburyastro.org.uk**

NEXT NEWBURY BEGINNERS MEETING

17th October James Webb Space Telescope
Website: **www.naasbeginners.co.uk**

A TOUR OF THE NIGHT SKY - OCTOBER 2018



The chart above shows the night sky looking south at about 22:00 BST on 15th October. 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 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 Sagittarius (the Archer), Capricornus (the Goat), Aquarius (the Water Carrier), Piscis (the Fishes), Aries (the Ram) and Taurus (the Bull) rising 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 (the Milky Way) is located in Sagittarius so the richest star fields can be found in the constellation. Many interesting deep sky objects are here along with the planet Saturn this year.

The summer constellations are still prominent in the night sky lead by Hercules (the strong man). 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 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 (a 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 'Pole' or 'North Star') is located in Ursa Minor. Polaris is the star that is located at the approximate position 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 once every 24 hours. This means Polaris is the only 'bright' star that appears to remain stationary in the sky as Earth rotates every 24 hours.

To the west of the Summer Triangle is the constellation of Hercules (the strong man). The main feature forming the asterism (shape) of Hercules is the misshapen square at its centre known as the 'Keystone' due to its resemblance to the central stone of an arch. Located in the right vertical side of the 'Keystone' is the most impressive 'Globular Cluster' known as Messier 13 (M13). This can be seen in a modest telescope as a beautiful ball of a million stars.

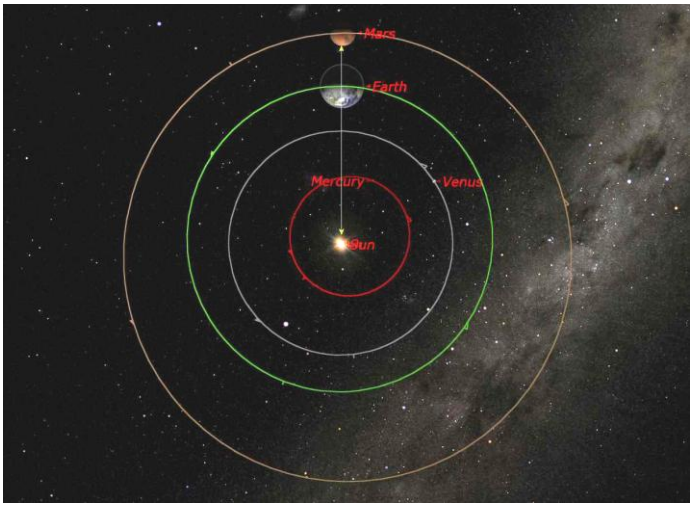
To the East of the Summer Triangle is the constellation of Pegasus (the Winged Horse). The main feature of Pegasus is the square formed by the four brightest stars. This asterism (shape) is known as the Great Square of Pegasus. The square is larger than might be expected but once found is easier to find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

MARS - OUR NEXT DOOR NEIGHBOUR

The comparative sizes of Earth and Mars

Mars is the 4th Planet out from the Sun, the next out from Earth and the second smallest planet in our Solar System after Mercury. It is approximately half the diameter of Earth at 6780 km (Earth 12,600 km). Earth orbits the Sun at an average distance of 146.6 million km and Mars orbits at an average distance of 229.9 million km. Due to the eccentricity of their orbits the distance between Earth and Mars can vary, at their closest approach (Opposition), from about 50 million km to about 100 million km.

Mars was in its best position for observing on 27th July when it was at 'Opposition'. This means it was in direct alignment with Earth and the Sun as Earth overtook Mars along the paths of their orbits. The orbit of Mars is on average 78 million kilometres further out from the Sun than the orbit of Earth. On 27th July this year Mars was just 57.7 million km from Earth.



The positions of Earth and Mars at 'Opposition'

The orbit of Mars does take it to the opposite side of the Sun to Earth when it can be where it can be up to 400 million kilometres from Earth. When a planet is on the opposite side of the Sun we call this 'Conjunction'. Approaching the Sun near Conjunction Mars appears small but at Opposition it is closer and appears comparatively large when viewed through a telescope.

It was not all good news for the amateur astronomer on this Opposition because Mars was positioned low in the sky during this approach. This means it was observed through a lot more of Earth atmosphere and in the thick murky and contaminated air closer to the horizon. However with opposition occurring in midsummer the nights were warm to make observing more comfortable.

Observing Mars can be very rewarding despite being a quite difficult target in a small telescope (100mm aperture). Some dark areas and the ice cap may be seen on a good night.

We all know that Earth moves around the Sun once a year which is 365¼ days this is known as its 'Sidereal Period'. Mars takes the equivalent of 1.88 Earth years (686 Earth days) to complete one orbit of the Sun. However, when Earth returns to the same place in its orbit, Mars has moved 686.67 – 365.25 = 321.42 days further around its orbit. This equates to (321.42 ÷ 686.72 = 0.468) of 1 Mars orbit. This means Earth takes (365.25 ÷ 0.468 = 780.615) Earth days (to catch up with Mars) or put another way (780.615 ÷ 365.25 = 2.137) Earth years. This is known as its 'Synodic' Period.

To summarize it takes Earth 780 days (2.137 Earth years) to catch up and overtake Mars at each successive opposition. This is the longest opposition period (Synodic Period) of all the planets in our Solar System.

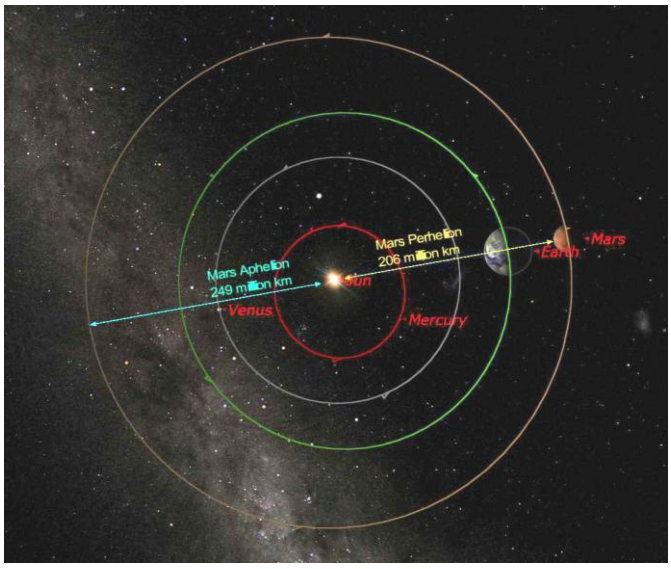
From the previous calculation we can see it takes Earth 2.137 years to catch up with Mars from one opposition to the next opposition. So every 2.137 years the planets and Sun are aligned as shown in the diagram on the previous page but the two planets will reach their next opposition at different places in their orbits.

