NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – January 2021

THE GREAT CONJUNCTION 2020

Jupiter and Saturn in conjunction at 17:30 on 20th December 2020

The Great Conjunction of 2020 was clouded out on the 21st December which was the evening of the closest approach of Jupiter to Saturn. However the evening of 20th December was clear and the author was able to take a few pictures from his back garden. The image above was taken with a DSLR camera mounted on a tripod and set to minimum zoom. The image below was taken with the DSLR mounted on the tripod and zoomed.

A wide field image using a DSLR zoomed

The following image (in the next column) was taken using the same DSLR but with camera attached to a 90mm aperture, 900mm focal length, refracting telescope. The lens assembly was removed and an adaptor fitted so the camera could be fitted directly into the focuser of the telescope.

With the DSLR attached to a 90mm refractor

The images appear a little blurred because the planets were very low and the remote shutter release button was not working. Saturn's ring is just visible in the image above when the image is enlarged.

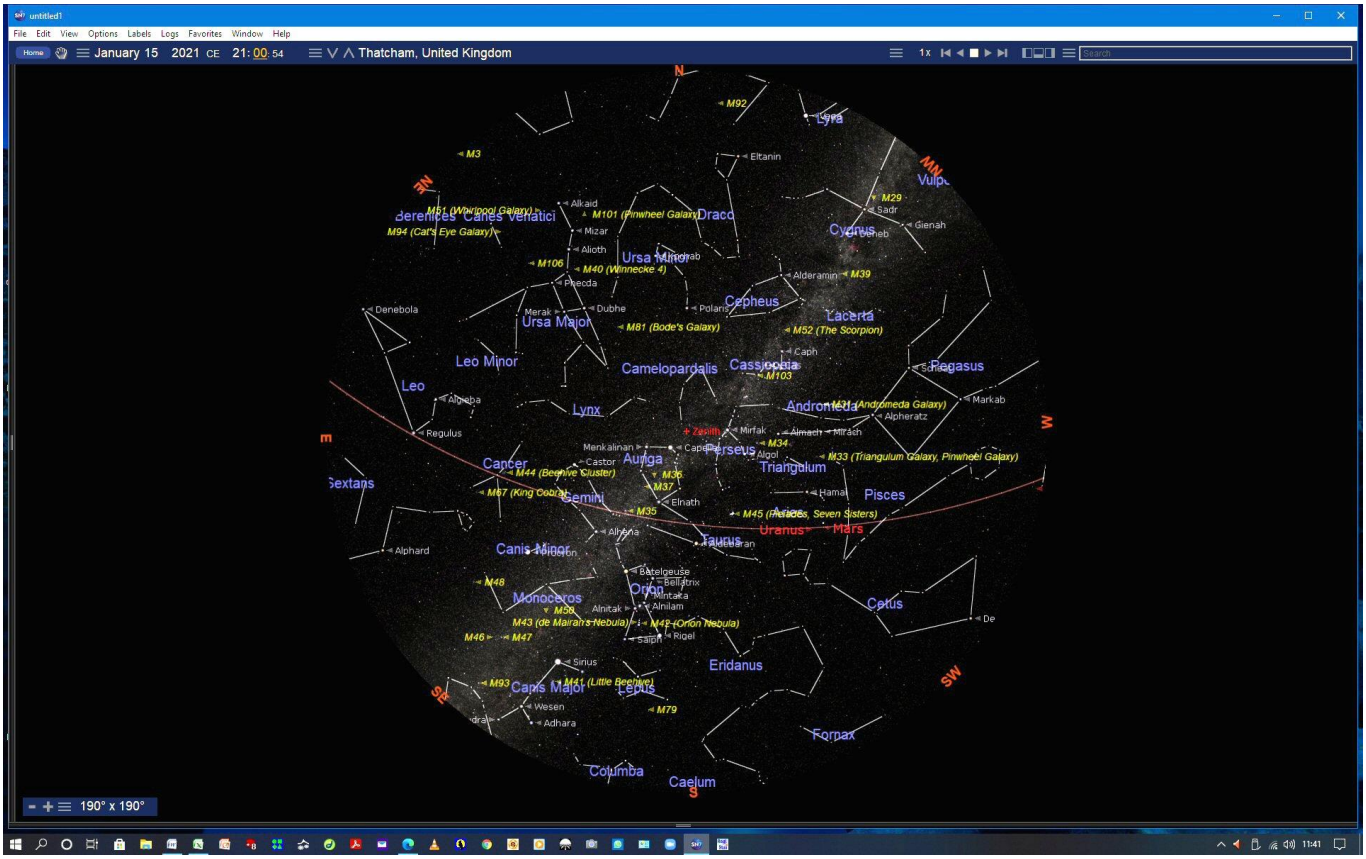
NEWBURY ASTRONOMICAL SOCIETY MEETING

8th January	NAS Members Evening
Website:	www.newburyastro.org.uk

NEXT NEWBURY BEGINNERS MEETING

20th January	Planetarium Applications
Website:	www.naasbeginners.co.uk

USING PLANETARIUM APPLICATIONS



The opening screen of Starrynight Planetarium Application

Modern astronomers are very fortunate that we now have access to electronic star charts and planetarium applications to use on our personal computers and even mobile phones and pads. In the past astronomers had to refer to star chart books or charts of the night sky. These could be difficult use in the dark, outdoors and in the damp night air. Our modern electronic charts are self illuminating and can be zoomed to obtain a closer view of the area of sky that is of interest.

The chart shown above is a 'screen shot' of a typical PC Planetarium Application called Starrynight. This is one of the most popular astronomy applications that can be purchased for use on a PC or Laptop computer. They are supplied as four levels of advancing packages costing between $50 and $250. There are other similar packages from different suppliers. This application is used to produce all the charts for this magazine.

These types of charts can be personalised for personal use by entering the owner's location which is saved so the opening view is as would be seen from the owner's normal location. The time is taken from the computer's clock and is continually updated to track the sky. The viewing location time can however be set manually to any place and any time in the past 40,000 years or for 40,000 years in to the future. The viewing location can also be on or above the surface of other planets or stars. See the time and location strip at the top of the chart.

