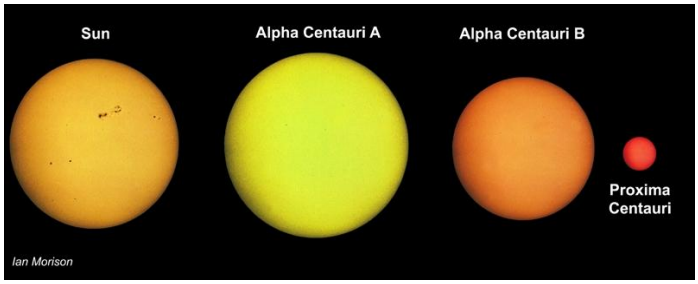
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – December 2016

Proxima 'b' may be a Water World

An artist's impression of Proxima Centuri and Proxima b with Centuri A and B behind

The planet Proxima b was discovered earlier this year and reported in the September magazine. It was found orbiting our closest neighbour star Alpha Centuri C. It was thought to be at the right distance from its star for liquid water to exist on the surface. New research has suggested the planet may actually be a 'Water World'.

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



The Alpha Centauri stars compared to our Sun

The newly discovered planet is called Proxima b and it is a terrestrial world (Earth like) whose existence has now been confirmed after 16 years of study.

It is not yet confirmed whether Proxima b has an atmosphere or liquid water but recently published research has suggested that there may more water than previously thought possible. Computer models were used by researchers at the University of Bern, in Switzerland to simulate the formation of planets around small Red Dwarf Stars. The results indicated that the planets in orbit around Red Dwarf Stars are likely to form with large amounts of water present that could comprise up to 10% of the total mass of the planet. This is a huge amount of water compared to the 0.02% of water present on Earth.

It has been found that small Earth like planets forming around these stars are likely to be 0.5 to 1.5 of the mass of Earth. It has also been found through this latest research that 90% of these planets would be likely to have large amounts of water present. These planets being so close to the star would be tidally locked (with the same part of the planet facing the star). However the planets would be expected to have a thick atmosphere that would distribute the heat around the whole surface.

NEWBURY ASTRONOMICAL SOCIETY 2016 - 2017

2nd December Spectroscopy - starlight's hidden code
Website: **www.newburyastro.org.uk**

NEXT NEWBURY BEGINNERS MEETING

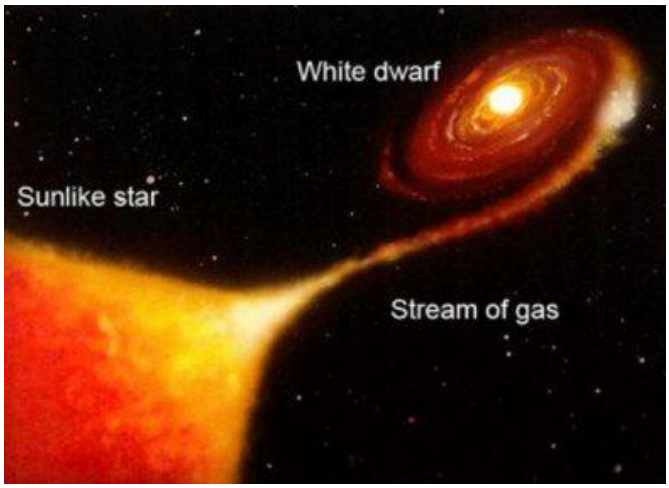
21st December The shortest day
Website: **www.naasbeginners.co.uk**

THE STAR OF BETHLEHEM – WHAT WAS IT?

A traditional view of the Wise Men and the Star of Bethlehem

For nearly two thousand years scientifically minded people have wondered what was the 'Sign in the Sky' that the Wise Men saw? What sign could have been so important that they would have started a very dangerous journey covering over a thousand kilometres to witness what the sign had foretold? We tend to accept that the Star of Bethlehem was a star but was it a star and if it was is there any evidence of it in the sky today?

If it had been a 'New Star' then it would have been either a Nova or a Supernova in our vicinity. A Nova is a star that is one component of a double star system that has exploded. It would have been an older star that had reached the end of its time as a normal star and become a small but very dense White Dwarf. The pair of stars would have been a very close double system with the White Dwarf pulling Hydrogen gas off the other star.



A white dwarf feeding off and normal star

The Hydrogen would build up a very dense layer on the surface of the White Dwarf until the pressure and temperature on the surface created a run-away Nuclear Fusion explosion. The explosion (Nova) would cause the star to increase in brightness by millions of times.

When a very large star has used up is available supply of Hydrogen fuel it will explode and destroy itself in a massive explosion called a Super Nova. This causes the star to increase in brightness and shine brighter than all the stars in its host galaxy put together.

A Supernova explosion in a distant Galaxy

For either of these events the stars would have needed to be in our vicinity for them to be seen using the naked eye. If it had been that close then it would have left an expanding cloud of debris that would still be visible today. A Supernova was seen in the year 1054 AD and recorded by Chinese astronomers at the time. The star was located 6000 light years away so the light took that time to reach Earth. The Supernova Remnant can still be seen in the constellation of Taurus. See next page.

The Super Nova Remnant is known as Messier 1 (M1) or the 'Crab Nebula' in the constellation of Taurus.

Messier 1 (M1) the Crab Nebula

There is no evidence that there was a Nova or Supernova anywhere in our local area that can be linked to an event that occurred around 2000 years ago. So this rules out a Nova or Super Nova. Historically there are no reports of a naked eye Supernovae, bright comet or any large meteor strikes so it was unlikely to have been any of these and there is no astronomical evidence. So what was it?

This really only leaves us with one option, that is: there might have been a special alignment of the planets. The Magi (the Wise Men) were expert astronomers who knew the sky well and were able to calculate and predict the movements of the planets very accurately.

We can programme our modern computer planetarium applications to show what was happening in the sky around this time. However we do have a bit of a problem because we don't know exactly when Jesus was born. In fact we also have a problem with our calendars that makes it even more difficult.

