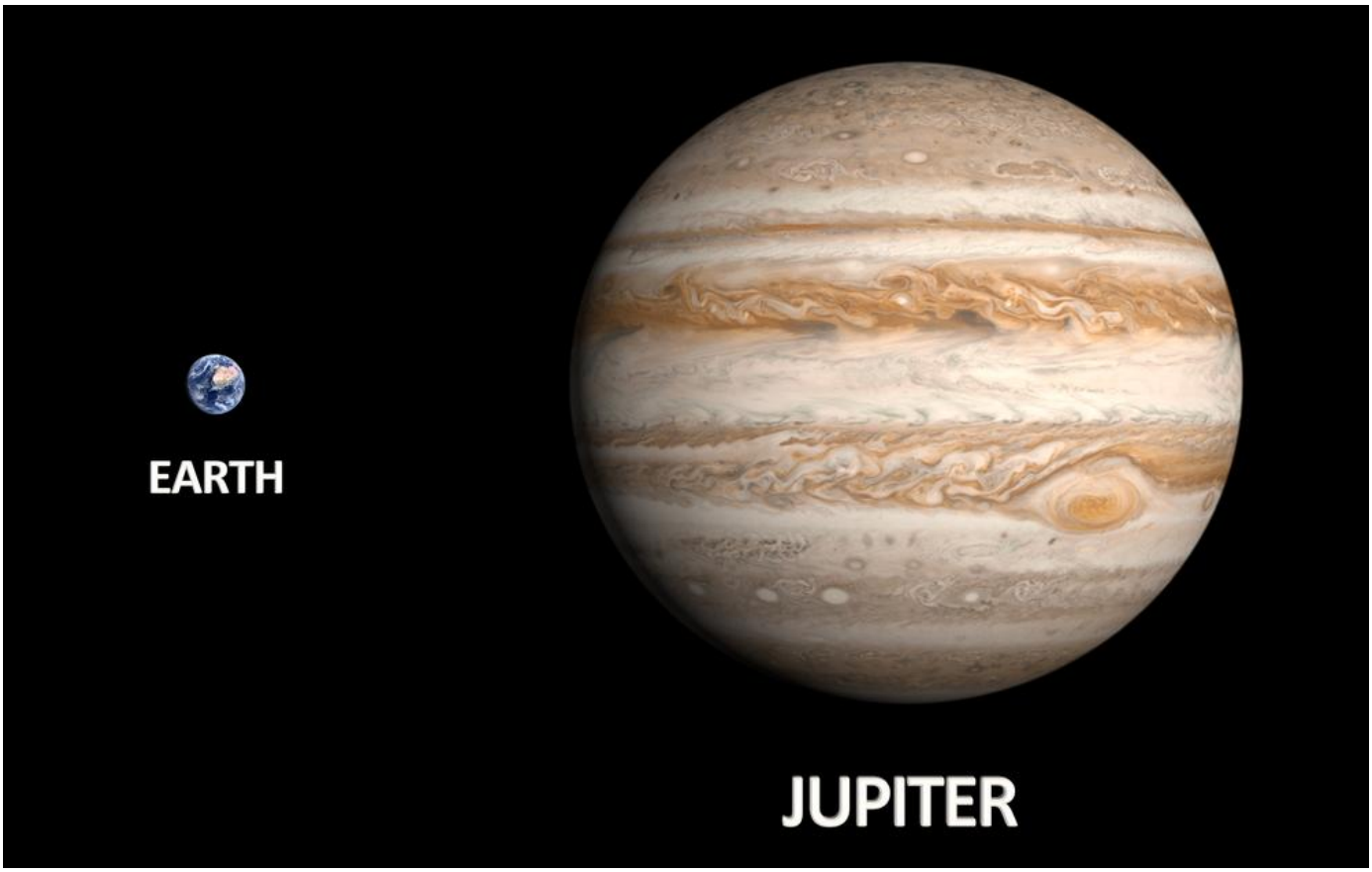
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – MARCH 2019

JUPITER – THE KING OF THE PLANETS RETURNS



The comparison in size of Earth and Jupiter

Jupiter has been in conjunction with the Sun for the last few months. This means it has appeared to move closer to the Sun (from our point of view) and pass behind the Sun. It has now reappeared from behind the Sun and is observable in the east before sunrise. Jupiter has not actually moved closer to the Sun it is just a line of sight thing. It simply moved into a position where it appeared to be on the other side of the Sun from our point of view on Earth.

Jupiter is fifth planet out from the Sun and is the largest planet in our Solar System. It is so large that its volume is greater than all the other [main] planets added together. Jupiter has a diameter of 142,984km which when compared to our Earth's diameter at 12,756km it is 11.21 times larger. See the picture above. Being so massive it has had a considerable effect on the formation of the other planets and still does.

The four inner planets: Mercury, Venus, Earth and Mars are known as the 'Terrestrial' or 'Rocky' planets because they are comprised mainly of solid rock and metal. The next two planets out from the Sun, Jupiter and Saturn, are called the 'Gas Giants'. They are mainly composed of gas with a comparatively small rocky and metallic core. So they do not have a solid surface, they just have a mainly Hydrogen atmosphere right down to the core.

Saturn has a similar composition to Jupiter but is slightly smaller at 120,536km in diameter. Unlike Jupiter, Saturn has a beautiful and large ring system that makes it striking to look at. Beyond Saturn are the 'Ice Giant' planets Uranus and Neptune. These are mainly compised of gas like Jupiter and Saturn but much of the gas is frozen because they are so far from the Sun.

The inner four planets are relatively close together as they move around the Sun in there prescribed orbits. Their orbits increase by approximately 50 million km for each orbit out from the Sun. Mercury 57.9, Venus 108, Earth 149.6 and Mars 227.9 million km (Mars a little over the 50 million km).

The Outer Planets orbit at greater distances: Jupiter 778.3, Saturn 1,429.4, Uranus 2,875 and Neptune 4,504 million km (approximately double the previous orbit).