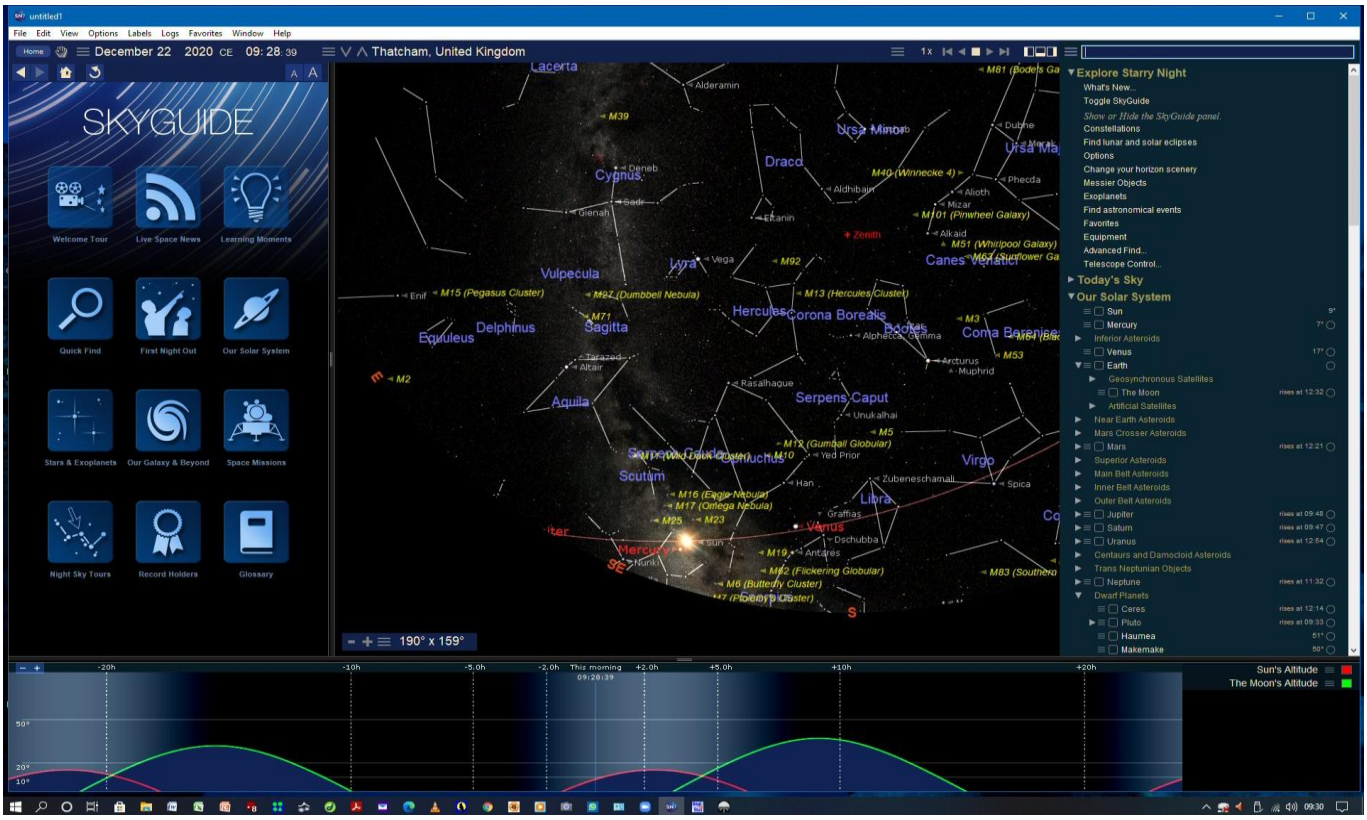
The information to be displayed on the screen can be selected or removed to show the type of view required. Labels for stars, constellations and the planets can be added, formatted or removed as required. Daylight can be switched on or off to make it easier to find and see object that is in the sky during daylight. The view of the sky shown above is the full sky view using maximum 'zoom out' and shows 190º x 190º as indicated at the bottom left of the screen. The screen can be 'zoomed in' by clicking on the + and - at the bottom left of the screen. Individual objects can be 'zoomed' by clicking on that object then selection 'magnify' from the displayed 'drop down' menu. This menu also contains many other functions that can be applied to that selected object.

The chart above shows the view of the whole visible sky down to the horizon in all directions indicated by the compass points shown around the horizon. The point in the sky directly overhead at the viewing location (known as the Zenith) is indicated at the centre of the chart in red lettering. The direction of view can be selected from the dropdown 'VIEW' menu on the white bar at the top of the screen. All the other control and selection menus are dropped down from this same white Menu Bar. The chart can also be moved manually by clicking and dragging the mouse pointer.

Various grids and chart guides can be added to indicate the various sky divisions that are used in astronomy. The orbits of the planets can also be displayed to show their paths across the sky. This option can be used in many ways. One example is to select and display all the orbital paths and then change the viewing location to hovering very high (2 or 3 AU's) above the North Pole of the Sun. The orbits and the current location of the planets can be displayed around the Sun.

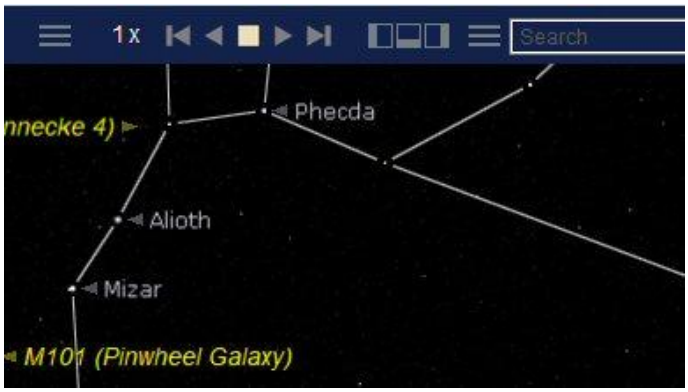
There are far too many options and uses to describe in detail in this article so the following pages will outline some of the functions available. Needless to say there is a way to utilise the application to do almost anything that is asked of it.

HOW TO USE A PLANETARIUM APPLICATION



The main sub-screens of Starrynight

Starry night has three sub-screens that can be activated any time by clicking on the three screen icons at the top right of the screen. See the image below. The left sub-screen accesses the information panel shown on the left of the main screen. This is SKYGUIDE and provides guidance and information about the night sky in the form of presentations and guides.



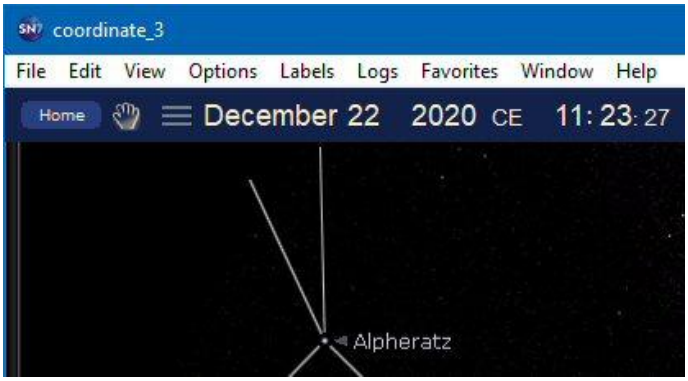
The TIME, SUB-PANEL and SEARCH icons

On the left of the main screen is the search and display panel. This is used to search for objects in the night sky that can then be selected and information about the object displayed on the main chart. So a planet can be selected and then be displayed and the chart may be re-orientated to a different time of direction to display it. This can be applied to stars, comets and deep sky objects. Orbits of selected objects can also be displayed. Items found by the SEARCH box will be displayed in this information panel

The lower panel can show information in a graphical representation. The example shown on the chart above shows the altitude obtained by the Sun (red line) and the Moon (green line) at the time required (default now).