Oppositions of Mars and Earth occur about 6 weeks later every two years. So this means that the oppositions 'process' (advance) around the Ecliptic (the imaginary line along which the Sun, Moon and planets appear to move across the sky). The changing of the location, in the sky, of successive oppositions has two important effects on the viewing quality of Mars.

Due to the 23.4° axial tilt of Earth the Ecliptic appears low in the summer nights and high in winter. This is noticeable by the height of the Sun during the summer when the ecliptic is high during the day and the Moon appearing low because the ecliptic is low at night. When a Mars opposition occurs in the summer (like this year) Mars is low and in the turbulent and dirty air close to the horizon. So the view of Mars is generally poor.

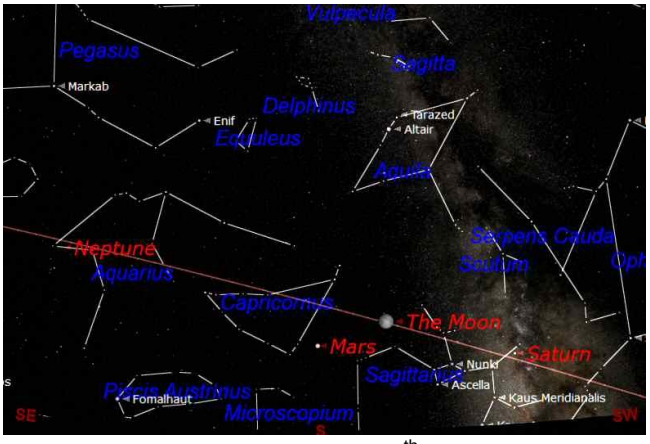
The other effect on observing Mars is the relative positions of the planets on their eccentric orbits around the Sun. The planets do not orbit the Sun in a circular orbit, the orbits are elliptical (slightly 'egg shaped'). Consequently the planets are slightly closer or further from the Sun at different parts of their orbits.

Mars has a large eccentricity in its orbit around the Sun. At its closest (perihelion) it can be 206 million km at it furthest (aphelion) it can be 249 million km from the Sun. The eccentricity of the orbit of Mars is shown clearly on the diagram below (but not to scale). As the elliptical orbits of all the planets are 'sort of' randomly aligned at oppositions, the distance between planets at opposition can vary and is particularly noticeable with the Earth / Mars oppositions.



The eccentric orbit of Mars (August 2003)

The August 2003 Mars opposition brought Earth and Mars just about as close as they can ever get at just 55.8 million km. Mars was at its closest approach to the Sun (perihelion) and Earth was at its most distant from the Sun (aphelion). Consequently Mars and Earth were close together and Mars appeared as large as it can be when seen from Earth at 25.1 arc-seconds in diameter. Mars was 24.1 arc-seconds in diameter in July 2018.



Mars at opposition on 27th July 2018

The chart above shows the position of Mars in the south at midnight (01:00 BST) on 27th July 2018. The brown curved line across the chart is the Ecliptic (the imaginary line along which the Sun, Moon and planets appear to move across the sky). Mars appears a little below the Ecliptic due to the tilt of its orbital axis compared to the plane of the Ecliptic. The Ecliptic is the equatorial plane of the Sun and the orbital planes of the planets are in this plane (or very close to it). Mars will be at this same location, in the south, at 21:30 on 19th September and at 20:15 on 18th October.

Mars is very low in the south this summer as can be seen in the chart above. So despite Mars appearing relatively large (16 arc-seconds on 1st October) it will be difficult to make out detail on the surface. When an object is close to the horizon its light must pass through about 300 to 400 km of the thickest part of our atmosphere before reaching our eye.

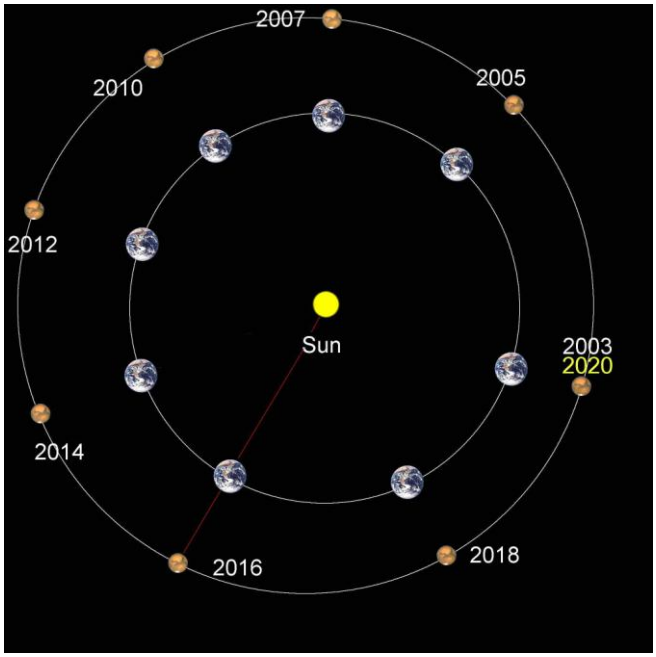
An object directly overhead has only to pass through about 100 km of our atmosphere (only about 20km can be considered thick). We have already mentioned the turbulence caused by heat close to the horizon but the thicker air also causes refraction that separates the colours in the image. This has the effect of causing a blue tinge to one side of the image and a red (orange) tinge on the opposite side.

The best image by the author on 12th Sept. 2018

The view looking directly through the telescope has also been very disappointing. Despite the sky being clear and still it has been almost impossible to make out the darker areas on the surface of Mars. The image above does show some darker markings and the polar ice cap at the top of the image. The colour distortions can be seen on the top and bottom edges.

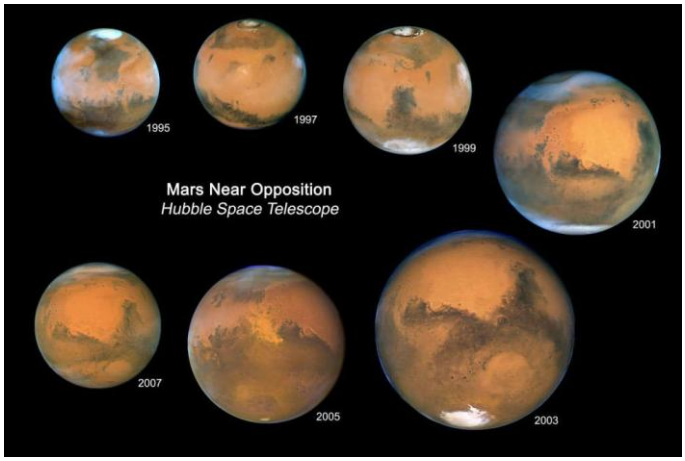
The processed image above shows a much better view than was obtained when simply looking through the telescope. The view at the eyepiece was bright and large (for Mars) but was scintillating and dancing around making it almost impossible to see any detail.