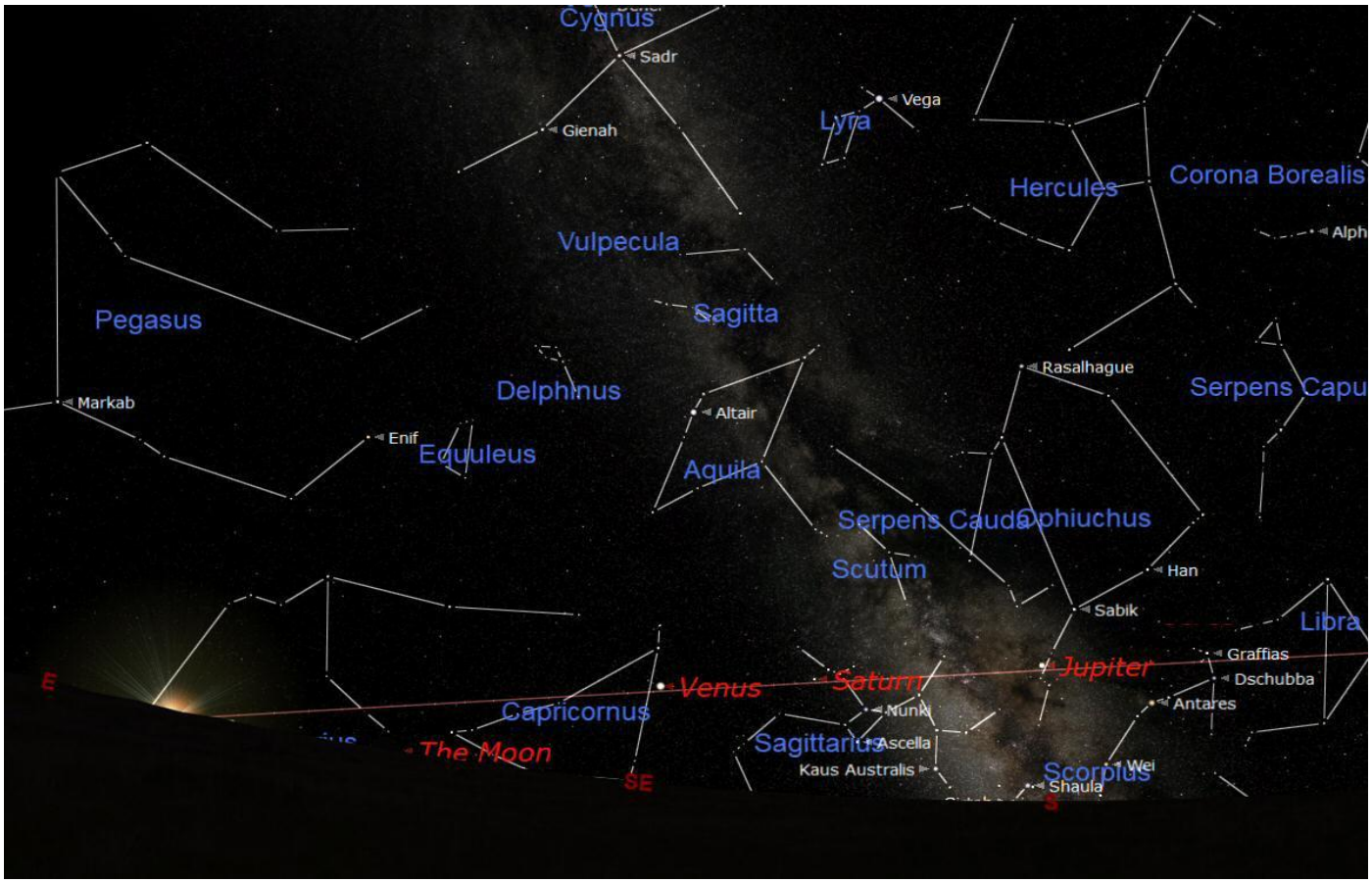
NEWBURY ASTRONOMICAL SOCIETY MEETING

1st March The violent High Energy Universe
Website: **www.newburyastro.org.uk**

NEXT NEWBURY BEGINNERS MEETING

20th March The Cosmic Zoo, What's out there?
Website: **www.naasbeginners.co.uk**

JUPITER IN THE DAWN SKY



The position of Venus, Saturn and Jupiter at sunrise at 06:30 on 1st March

The chart above shows the location of the planets Venus, Saturn and Jupiter as the Sun rises over the Eastern Horizon at 06:30 on 1st March. To observe the planets it will be necessary to be ready to observe at least one hour before this time. At 05:30 the sky will have started to brighten but Jupiter and Venus will be easy to see and observe. Saturn will be a little more difficult as it is a lot fainter.

A good pair of 9 x 50 binoculars will show Jupiter as a small but bright disc and the four brightest moons will be 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'.

Jupiter and the four 'Galilean' moons on 1st March

The chart above shows the positions of the moons at sunrise on 1st March. The inner moon Io is also the smallest and moves most noticeably from day to day and even hour by hour when close to Jupiter. Europa is the second moon from Jupiter and appears slightly brighter and also moves quite noticeably, if you are looking for its movement. Ganymede is the third moon out from Jupiter and Callisto the most distant. There is some more information about Jupiter's moons on page 4.

OBSERVING JUPITER USING BINOCULARS

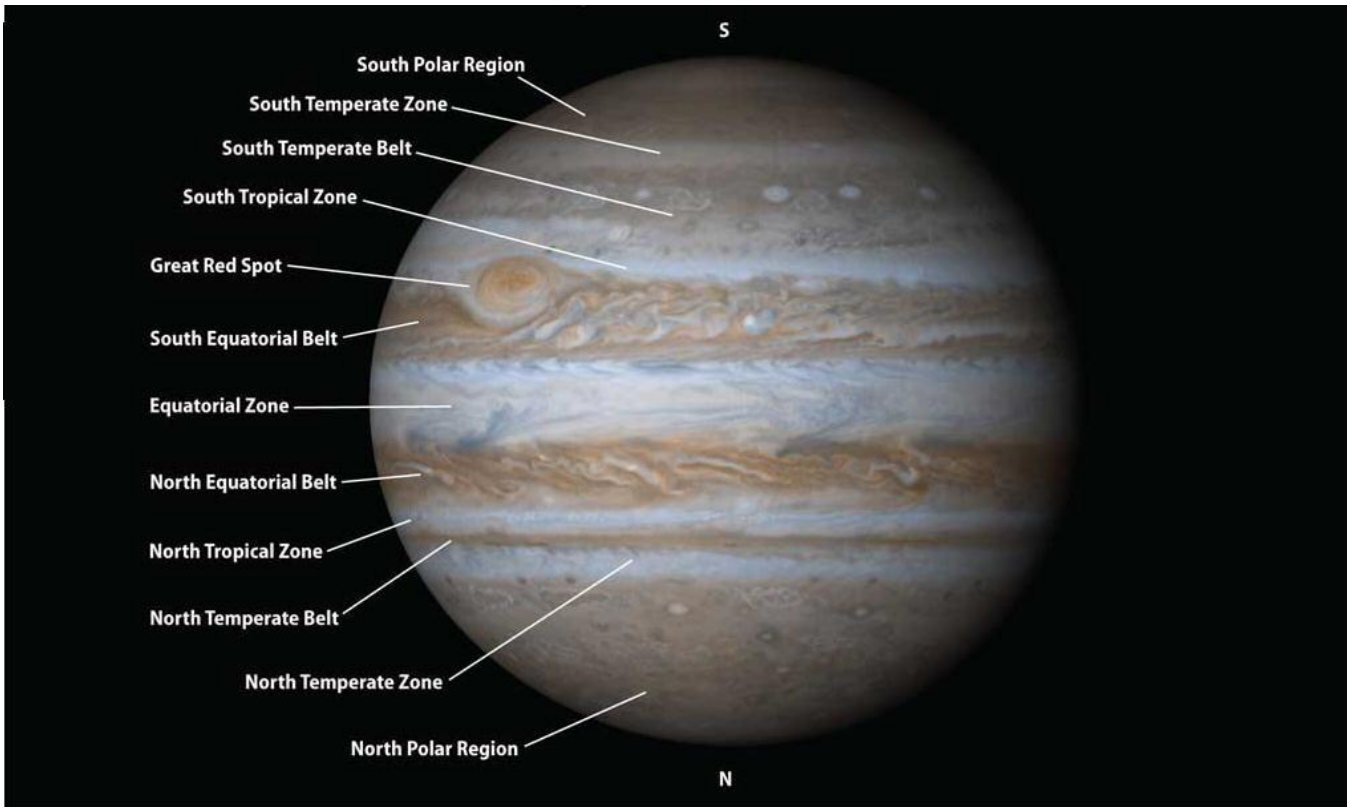
Using binoculars to observe Jupiter is better if you prepare first. There are two things that can help improve the view. The first is to set up the binocular to suit your eyes.