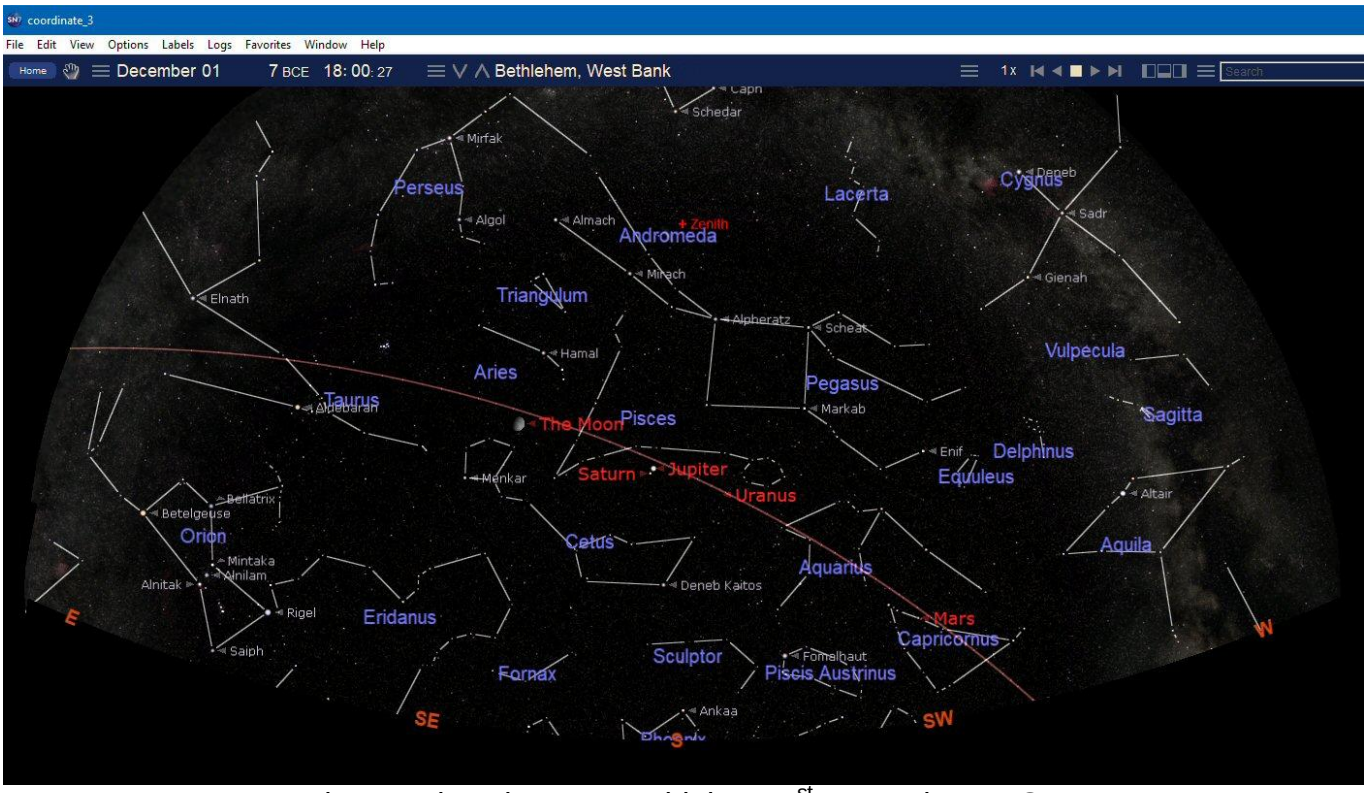
Time can controlled by using the icons at top left of the screen. See the image in the previous column. Time can be stopped or run faster using these icons. The ☐ starts or stops time when coloured white this shows that time has been stopped. Clicking on the ≡ icon allows the unit of time to be selected. Clicking on the 1x icon allows the 1 to be changed to any number and the speed of time to be adjusted (normal time or increments of time). The arrows ►◄ start time forward or backwards. The ►▌ or ▐◄ moves time one selected increment forward or back.

At the top left of the main screen is the white Menu Bar with the time and date controls on the blue bar.



The Menu and Time/Date bars

To the left of the Time/Date icons is a HOME button that returns the programme to the default screen. The hand icon is for the mouse pointer options. On the Time/Date menu clicking on the ≡ icon displays time and date information. To change the time or date click on the time or date item then press the keyboard up or down key to change or type in the required time or date. This can be the time or date up to 40,000 years ago or into the future. See next page for using Menus.

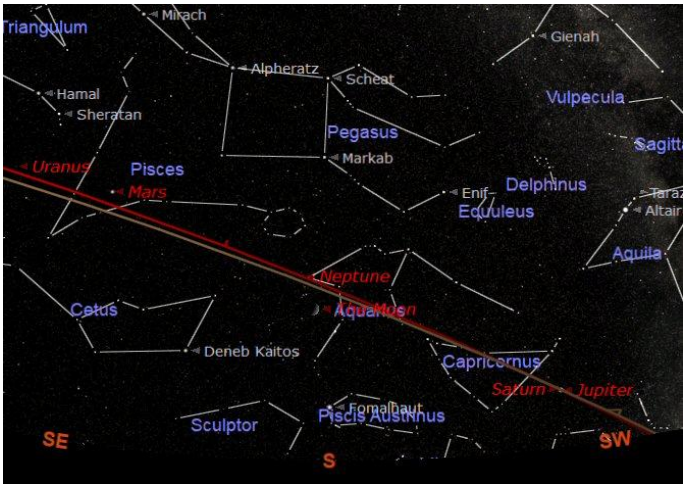


The evening sky over Bethlehem 1st December 7BCE

The chart above gives an example of what can be done using a planetarium application on a PC. The view shown in the chart is the Jupiter / Saturn Great Conjunction that occurred during December in the 7BC. The date is indicated on the blue menu bar at the top left of the chart along with the viewing point location.

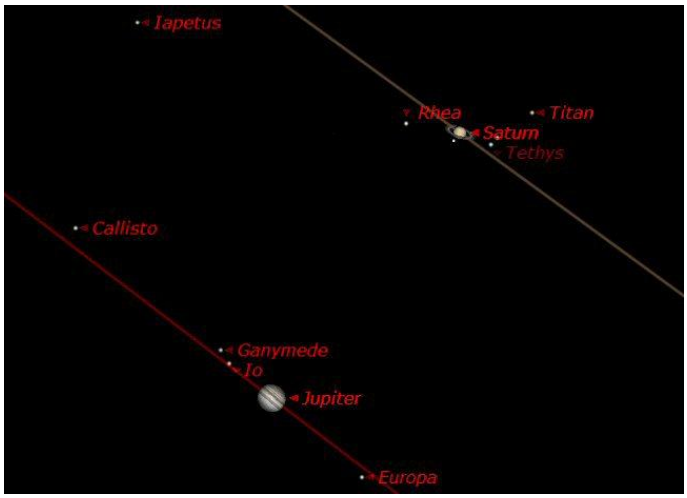
Using this chart format it is possible to search the skies around the time that the Bible records the Wise Men from the east followed a sign in the sky. We can look for any events that are unusual and may have prompted these men to travel to Bethlehem. The conjunction of Jupiter and Saturn could have been of great importance to these ancient Astronomers / Astrologers. Another event may have been an alignment of the planets in March 6BC.

It is also easy to add the orbital paths of the two planets as they converged through the autumn of 7BC. The chart below shows, for example, the orbital paths added to a chart showing the converging orbits leading up to the Great Conjunction of Jupiter and Saturn this year. See page 1.



The orbital paths of Jupiter and Saturn in 2020

There are many uses for the Planetarium Applications but the primary purpose for astronomers is to provide information about the sky for observations. Charts produced by the application can show us the current sky with stars and constellations labelled. They can also show the position of planets and their moons that can also be labelled for identification. The chart below was produced to show a detailed view of Saturn and Jupiter at their closest point in the 2020 conjunction.