The diagram below shows how the two planets moved further apart at subsequent oppositions and then from 2014 started to move closer together. The next opposition in October 2020 will show Mars appearing to be further from Earth at 62.7 million km and with have an apparent diameter of 24.1 arc-seconds.



The relative distance to Mars 2003 to 2018

The diagram below shows how Mars appeared to grow larger over the years approaching the 2003 opposition and smaller from 2003 to 2007.



The comparative size of Mars from 1995 to 2007

Over the next year Mars and Earth will move around the Sun until Mars is on directly opposite side of the Sun to Earth. We call this alignment 'Conjunction'. At this point Mars will not be visible because it will be lost in the glare around the Sun and will be in our sky during the day.

At conjunction Mars will be at its greatest distance about 400 million km from Earth so will appear very small, even if we could see it. This is very far away compared to the 57.7 million km at opposition on 27th June.

Mars is still in a good position for observing for the next couple of months. Although the telescopic view is not good this year Mars will not be back in the sky in a favourable position for observing for another two years so we should really take a look.

The charts on the previous page and on page 9 show the location of Mars in the southern sky. Except for the Moon Mars is the brightest object in the south during the evening. To the naked eye it looks bright and distinctly golden in colour. A pair of binoculars will show it brighter and sparkling rather beautifully.

A telescope is required to see Mars as a disc. A small telescope even with an aperture of just 75mm will do because Mars is so bright. It will however require a magnification of at least 100 times. This means a telescope with a focal length of 1000mm will require a 10mm eyepiece to be used (1000 ÷ 10 = 100x).

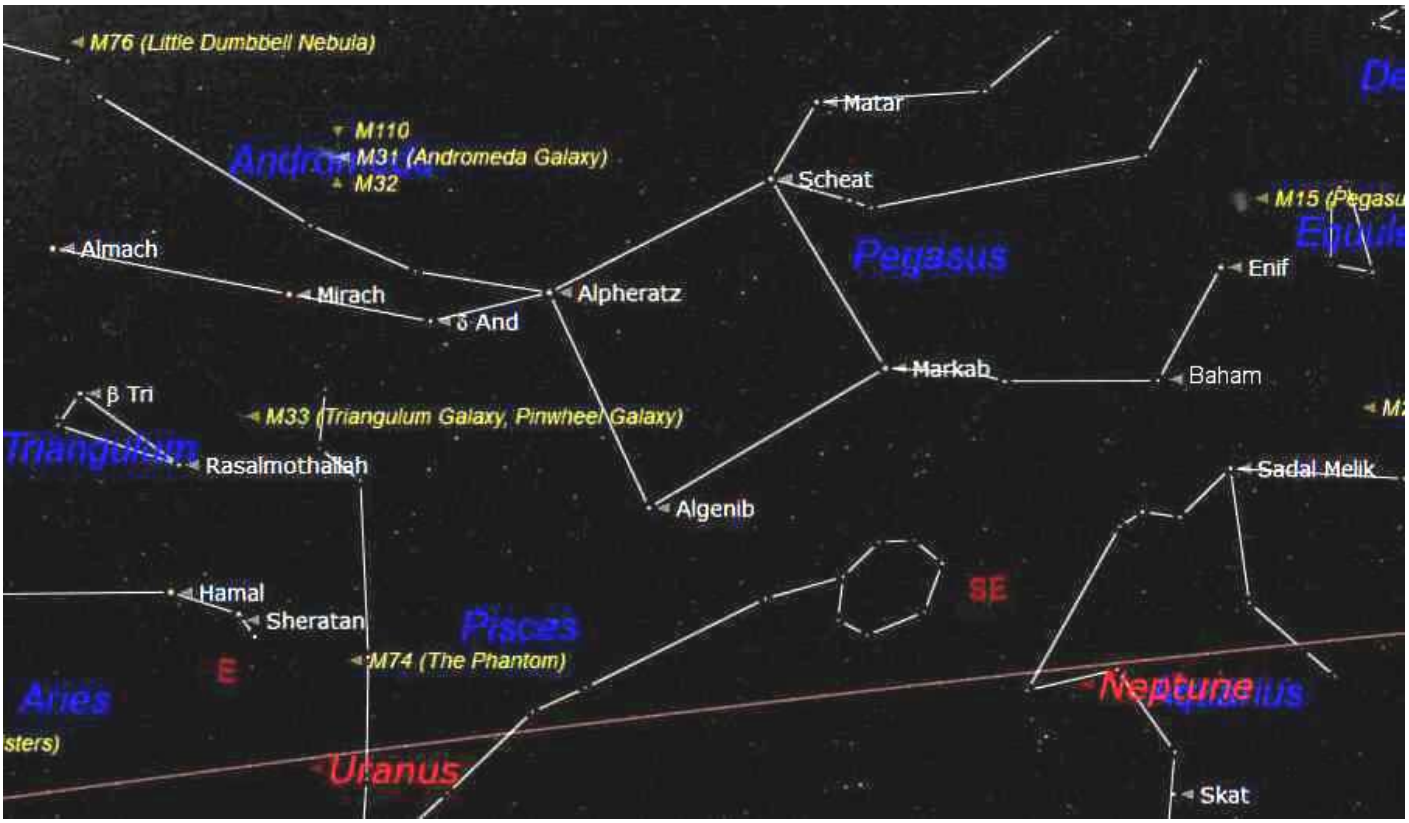
The author's 90mm x 900mm *fl* telescope

The telescope shown above was used to observe Mars and proved satisfactory although the quality of the view was poor due to the low altitude of Mars. The image of Mars shown on page 4 was taken using a larger telescope and a webcam.

The sort of view obtained using a smaller telescope

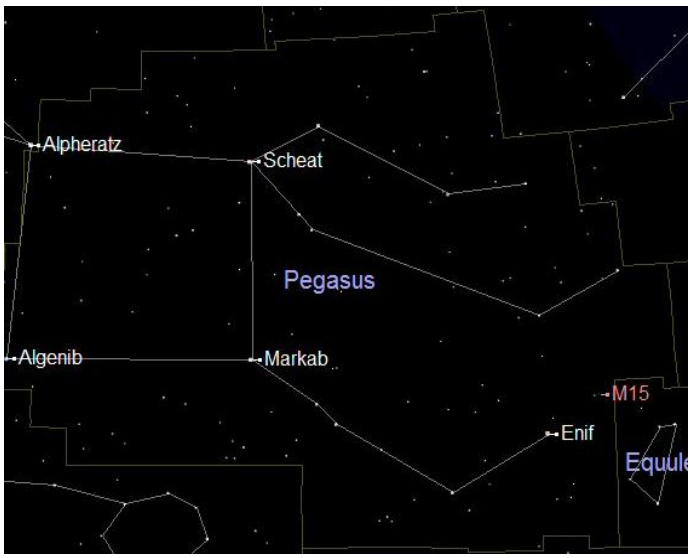
We can go on to the internet and see the wonderful NASA images taken by Hubble or the Mars explorer probes but there is still the thrill of seeing the planets for real. The photons of light reflected off the surface of Mars are actually entering our eye so we are almost touching Mars.

