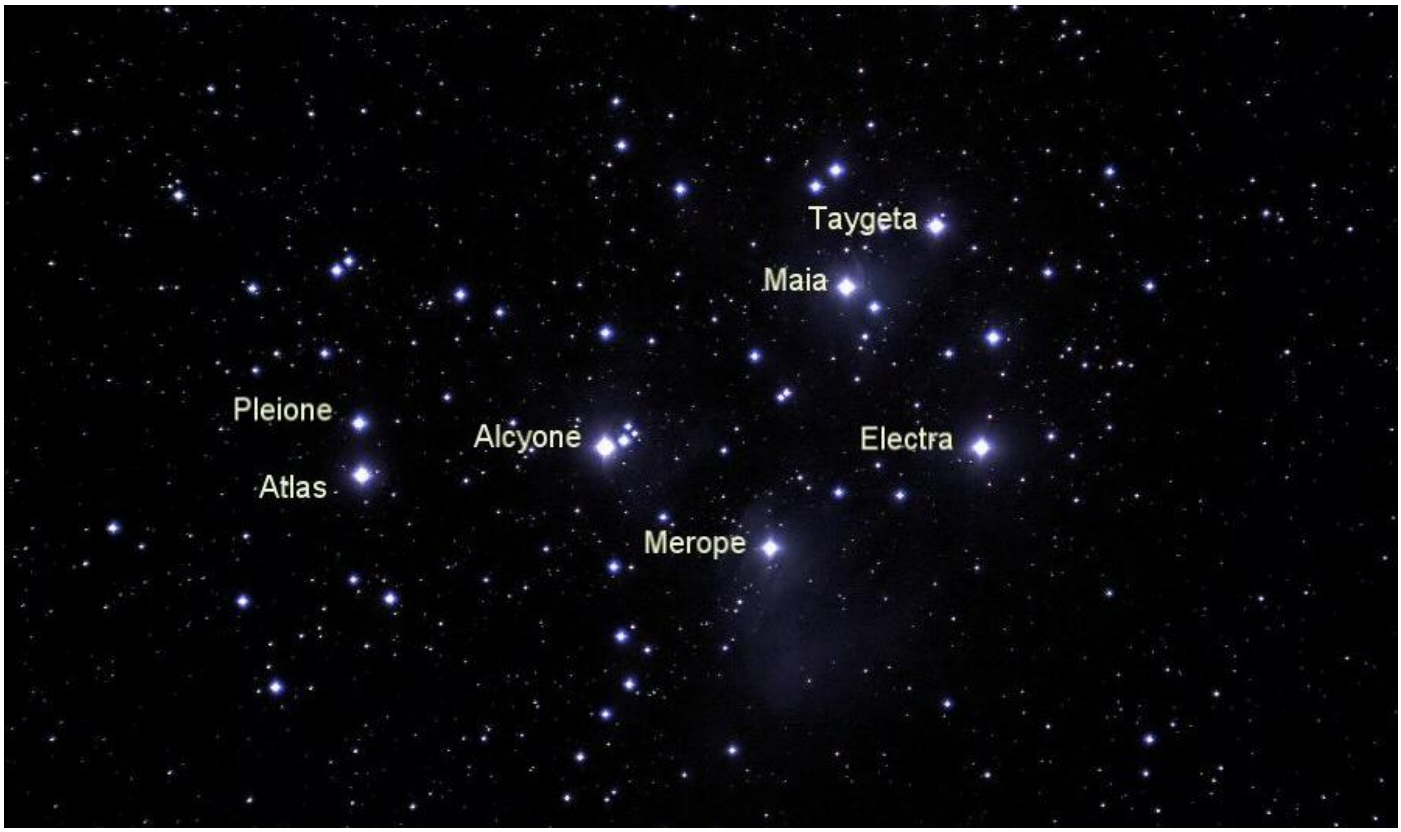
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – FEBRUARY 2018

SEVEN BEAUTIFUL SISTERS



Messier 45 (M45) the Pleiades (Seven Sisters)

Almost directly overhead this month, in the constellation of Taurus, is the beautiful Open Star Cluster known as the Pleiades. The cluster is officially named Messier 45 (M45) or the Seven Sisters. To the naked eye it initially appears to be a small smudge of light but when examined closer it can be seen to be a cluster of six or seven stars. (Under perfect conditions and with very good eyesight up to nine stars can be seen.) It is the most striking Open Cluster in our sky.

Open clusters are groups of young stars that have formed together from a nebula (a vast cloud of Hydrogen gas and dust). Gravity draws the atoms of the nebula together to form denser 'clumps' of gas. As these 'clumps' of gas grow they become even denser and are drawn in to form vast spheres of gas. Gravity compresses the gas in the centre of the sphere until the pressure rises to millions of times our atmospheric pressure and has a temperature of millions of degrees. At this point the Hydrogen atoms fuse together to create an atom of Helium in a process called Nuclear Fusion.

Nuclear fusion produces an enormous amount of X Rays that heat the sphere and cause it to shine. The spheres become stars and begin to radiate their energy as Ultraviolet light and visible light. The intense radiation produces a 'wind' that blows away any gas left around the stars and a new star cluster is revealed. Messier 45 is located 443 light years away from us.

Using our 'naked' eyes we can, on average, see the six or seven brightest stars in the cluster. Binoculars will reveal about forty other bright stars and the view will be magnificent, in fact the best view is obtained using binoculars. A small short focal length telescope will also give a wonderful view but the whole cluster cannot fit into the narrow field of view of most telescopes. There are a host of smaller stars in the cluster that cannot be seen and identified in amateur astronomer's telescopes. There are thought to be more than 1400 stars in the cluster.

As all the stars were 'born' in the same nebula they are all the same age and about 125 million years old. The stars are still close together but over millions of years they will gradually disperse and the cluster will disappear. It is thought that all stars are created in clusters and formed from Nebulae. This leads to an interesting conclusion that our Sun must have been created in a cluster but over the past 4.3 billion years her siblings have flown.