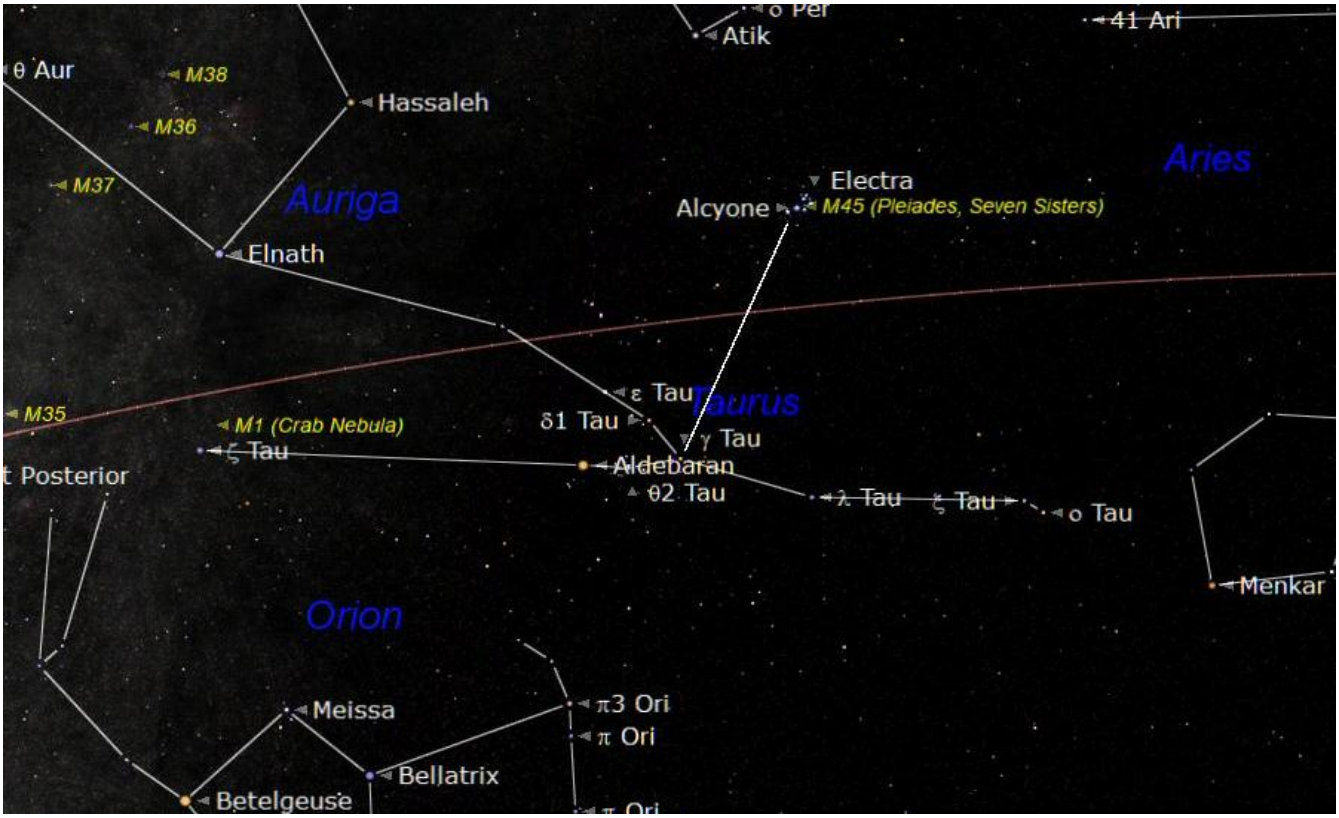


The conjunction at 17:00 on 21st December 2020

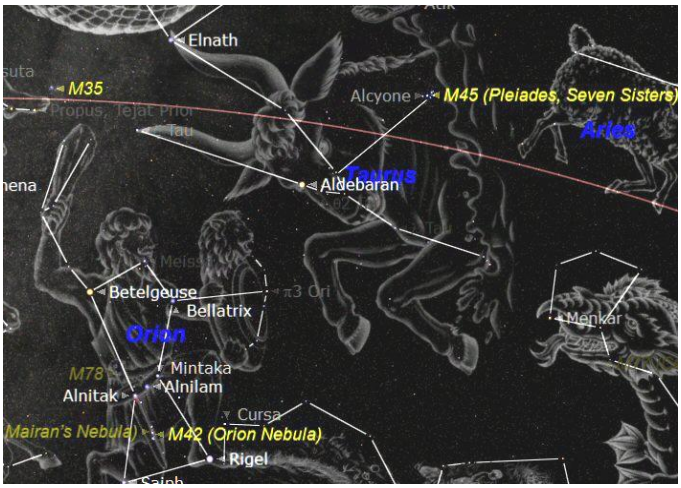
The applications are regularly updated so there are many other uses for the Planetarium Applications. The appearance of new comets will be shown as they move across the sky night after night so their paths can be plotted. Other events like eclipses and occultations (when one object appears to pass in front of another) can be predicted and detailed.

The other good news is: there are very good and free to download applications available on the internet. Stellarium is a good and most the popular example to download 'free' to try.

CONSTELLATION OF THE MONTH – TAURUS



The chart above shows the constellation of Taurus the Bull. There are many different representations of Taurus but he is generally shown with his horns tipped by the stars at the end of the obvious '>' shape. The bright red star Aldebaran is normally used to show the bull's eye.

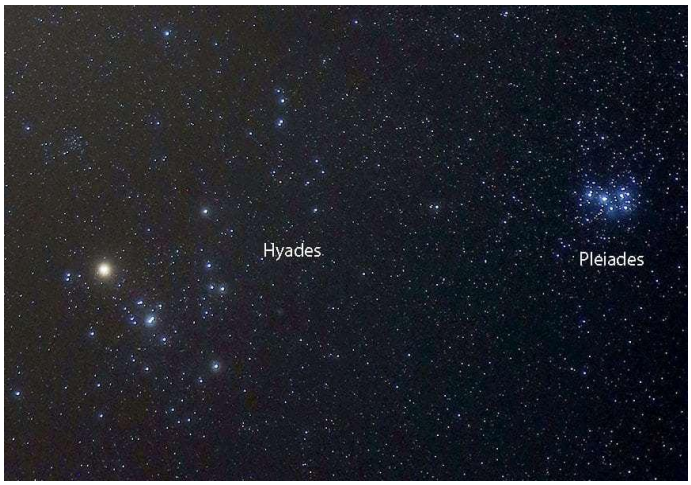


An illustration of the constellation of Taurus

With a little imagination Taurus appears to be charging Orion in the illustration. It sits on the Ecliptic and is one of the star signs of the Zodiac. The asterism (shape) used to identify Taurus resembles a stretched 'X'.

The bright red star Aldebaran is located at the centre of Taurus. It is easy to find and therefore helps to identify the constellation of Taurus. It is in fact a Red Giant Star and that is why it appears distinctly orange. A Red Giant is a star similar to our Sun (perhaps a little larger) that is approaching the end of life as a normal star. It has used up most of its Hydrogen fuel and has swollen into a giant. Its outer layers are now stretched over a larger area so the available heat is also spread over a bigger area so it its surface is cooler and appears orange in colour.

Surrounding the bright red star Aldebaran is an Open Cluster of Stars known as the Hyades. It is an older cluster so its stars have begun to disperse. It is also quite far away from us so the stars appear quite faint. In a dark Moonless sky the cluster can be seen with the naked eye but is best seen using binoculars. The cluster is large, at 3.5° in diameter (about 7 Moon diameters) and well dispersed.



The Open Star Clusters Hyades and Pleiades

The real jewel of Taurus is without doubt the beautiful Open Cluster, Messier 45 (M45) also called the Pleiades or the Seven Sisters. An Open cluster is created as stars form in a giant cloud of gas and dust called a 'Nebula'.