A monk called Dionysius produced the calendar on which our modern calendars are based. In the 6th century when Dionysius calculated the dates for the start date of his calendar, he used the length of the reigns of the Roman emperors to calculate back to the date of the birth of Jesus. However he made two major mistakes and possibly a couple of others. This calendar was used as the basis for our Julian calendar so the mistakes were built in and are still there.

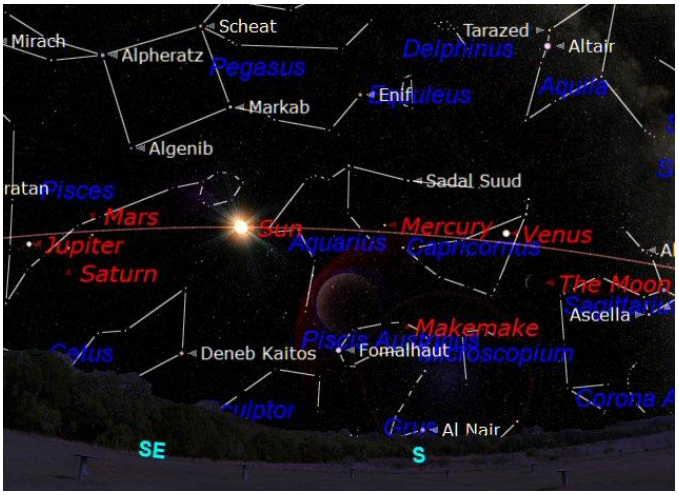
Augustus, Emperor of Rome ruled from 27BC to 14AD but he also ruled under the name Octavius from 31BC to 27BC. Unfortunately Dionysius forgot to allow for these 4 years so they were not accounted for in his calendar. Also the Romans had no concept of the number 0 (zero) so the Dionysius calendar went from 1BC to 1AD with no year zero. From this we can estimate that, if all the Bible stories are true, Jesus was probably born between 5BC and 7BC.

There are three events that could have been very significant to these ancient astronomers who were also astrologers believing that the future was governed by what could be seen in the heavens. The constellations had special meanings for certain regions of the known world and astronomical events occurring in these constellations would affect these regions.

The planets also had special significance, for instance Jupiter would be associated with kings and the constellation of Aries (the Ram) was associated with the region around Judea. So the Magi (the wise men) could have interpreted an event involving these as a sign in the sky that could mean a king was to be born in Judea.

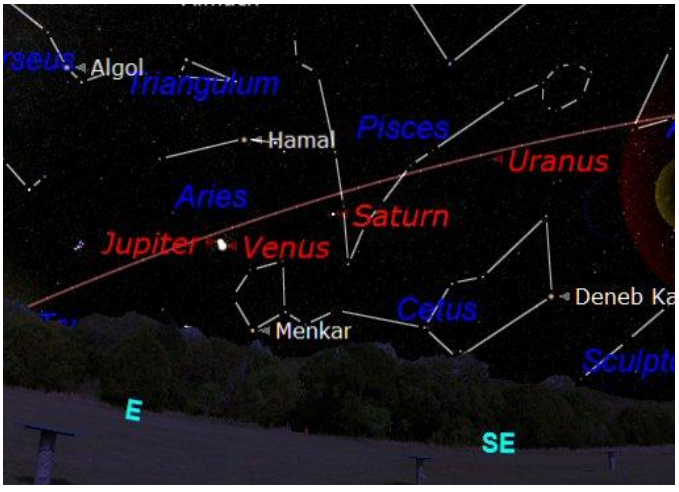
If we check our computer planetarium application we can see there were three interesting astronomical events that occurred in our time frame of 5BC to 7BC. These individually or in combination would also have been of great astrological significance for the Wise Men.

The last event occurred in March 6BC when all the known planets were aligned in the sky. What made this event more significant was the planet Jupiter (associated with a king) was moving into the constellation of Aries (which was associated with the kingdom of Judea). This could have been interpreted as meaning a king was to be born in Judea. The chart below shows the sky as it appeared in March 6BC when viewed from Bethlehem. The planets are shown in the daytime but they could be seen in the dark sky before sunrise and after sunset.