NEWBURY ASTRONOMICAL SOCIETY 2017 - 2018

2nd February The Geology of the Moon
Website: **www.newburyastro.org.uk**

NEXT NEWBURY BEGINNERS MEETING

21st February Is the Universe trying to kill us?
Website: **www.naasbeginners.co.uk**

If you have any questions or comment please contact Steve Harris by email on: steveh23448@gmail.com

IS THE UNIVERSE TRYING TO KILL US?

We think of our home on Earth as being a safe haven and a safe place to live and that must be true after all Earth has been around for about 4.3 billion years. So are we safe and what might the threats to our safety here on Earth be?

The main threat to Earth is usually perceived as being from a comet or Asteroid impact. The most recent large meteor strike was the Chelyabinsk meteor on 15th February 2013. This was a caused when a 20 metre rock entered Earth's atmosphere. It was attributed to a 'Near-Earth' asteroid that entered Earth's atmosphere over Russia with a speed of 60,000 to 69,000 km/h. It quickly became a brilliant superbolide meteor over the Southern Ural region and exploded with the force of a nuclear bomb.

An image of the 2013 Chelyabinsk meteor

The light from the meteor was brighter than the Sun and visible up to 100 km away. It was observed over a wide area of the region and in neighbouring republics. About 1000 people were injured when windows were smashed and buildings damaged by the explosion and the shockwave. Some eyewitnesses also reported they had felt an intense wave of heat from the fireball.

Although this was a very traumatic event nobody was seriously hurt but there were some injuries caused by flying glass. These events are very rare and usually occur over the oceans or uninhabited areas. Until 2016 there had never been a report of anyone being directly injured by the falling material from a meteor strike. There was an unconfirmed report of a dog being killed by a meteorite (a piece of material from a meteor hitting the ground) in Egypt in 1911.

However, a meteor strike was the only explanation that authorities had for the bizarre demise of a 40-year-old man in India on 6th February 2016. He was last seen relaxing in the grounds of a small engineering college in the southern Indian state of Tamil Nadu when an explosion was heard. Once the dust had settled, Mr Kamaraj was found lying unconscious next to a mysterious, 60cm wide crater. He had very serious facial injuries from which he died. The reports from the official investigation were inconclusive.

These rocky meteors originate from asteroids (lumps of rock and Iron that orbit the Sun. Some groups of asteroids have orbits that cross the orbit of Earth and could in theory hit Earth at some time. These are called 'Near Earth Asteroids'.

Most meteors originate from Comets and are completely harmless as they are small and burn up high in the atmosphere. As a comet approaches the Sun the water ice, that it is composed of, begins to melt. Dust particles trapped in the 'dirty' ice are released and form a trail through space along the path of the comet. If Earth happens to pass through this trail of dust the combined speed of Earth and the particles, known as 'Meteoroids', may reach over 100,000 km/h. As the particles hit our atmosphere the friction causes the particle to burn very quickly and produce a streak of light called a 'Meteor'.

The meteors from comets are always small and burn up harmlessly in the atmosphere about 80km above the ground. However if a comet was to enter Earth's atmosphere it could cause a major problem for us. A large comet may hit the ground if its entry is almost perpendicular to the ground and cause a massive explosion and a crater. However if a comet enters at an oblique angle and being composed of water ice it may explode in the atmosphere in what is called an 'Airburst'.

On the morning of 30th June 1908 there was a massive explosion that occurred near the Stony Tunguska River in an area now known as Krasnoyarsk Krai in Russia. The explosion, over sparsely populated Eastern Siberian, flattened 2,000 square kilometres of forest yet caused no known human casualties. The Tunguska event is generally attributed to the air burst of a water ice meteoroid. It is classified as an impact event, even though no impact crater has been found. The object is thought to have disintegrated at an altitude of 5 to 10 kilometres rather than to have hit the surface of Earth.

The Tunguska event was the largest impact event on Earth in recent recorded history. Studies have yielded different estimates of the meteoroid's size, probably in the order of 60 to 190 metres, depending on whether the body was a water based comet or a rocky asteroid.

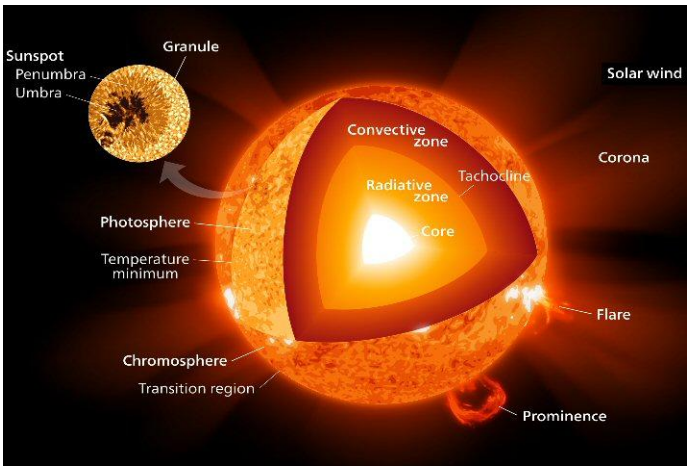
Trees were flattened over a 25km radius.

The last thing to create a large crater on Earth was the object that created Meteor Crater near Flagstaff, Arizona. This is about 1.2 km across, 170 metres deep. It was created when a tennis court sized lump of pure Iron hit the ground almost vertically about 50,000 years ago.

Meteor Crater, Flagstaff, Arizona

So the chances of being killed by an object falling from the sky are very small. We should perhaps look for other things that may be a threat to us.

The very object that that provides for our needs does also have the power to kill us, this is our Sun. Being a star it is by its very nature an extremely dangerous thing. It is powered by the same process that provides a Hydrogen Bomb with its energy, this is Nuclear Fusion.



A cut-away diagram of the Sun

Hydrogen atoms in the core of the Sun are compressed together by the tremendous gravitational forces. The enormous pressure and the heat caused by the pressure causes the Hydrogen atoms to 'fuse' together to form a heavier Helium atom. In the process a small amount of mass is lost and converted into energy in the form of a flash of X-Rays. It is these X Rays that heat the centre of the Sun.