CONSTELLATIONS OF THE MONTH – PEGASUS AND ANDROMEDA



The constellations of Pegasus and Andromeda

The constellations of Pegasus and Andromeda share and are joined at the star Alpheratz. Alpheratz is actually designated as belonging to Andromeda but looks to be more a part of Pegasus as it is required to complete the familiar 'Great Square of Pegasus'. It is larger than may be expected which sometimes makes it a little difficult to initially identify. However once it has been identified it is easy to find again in a clear dark sky.



The constellation of Pegasus

Pegasus is named after the mythical winged horse and with Andromeda included to provide the wings and a lot of imagination the stars could be said to resemble the flying horse. The square generally is used to represent the body of the horse and the three lines to the west (right) of the stars Scheat and Markab do look a little like the horse's legs.

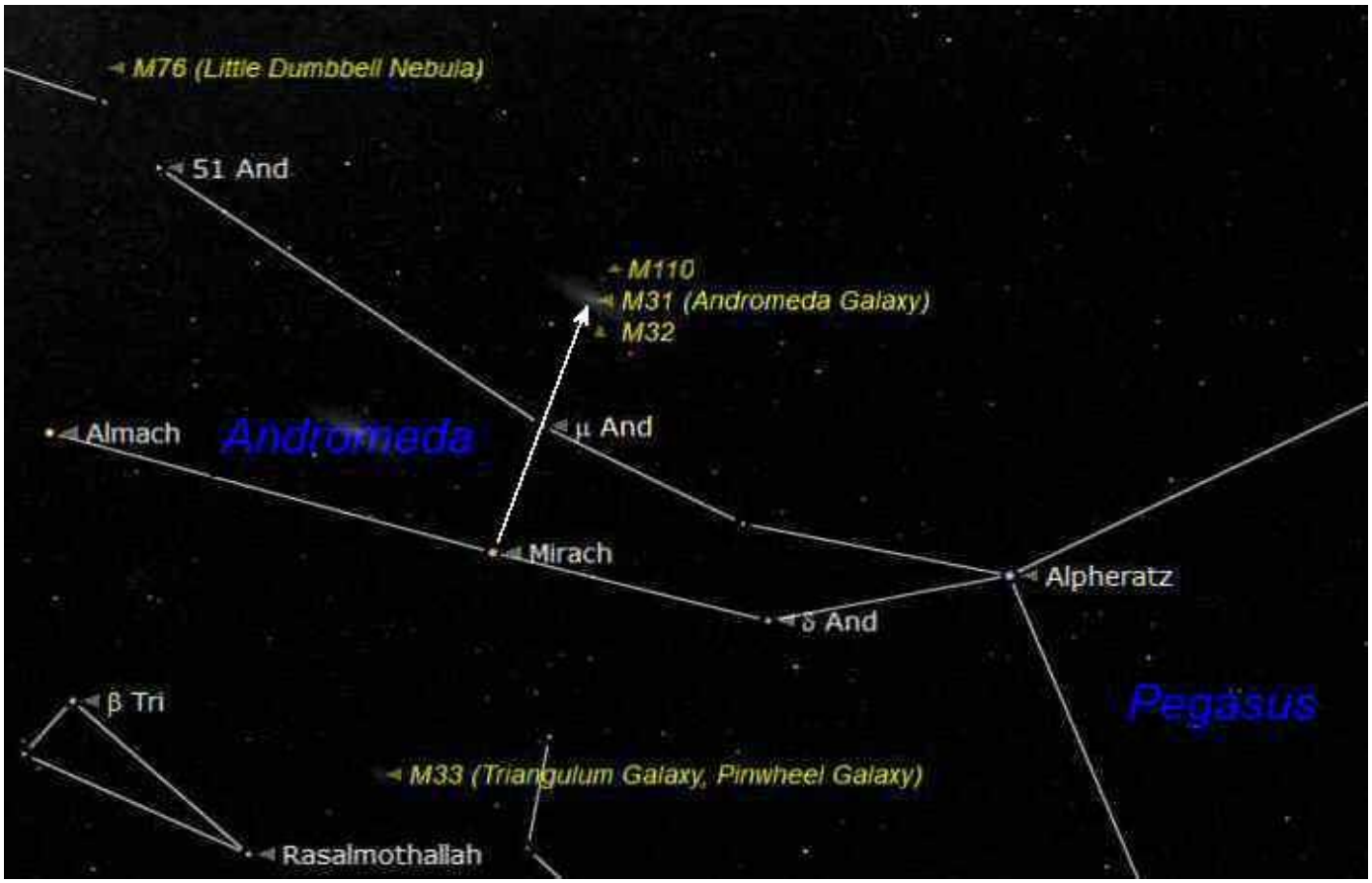
The square can be used to judge the seeing condition of the night sky. On the chart above about ten stars can be seen inside the square. If this was true in the sky then it would be a very good night for observing the fainter deep sky objects like the globular cluster M15 just off the end of the lower leg of Pegasus. If three to five stars can be seen then conditions will still be good. If fewer or none can be seen then stick to looking at the Moon or planets.

There is a nice Globular cluster in Pegasus. Known as Messier 15 (M15). It is a lovely sight to see in a medium to large telescope.

Messier 15 (M15) Globular Cluster in Pegasus

To find M15 start at the star Markab, located at the bottom right of the Great Square. Follow the fainter line of stars to the west (right) to the star Baham then north west (up and right) to the star Enif, see the chart above. Continue the imaginary line on for about the same distance to find the fuzzy patch that will be the Globular Cluster M15.

CONSTELLATION OF THE MONTH – ANDROMEDA



The constellation of Andromeda is host to the only 'naked eye' Galaxy known as Messier 31 (M31). It is the most distant object that can be seen with our naked eyes (2.4 million light years). It is quite easy to find using binoculars and is well place at this time of year.