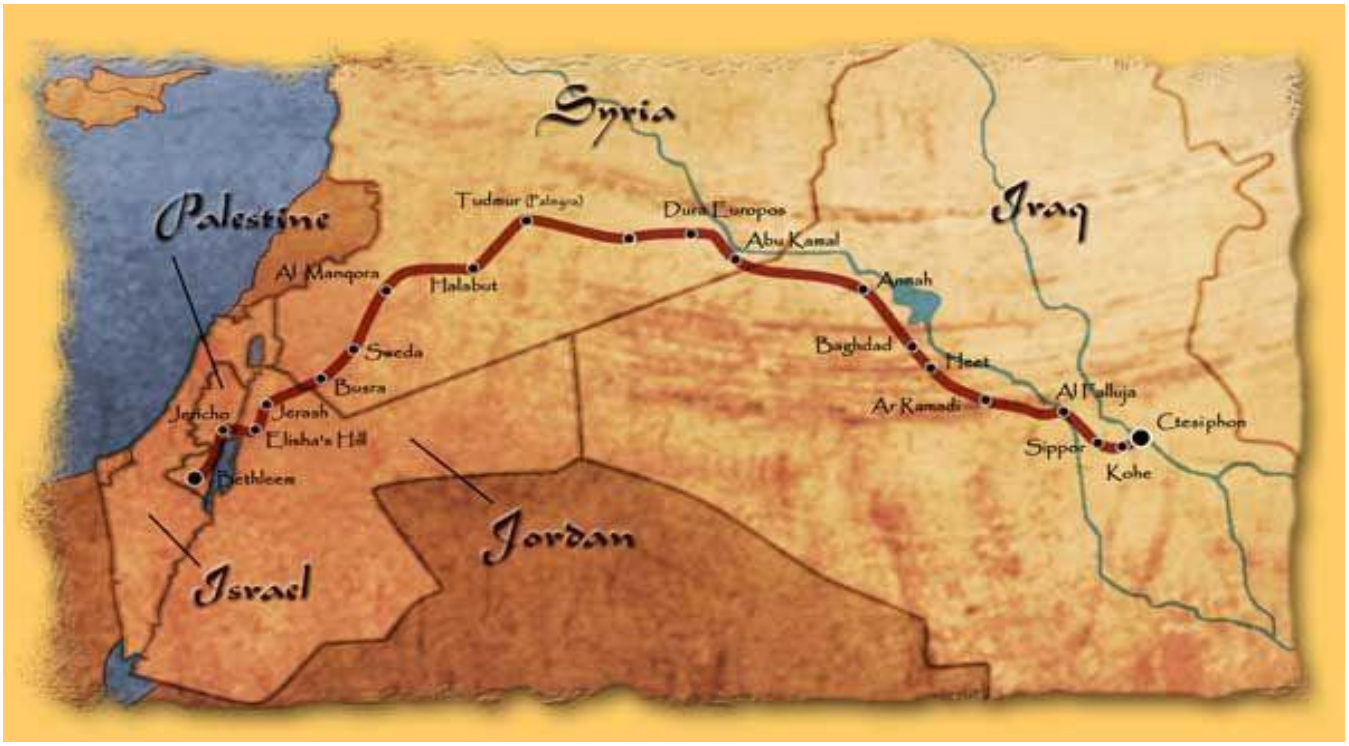


The Planets aligned in March 6BC

The second interesting event occurred on 8th May 6BC when Venus was in conjunction with Jupiter (very close) in Aries and visible low in the east before sunrise. The Chart below shows the sky as it appeared on 8th May 6BC when viewed from Bethlehem. It shows the planets Jupiter and Venus very close together in the constellation of Aries just before sunrise.



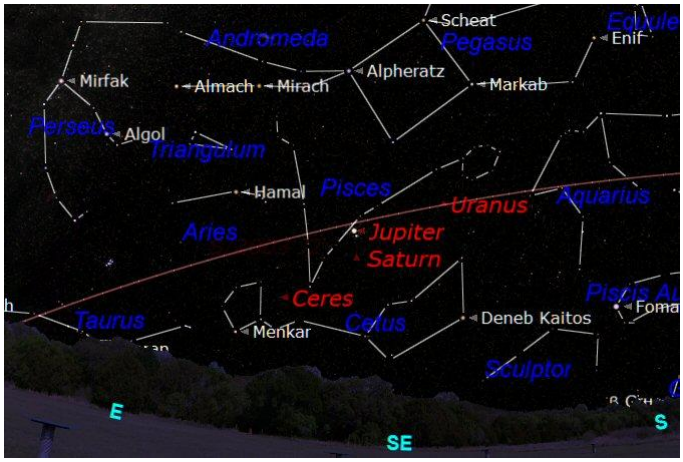
Jupiter and Venus in conjunction on 8th May 6BC



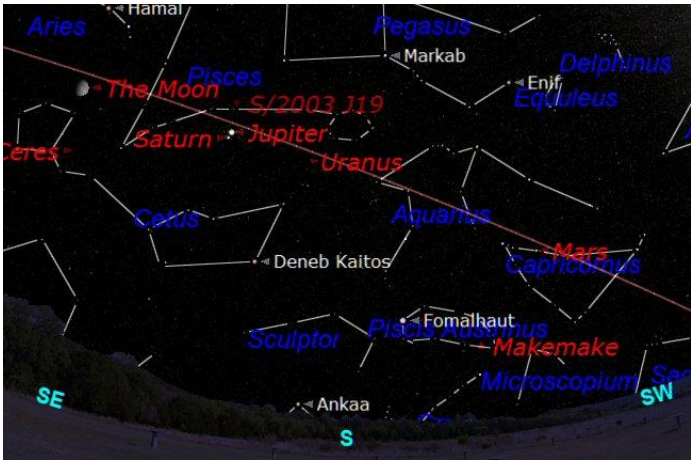
A map showing the route the Wise Men must have taken to Bethlehem

The first event occurred in 7BC and was even more intriguing. It was a double conjunction (close approach) of Jupiter and Saturn in the early morning sky in June 7BC and again in December 7BC in the evening sky. The chart below shows the sky as it appeared from Bethlehem (and Bagdad) at 04:00 (before sunrise) on 1st June 7BC. These conjunctions occurred in the constellation of Pisces, the constellation next to Aries.

This is very interesting because the Magi could have seen the June 7BC event from Iraq where they lived. They could have started their journey then or before and seen the December event in Judea 6 months later. This could have easily been achieved in the time it would have taken them to travel there in 7BC. The chart below shows the sky as it appeared from Bethlehem at 17:00 (after sunset) on 1st December 7BC.