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

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

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

OBSERVING JUPITER AND ITS MOONS



Jupiter showing its cloud Belts and Zones

Jupiter will appear low in the sky and in the brightening pre-sunrise dawn sky so it will not be a very good time for observing it. However on the 10th June 2019 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 about 50° above the horizon and 45.4 arc-seconds in 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 labelled on the diagram 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.

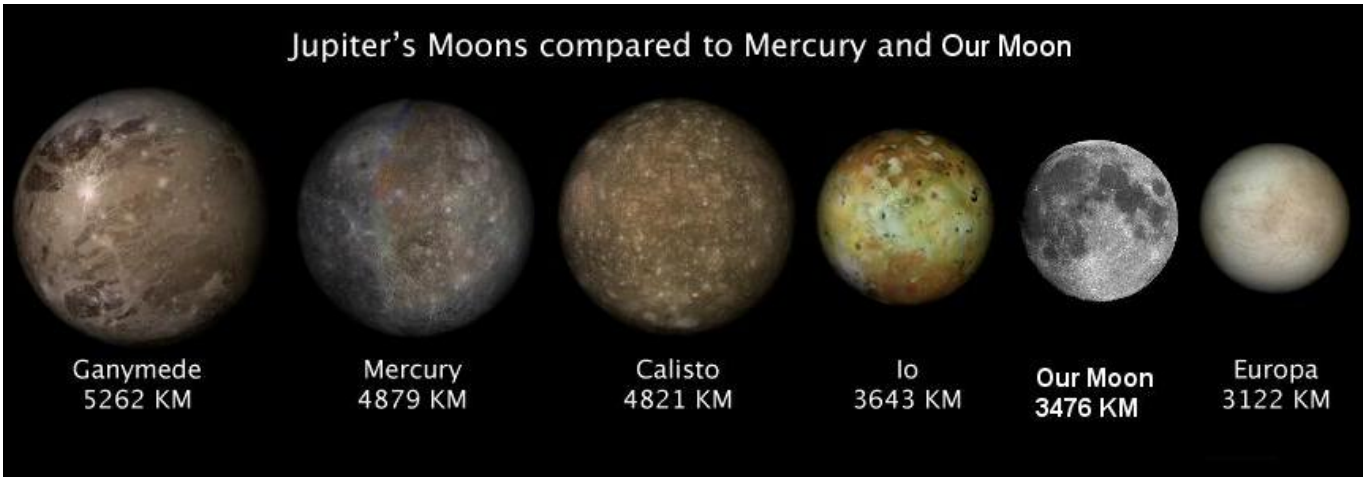
A larger telescope will allow some of detail of the storm patterns to be seen. Swirls and waves can be seen in the Belts and zones and the whole system is very active and interesting to monitor as it changes. Spots also appear and disappear and can be monitored as they develop and move along through 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 deep in Jupiter's atmosphere.

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

With Belts and Zones moving and different speeds and directions huge storms are created with gigantic lightening flashes. These were seen by probes as they explored the dark night side of the planet that we cannot see from Earth. We can only see the bright sunlit side and can't see the far dark side.

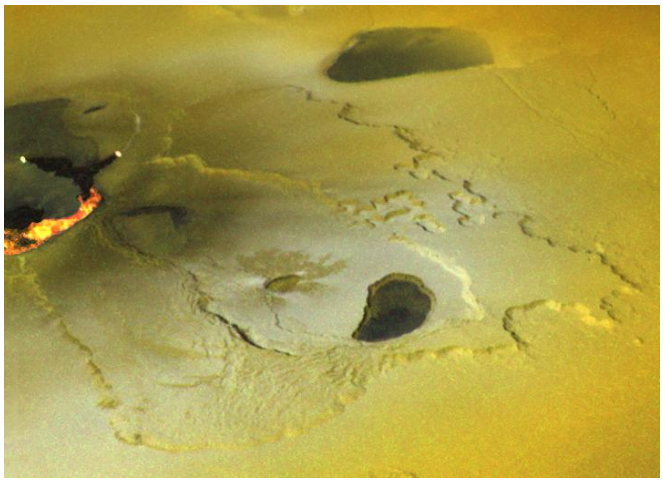
THE MOONS OF JUPITER



The Galilean moons with Mercury and Our Moon for comparison of diameters

Until exploratory probes were sent to explore Jupiter and its moons we assumed that Jupiter's Galilean moons would be similar to our Moon but we were very wrong. All the moons are very different to our Moon and different to each other.

Io is the smallest of the four Galilean moons and possibly the weirdest of them all.



Lava flowing on the surface of Io

During the first 'fly-by' space mission strange plumes were seen on the edge of Io. The plumes were found to be active volcanoes, this was a great surprise. It was not clear whether these volcanoes were gas erupting from fissures on the surface or eruptions of liquid rock like the volcanoes on Earth. Later missions were able to take better pictures of the surface and see lava flows just like here on Earth as shown in the image above.

It is now known that Io has the most active volcanism in our Solar System. The whole surface of Io is covered with Sulphur that gives it the yellow and orange colours.

The volcanoes are caused by the huge gravitational force of Jupiter as Io moves around its orbit close to Jupiter. The tidal forces in the rocks cause the rocky surface to rise and fall by an estimated 100m. This causes enormous pressure and heat through friction that melts the rock and forces it up to the surface as lava. As Io is small, some of the gas and rock is able to escape Io's gravity and forms a thin ring around Jupiter that is eventually pulled into Jupiter's atmosphere.