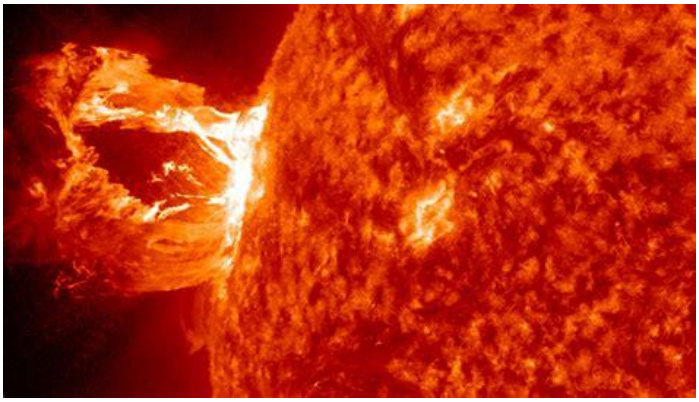
Although the mass lost when each Helium atom is created is tiny and the energy produced by the fusion of two Hydrogen atoms is also tiny the total amount of energy produced is huge. About 4.25 million tonnes of hydrogen atoms are converted into energy every second. X Ray energy is first radiated from the core into the Radioactive Zone around the core. Heat is then conducted by the Hydrogen gas to the surface. Hot Hydrogen at the surface shines in white light

We see the white light and its spectrum (the colours of the rainbow) that provides us with the light that powers our ecosystem and life. However the sunlight also contains light that we cannot see but can harm us. This light is Ultraviolet rays that have shorter wavelengths than visible light and Inferred rays that have longer wavelengths than visible light.

Fortunately for us our atmosphere blocks out most of these harmful rays. However some gasses that we produce during our everyday lives can damage the atmosphere and let the ultraviolet rays through. The layer of atmosphere that protects us is called the Ozone Layer. Ozone $\mathbf{O_3}$ (Trioxygen) is an Oxygen molecule comprised of three Oxygen atoms. It is created when an Ultraviolet photon interacts with a more common Oxygen molecule comprised of two Oxygen atoms $\mathbf{O_2}$ (Dioxygen).

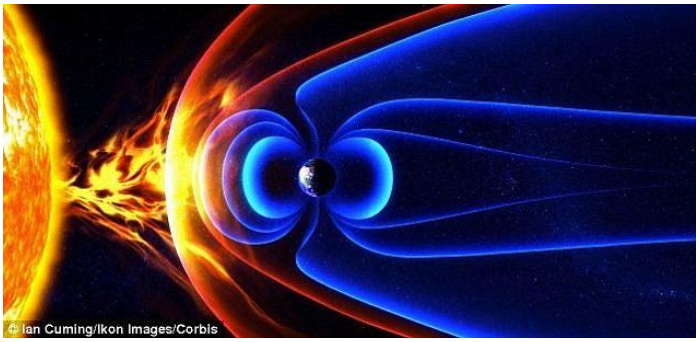
Inferred light cannot be seen but can be felt as heat. It heats our atmosphere and the surface of our planet and keeps us warm. The heat is then radiated back out of our atmosphere as Inferred light. However if the atmosphere composition is altered by increasing the Carbon Dioxide content then the heat can be trapped in the lower atmosphere. As the heat cannot escape the atmospheric temperature will increase. The Carbon Dioxide content of our atmosphere is increasing due to the use of Carbon Fuels and the temperature is rising.

Our Sun also throws very dangerous highly energetic particles into the space around it. Solar Flares eject clouds of electrons, ions, and atoms along very powerful electromagnetic waves that break through the Sun's corona and propel the particles into outer space.



A Solar Flare erupting from the surface of the Sun

Luckily for us Earth has a magnetic field that directs these very dangerous particles safely around the planet.



Earth' Magnetic Field

When there is a large eruption on the Sun, called Coronal Mass Ejection (CME), the particles interact with our upper atmosphere and produce the Aurora.

There are also many things from outer space (beyond our Solar System) that could potentially harm us. These dangers come in many forms and all directions.

When our solar system formed it is thought that many more planets formed around our Sun than the eight main planets we see today. In the early solar system the planets had unstable orbits and may have even changed their orbital paths. Planets could have even migrated from the outer solar system to the inner parts and out again.

During this 'settling down' period there were many close encounters and even collisions. It is now accepted that our Earth was struck by a 'Mars' sized planet, that we call Thea, very early in this process. The impact of Thea created our Moon and knocked our planet over giving it the 23.4° axial tilt that we can still see today.

Planetary close encounters can be disastrous for the planets. As they they pass each other their gravity pulls on each of them and disturbs their orbits. If close encounters occurred the reaction could be so great that one of the planets could be sent spiralling in towards the Sun with dire consequences for that planet. Other planets could be given a gravitational kick that might have throw them completely out away from the influence of the Sun into deep space. These planets would be destined to become Wandering Planets that journey around the galaxy between the stars forever.

An artist's impression of a Wandering Planet

It is thought that our Sun may originally have had as many as eighty young planets. This means that around seventy planets could have been lost. If we assume an even split between those being devoured by the Sun and those thrown out of the Solar System there could be 35 of our planets out there. There are estimated to be 200 billion stars in our galaxy and many will have planets like our Sun. If we assume that only half the stars had planets there could still be around 3500 billion wandering planets out there that could pay us a visit.

Our Galaxy is full of stars and all these stars have slightly different paths around the galaxy as the whole system rotates once every 220 million years. This means our Sun has rotated around the centre of the galaxy about 20 times since it formed. There is always a chance that stars could collide but the stars are so far apart compared to their size that collisions are very rare indeed.