Jupiter and Saturn in conjunction 04:00 1st June 7BC



Jupiter and Saturn in conjunction in December 7BC

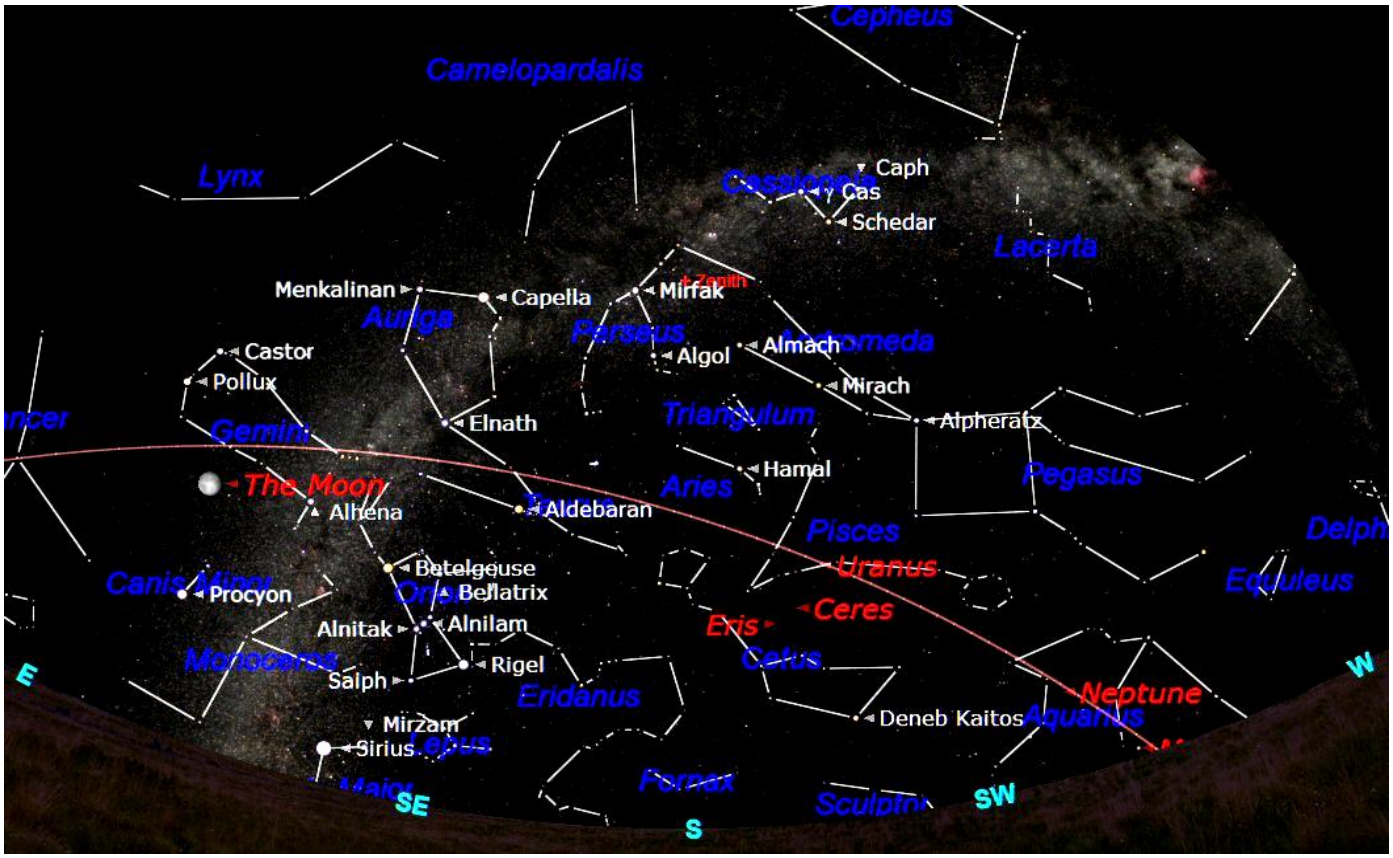
Jupiter appeared to approach Saturn from the west (right) and was at its closest at the beginning of June 7BC. Jupiter then moved away from Saturn to the east (left) until September 7BC when it began to move back westward and returned to Saturn. Through October and November Jupiter moved closer and closer to Saturn.

Jupiter made another loop around Saturn towards the end of 7BC and into early 6BC. Jupiter then moved eastwards (to the left) again. Late March 6BC Jupiter moved out of Pisces and into Aries. The Jupiter/Saturn conjunctions were followed by the Jupiter/Venus conjunction in May 6BC. Then all the planets assembled in March 6BC when Jupiter was in Aries.

The Wise Men would have travelled north from Iraq then west and south to take them around the dangerous desert on the only safe route. See the chart at the top of this page. The highly educated Magi could easily have predicted all these very important astrological events and made the decision to travel to see the new king.

The June conjunction could have predicted the birth of a king and would have been seen from Iraq. The December conjunction might have heralded the birth of the king and they could have seen it as they approached Bethlehem. Interestingly this means they would have seen it occur in the south and above Bethlehem as they approached from the north.

THE NIGHT SKY - DECEMBER 2016



The chart above shows the night sky looking south at about 21:00 GMT on 15th December. 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 at the bottom is the Ecliptic or Zodiac. This is the imaginary line along which the Sun, Moon and planets appear to move across the sky. The constellations through which the ecliptic passes are known as the constellations of the 'Zodiac'.

Constellations through which the ecliptic passes this month are: Aquarius (the Water Carrier), Pisces (the Fishes), Aries (the Ram), Taurus (the Bull), Gemini (the Twins) and Cancer (the Crab) rising over the eastern horizon, just coming on to the chart to the left.

The Milky Way (our Galaxy) appears to rise up from the south eastern horizon. It continues up through the constellations of Monoceros, Orion, Gemini, Auriga and into Cassiopeia. It then dips down into Cygnus which is moving towards the north western horizon.

The planet Mars is in Capricornus and is still visible in the south west in the evening twilight. Neptune is in Aquarius and Uranus is in Pisces, both are still in a good position for telescopic observation. Saturn is now too close to the Sun and not observable. Venus is moving away from the Sun and will be rising higher in the west in the evening over the next few months. Jupiter is an early morning object rising about six hours before the Sun in the east. It is very bright and easy to find in the south until the sky brightens at about 7 o'clock.

Early in the evening it will be easy to start exploring the night sky from the Summer Triangle in the west. First find the three stars Deneb, Vega and Altair at the corners of the triangle.

Later in the evening when the Summer Triangle is disappearing over the north western horizon the constellation of Pegasus (the Winged Horse) can be used as our starting position. 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. It was the constellation of the month in the October issue of this magazine.