Io orbits around Jupiter at a distance of 421,600km, as measured from the centre of Jupiter (our Moon orbits 384,400km from the centre of Earth). This means Io is just 350,108km above the top of Jupiter's atmosphere (our Moon is 378,022km above Earth's atmosphere). So Io is closer to Jupiter's atmosphere than the Moon is to Earth's atmosphere and orbits Jupiter in just 1.77 Earth days.

Europa is the second moon out from Jupiter and the smallest of the four Galilean moons. It is also quite close to Jupiter with an orbit 670,900km from the centre of Jupiter. Europa is also affected by Jupiter's enormous gravity but its effect is manifested in a very different way.

This small moon (3,138km diameter compared to our Moon's 3,476km) is primarily composed of water ice and Carbon Di-oxide ice. The very strong gravitational force from Jupiter produces powerful tidal forces and heat in a similar way to those on Io. Heat produced from the friction causes the ice to melt and seems to have produced a liquid ocean of what is thought to be salty water, similar to the seas on Earth, beneath a ~50km thick crust of ice.

On Earth, anywhere that liquid water is found, we find life so we have the intriguing question 'is there life in the ocean beneath the ice on Europa?' There are volcanic vents on the ocean floor of our oceans that produce an ecosystem of life that does not need the energy from the Sun to thrive. There could be similar volcanic vents at the bottom of the ocean on Europa so there is the possibility that life may have developed there as well.

There is a possible hint that there is some form of primitive life on Europa. It is thought the tidal movement of the ice causes it to crack and probes have observed huge crack systems on the surface of Europa. Around these cracks discolouration of the ice has been seen. This sort of discolouration seen on Earth is usually caused by bacterial and microscopic life forms. So there is the possibility that similar life may exist on Europa.

Much work and research is being carried out to develop a probe that can be sent to Europa to take samples of possible life. It would be very difficult to land a space craft on the surface and drill the 30 – 70 kilometres through the ice to the water. It would be even more difficult to return a sample to Earth so a different approach was needed to obtain a sample of Europa's water. Cont.

Probes passing Europa have recorded what appeared to be plumes of gas emerging from some of the cracks in the ice covering the surface. This has given rise to an intriguing idea to send a probe to pass through a plume and collect a sample without landing on the surface. A sample could even be returned to Earth for analysis.

The Hubble Space Telescope (HST) team used the telescope at its extreme capabilities to examine the plumes. They found that the intensity of the Europa plumes were similar to those found erupting from Saturn's tiny moon Enceladus. Active jets have only been seen when Europa was at its furthest from Jupiter. The researchers could not detect any sign of venting when Europa was closer to Jupiter.

One explanation for the variability is that these cracks known as 'Lineae' may experience more stress as gravitational tidal forces push and pull on the moon and open the vents at larger distances from Jupiter. The vents are narrowed or closed when the moon is closest to the planet. So they open and close every 3.55 Earth days as Europa orbits Jupiter. The apparent plume variability supports a key prediction that Europa would tidally flex by this significant amount if it does have a subsurface ocean.

An artist's impression of a water plume

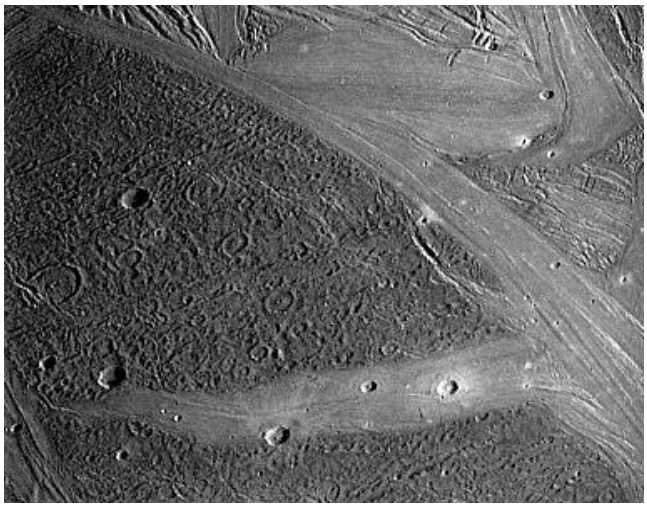
The Europa and Enceladus plumes have remarkably similar abundances of water vapour. Europa has roughly 12 times the gravitational pull than at Enceladus so most of the -40º Celsius vapour in the plume does not escape into space as it does at Enceladus. It would be expected to fall back on to the surface after reaching an altitude of 201 kilometres. Researchers have now hypothesised that this could have produced the bright surface features that have been seen near the moon's South Polar Region.

The two inner and smallest of the Galilean moons show the most exciting and unexpected features but the outer moons are also very interesting. Both Io and Europa have surfaces that have been recycled so they do not show evidence of the early solar system. In contrast the outer moons are large and have their own interesting points. Ganymede is the largest moon in our solar System and Callisto is third largest after Saturn's Titan.

Ganymede is the largest moon in the solar system (5,263km in diameter). It orbits Jupiter in about 7.16 (Earth) days at just over 1 million km from Jupiter. Ganymede is the only moon known to have a magnetosphere and that indicates it may have a hot (<1500°K) liquid Iron core. Polar ice caps have been detected that may be formed by water molecules migrating along the magnetic force lines and being deposited at the poles. There may be a multilayered water and ice surface layer up to 800km deep.

Ganymede appears as if it has suffered a massive impact in the distant past. It seems to be made up from continent sized blocks that have been reassembled after a catastrophic collision.

It also has what appear to be clacks known as 'furrows' that have refrozen. They have fewer craters compared to the rest of the surface indicating that they have been formed more recently. This leads scientists to conclude that there must have been activity in the interior of Ganymede long after it was formed. There is no evidence that this surface activity is still active.



The 'furrow' like features on the surface of Ganymede

The surface has many fault lines, resembling a ploughed field. These strange 'furrow' like features are 100m high and 10km wide and appear to be caused by ice movements on the surface. From a distance it resembles our Moon with large dark areas and smaller lighter patches. However its density is much less and appears to have a large proportion of its mass made of water ice. Radar probes have revealed that there may be large pieces of rock suspended in the ice layers. This indicates that much of the water is frozen solid but there may some liquid layers.

Callisto**,** unlike the other three Galilean moons, appears not to have had any noticeable internal activity or source of heat. Consequently the surface is old and has one of the most heavily cratered surfaces in the Solar System. It is a large moon with a diameter of 4,800km orbiting Jupiter at 1.8 million km and takes 16.69 (Earth) days to complete each orbit.

Callisto would be a very interesting place to visit because it appears to have what may be the oldest undisturbed planetary surface in our Solar System. Samples of this surface may be able to tell us about the original composition of the nebula that our Sun and the planets formed in 4.3 billion years ago.