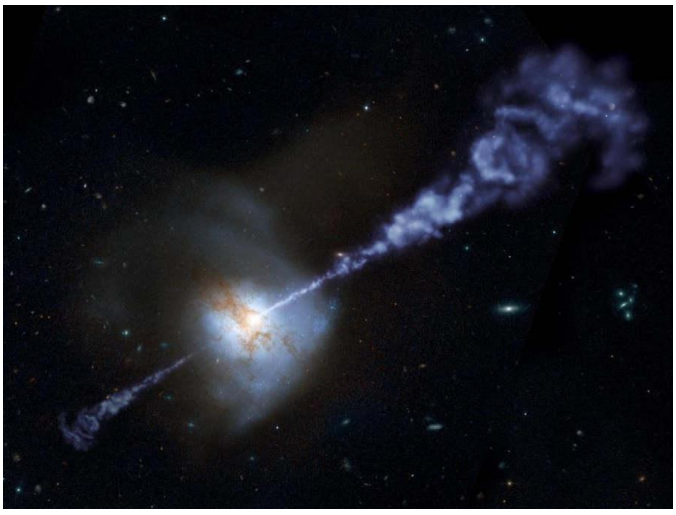
Our closest neighbour Messier 31 the Great Spiral galaxy in Andromeda will collide with our Galaxy in about 4.5 billion years time. However hardly any, if any at all, stars will collide as they pass through each other.

The stars themselves could be a threat to us especially when they come to the end of their 'lives'. Smaller stars meet their end in a gentle way as their Hydrogen fuel runs out. As their Hydrogen begins to run out Helium that had accumulated in the core begins to be fused to eventually produce Carbon atoms. This provides additional energy and the star begins to expand to become a Red Giant then collapse into a White Dwarf.

Giant stars have higher pressure in their cores and fuse Hydrogen into Helium at a much faster rate. The additional pressure and heat allows Helium to be converted into ever heavier atoms until Iron is produced. All this additional energy from each fusion level causes the star to expand into a Super Red Giant. Suddenly the fusion processes break down and the giant star collapses under its own gravitational force. Very quickly the pressure and heat inside the collapsing star causes a massive runaway fusion explosion called a Supernova that destroys the star.

A Supernova explosion produces huge flash of deadly radiation as the star is destroyed. This radiation is composed of all wavelengths of the electromagnetic spectrum. Any planet with life on it, in the vicinity, will be bathed in this radiation flash and life will be destroyed. Fortunately for us there are no supernova candidates close enough to us to threaten us with great harm.

Like all Galaxies our Milky Way Galaxy has a Super Massive Black Hole at its centre. Our Super Massive Black Hole is thought to have a mass of about 4 million times the mass of our Sun. The good news is our Super Massive Black Hole is quiet and presents no danger to us but other galaxies have an active black hole at the centre. These objects are pulling material in from its surrounding area and consuming it.

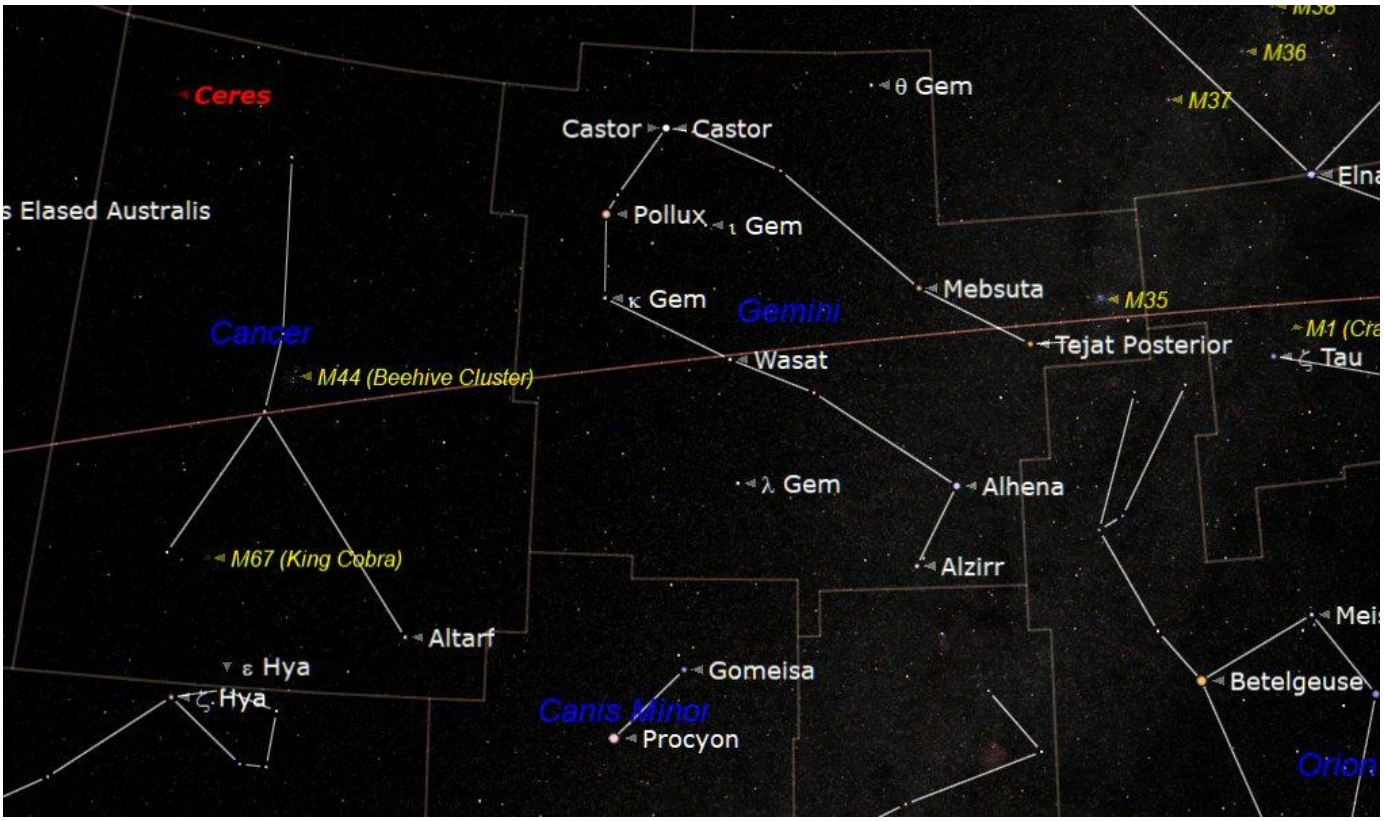


An Active Galactic Super Massive Black Hole

If these black holes are too veracious they can over indulge. Then the excess energy they produce as they feast on gas, dust and even whole stars produces powerful jets of energetic particles that stream out from the poles. Anything in the path of these jets and within a few million light years will be doomed. Our own central black hole is very unlikely to become active anytime soon and we are unlikely to be in the firing line if it does.