The easiest way to find M31 is to first locate the Great Square of Pegasus. Once the square is found the pointer to Andromeda is the top left star of the square named Alpheratz. Strangely Alpheratz is officially not part of Pegasus but is designated as Alpha (α) Andromedae. From Alpheratz follow the fairly obvious line of stars to the left (east). Locate the second star in the line which is shown as Mirach on the chart above. From Mirach follow a slightly fainter short line of stars to the north (above) Mirach to the second star. Just to the right of this star is the faint fuzzy patch of light that is M31 the Great Andromeda Galaxy.

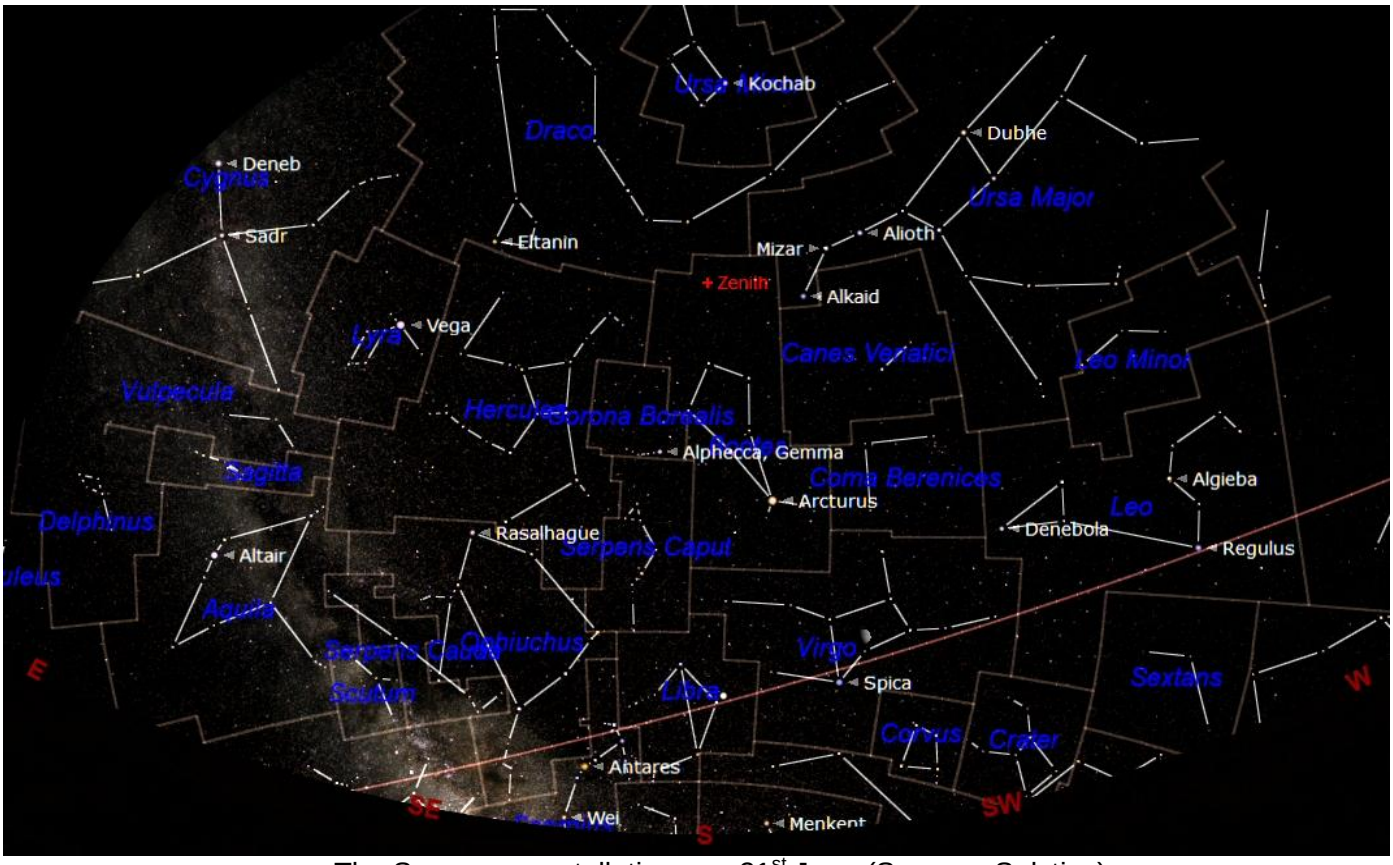
M31 The Great Spiral Galaxy in Andromeda

The image opposite shows M31 imaged through a telescope and is much clearer than can be hoped to be seen with the naked eye. However a pair of binoculars will enable the galaxy to be seen. A small telescope will show a cigar shaped hazy patch with a brighter spot in the middle. Larger telescopes will show it more clearly but photographic imaging is required to reveal its true nature as shown in the previous column.

At the end of the lower line of stars that constitute the constellation of Andromeda is the star Almach or (Almaach). This is a very interesting and beautiful star to see through a telescope. It is a beautiful example of a pair of stars that are not physically related. They are thought to be at different distances but just appear to be in the same 'line of sight' from Earth. The apparently brighter golden coloured star is thought to be located much nearer to us than the apparently fainter blue star. The blue star is in fact a Blue Giant a very hot and powerful star that is many thousands of times brighter than the golden star.

Almach the 'line of sight' double star in Andromeda

EXPLAINING ASTRONOMY – CONSTELLATIONS



The Summer constellations on 21st June (Summer Solstice)

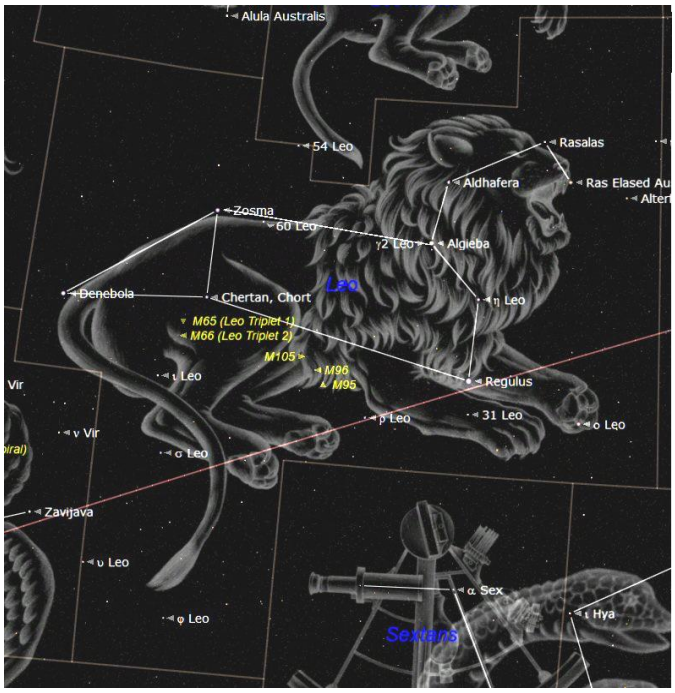
Mapping the night sky is actually rather difficult as there are only the stars to use as reference features and stars all look quite similar. The only difference to the untrained eye is that some stars appear brighter than others. So that is the bad news but the good news is our brains have a fortunate attribute to help us. We as humans have the ability to group multiple objects into groups and patterns. A simple example of this ability is how we are able to see shapes in the clouds such as dogs, rabbits, birds and even dragons. Most of us have played games doing this as children.