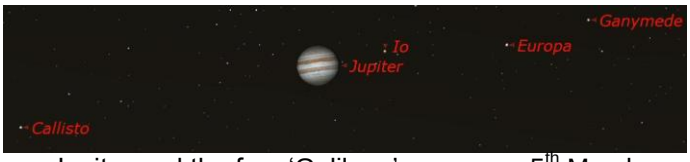
Observing the Jovian System (Jupiter and its Moons) is quite easy but does need a pair of binoculars or a telescope. Using standard binoculars (9x50) shows Jupiter as an extended fuzzy star like object and if good quality may show the four Galilean moons. A telescope will be required to see detail on the surface and a clear view of the moons. See page 2 for setting up binoculars.

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.

The charts below have been produced using a computer planetarium application called Starry Night to show the positions of the Galilean moons this month.

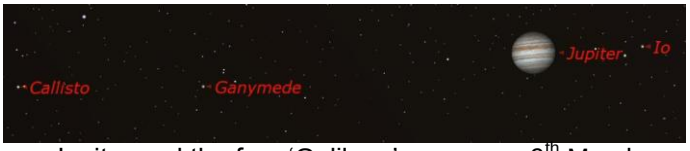
Jupiter and the four 'Galilean' moons on 1st March

Jupiter and the four 'Galilean' moons on 3rd March



Jupiter and the four 'Galilean' moons on 5th March

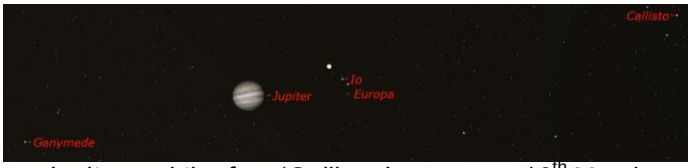
Jupiter and the four 'Galilean' moons on 7th March



Jupiter and the four 'Galilean' moons on 9th March

Jupiter and the four 'Galilean' moons on 12th March

Jupiter and the four 'Galilean' moons on 14th March



Jupiter and the four 'Galilean' moons on 16th March

Jupiter and the four 'Galilean' moons on 19th March

Jupiter and the four 'Galilean' moons on 21st March

Jupiter and the four 'Galilean' moons on 23rd March

Jupiter and the four 'Galilean' moons on 26th March

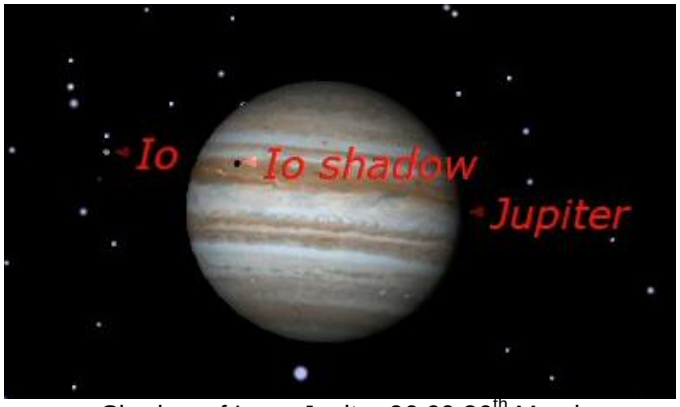
Jupiter and the four 'Galilean' moons on 28th March

Jupiter and the four 'Galilean' moons on 29th March

Jupiter and the four 'Galilean' moons on 30th March

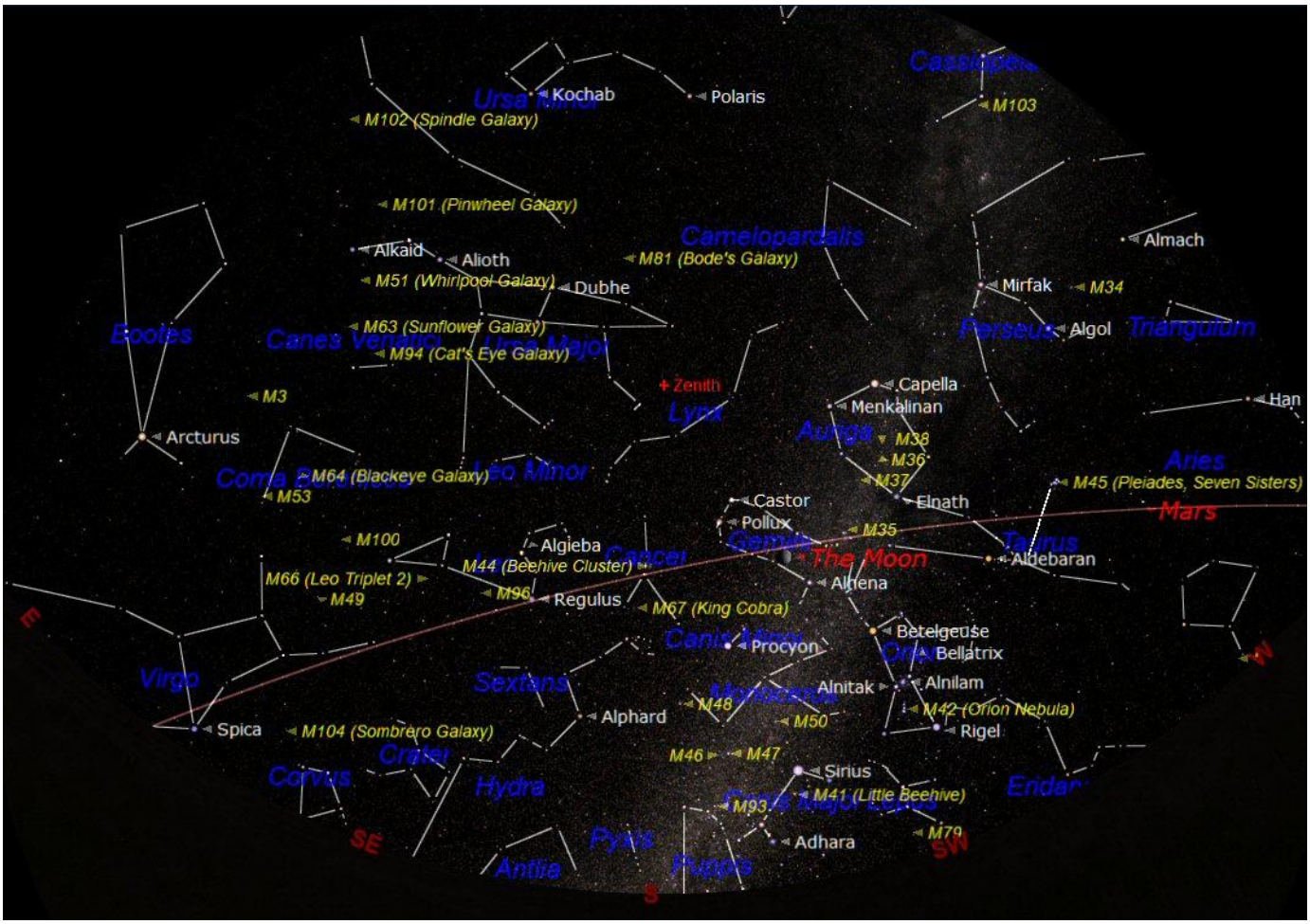
Special events to look out for

Shadow of Io on Jupiter 06:00 3rd March



Shadow of Io on Jupiter 06:00 26th March.