So there are lots of things in the universe that could potentially cause us harm but the universe is very big and our planet is relatively small so we are quite safe.

CONSTELLATIONS OF THE MONTH – GEMINI and CANCER



The chart above shows the winter constellations of Gemini (the Twins) and Cancer (the Crab). These are interesting constellations to search out and have some interesting objects to see when using a small telescope. They are located on the Ecliptic and therefore are occasional hosts to the Sun, Moon and Planets as they appear to move along this imaginary line.

Gemini is easy to find because its two brightest stars are quite close together and similar in appearance. The two brightest stars are called Pollux (β) and Castor (α) and are known as the Gemini Twins.

The recognised shape of Gemini is in the form of a rough rectangle with Pollux and Castor at the eastern short side. A line of stars runs south west from Castor to the star Tejat Posterior. The line from Pollux takes a diversion south through kappa (κ) then south west through Wasat to Alhena and Alzirr.

Although Castor has been given the Greek letter designation α (alpha), which is normally given to the brightest star in a constellation, it is not actually the brightest. Pollux is brighter at magnitude +1.59 compared to the +1.9 of Castor. However Castor is a double star with a fainter companion that has a magnitude of +2.9 and separated by 6 arc-seconds. The two stars, known as Castor A and Castor B, orbit their common centre of gravity every 467 years. The pair can be separated in a 75mm aperture telescope on a good clear night.

Each of the pair of stars that comprise Castor is in fact a double star in its own right. However they are much too close together to be separated in any telescope. The only way that their presence can be detected is by examining the light through a spectroscope. This instrument shows each star has two sets of spectral lines revealing that they are double stars.

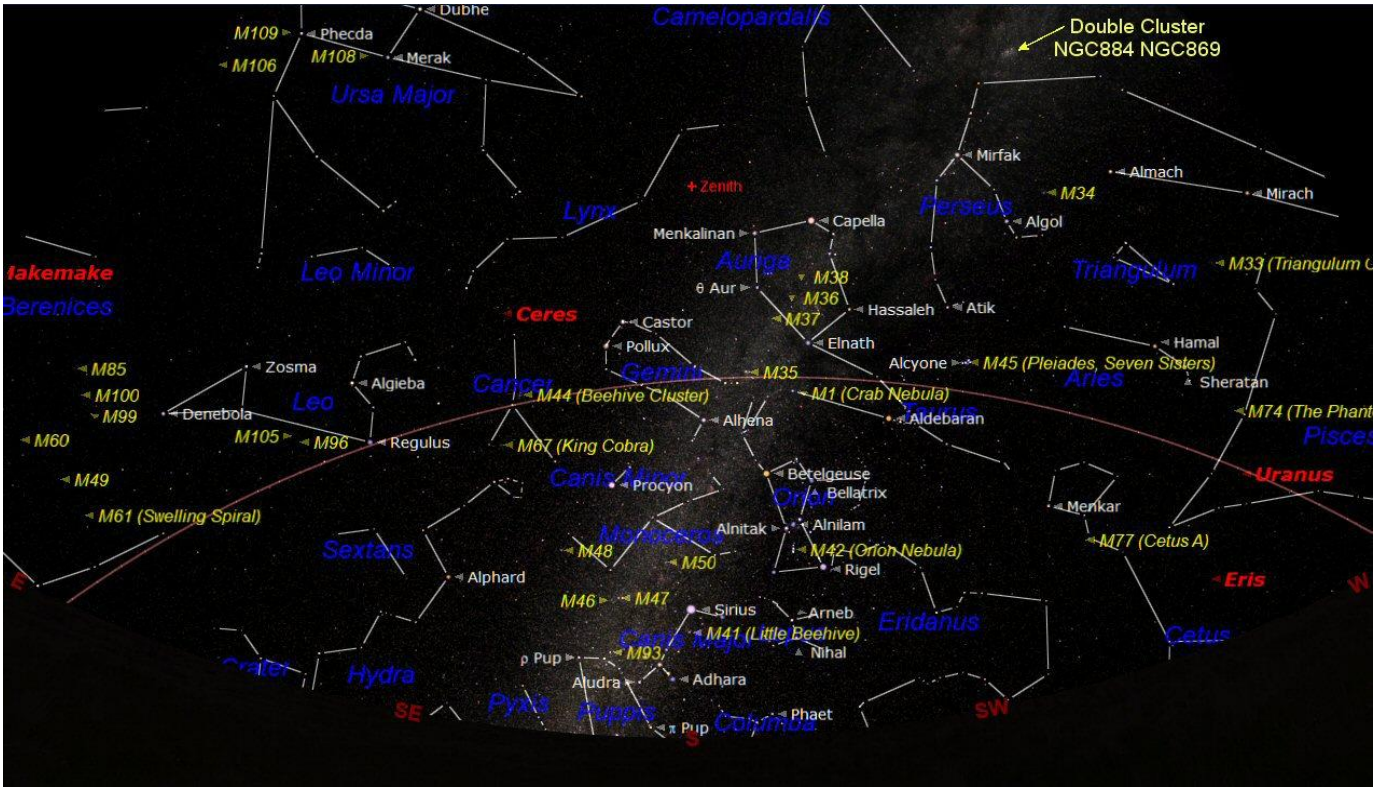
The Castor pair also has a faint companion, known as Castor C, orbiting them. It is separated from A and B by about 72 arc-seconds but is at the same distance from us. This star is also a double making Castor a very unusual six star system.