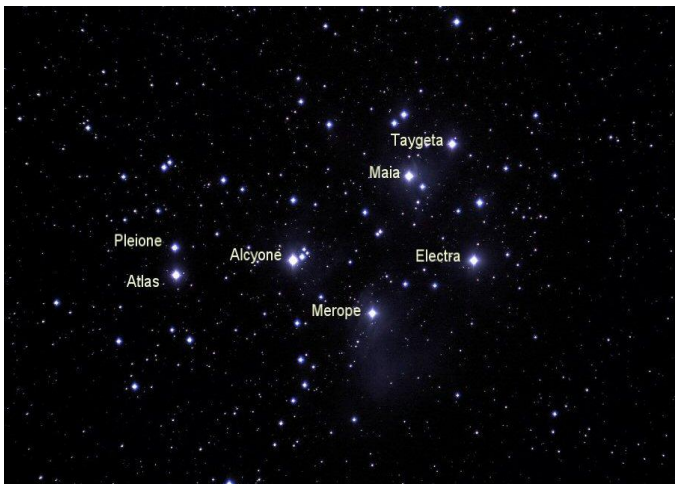
M45 is visible to the naked eye initially looking like a patch of light. Closer observation will reveal a cluster of up to seven stars. Using a good pair of binoculars many more stars will be seen. There are in fact about 300 young stars in the cluster that is estimated to be about 100 million years old. M45 is one of the closest open clusters to us at 400 light years.

The Pleiades look brighter than the stars of the Hyades because they are very bright large young stars and are relatively close to us. The largest is Alcyone which is 10 times the mass of our Sun and 1000 times brighter. The larger and brighter stars of the Pleiades are also rotating very fast.

Messier 45 (M45) the Pleiades (Seven Sisters)

The stars of the Pleiades cluster would have formed from the gas and dust of a Nebula. Gravity draws the atoms of the Nebula together to form denser clumps of gas that become ever denser. Eventually the gas is squeezed into dense spheres where the pressure and high temperature at the core causes Hydrogen atoms to combine through Nuclear Fusion. As Hydrogen atoms are fused into Helium heat is produced and the sphere becomes a shining star. Any left-over gas and dust is blown away by intense radiation from the young stars and a cluster of new stars is revealed. This type of star cluster is called an 'Open Cluster'.

The biggest and brightest stars of M45 (the Seven Sisters) have been named after seven sisters from Greek Mythology. They were the seven daughters of the Titan called Atlas and the sea-nymph Pleione and were born on Mount Cyllene.



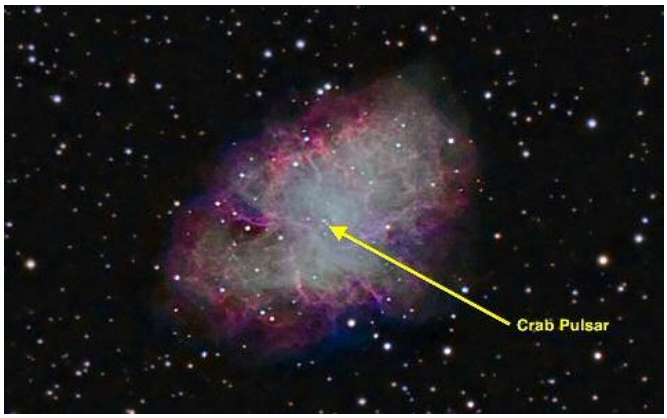
The names of the Seven Sisters

Impressive as they are, the Seven Sisters are just the brightest (naked eye) stars in a cluster of around 300 young stars. In the images above the Seven Sisters appear to be surrounded by gas remaining from the original nebula. However it is now thought the cluster is just passing through a cloud of Hydrogen gas in space.

As M45 is so close to us the cluster has a relatively high apparent movement across the sky although it is still too slow for us to perceive. It will take 30,000 years to move a distance equal to the diameter of our Moon.

Although the cluster is moving through space the individual stars all have slightly different trajectories and relative speeds. Gradually over millions of years the stars will move further apart and the cluster will disperse, like the Hyades. Binoculars will reveal around 30 to 50 stars in the cluster and a telescope will reveal many more. However the cluster is too large to fit into the field of view of most telescopes so the outline of the cluster will be lost.

There is another very interesting object in Taurus. At the end of the lower left (eastern) arm of Taurus is Messier 1 (M1) the Crab Nebula. It can be seen using binoculars in a dark clear sky but really needs a telescope. From Aldebaran look east to the star ξ (Ksi) Tauri. Just above ξ Tauri is a small smudge of light, this is M1.



Messier 1 (M1) the Crab Nebula imaged by Hubble

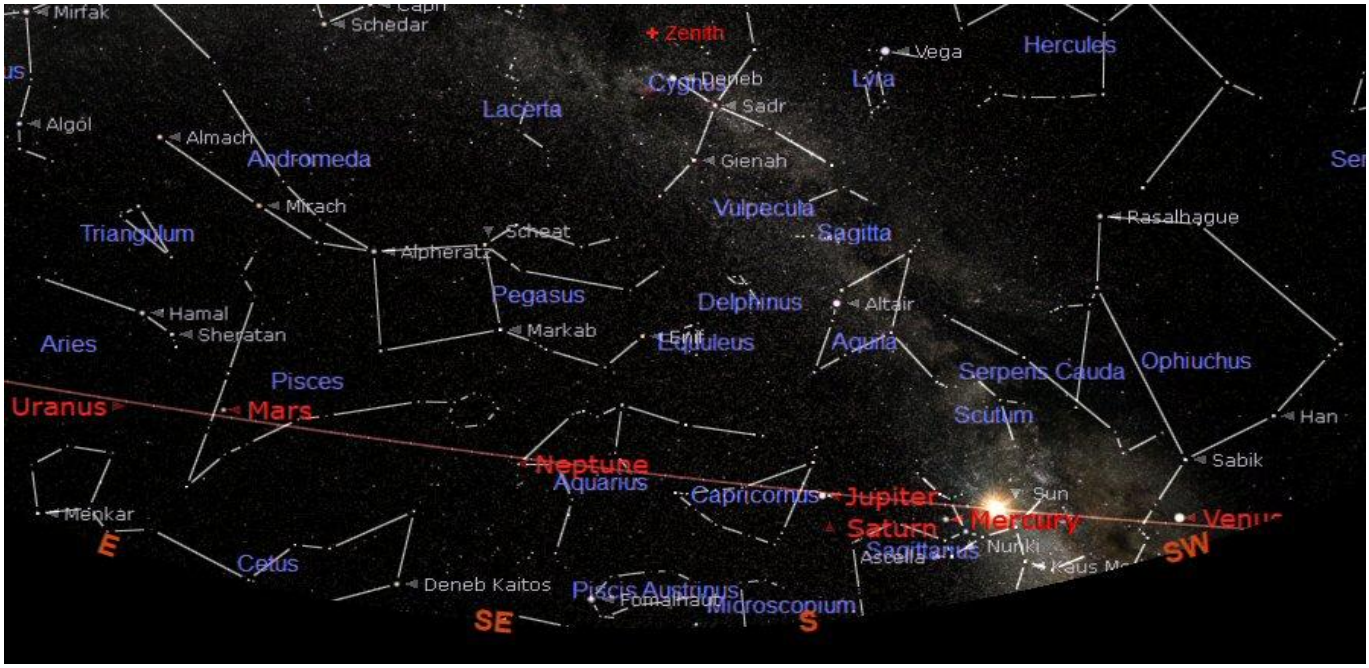
M1 is the remnant of a giant star that exploded as a Supernova about 7000 years ago. Its light took 6000 years to reach Earth and was observed by Chinese astronomers in the year 1054 AD. It can still be seen in a dark clear sky as a 'fuzzy' patch of light using a medium sized telescope.