With our unaided eyes (astronomers call 'naked eyes') we can see a total of about 6000 stars in a good dark sky. The brighter stars do seem to form (sometimes indistinct) groups and patterns in the night sky. From ancient times these patterns have been recognised by different cultures around the world and given special names. The names have traditionally been taken from characters in mythological stories and are often very old. In 1922, the International Astronomical Union (IAU) standardised the constellation names and adopted the modern list of 88 universally recognized constellations.

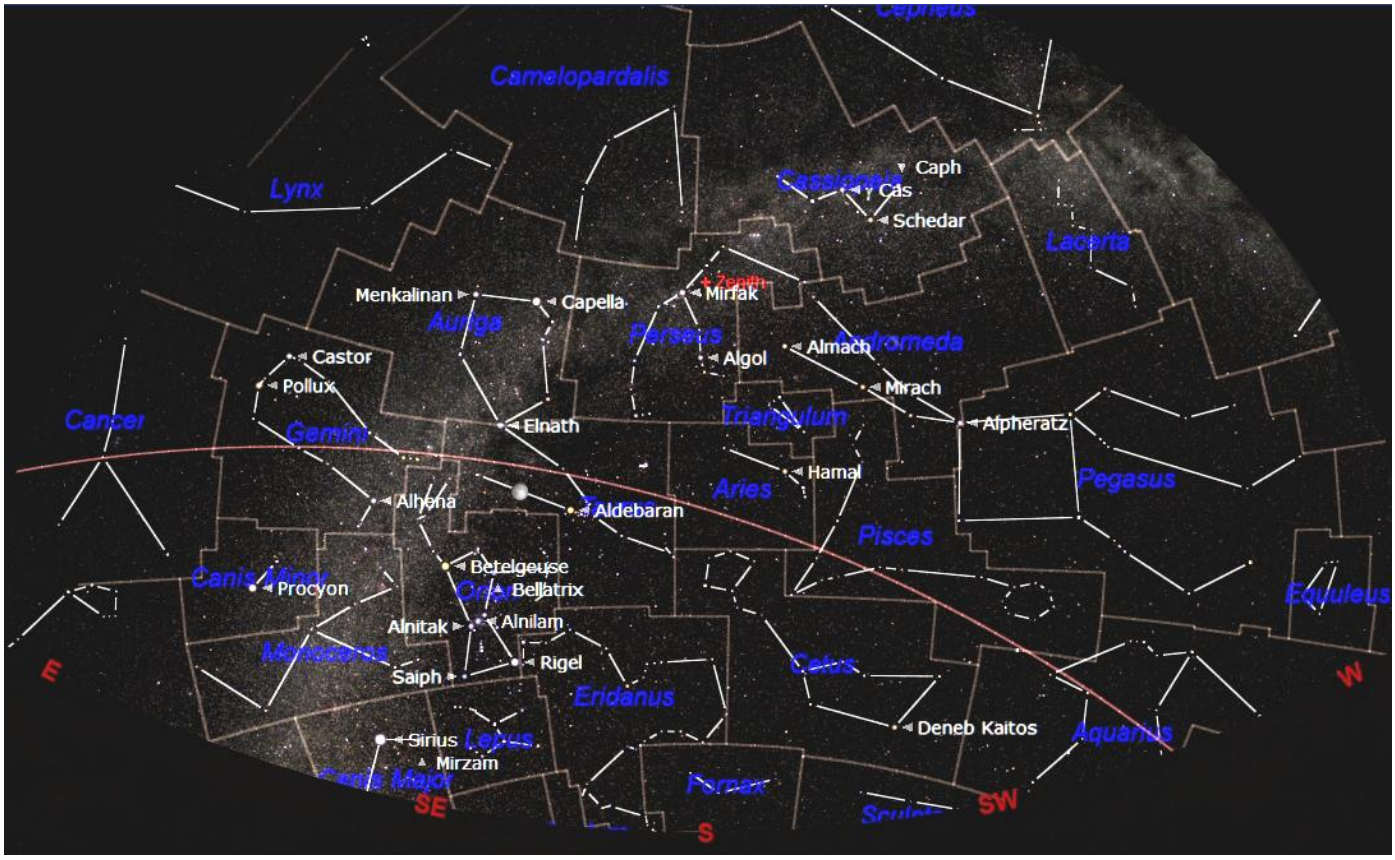
Early star charts were often illustrated by artists to produce beautiful documents to represent the night sky. Artists drew and coloured the constellation images to make them look beautiful. The problem was that each artist produced their own interpretation of what the figure should look like. Sometimes they would even move the stars on the chart to make them fit their interpretation of the illustration they had created. This was not what the astronomers needed to find their way around the sky so they moved away from artistic charts and on to modern scientifically based charts.

Astronomers adopted a 'stick figure' illustration for the constellations using a 'dot-to-dot' method to join the brightest stars and produce an easy to recognize shape. A 'stick figure' is shown on the chart below with artistic figures superimposed. The chart above shows the constellations but with just the 'stick figures' shown.

The image below shows the typical modern chart representation of the constellation of Leo (the Lion) with an illustration superimposed. Leo is prominent in the late winter and spring. See Leo on the chart above.



The constellation of Leo (the Lion)



The Winter constellations on 21st December (Winter Solstice)

The chart above shows the winter night sky looking south at about 22:00 (10 o'clock GMT) on 21st December. This is midwinter day called the Winter Solstice. On this day the Sun will appear at its lowest position in the daytime sky. The Winter Solstice will be on the shortest day of the year (between sunrise and sunset, not including twilight). Days around the Winter Solstice will only be about 8 hours long and the night will be 16 hours long, not including twilights.

The chart on the previous page shows the Summer night sky looking south at about 22:00 (10 o'clock GMT) on 21st June. This is midsummer day and is called the Summer Solstice. On this day the Sun will appear at its highest position in the daytime sky. The Summer Solstice will be on the longest day of the year (between sunrise and sunset, not including twilight). Days around the Summer Solstice will be about 16 hours long and the night will be only 8 hours long, not including twilights.