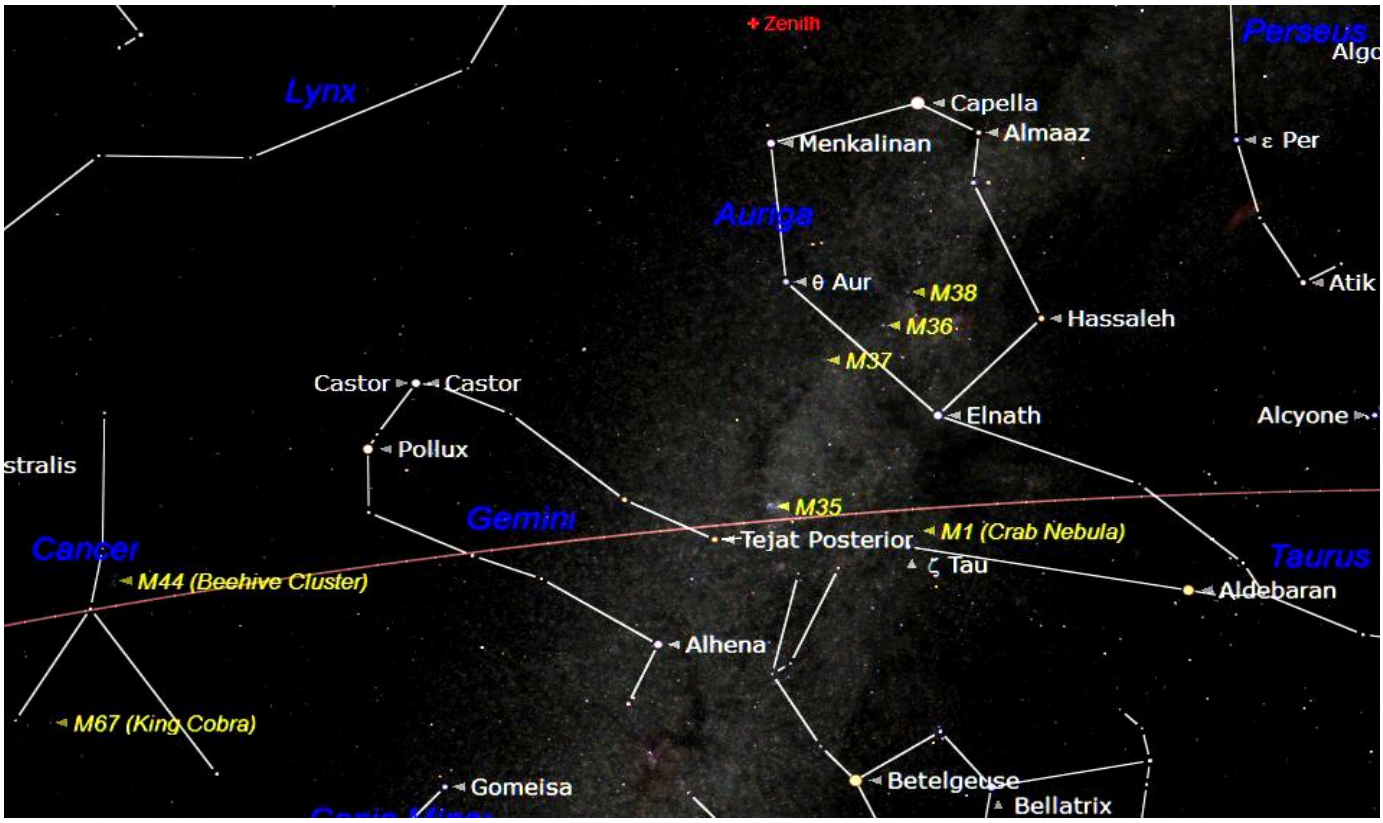
Joined to Pegasus at the top left star Alpheratz is the elongated shape of the constellation of Andromeda. It is rather odd that Alpheratz is actually the brightest star in Andromeda and is not officially a member of Pegasus. It obviously forms part of the Great Square of Pegasus so is regarded as belonging to both constellations.

Following the lower and brighter line of stars that define Andromeda, count along two stars (three including Alpheratz) to Mirach. Then count two stars up (three including Mirack) and just to the right of the second star is a small fuzzy patch of light, this is Messier 31 (M31) the Great Spiral Galaxy. See page 7.

Sitting astride the ecliptic to the east 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 faint and dispersed Open Cluster called the Hyades. It has the bright Red Giant star Aldebaran in the centre. The real beauty of Taurus is the naked eye Open Cluster M45 the Pleiades. See November magazine.

Following Taurus along the ecliptic is Gemini (the Twins). The twin stars Pollux and Castor are easy to find. Below Taurus and Gemini is the magnificent winter constellation of Orion (the Hunter) rising in the south east. As Orion climbs higher in the sky over the next few months it will begin to dominate the winter sky and become our start point for finding our way around.

Constellations of the Month – Gemini, Auriga and Cancer



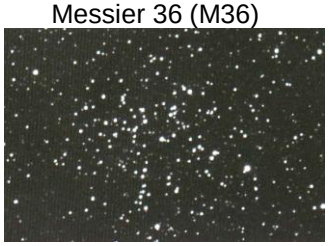
The chart above shows the winter constellations of Auriga (the Charioteer), Gemini (the Twins) and Cancer (the Crab). These are interesting constellations to search out and have some interesting objects to see even when using just a pair of binoculars. Gemini and Cancer are located on the Ecliptic and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

Auriga is located above the ecliptic and is conjoined with Taurus at the star Elnath. In Greek mythology, Auriga is often identified as the mythological Greek hero Erichthonius of Athens, the son of Hephaestus who was raised by the goddess Athena. Erichthonius was generally credited to be the inventor of the quadriga, the four-horse chariot. He is said to have used this chariot in the battle against Amphictyon, the event that made Erichthonius the king of Athens.

The most prominent star in Auriga is Capella which is the sixth brightest star in the night sky. Capella is located almost directly overhead at this time of the year.

Messier 36 (M36)

Messier 37 (M37)



Messier 38 (M38)

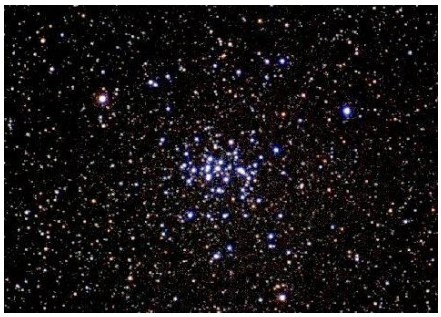
Messier 35 (M35)

Auriga has three Messier Open Clusters that can be seen using binoculars. These are M36, M37 and M38. See the images in the previous column. Open Clusters are groups of stars that have formed from the gas and dust in a Nebula (large cloud of gas and dust). These clusters can be seen using binoculars looking like small smudges of light. They are best seen using a telescope which will show the individual stars of the cluster.