A TOUR OF THE NIGHT SKY - March 2019



The chart above shows the night sky looking south at about 20:00 GMT on 15th March. 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 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 Aries (the Ram), Taurus (the Bull), Gemini (the Twins), Cancer (the Crab), Leo (the Lion) and Virgo (the Virgin) rising over the eastern horizon.

The Milky Way (our Galaxy) flows up from the south horizon through Orion and Gemini. It continues up through Perseus and Cassiopea and on to Cygnus which is on the northern horizon.

Mars is still in a reasonable position, for observing during the early evening but is looking small now, in the constellation of Aries. Uranus is close to the southern horizon in the early evening but will need a good pair of binoculars or better still a telescope to find it.

Along the Ecliptic is the constellation of Taurus (the Bull). The stick figure representation of Taurus resembles a squashed 'X' with the bright orange coloured Red Giant star Aldebaran at its centre. This is a lovely star to look at especially using binoculars or a telescope and does look noticeably orange in colour.

Following the North western (upper right) arm of the 'X' shape of Taurus guides us to the beautiful Pleiades 'naked eye' Open Star Cluster. This bright Open Cluster with its seven brightest stars is known as Messier 45 (M45), the Pleiades or 'Seven Sisters'.

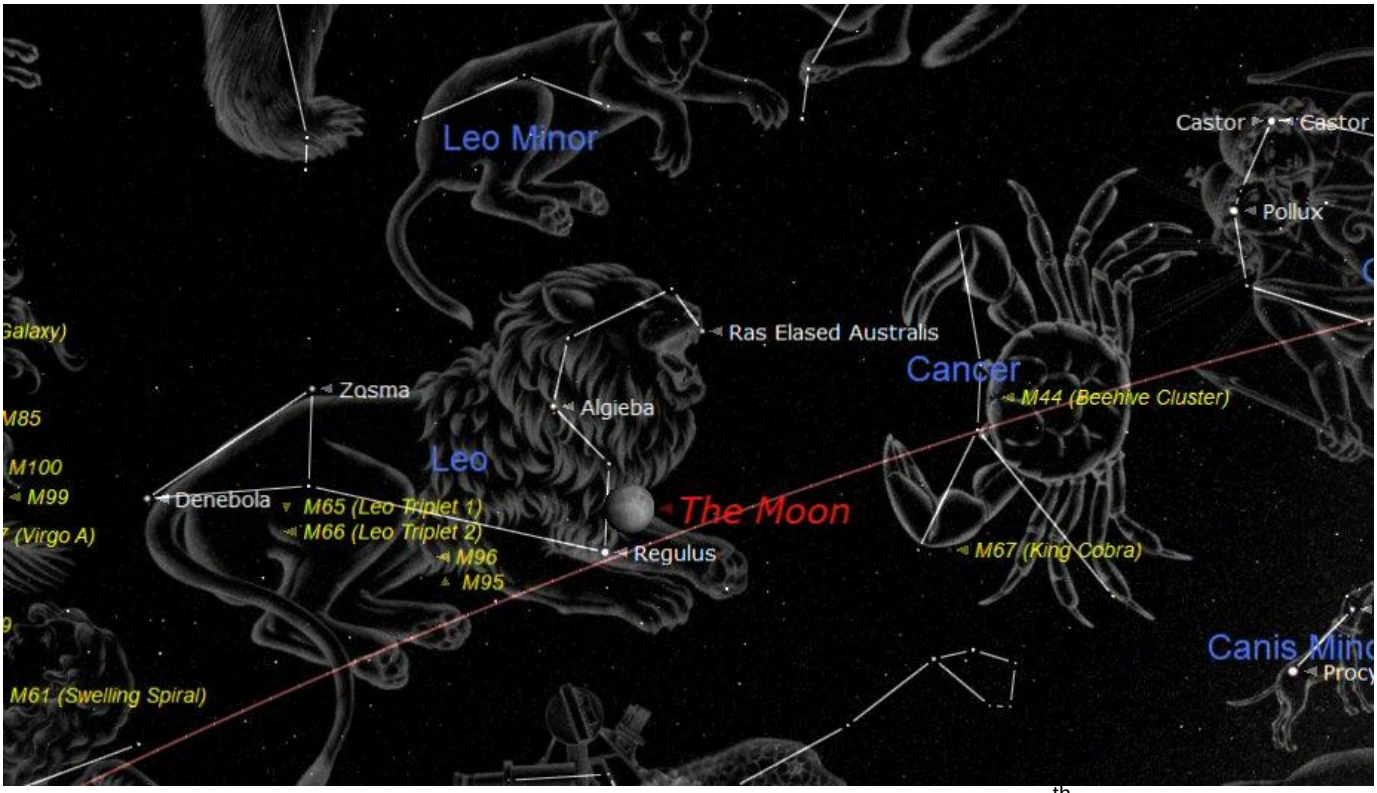
Attached to the upper left star of Taurus called 'Elnath' in the constellation of Auriga the Charioteer. Auriga appears like an odd shaped pentagon with the beautiful bright white star Capella on the opposite side to Elnath.

To the east of Taurus along the Ecliptic is the constellation of Gemini (the Twins). The twin stars Castor and Pollux are easy to identify. To the east is the constellation of Cancer with a lovely cluster M44.

Below Gemini is Orion the second most recognisable constellation. Orion is depicted as a hunter with two hunting dogs called Sirius and Procyon. The two stars that represent Orion's hunting dogs are also called Sirius and Procyon. Sirius and Procyon are the brightest stars in the constellations of Canis Major (the great dog) and Canis Minor (the little dog). Sirius is the closest and brightest star visible from the UK.

Further to the east (left) of Gemini is the constellation of Leo (the Lion). Leo is quite distinctive with the 'Sickle' shaped pattern of stars looking much like the head of the lion that Leo represents. In fact the traditional 'stick figure' shape of Leo as shown on the chart above does look rather like the lion's body or the Sphinx in Egypt. The 'Sickle' shape is also described as looking like a backwards question mark (?). See page 8.