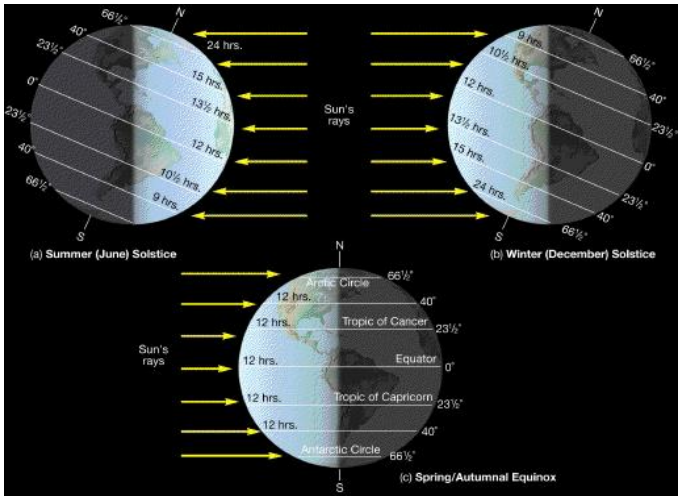


Chart showing the lengths of the day during the year

The chart at the top off this page shows the location of the Winter Constellations and the chart at the top off the previous page shows the location of the Summer Constellations. Constellations are the brightest stars in the sky that appear to for groups that can (in most cases) be fairly easily identified. Astronomers use these groups of stars to identify areas of sky around the groups that can then be given names and have agreed borders.

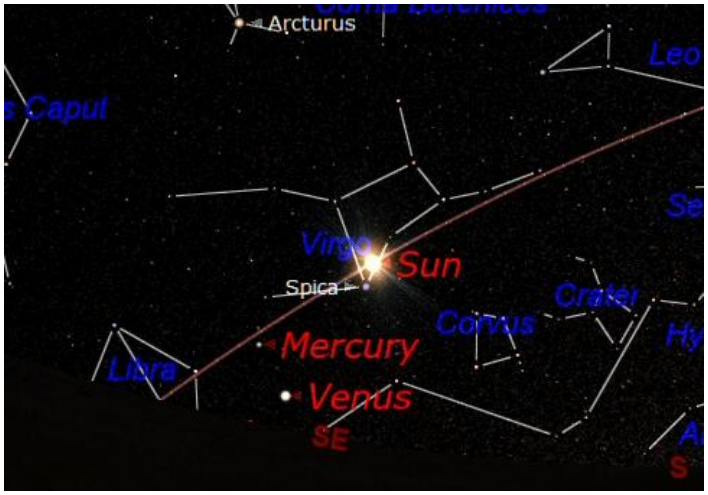
Many of the names for the universally recognised names of the constellations are very old and are founded in Greek or Roman mythology. Some may be even older. The names used for the constellations in the southern hemisphere are more modern as they were first observed by European explorers mainly in the 18th and 19th century.

There is no other method to identify a particular point in the night sky as the only fixed reference points in the sky are the stars. We can give directions to a point in the sky where there is an interesting object by saying it can be found in a certain constellation, 'Leo' for an example. This will of course just give an approximate location because some constellations are large. Knowing the Constellation we can 'Star Hop' from one star to another to find the exact location. There is an example of this methodology on page 7 that is used to point the way to Messier 31 (M31) the Great Galaxy in the constellation of Andromeda.

Before starting an observing session, it is a good practice for the beginner to astronomy to spend the time looking around the sky. This time will allow the eyes to fully adapt to the dark so we can have a general look around the sky and identify the constellations. Initially only the brightest stars will be seen so only the best known constellations can be identified. As our eyes become adapted to the dark more stars will be seen. This familiarity with the night sky and constellations will prove to be useful in the future.

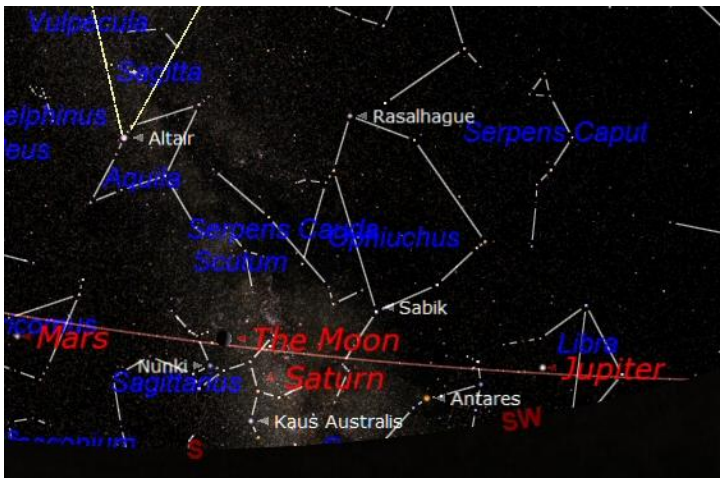
THE SOLAR SYSTEM THIS MONTH

MERCURY was in conjunction with the Sun on 21st September and is still too close to the Sun to be seen. It actually rises an hour after the Sun and is therefore in the bright morning sky. See the chart below.



Mercury and Venus in the east at 10:00

VENUS will be in Inferior conjunction (passing in front of the Sun) on 26th October. Throughout October it will be too close to the Sun to be seen.



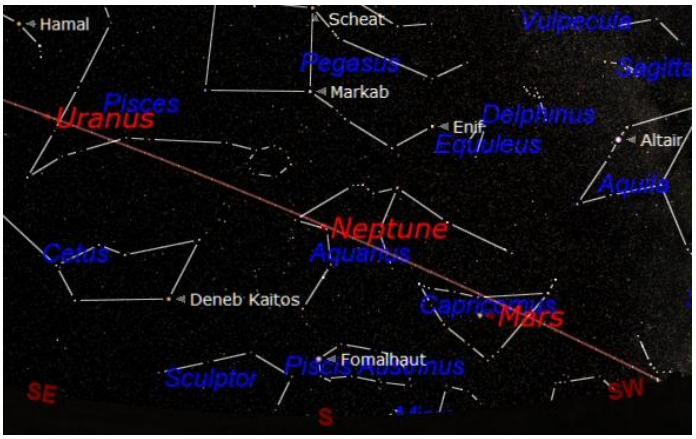
Mars, Saturn and Jupiter at 20:00

MARS will be well placed this month for observing but is very low over the southern horizon in turbulent and smoggy air. .The Red Planet passed through 'Opposition' on 27th July so is still relatively close to Earth. It still appears fairly large at 13.5 arc-seconds in diameter and is still very bright at magnitude -1.80. See pages 3 to 5.

JUPITER is moving into conjunction with the Sun on 26th November so it is beginning to be difficult to observe low in the west. See the chart above.

SATURN is well positioned in the south but low in the sky and in turbulent, smoggy air close to the horizon. A small telescope will show the ring system but a larger telescope will be required to show it well.