There is a fourth Open Cluster that appears to be in the same line as M36, M37 and M38 over the border in the constellation of Gemini, this is Messier 35 (M35). Gemini is named after the mythical twins Pollux and Castor from Greek mythology. Castor and Pollux were the children of Leda and Argonauts. Pollux was actually the son of Zeus who seduced Leda but Castor was the son of Tyndareus, King of Sparta and Leda's husband.

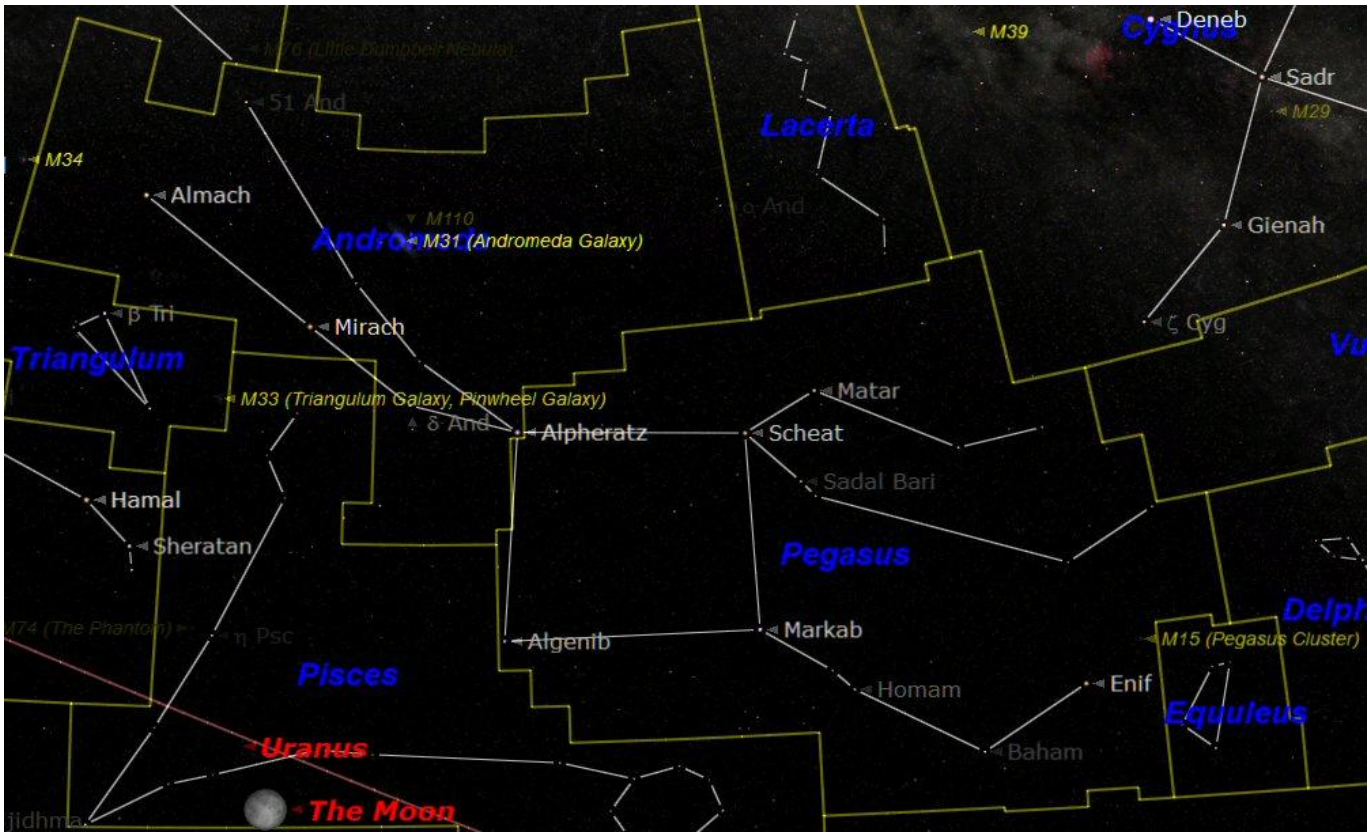
Messier 35 is located at the end of the upper of the two lines of stars that emanate from Pollux and Castor. It is the most spectacular of the four Open Clusters and is shown in the previous column.

Cancer is a faint and rather indistinct constellation but it does have a rather nice Open Cluster called Messier 44 (M44) Praesepe or the Beehive Cluster. It is large and dispersed and best seen using binoculars.



Messier 44 (M44) Praesepe the Beehive Cluster

Special Constellation of the Month – Andromeda



The conjoined constellations of Pegasus and Andromeda

To find the constellation of Andromeda start at the upper left star of the Square of Pegasus called Alpheratz. To the east (left) of Alpheratz there are two fairly distinct lines of stars converging on Alpheratz, these two lines of stars are the main star formation of Andromeda. By following the lower line to the star Mirach then hopping up to the star in the upper line and on to another star at about the same distance the crowning glory of Andromeda can be found. This is the Great Spiral Galaxy Messier 31 (M31).

Messier 31 (M31) the Great Spiral Galaxy

M31 is the closest large Spiral Galaxy to us 2.4 million light years away. It is quite easy to find using binoculars and looks like a fuzzy patch of light. On a good clear night and from a dark sky it can be seen using the unaided eye. This makes it the most distant object that can be seen by the human eye. M31 is thought to look quite similar to our Milky Way Galaxy but a larger. It is estimated to contain 300 to 400 billion stars and the Milky Way is estimated to have 200 to 300 billion stars.

A telescope will show M31 as an elongated patch of light with a bright nucleus similar to the photographic image in the previous column but not so detailed. The galactic disc is tilted to our point of view so we see the disc as being elliptical in shape with a brighter central bulge.

M31 and our Milky Way Galaxy are the two largest spiral galaxies in our local group of about 30 galaxies. The Andromeda Galaxy is actually moving towards our Galaxy at great speed and is expected to make a close pass or even sweep through our galaxy. The close encounter will occur in about 5 billion years which is about the same time that our Sun will reach the end of its existence as a normal star to become a Red Giant then a White Dwarf.