There is a beautiful Open Cluster Messier 35 (M35) located at the end of the upper of the two lines of stars that emanate from Pollux and Castor. It is the most spectacular of an apparent line of four Open Clusters. The other three are over the border in the constellation of Auriga and are known as M36, M37 and M38.

Messier 35 (M35) a very nice Open Cluster

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 the centre. The cluster is large and dispersed and demonstrates the later stages of the formation process of Open clusters. M44 (Praesepe) is best seen using binoculars.

THE SOUTHERN NIGHT SKY - FEBRUARY 2018



The chart above shows the night sky looking south at about 21:00 GMT on 15th February. 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 upper centre of the chart. The curved brown line across the sky towards 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: Pisces (the Fishes), Aries (the Ram), Taurus (the Bull), Gemini (the Twins), Cancer (the Crab), Leo (the Lion) and just coming on to the chart in the east is Virgo (the Virgin).

The Milky Way (our Galaxy) appears to rise up from the western horizon through the Summer Triangle and Cygnus. It continues up through Cassiopeia then down towards the East through Perseus and Auriga. Then the constellations of Gemini, Orion, Monoceros and Puppis at the bottom of the chart. As the galaxy is like a disc and our Sun is inside it, we see the billions of stars it is composed of as a band of light across the night sky.

Uranus is located in the constellation of Pisces and it can be seen as a small disc using a *beginner's* telescope with a magnification of 100x or more. It is now moving towards the western horizon. There are no other planets visible in the evening sky this month. Mercury, Venus and Neptune are too close to the Sun to be seen. Mars Jupiter and Saturn are early morning objects rising in the east before the Sun rises.

Strangely there will not be a Full Moon this month. There was one on 31st January and with February being a short month the next will be on 2nd March. This also means January and March both have two Full Moons.

Sitting astride the ecliptic in the south is the constellation of Taurus (the Bull). The Taurus asterism (shape) looks like a squashed cross 'X'. At the centre of the cross is a large, faint Open Cluster called the Hyades. It has the bright Red Giant star Aldebaran at its centre. The real beauty of Taurus is the naked eye Open Cluster M45 the Pleiades (Seven Sisters). Another interesting object for those with a telescope is Messier 1 (M1) the Crab Nebula. This is a Supernova Remnant (a giant star that exploded seven thousand years ago and was seen by astronomers in the year 1054AD.

To the north of M45 (the Pleiades cluster in Taurus) is a line of stars defining the constellation of Perseus. The whole asterism (shape) of Perseus looks like a horse rider's stirrup. At the top of the line of stars is the beautiful object 'the Double Cluster' best seen using binoculars.

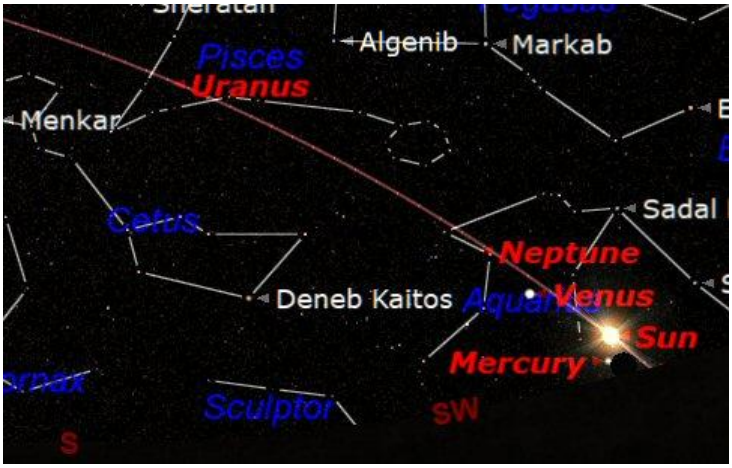
Above and linked to the constellation of Taurus by the star Elnath is the constellation of Auriga (the Charioteer). The shape of the 'stick figure' of Auriga is like a misshapen pentagon. The brightest star in Auriga is the beautiful bright white star Capella. It is the sixth brightest star in the night sky. Auriga has three Messier Open Clusters: M36, M37 and M38. They appear to form a straight line through Auriga which also appears to continue on in line to M35 in Gemini.

To the south of Taurus is the magnificent constellation of Orion (the Hunter). He has a distinct line of three stars depicting his belt with a line of fainter stars tracing out a sword appearing to hang from his belt. Orion was the constellation of the month in the January magazine.

Leo (the Lion) is just moving into prominence in the evening sky and does actually resemble the lion it represents. It does look like a lion resting and also resembles the Sphinx in Egypt.

THE SOLAR SYSTEM THIS MONTH

MERCURY rises in the south east at 07:30 with the Sun and in the bright sky. The smallest planet will be much too close to the Sun and will not be visible this month.



Mercury, Venus, Neptune and Uranus in the south west

VENUS is still close to the Sun and will not be observable. The location of Venus on the evening of 16th February is shown on the chart above. Venus is now beginning to move away from the Sun to the east to become an evening object close to the western horizon at sunset. As it climbs higher in the evening sky it will become the 'Evening Star' in the west. The sky has been darkened on the chart so the positions of Venus and the Sun can be seen. Venus has just moved out from behind the Sun so will appear as a small disc. It will appear to get larger as moves closer to us.

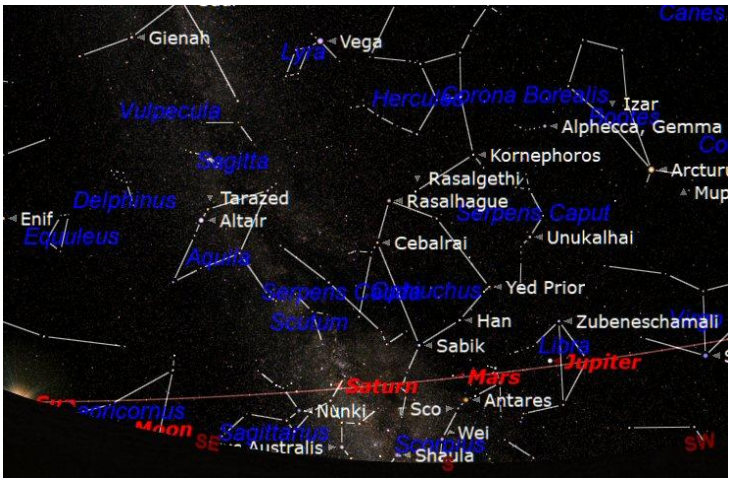


Chart showing Jupiter, Mars and Saturn at sunrise

MARS will be rising in the south east at about 03:00 this is over four hours before the Sun rises. The Red Planet appears small at just 6.0 arc-seconds in diameter but is quite bright at magnitude +1.0. Mars looks fainter and redder than Jupiter. See the chart above (the sky has been darkened).