THE CONSTELLATIONS OF LEO AND CANCER



The constellations of Leo (the Lion) and Cancer (the Crab) on 18th March 2019

Cancer is a faint and rather indistinct constellation but it is well worth searching out. It does have a rather nice Open Cluster called Messier 44 (M44) Praesepe or 'the Beehive Cluster' located at its centre. The cluster is large and dispersed and demonstrates the later stages of the formation process of Open Clusters. It contains stars at all stages of their 'life cycle'.

Observationally, the Beehive is easily visible using binoculars as a lovely cluster of stars from February to May. At 1.5° across, the cluster nicely fits within the field of view of binoculars or low-powered telescopes.

Messier 44 (M44) Praesepe or the Beehive Cluster.

Leo (the Lion) is quite distinctive with the 'Sickle' shaped pattern of stars looking much like the head of the lion that Leo represents. In fact the traditional 'stick figure' shape of Leo as shown on the chart above does look rather like the lion's body or the Sphinx in Egypt. The 'Sickle' is also described as looking like a backwards question mark (?).

Leo does look unexpectedly large in the sky and may be a little difficult to find for the first time but once found it is found it is easy to recognise and find again.

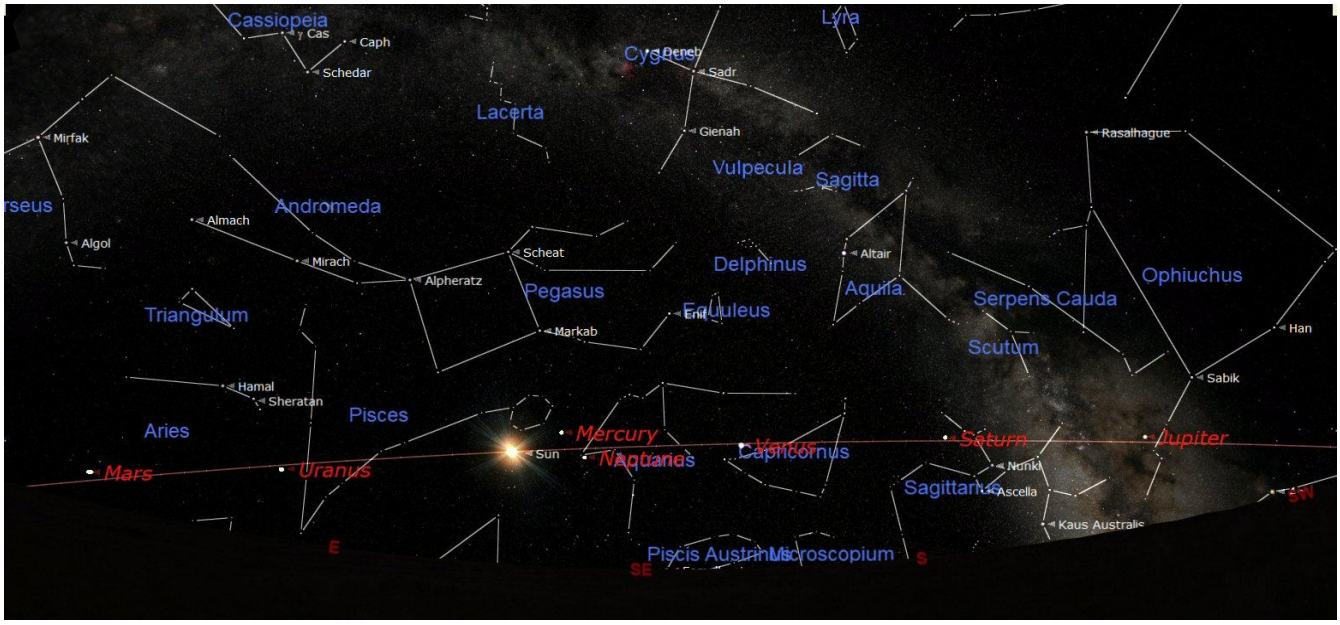
Regulus is a large blue / white star approximately 160 times brighter than our Sun and lying at a distance of 69 light years. When viewed through a small telescope a smaller companion star can be seen close by making Regulus a double star. Regulus sits virtually on the ecliptic line (the brown line shown on the chart above). This is the imaginary line along which the Sun, Moon and planets appear to move across the sky. Leo is therefore one of the twelve constellations of the Zodiac.

Every eighteen years Regulus is 'occulted' by the Moon once a month for a period of eighteen months. An occultation occurs when the Moon passes in front of the star so the star disappears behind the Moon. The last series of occultations occurred around 2007 and the next series will be around 2024. The Moon does however pass close to Regulus every month. It will pass close but above Regulus on the 18th March this year as shown in the chart above.

The star Algieba, located above Regulus on the 'Sickle', is a very nice double star about 75 light years from us. The two stars orbit each other around their common centre of gravity every 620 years and have magnitudes of +2.2 and +3.5 which give them a combined magnitude of +1.98.

Spring time is regarded as the season of galaxies and Leo is on the edge of a large group of galaxies. The main group is located in the neighbouring constellations of Virgo and Coma Berenices to the east (left) of Leo. However Leo does have four lovely bright galaxies of its own, these are known as: M65, M66, M95 and M96. They are marked in yellow on the chart above just below the 'lion'. The galaxies in and around Leo do require a medium sized telescope and a dark unpolluted sky.

THE SOLAR SYSTEM THIS MONTH



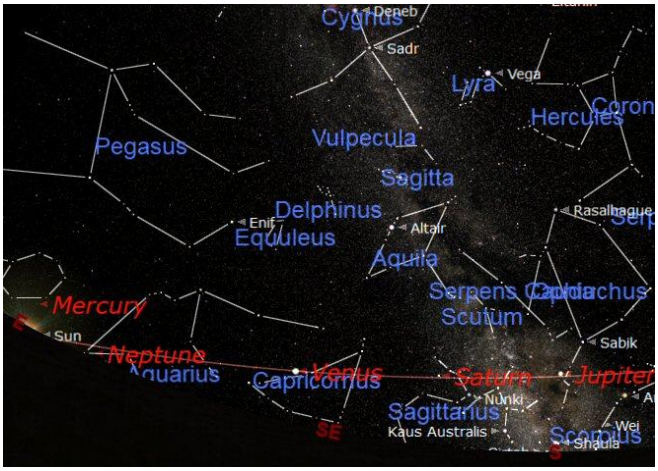
The positions of the planets at 08:00 in the middle of the month (the sky has been darkened)

MERCURY is visible at the very beginning of March soon after sunset low above the western horizon.

VENUS rises over the eastern horizon at about 05:00 and will be very bright in the south east even at 06:30 as the sky brightens at dawn. Venus is very bright at magnitude -4.0 and is appearing to move back towards the Sun. It will move into Superior Conjunction (pass behind the Sun) on 14th August. See the Jupiter and Saturn chart below.

MARS is still well placed in the early evening. It is low over the southern western horizon in turbulent and smoggy air. The Red Planet is moving away from Earth and looking smaller at 5.0 arc-seconds in diameter but still quite bright at magnitude +1.3.