A Supernova is the 'death' of a star more than three times the mass of our Sun. Giant stars consume their Hydrogen fuel at an expediential faster rate than smaller stars. Consequently bigger stars do not 'live' as long as smaller stars. As stars begin to exhaust their supply of Hydrogen they develop into a Red Giant like Aldebaran. Even larger stars develop into even larger Red Giants like Betelgeuse in Orion.

A star like our Sun and those up to about twice the mass of our Sun eventually slowly collapse as their fuel eventually runs out. The outer layers of the Red Giant drift away to form a gas bubble. The core 'gently' collapses to form a White Dwarf Star.

Stars that are 2½ to 3 times the mass of our Sun come to a more dramatic end. As the fuel of a larger Red Giant Star finally runs out the star suddenly collapses and all the mass of the star falls inwards under the massive force of its own gravity. The collapse reaches a point where the pressure and heat causes a gigantic thermonuclear explosion. The outer regions are blown into space to create a Supernova Remnant like M1 and a dense Neutron Star about 12,000km in diameter. These tiny, super dense stars are also called 'Pulsars'.

GOODBYE TO THE PLANETS



All the planets in the sky at 14:00 on 31st December 2020

At the end of last year we were treated to a promenade of all the planets across the sky. This is very much a random event but it occurs every few years so let's have a look at how it happens. The table below shows the Sidereal Periods of the planets. This is the time it takes for each planet to orbit the Sun. The other column shows the Synodic Periods. This is the time it takes for the two Inferior Planets (Mercury and Venus) to return to the same position relative to Earth or for Earth to catch up with each of the Superior Planets (outer planets).

Planet	Synodic Period (days)	Sidereal Period
Mercury	116 (~3x y)	88 days
Venus	584 (~1.5x y)	225 days
Earth	-	1.0 year
Mars	780 (2.137y)	1.9 years
Jupiter	399 (y + ~34d)	11.9 years
Saturn	378 (y + ~13d)	29.5 years
Uranus	370 (y + ~5d)	84.0 years
Neptune	368 (y + ~3d)	164.8 years

The Sidereal and Synodic Periods of the Planets

When a planet aligns with Earth as they pass on their orbits we call this an Opposition. There is a difference in oppositions of the Inferior and Superior planets. Earth overtakes the Superior planets on the inside. So when this occurs the two planets will be aligned with Earth between the Sun and the planet being overtaken. That planet will be in the South at midnight (GMT).

Inferior planets have two Oppositions on each of their orbits because they pass behind the Sun and also pass in front of the Sun. It is slightly confusing that the oppositions are called Superior Opposition (behind the Sun) and Inferior Opposition (in front of the Sun).

So with all the planets moving at different speeds around their orbits the timings of oppositions need to take account of how far the other planet has moved while Earth has been moving around its orbit.

The Synodic Period shown on the table opposite is the time between oppositions (overtaking point) with Earth. Taking the Superior Planets first we can see that Mars has the longest Synodic Period. This is because it moves a long way around its orbit before Earth catches up with it. Consequently we will not see Mars in the night sky again for about 2 years and 1 month.

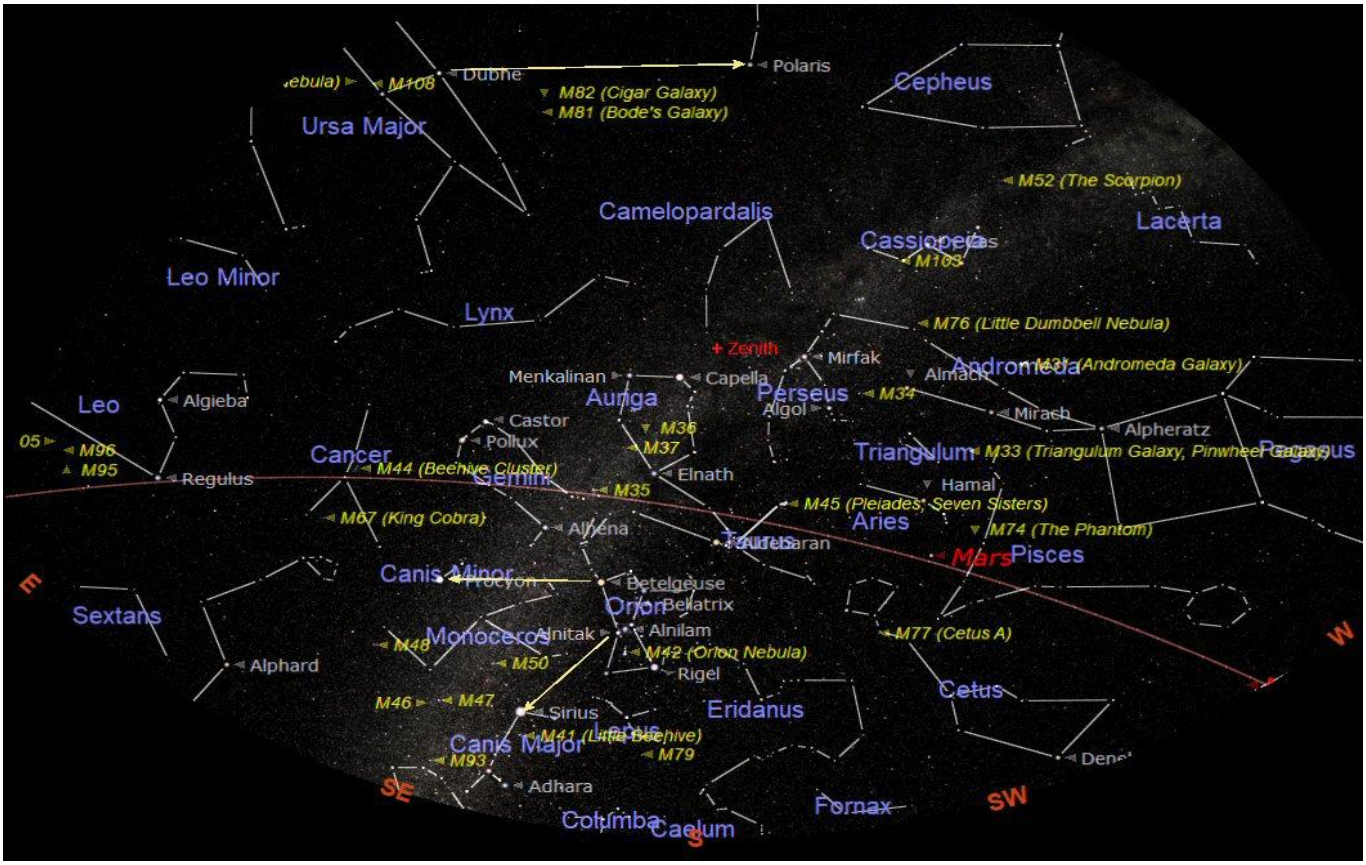
So how long before we see the other planets again? It will take Earth 1 year + 1 month to catch up and overtake Jupiter, 1 year + 13 days to overtake Saturn, 1 year +5 days for Uranus and 1 year + 3 days to catch up and overtake Neptune (Neptune moves slowest).