URANUS will be in a good observable position and will be at opposition on 23rd October when it will be due south at midnight (01:00 BST). Uranus will be quite high in the south east as soon as the sky is dark, see the following chart. A good pair of 9x50 binoculars will reveal a slightly fuzzy blue, star like, object. A telescope at a magnification of 100x will show it as a small blue/green disc.



Uranus, Neptune and Mars at 20:00 BST

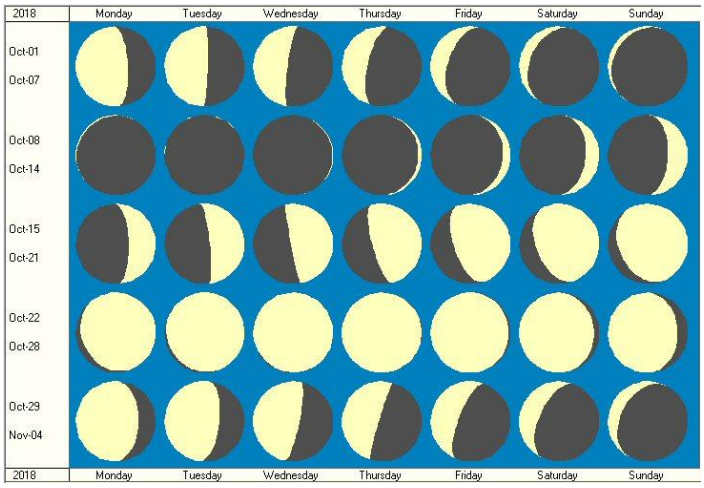
NEPTUNE was at opposition (due south at midnight – 01:00 BST) on 7th September and was at its best position for observation this year. A telescope will be needed to show Neptune as a small blue/green disc using a magnification of 100x but it is small and difficult to find.

THE SUN

There may still be the odd small sunspots even though the active phase of the Solar Cycle is now over.

The Sun rises at 06:00 at the beginning of the month and at 06:45 by the end of the month. It will be setting at 17:35 at the beginning and 16:50 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 OCTOBER



Last Quarter will be on 2nd October

New Moon will be on the 9th October

First Quarter will be on 16th October

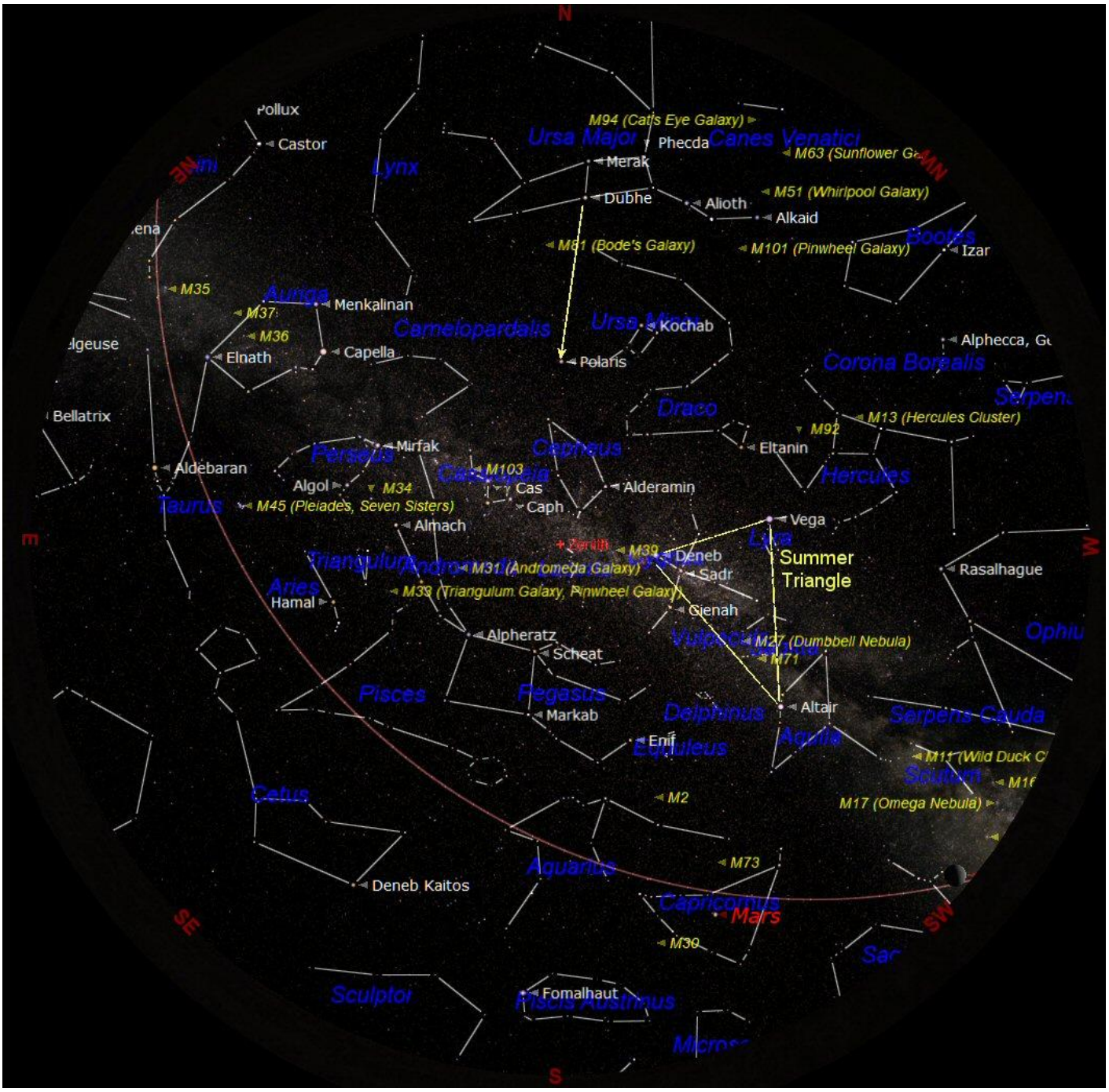
Full Moon will be on 24th October

Last Quarter will be on 31st October

Draconid Meteor Shower peaks around the 7th and 8th October. The best time to view the Draconids is just after the Sun sets and looking directly overhead.

Orionid Meteor Shower peaks in the early morning October 21st. The best time to view the Orionids is from just after midnight through to dawn and to look high to the south east. Orion will be rising in the south east.

THE NIGHT SKY THIS MONTH



The chart above shows the night sky as it appears on 15th October 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. British Summer Time ends on 28th October and Greenwich Mean Time begins.

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. 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: Jupiter (early evening) Saturn, Mars, Uranus and Neptune.