The star at the end of the lower line of stars that define Andromeda is a beautiful double star Almach. This double is rather unusual in that it not an associated double but is a line of sight double. In the image below, the blue star is a much larger and more powerful than the yellow one but the blue star is many times further away.

The double star Almach in Andromeda

THE SOLAR SYSTEM THIS MONTH

MERCURY will be at its meagre best on 11th December. It will be very low on the south western horizon just after sunset. A clear view to the horizon will be required.

VENUS is moving away from the Sun and can be seen in the constellation of Capricornus. It will appear very bright in the south as the Sun sets. The telescopic view is not good because Venus is still low and in the turbulent, dirty air close to the horizon. See the chart below.

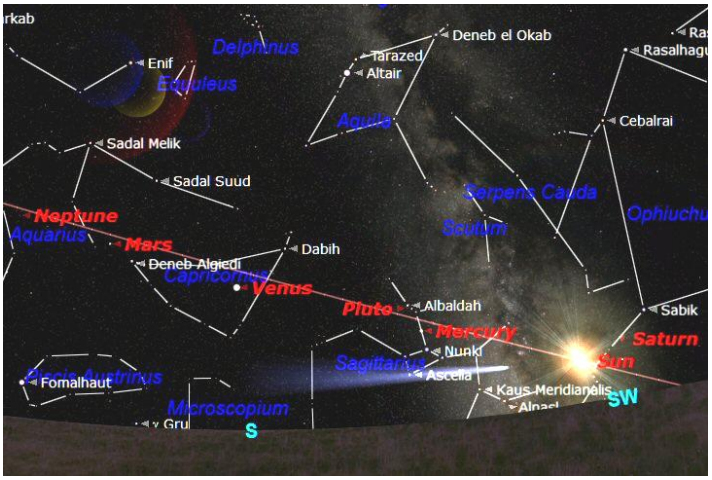


Chart showing Mars, Venus, Mercury and Saturn at sunset

MARS will be in the south as the Sun is setting and the sky begins to darken. The Red Planet appears small at just 6.0 arc-seconds in diameter and is fading to magnitude +0.8. Mars is getting low in the turbulent air near the horizon and will set at 21:15. See the chart above.

JUPITER is now a good early morning object. It rises over the eastern horizon at 02:00 this is about 6 hours before the Sun rises. It will be in a good position for observing between 04:00 and 07:00. See the chart below.

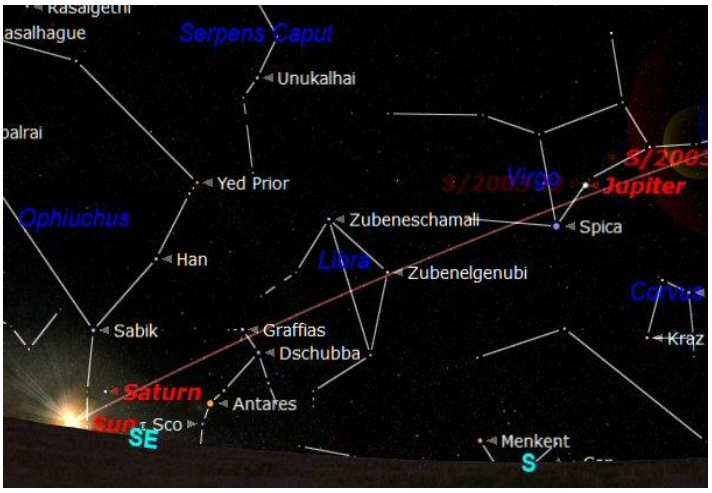


Chart showing Jupiter in the east at 08:00 (sunrise)

SATURN is not visible. See the chart above.

URANUS will be in a good observable position this month. It will be quite high in the south east as the sky darkens. It will be visible using a good pair of 10x50 binoculars but a telescope at a magnification of 100x or higher will be needed to see it as a small blue/green disc. See page 5.

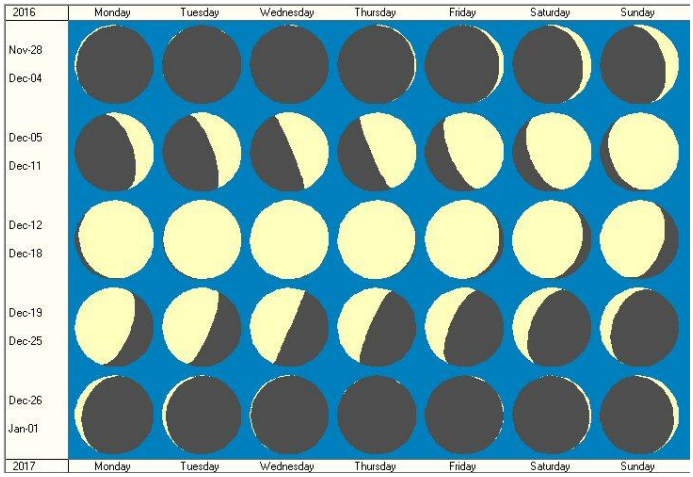
NEPTUNE will be visible in the south as soon as the sky is dark. A telescope with a magnification of 150x will be needed to show Neptune as a small blue/green disc but it is small and difficult to find. See the chart in next column.

THE SUN

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

The Sun rises at 07:45 at the beginning of the month and at 08:10 by the end of the month. It will be setting at 16:00 at the beginning and 16:00 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 DECEMBER



First Quarter will be on 7th December

Full Moon will be on 14th December

Last Quarter will be on 21st December

New Moon will be on the 29th December

NEW YEARS EVE CONJUNCTION

There will be a nice and unusual event to have a look out for on the last evening of 2016. The planets Mars and Neptune will be very close together in the south west after sunset on 31st December.