The Inferior planets (Mercury and Venus) have two Oppositions / Conjunctions on every orbit so Mercury conjunctions occur approximately 3 times in each Earth year and Venus every 1½ Earth years. They have one Conjunction when they pass behind the Sun called a 'Superior Conjunction' and another when they pass between the Sun and Earth called an 'Inferior Conjunction'.

Mercury always appears close to the Sun and is consequently difficult to see. However occasionally when it is at 'Greatest Elongation' (that is at its furthest distance from the Sun) and the tilt of its orbit conveniently making it appear higher in the sky it may be easier to see. However it always needs a clear view towards the Eastern or Western horizon.

Venus is much brighter and appears to move a lot further away from the Sun. It also displays distinct phases (like our Moon). When Venus is on the other side of the Sun it appears full. As it begins to move out from behind the Sun and the illuminated side starts to disappear. It becomes 'half Moon' shaped, then a crescent but larger in diameter as it moves towards Earth until it passes in front of the Sun in and Inferior Conjunction. It then reverses this sequence as it move back behind the Sun again for another Superior Conjunction.

A TOUR OF THE NIGHT SKY - JANUARY 2021



The chart above shows the night sky looking south at about 20:00 GMT on 15th January. 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 (in red) 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 brightest stars often appear to form a group or recognisable pattern; we call these 'Constellations'.

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), Cancer (the Crab) and Leo (the Lion).

Close to the south western horizon is the constellation of Pisces (the Fishes). Pisces a little faint and indistinct but it is easy to find this month because the bright and orange coloured planet Mars is located within its boundaries.

Prominent in the south west is the constellation of Pegasus (the Winged Horse). The main feature of Pegasus is the square formed by the four brightest stars. This asterism (shape) is known as the Great Square of Pegasus. The square is larger than might be expected but once found is easier to find again. The Great Square can be used to judge the condition of the sky for observing. If stars can be seen within the square there seeing should be good. If no stars can be seen then seeing will not be good.

High in the south is the constellation of Taurus (the Bull). The most obvious star in Taurus is the lovely Red Giant Star called Aldebaran. It appears slightly orange to the 'naked eye' but it is very obviously orange when seen using binoculars or a telescope. Aldebaran is located at the centre of the 'flattened' X shape formed by the brightest stars in Taurus. At the end of the top right (upper west) arm of the 'X' is the beautiful 'naked eye' Open Star Cluster Messier 45 (M45) known as the Pleiades (or the Seven Sisters). It really does look magnificent using binoculars. See pages 5 and 6.

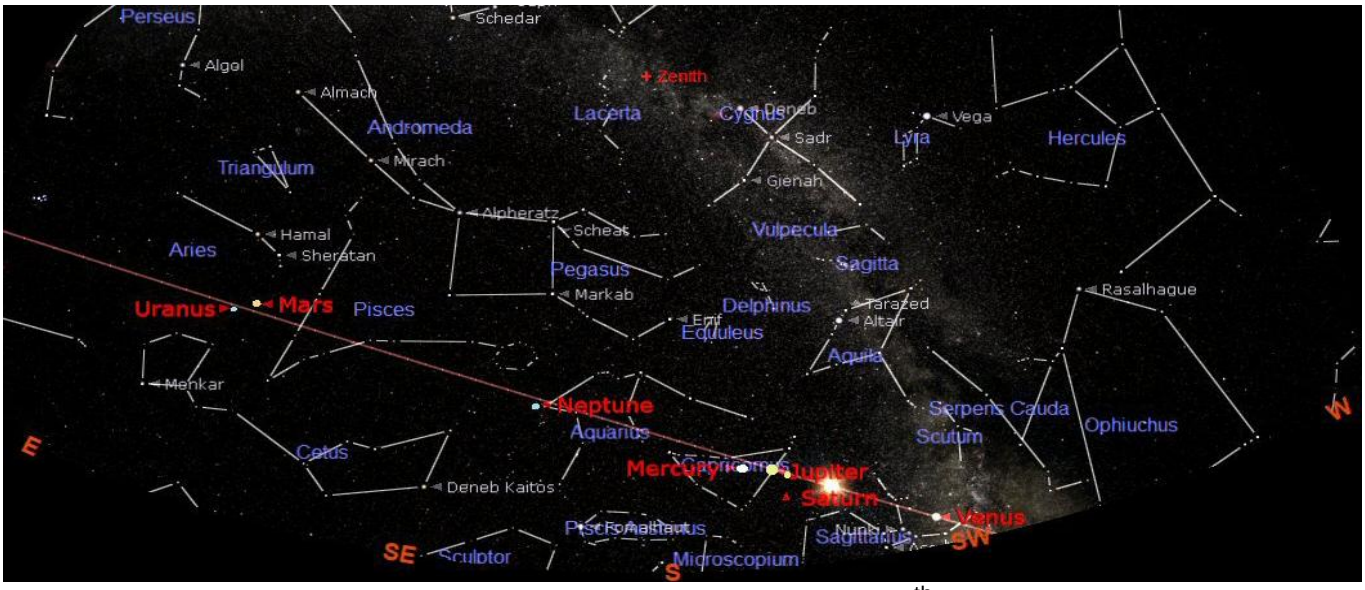
Following Taurus is the constellation of Gemini (the Twins). The two brightest stars in Gemini are Castor and Pollux and they are named after mythological twins. To the north of Taurus is the odd pentagon shape of Auriga (the Charioteer). Dominating Auriga is the brilliant white star Capella which is almost directly overhead. For those with a telescope there is a line of lovely open clusters to search out in Taurus and Auriga. These are M35 in Taurus and M36, M37 and M38 in Auriga.

To the east (right) of Taurus is the rather indistinct constellation of Cancer (the Crab). The stars of Cancer are quite faint and can be difficult to discern especially in a light polluted sky. It is really worth searching out Cancer using binoculars or a telescope to see the Open Cluster M44 (the Beehive Cluster). M44 is older and further away than M45 (the Seven Sisters) so is fainter than M45 but still looks lovely. It has a group of stars that resemble an old straw Beehive with bees around it.

To the south of Taurus and Gemini is the spectacular constellation of Orion (the Hunter). Orion is one of the best known constellations and hosts some of the most interesting objects for us amateur astronomers to seek out. We will be having a closer look at Orion in the February issue of this magazine.

The Milky Way (our Galaxy) flows through the pentagon shape of Cepheus and down through the 'W' shape of Cassiopeia then on through Auriga and Orion to the south eastern horizon.

THE SOLAR SYSTEM - JANUARY 2021



The locations of the planets at 14:00 on 15th January

MERCURY will be close to the Sun low in the east this month. It will be difficult to see but at its best on 24th.

VENUS is moving closer to the Sun, low in the eastern early morning sky. It is now 'gibbous' (wider than half Moon shaped) and becoming difficult to see. It is moving back towards the Sun and will move into Superior Conjunction (behind the Sun) on 25th March 2021.

MARS is still well positioned in the evening sky. However it is getting smaller at about 9 arc-seconds as Earth pulls further away from it. It will be around until May but will be moving closer to the south western horizon and appearing smaller. After it has moved over the horizon we will not see it again for two years.

JUPITER is now past its best and just visible in the South West after sunset. It will be difficult to see in the bright twilight sky just above horizon. It will be in the thick, murky, turbulent air close to the horizon so the view will be badly distorted so very little detail will be seen. However it will be well worth searching out in the beginning of the month to see it still in conjunction with fellow Gas Giant Saturn. Jupiter moves in conjunction with the Sun on 29th January.