JUPITER will be an early morning object for the next few months and appears bright in the east before sunrise. It will rise at 01:45 at the beginning of the month and 00:30 at the end of the month. Jupiter is large at 37".5 and bright at magnitude -2.1. At the moment Jupiter forms a nice line in the east with Mars and the bright star Antares in the constellation of Libra. See the chart above.

The four brightest moons of Jupiter (Io, Europa, Ganymede and Callisto) can easily be seen using a small telescope or even a good pair of binoculars. Their movement can be tracked from evening to evening and are fun to monitor.

SATURN has just moved out from conjunction with the Sun. It rises at about 06:30 but is still too close to the Sun to be visible this month. See the Mars chart opposite.

URANUS will be in a good observable position this month and will be quite high in the south west as soon as the sky is dark. Using a good pair of 10x50 binoculars a slightly fuzzy blue, star like, object can be seen. A telescope at a magnification of 150x will show it as a small blue/green disc. It sets in the west at 22:45. See the Mars chart.

NEPTUNE is very close to the Sun this month and will not be observable. See the Mercury chart opposite.

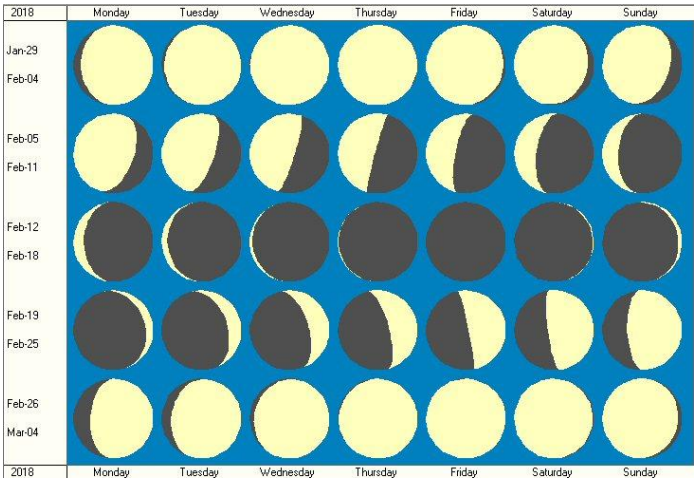
THE SUN

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 17:40 by the end of the month. There have been no sunspots recently so the Sun has been quite uninteresting to observe.

THE MOON PHASES IN FEBRUARY

There will be no Full Moon this month. The last full Moon was on 31st January and was the second Full Moon in January, an occurrence that is sometimes referred to as a 'Blue Moon'. March will also have two Full Moons.

The Full Moon on 2nd March will be the last of this series of, so called, 'Super Moons'. The full Moon will coincide with its closest approach to Earth. It will appear 14% larger than it appears when it is furthest from point Earth.