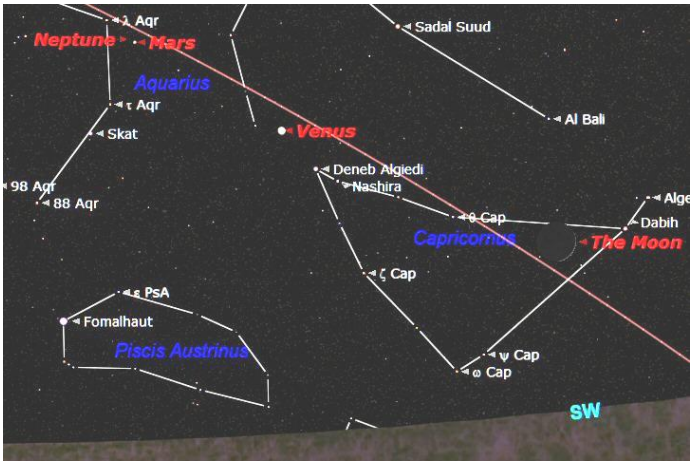
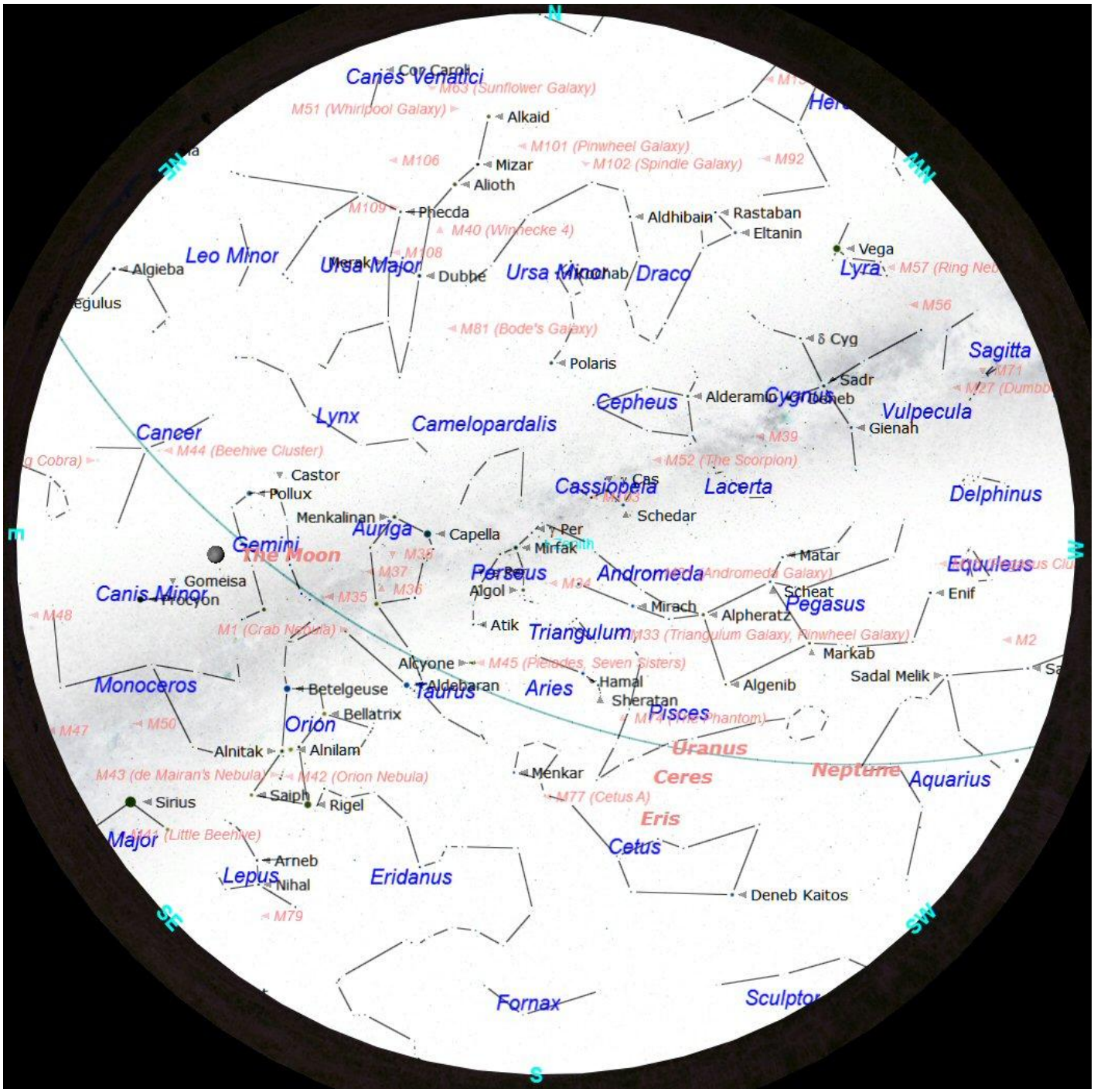


Chart showing Neptune and Mars with Venus

This could be a good opportunity for those who are lucky enough to own a telescope and have not yet seen Neptune to see it for the first time. Neptune is usually quite difficult to find but the close proximity to Mars should make it a lot easier. Venus is also close by to help find the rather faint Mars in the first place. Don't forget to have a look for the New Moon just after Sunset.

THE NIGHT SKY THIS MONTH



The chart above shows the night sky as it appears on 15th December 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 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: Mars and Venus (early evening), Uranus and Neptune and Jupiter (early morning).

SOME ASTRONOMICAL THINGS FOR SALE THIS MONTH

FOR SALE – Beginners Telescope £60

Celestron Power Seeker 114EQ telescope One year old and hardly used

Please contact: Mel Gurdon
13 Swans Close
Ramsbury
Marlborough
SN8 2PH
07774278167

FOR SALE – Selection of Astronomical Books

Wonders of the Solar System - Brian Cox

Philip's Atlas of the Universe (2001 edition)

Moon, Mars and Venus - Antonin Rukl (sectional map of the moon)

Philip's Moon observers guide, what star is that? - Peter Lancaster Brown

Hatfield's Photographic Lunar Atlas - the updated version by Jeremy Cook

Please contact: Bob Paterson
paterson143@btinternet.com