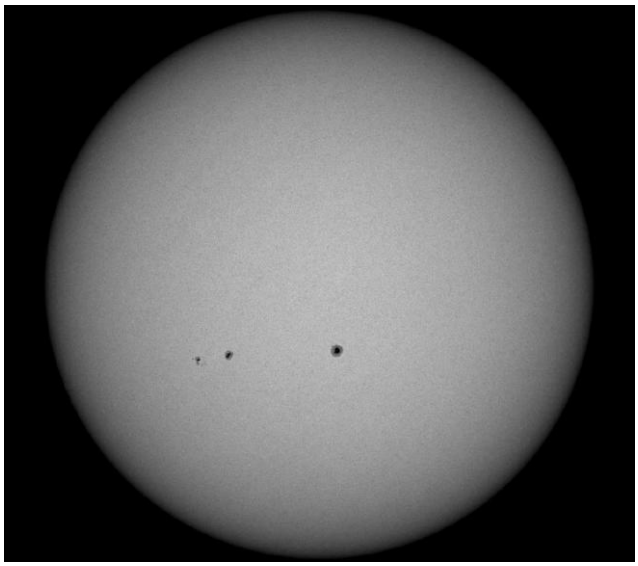
SATURN will be difficult to see in the bright twilight sky just above the South Western horizon. It will be worth going to a location with a clear view to the South West to see Saturn while it is still close to Jupiter. Saturn moves in conjunction with the Sun on 24th January.

URANUS will be easy to find as it will be close Mars. This month it will be due south and at its best at about 18:30 but it will need a telescope to see it.

NEPTUNE will not be easy to observe this month it will be in the south west and close to the horizon. It will be setting over the horizon at 21:15 about 19:30 and will require a telescope to see well.

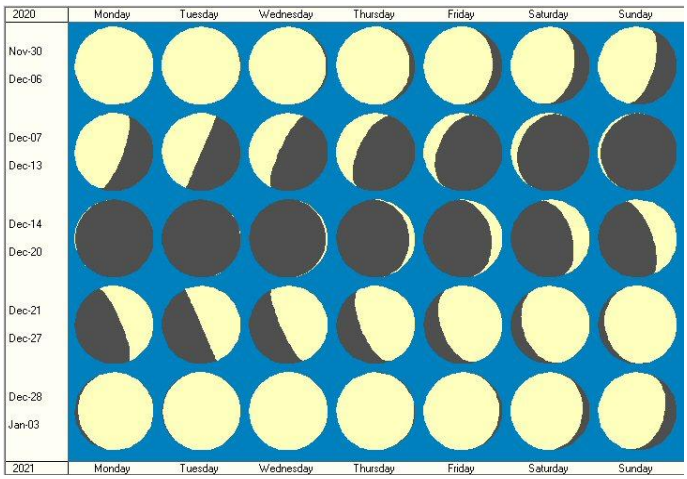
THE SUN

The Sun rises at about 08:10 at the beginning of the month and 07:40 at the end. It sets at 16:00 at the beginning of the month and 16:30 at the end. There have been some very nice Sunspots recently like those seen over Christmas see the following image.



Sunspots imaged by SOHO on 27th December

THE MOON PHASES DURING DECEMBER



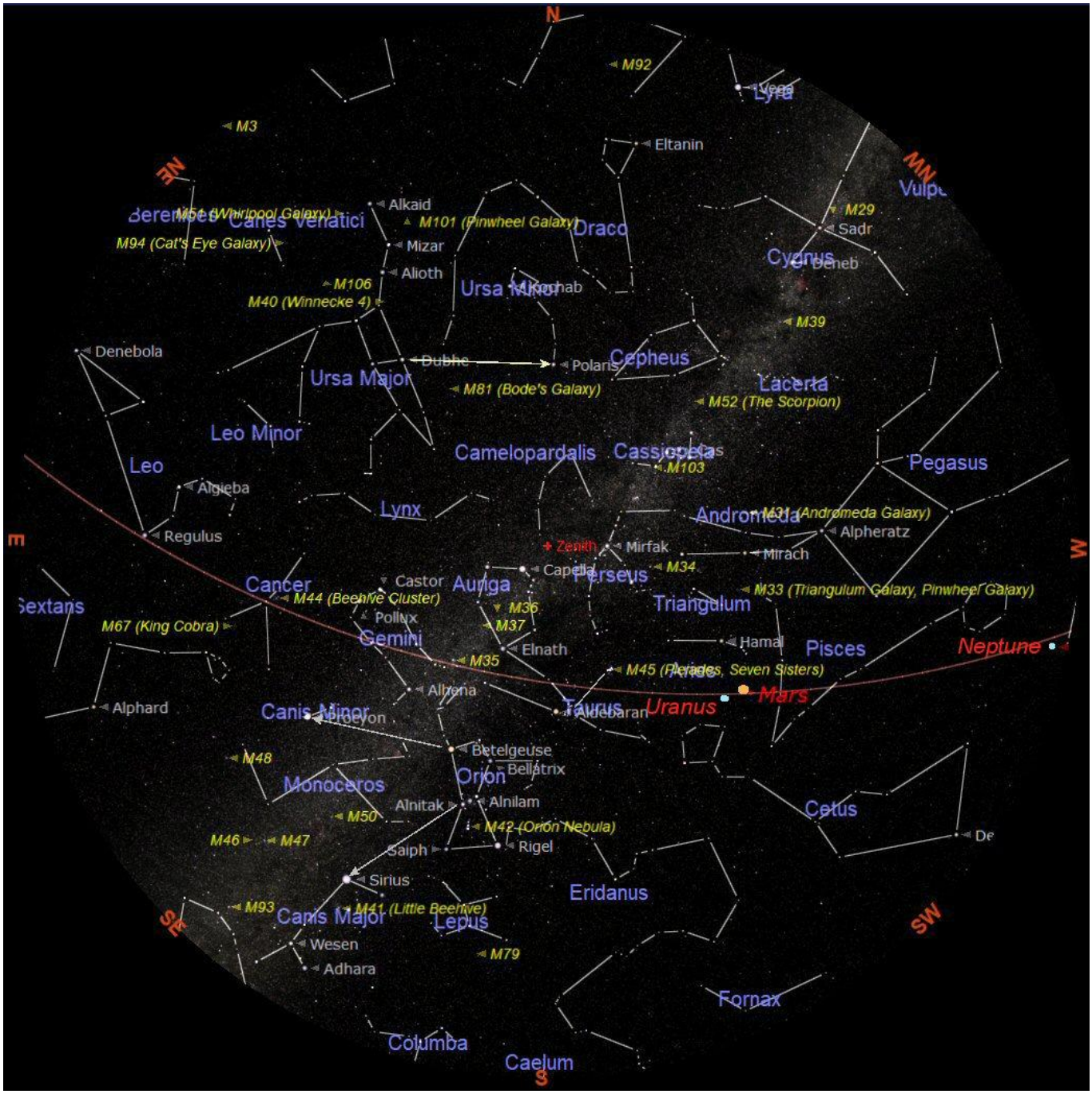
Last Quarter will be on 6th January

New Moon will be on 13th January

First Quarter will be on 20th January

Full Moon will be on 28th January

THE NIGHT SKY – JANUARY 2021



The chart above shows the whole night sky as it appears on 15th January at 21:00 (9 o'clock) 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 8 o'clock GMT at the beginning of the month and at 10 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 quite 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 in the evening sky: Neptune, Mars and Uranus.