Full Moon will be on the 31st January

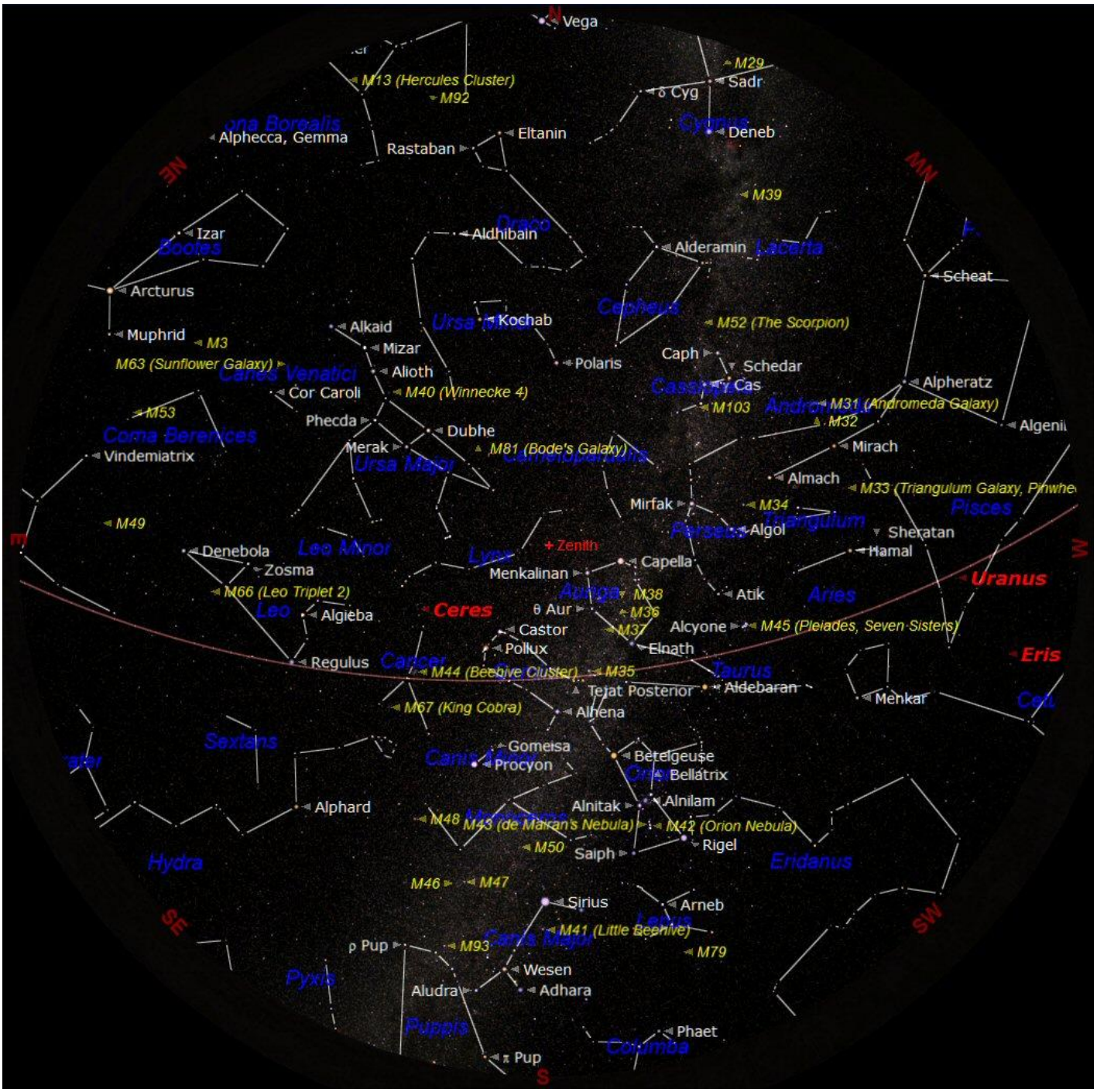
Last Quarter will be on 7th February

New Moon will be on 15th February

Last Quarter will be on 24th February

Full Moon will be on the 2nd March

THE NIGHT SKY THIS MONTH



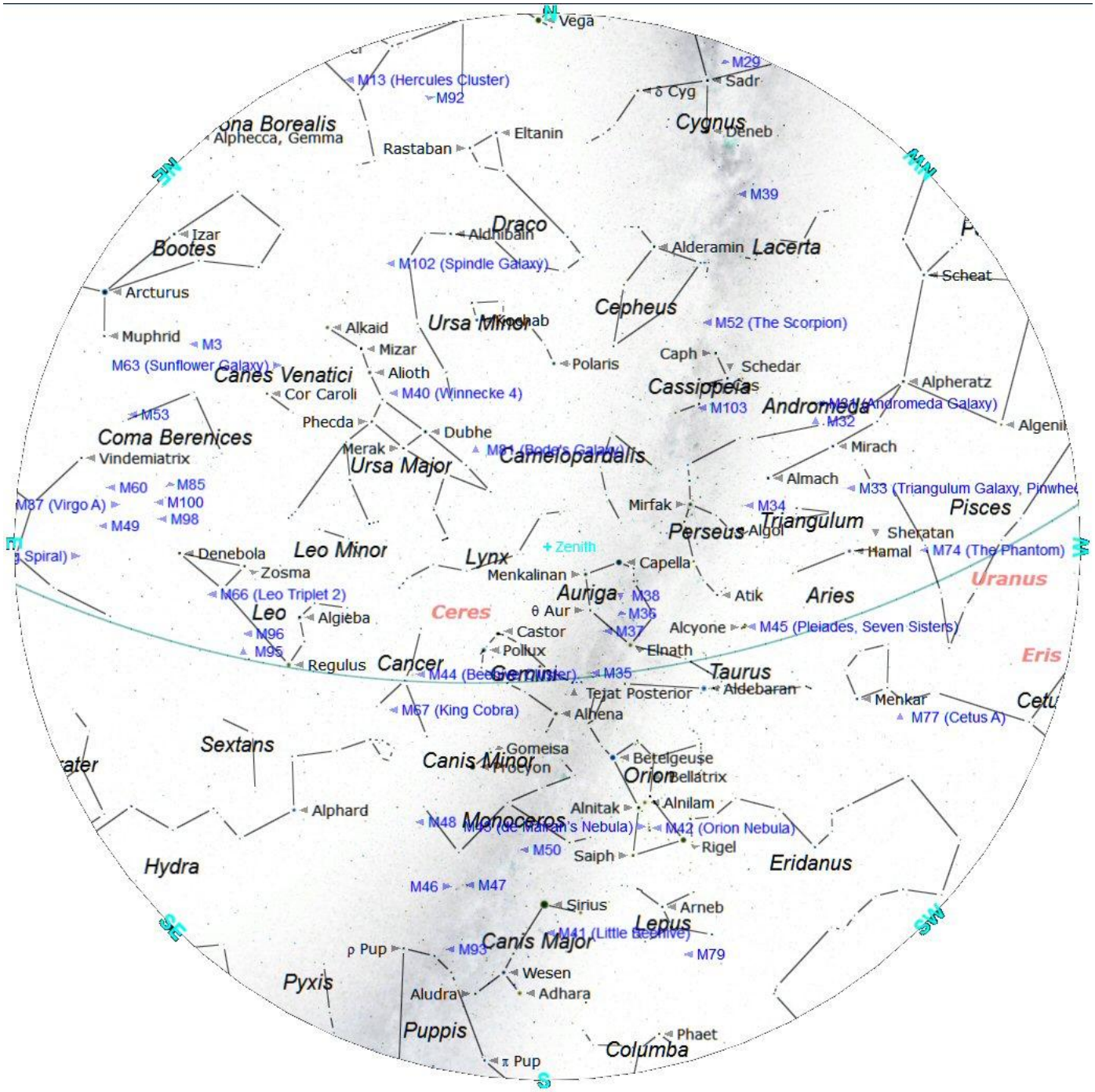
The chart above shows the night sky as it appears on 15th February at 21:00 (9 o'clock) in the evening Greenwich Mean Time (GMT). As the Earth orbits the Sun and we look out into space each night the stars will appear to have moved across the sky by a small amount. Every month Earth moves one twelfth 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 high in the north east. 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 and Mars (early morning) with Uranus in the early evening.

THE NIGHT SKY THIS MONTH

This chart below is included for printing off and use outdoors



Position yourself looking south and hold the chart above your eyes with south at the bottom

The chart shows the sky at 21:00 on 15th February 2018

The sky will appear the same as shown above at 22:00 on 1st and at 20:00 on the 28th