JUPITER is moving further away from the Sun before sunrise. It now rises over the eastern horizon around 02:00 nearly 4 hours before sunrise. It is well worth getting up early to see. See the chart below and the special Jupiter feature on pages 1 to 6.



Mercury, Neptune, Venus, Saturn and Jupiter at 06:00

SATURN is moving away from the Sun before sunrise and will be to the east of Venus. It is now observable before the sky brightens and will be in the south until the Sun rises in the east. A telescope will show the ring system reasonably well. See the chart above.

URANUS will be in an observable position in the south west in the early evening but will set over the south western horizon at 21:20. A telescope at a magnification of 100x will be required show it.

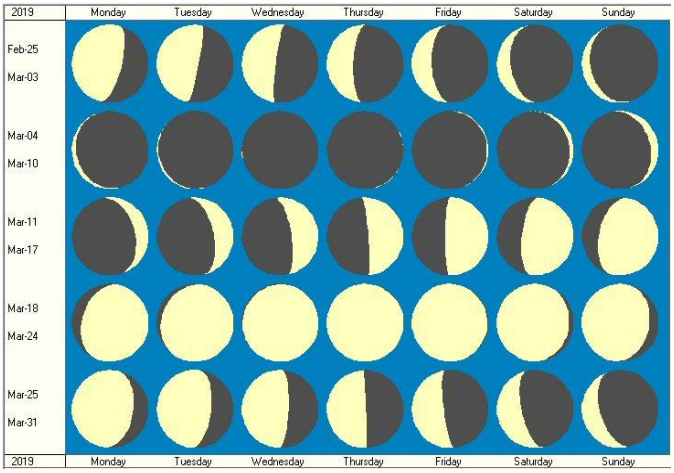
NEPTUNE is now close to the Sun and not visible.

THE SUN

The Sun rises at 07:30 at the beginning of the month and at 06:50 by the end of the month. It will be setting at 16:50 at the beginning and 17:30 at the end of the month. There has been no activity for some months.

THE MOON PHASES IN MARCH

The 'New Moon' will always be seen in the west after the Sun has set over the western horizon. At this phase the Moon will be emerging from conjunction with the Sun (passing between Earth and the Sun). The Moon orbits Earth once a month (Moonth). The cardinal phases listed below occur every seven days. Full Moon will always appear in the East as the Sun is setting in the West.



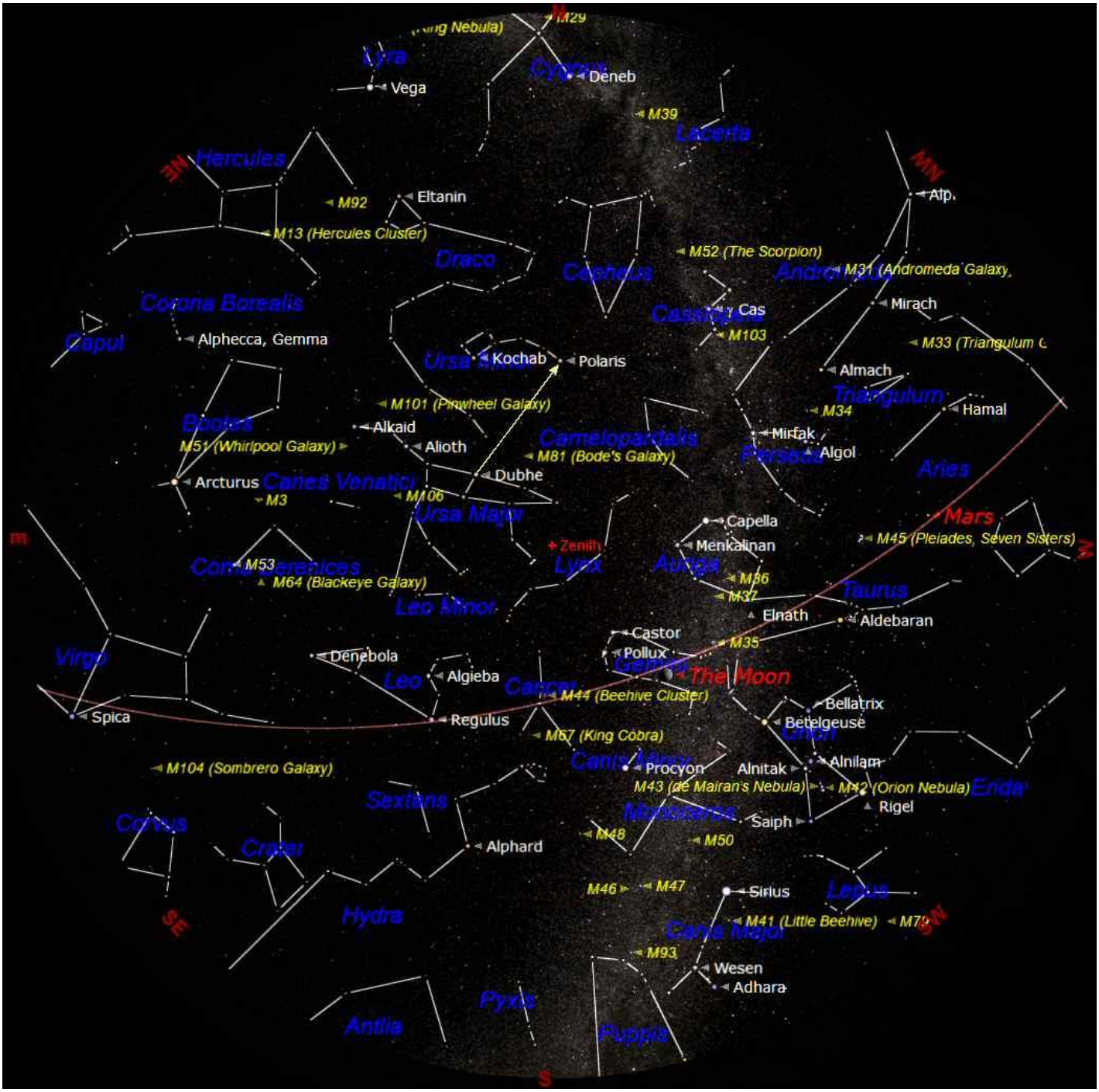
New Moon will be on the 6th March

First Quarter will be on 14th March

Full Moon will be on 21st March

Last Quarter will be on 28th March

THE NIGHT SKY THIS MONTH



The chart above shows the night sky as it appears on 15th March at 21:00 (9 o'clock) in the evening Greenwich Mean Time (GMT). 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 GMT at the beginning of the month and at 8 o'clock GMT 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 almost overhead. 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: Mars and Uranus. Venus, Saturn and Jupiter are observable in the early morning.